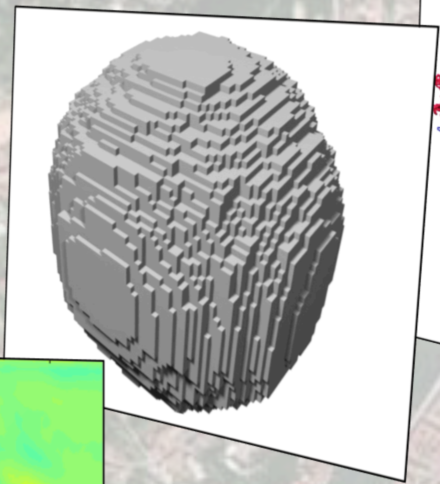
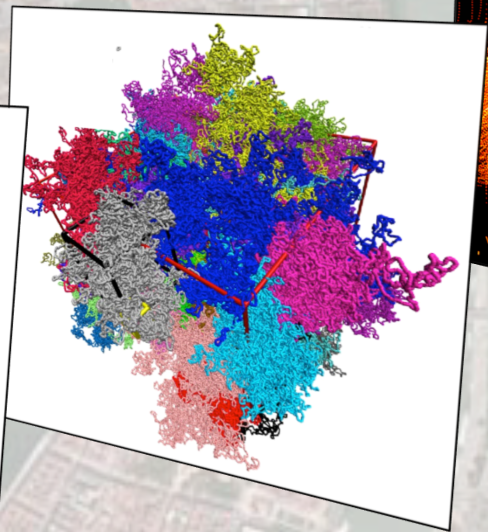
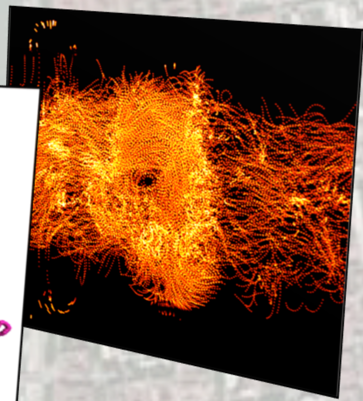
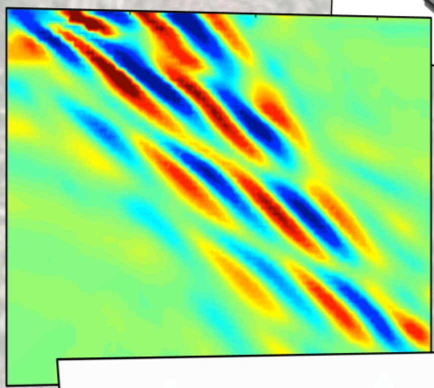
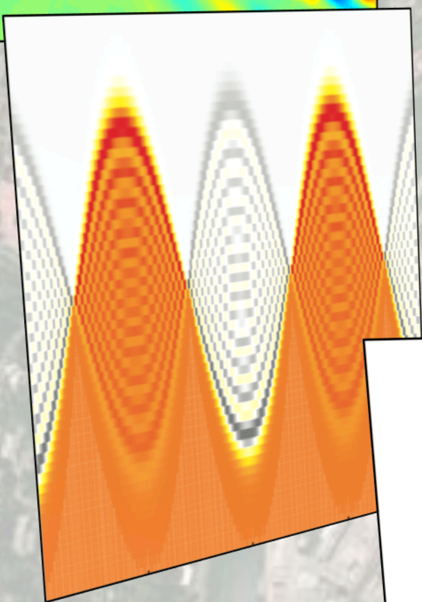
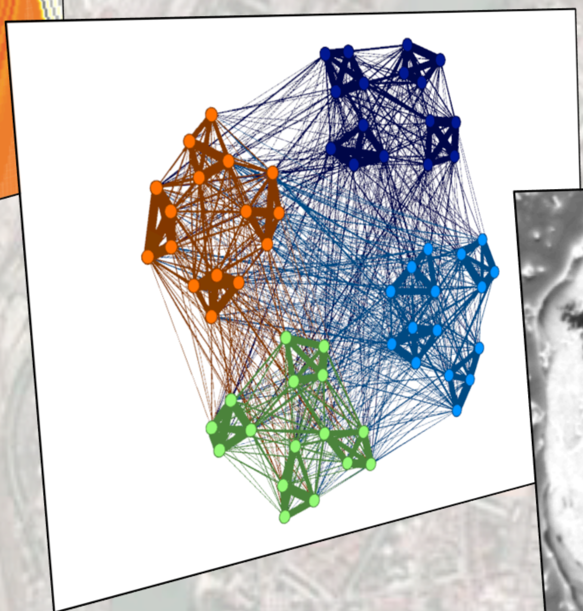
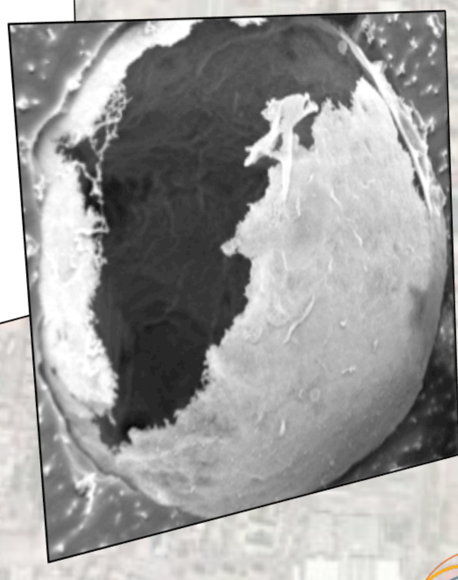





ACTIVITY REPORT 2009-2014

Laboratoire de Physique

UMR CNRS 5672
Ecole Normale Supérieure de Lyon

CNRS — dépasser les frontières

ENS DE LYON

UCBL Lyon 1

Table des Matières

I. PRESENTATION DE L'UNITE DANS SON ENVIRONNEMENT

A. Histoire et situation

Le laboratoire de physique a été créé en 1987 dès l'origine de l'Ecole Normale Supérieure de Lyon. Il était alors constitué de deux axes scientifiques principaux: le premier, dirigé par J.-P. Hansen, consacré à la mécanique statistique des liquides simples et complexes, et le second, conduit par S. Fauve, à la physique non linéaire, à travers les applications hydrodynamiques principalement. Un troisième thème, traitement statistique du signal et physique, piloté par P. Flandrin, a été associé à ces deux axes historiques dès 1991. Cette même année, un laboratoire de physique théorique a été créé à l'ENS de Lyon en lien étroit avec celui d'Annecy. Dirigé à l'époque par P. Sorba, les thématiques principales étaient la théorie des champs, les systèmes intégrables et la mécanique statistique. En 1997, au moment du départ simultané des deux directeurs, J.-P. Hansen et P. Sorba, les deux unités ont fusionné pour donner naissance au laboratoire dans la structure actuelle. Au cours de son histoire, le laboratoire a toujours eu comme double tutelle l'ENS de Lyon et le CNRS, initialement sous le statut d'Unité de Recherche Associée (URA) et, après 1998, d'Unité Mixte de Recherche (UMR). Depuis 2011, le laboratoire est également rattaché à l'Université Claude Bernard Lyon 1. Tous les locaux du laboratoire sont regroupés sur le site Monod de l'ENS de Lyon.

Les directeurs successifs du laboratoire ont été P. Oswald (1997-2000), S. Ciliberto (2000-2005), J.-F. Pinton (2006-2011). Ce dernier, nommé directeur de la recherche de l'ENS de Lyon début 2011, a laissé peu à peu la main à T. Dauxois, d'abord directeur adjoint, puis directeur du laboratoire depuis 2012.

Les chercheurs sont regroupés en quatre équipes:

- La première, *Matière et Complexité*, sous la responsabilité de J.-C. Géminard, qui a remplacé P. Oswald en 2010. Cette équipe regroupe l'essentiel des activités en matière molle, à prendre dans un sens très large, et une part des activités en physique des systèmes biologiques.
- La deuxième, *Physique Non-Linéaire, Hydrodynamique et Turbulence*, sous la responsabilité de L. Bellon, qui a remplacé J.-F. Pinton en 2011, couvre un spectre d'activité très vaste allant de la turbulence à la mécanique statistique avec comme lien l'étude des fluctuations et de leurs effets en physique.
- La troisième, *Signaux, Systèmes et Physique (SISYPHE)*, sous la responsabilité de P. Abry, concentre, depuis sa création, ses travaux sur l'interaction entre le développement théorique d'outils de traitement statistique du signal et leur mise en œuvre pratique sur des applications issues de la physique ou à d'autres systèmes, informatiques, biomédicaux, sociaux...
- La quatrième, *Physique Théorique*, sous la responsabilité de J.-M. Maillet, regroupe des chercheurs qui travaillent en physique mathématique et interactions fondamentales, en physique statistique et en matière condensée dans leurs aspects théoriques et pour une partie en lien fort avec des groupes expérimentaux, en utilisant des méthodes analytiques et/ou numériques.

B. Thématiques de recherche

Le champ de recherche du laboratoire couvre un spectre volontairement très large de la physique. Une caractéristique essentielle du laboratoire est son lien très fort avec l'enseignement de la physique dans les formations de l'ENS de Lyon. En conséquence, proposer un large choix d'activités reliées à la physique à travers les approches expérimentales, numériques ou théoriques a toujours été une volonté affirmée. Même le thème assez vaste que constitue la physique statistique des systèmes complexes ne suffit plus à résumer les activités de l'unité. Le laboratoire est, de ce point de vue, unique dans le paysage scientifique français.

En raison de la dynamique collective interne au laboratoire, il nous est apparu judicieux de présenter les résultats scientifiques sous la forme de sept thèmes scientifiques. Ils regroupent tous des chercheurs issus d'au moins deux équipes, souvent trois et même de toutes les équipes pour deux d'entre eux. Cette présentation autorise aussi les chercheurs ayant plusieurs activités suffisamment différentes d'apparaître dans deux thèmes.

- *Hydrodynamique et géophysique* (équipes 1, 2, 3 & 4). Cette thématique forte regroupe les nombreuses activités autour des fluides ou milieux poly-phasiques en mouvement. Nos approches expérimentales, théoriques et numériques visent, par exemple, à comprendre des phénomènes de transport (masse, chaleur, particules, grains) dans des écoulements modèles (turbulents) ou d'importance pratique (convection thermique, écoulements granulaires). Elles abordent également les aspects statistiques et la modélisation de la turbulence, mais aussi des écoulements inspirés de la géophysique comme les ondes de gravité interne (océans, atmosphère), les flots multi-phasiques (volcanologie, fracture hydraulique), ou la magnéto-hydrodynamique (dynamos planétaires ou stellaires).

- *Matière molle* (équipes 1 & 2). À travers ce thème, il s'agit de développer des outils originaux, expérimentaux, numériques et théoriques pour étudier, sur de larges gammes d'échelles de temps et de longueur, des propriétés physiques (vieillissement, déformations, rupture, écoulement, thermo-mécanique,...) de la matière molle au sens large, des cristaux liquides aux matériaux granulaires en passant par les émulsions ou les gels.

- *Physique des systèmes biologiques* (équipes 1, 2 & 3). Étude des mécanismes physiques par lesquels les organismes vivants croissent, s'adaptent ou survivent. Nous considérons de larges gammes d'échelles de temps et de longueur, de la molécule au noyau, de la cellule à l'organisme. Nos approches impliquent l'expérience, l'analyse de quantités massives de données ou bien la modélisation physique au moyen de techniques numériques et théoriques.

- *Physique mathématique et interactions fondamentales* (équipes 2 & 4). Les activités de ce thème concernent les systèmes quantiques intégrables et les théories conformes, des résultats exacts en physique statistique et systèmes dynamiques, les théories des cordes et de supergravité, la correspondance AdS/CFT, ainsi que la gravitation quantique.

- *Matière condensée* (équipes 3 & 4). Les activités de ce thème couvrent un large spectre de sujets allant de la physique des solides à celle des nano-structures, aux fluides quantiques et aux gaz quantiques dilués et dont les comportements complexes résultent des corrélations fortes entre constituants et/ou de leurs statistiques quantiques.

- *InfoPhysique, signal et systèmes* (équipes 1, 2 & 3). Ce thème est construit autour de l'interaction dialectique entre les applications (principalement issues de la physique, mais aussi des domaines informatiques, biologiques, biomédicaux, sociaux,...), et les développements méthodologiques et théoriques en traitement statistique du signal (invariance d'échelle, non stationnarité, graphe, physique statistique) : les premières produisent des bases de données, parfois massives, et posent des questions, souvent difficiles, auxquelles les seconds formulent des réponses dont la portée est espérée générique et systématique. Ces réponses sont testées sur les données originelles et génèrent ainsi de nouvelles questions et développements.

- *Physique statistique* (équipes 1, 2, 3 & 4). Ce thème fédérateur explore de nombreuses questions fondamentales de la mécanique statistique et leurs applications dans de nombreuses thématiques du laboratoire. Grandes fluctuations, confinement, désordre ou situations hors d'équilibre sont des éléments clefs de systèmes complexes qui présentent un défi pour une description statistique pertinente. Notre approche analytique, expérimentale ou numérique a permis des avancées significatives sur des questions de dynamique collective, interactions à longue portée, défauts et accrochage, turbulence, ou encore théorèmes de fluctuation, tout en ouvrant de nombreuses pistes à explorer.

⋆ *Imagerie et instrumentation* est un axe transversal, qui permet de mettre en avant la forte tradition du laboratoire dans le développement conjoint de nouvelles techniques de mesures, essentielles à la recherche, combinées à des développements théoriques et algorithmiques d'analyse de signaux ou d'images. Cet axe couvre de nombreux champs de la physique allant de la microscopie par force atomique à l'imagerie acoustique/optique dans des fluides complexes.

Notre laboratoire bénéficie énormément du mariage des différentes sous-disciplines. Du fait de l'étendue de ses activités mais aussi de la volonté des directeurs successifs, le laboratoire a développé des liens forts avec la biologie, la chimie, l'informatique, la géophysique ou les mathématiques, et plus récemment les sciences humaines et sociales. L'exemple emblématique est la création d'une activité traitement du signal au sein même de l'unité. Cela a facilité le transfert d'outils vers les applications, mais a aussi suscité des développements méthodologiques, motivés par les applications. D'autres exemples seront présentés dans ce document, mettant en valeur le bénéfice apporté par une approche scientifique pluri-disciplinaire.

C. Politique scientifique

Principaux objectifs. Nous souhaitons développer des activités de recherche au meilleur niveau international, tout en gardant un spectre très large d'activités. Excellence, réactivité et mobilité thématique sont les éléments décisifs en la matière. Par ailleurs, tout en essayant d'offrir les meilleures conditions possibles pour que la recherche puisse se développer, la direction privilégie une dynamique collective à l'échelle du laboratoire et notamment la collaboration entre équipes, plutôt qu'une compétition entre les chercheurs qui serait inévitablement nocive au niveau local. Cette politique a pour but de pallier les effets, en partie négatifs, des nouveaux modes de financement de la recherche sur contrat. Elle permet de préserver la diversité de nos activités en soutenant les thèmes qui ne sont pas encore financés, sans pénaliser les porteurs de contrats. Cette volonté de la direction est pleinement soutenue par le conseil de laboratoire et les membres du laboratoire dans son ensemble. Cela semble être en outre un élément incontournable dans la politique scientifique d'un laboratoire ayant un spectre thématique large et souhaitant maintenir cette diversité scientifique en son sein.

Une dynamique collective. Si chacune des quatre équipes a une cohérence scientifique propre, leurs contours thématiques sont fluctuants et le rattachement des chercheurs est souvent d'origine historique. Il existe de nombreuses collaborations entre les équipes et on peut en citer plusieurs exemples nés au cours de cette période: le travail de S. Ciliberto sur la limite de Landauer a conduit à de très beaux résultats avec K. Gawędzki, alors que l'étude des fluctuations en géométrie confinée doit beaucoup à sa collaboration avec P. Holdsworth. Par ailleurs, P. Abry et E. Bertin ont développé en étroite collaboration leurs recherches sur les liens entre mécanique statistique et signal. A. Arneodo, B. Audit et P. Jensen ont proposé ensemble l'utilisation de la théorie des graphes pour mettre en évidence l'équivalent de hubs pour la chromatine humaine. Les capteurs développés par J.-F. Pinton pour la turbulence ont été utilisés, en collaboration avec P. Borgnat, pour caractériser la formation de réseaux sociaux. Nous pourrions donner de nombreux autres exemples. Le rôle des directions successives a toujours été d'encourager ces collaborations entre équipes, notamment dans leur genèse en soutenant, voire en suscitant, des demandes conjointes à l'appel à projet (BQR interne) du laboratoire. Cette fertilisation transdisciplinaire est favorisée, non seulement par la proximité et le partage des bureaux entre membres d'équipes différentes, mais aussi par le colloquium qui regroupe l'ensemble du laboratoire le lundi et les très importantes rencontres à la salle café : autant de moyens efficaces, en relais de la curiosité scientifique des chercheurs du laboratoire. Sans restreindre de quelque manière que ce soit la liberté individuelle de développer ses activités propres sans collaborateur au niveau local, nous fonctionnons vraiment comme un laboratoire très loin d'une structuration avec des équipes étanches, comme a souvent tendance à l'inciter le financement actuel de la recherche.

Pour définir la politique scientifique, le directeur bénéficie de l'aide précieuse des quatre chefs d'équipe. Ces derniers sont très régulièrement consultés et aident à définir les choix stratégiques pour le laboratoire et à préparer les réunions du conseil de laboratoire. Le directeur s'appuie aussi fortement sur le conseil de laboratoire qui oriente et régit, pour une très grande part, la vie du laboratoire. Le conseil regroupe 18 personnes. À noter que nous avons décidé en 2013, l'élection d'un représentant des post-doctorants afin de prendre en compte les avis de cette catégorie de personnel dont la part est de plus en plus importante dans les laboratoires. Nous avons, bien évidemment, maintenu la présence d'un représentant des doctorants. Réunis au moins cinq fois par an, le conseil discute longuement et en profondeur les différents choix qu'un laboratoire comme le nôtre doit faire (priorités scientifiques, définition de profil de postes, classement des professeurs ou chercheurs invités, préparation de la demande annuelle Dialog, ...). L'ordre du jour des réunions du conseil de laboratoire est annoncé plusieurs semaines à l'avance, permettant l'organisation de réunions de préparation au niveau des équipes. Un rapport est systématiquement diffusé à l'ensemble du laboratoire dans les sept jours. Vient s'ajouter à cette réflexion organisée et régulière une assemblée générale annuelle pour discuter de l'orientation du laboratoire (réflexion sur les perspectives scientifiques, choix du nouveau directeur, préparation du rapport quinquennal, discussion sur les locaux, 25ème anniversaire du laboratoire,...). Sans oublier, la traditionnelle journée des thésards et le repas de Noël qui, institué en 2011, regroupe l'ensemble du personnel pour un moment très convivial. C'est l'occasion de présenter les nouveaux arrivants, toujours plus nombreux, de se remémorer les bonnes nouvelles de l'année et, bien sûr, de partager un buffet tous ensemble.

Points clés. Soutenir l'émergence de nouvelles idées, collaborations ou thématiques, profiter de la mixité entre expérimentateurs et théoriciens au sein d'un même laboratoire, tirer profit de la proximité avec l'atelier de mécanique et le bureau d'études électroniques, encourager la soumission de projets européens, nationaux ou locaux, notamment dans la période critique qui précède le passage de junior à senior, être attentif à ceux qui sont en difficulté temporaire pour leur suggérer des pistes ou tout simplement leur apporter notre attention ou notre soutien, transformer les nombreux contacts personnels tissés par les membres du laboratoire avec des institutions étrangères en un véritable réseau de collaborations, trouver le bon équilibre entre opportunisme et affichage à l'avance des priorités scientifiques, sont aussi des éléments forts de notre politique scientifique.

D. Profil d'activités

Comme cela est explicitement demandé par le HCERES, nous résumons schématiquement la répartition du temps consacré aux différentes activités du laboratoire à travers les quatre missions suivantes:

60% Recherche académique,
10% Interactions avec l'environnement social, économique et culturel,
20% Formation à et par la recherche,
10% Appui à la recherche.

- *Recherche académique.* La part de l'unité de recherche consacrée à la production scientifique, au rayonnement et à l'attractivité académiques constitue naturellement la part la plus importante de l'activité de l'ensemble des personnels, permanents et non-permanents. Le spectre des activités de recherche et le niveau des contributions nécessitent un investissement très important.

- *Interactions avec l'environnement social, économique et culturel.* Nos activités étant principalement consacrées à la recherche fondamentale, notre interaction avec l'environnement économique est relativement réduite. Néanmoins, notre investissement en la matière est tout à fait conséquent si on le compare à la majorité des autres laboratoires de physique fondamentale. Une fraction très importante des chercheurs est en outre fortement impliquée dans la diffusion de la culture scientifique notamment vers les lycées et les collèges.

- *Formation par la recherche.* Cette partie de nos activités est très importante au laboratoire même si, comme cela est demandé, on en donne une estimation sans tenir compte du temps réglementaire consacré à l'enseignement. Le nombre de doctorants a significativement augmenté durant les cinq dernières années, ce qui nécessite bien évidemment un suivi. Les stagiaires accueillis sont aussi très nombreux et cela est encouragé par le financement collectif par le laboratoire de la majorité des gratifications de stage.

- *Appui à la recherche.* Enfin, la part de l'activité de l'unité de recherche consacrée au service de la communauté universitaire et scientifique est assez importante. Les membres du laboratoire sont à l'origine d'une quantité impressionnante de conférences et sont impliqués dans de nombreux comités éditoriaux de journaux scientifiques. Enfin, le laboratoire a un investissement remarquable au niveau du pilotage de structures de recherches.

E. Évolution du personnel

De 2009 à 2014, le laboratoire est passé de 111 à 155 personnes (nous étions 93 en 2005). On décompte aujourd'hui 14 membres du personnel technique (4 personnels ENS et 10 CNRS), 21 enseignants chercheurs (20 ENS et 1 Université Lyon 1) et 41 chercheurs CNRS.

Si l'on compare à la situation de 2009, on constate que les effectifs du personnel permanent sont constants avec un renouvellement conséquent, de l'ordre de 15%, puisqu'il y a eu 11 arrivées pour 7 départs auxquels s'ajoutent les 4 premiers éméritats accordés au laboratoire. Si l'on fait abstraction du départ temporaire de chercheurs pour rejoindre le laboratoire Joliot-Curie en janvier 2011, avant de revenir au laboratoire en mai 2012, les changements sont résumés dans les deux tableaux ci-dessous. Si l'effectif des permanents reste constant, on notera cependant une augmentation significative de la proportion de femmes.

Départs et éméritats

NOM Prénom	Grade	Section	Année	Mutation	Raison
SANEJOUAND Yves-Henri	CR1	13	2009	x	personnelle
CHARVIN Gilles	CR1	11	2010	x	personnelle
BERGUIBA Lofti	IR2	C	2011	x	restructuration
TONINELLI Fabio	CR1	02	2012	x	promotion DR2 en 41
LEVEQUE Emmanuel	CR1	10	2013	x	promotion DR2 en 10
BERTIN Eric	CR1	02	2013	x	personnelle
TERRAS Véronique	CR1	02	2013	x	personnelle
PEYRARD Michel	PRCE	28	2010		retraite
ARNEODO Alain	DR1	02	2013		retraite
CASTAING Bernard	PRCE	28	2014	x	retraite
GAWĘDZKI Krzysztof	DR1	02	2014		retraite

Recrutements

NOM Prénom	Grade	Section	Année	Mutation
BOUCHET Freddy	CR1	02	2010	x
FEDORENKO Andrei	CR1	02	2009	
JOUBAUD Sylvain	MCF	28	2009	
STEINBERGER Audrey	CR2	05	2010	
PUSTELNIK Nelly	CR2	07	2011	
BARTOLO Denis	PR2	28	2012	
GIBAUD Thomas	CR2	11	2012	
VENAILLE Antoine	CR2	02	2012	
CRAUSTE THIBIERGE Caroline	CR2	11	2013	
NICOLLI Giuliano	CR1	02	2013	
BOUCHNEB Fatiha	TCN	J	2014	

À ce personnel permanent, vient s'ajouter un personnel temporaire significativement plus nombreux aujourd'hui réparti en 46 doctorants, 32 post-doctorants et un membre non permanent du personnel technique. Deux éléments importants sont à noter : le nombre de doctorants et celui de post-doctorants a quasiment doublé en cinq ans puisqu'il y avait 24 doctorants et 17 post-doctorants en juin 2009. On peut y voir deux origines: premièrement, une volonté assumée de former davantage de doctorants, comme cela nous a été recommandé par le précédent comité de visite AERES en 2010. Deuxièmement, le nombre de post-doctorants a véritablement explosé suite aux multiples succès des projets ANR et ERC. L'effectif du laboratoire a donc augmenté de plus d'un tiers (sous contrat temporaire donc) en 5 ans, puisque le laboratoire compte 40 personnes supplémentaires sans compter les nombreux stagiaires ou visiteurs. Cela n'est bien évidemment pas sans incidence sur la capacité d'accueil au laboratoire, puisque la superficie de nos locaux est essentiellement figée depuis la construction du bâtiment LR6 en 2006. Les premiers espoirs que l'on peut avoir pour revenir à un taux d'occupation raisonnable ne se concrétiseront au mieux qu'en 2017.

F. Financement

Dotations annuelles. Le laboratoire reçoit chaque année une dotation de la part de l'ENS de Lyon et du CNRS, à laquelle on doit rajouter une petite contribution de l'Université Lyon 1. Ces sommes (300 k€ en 2014, avec de faibles oscillations depuis 2005) constituent un socle vital pour la pérennité du fonctionnement du laboratoire et pour le soutien aux activités en cours de mûrissement. Elles permettent de couvrir les charges communes et un soutien minimal à chaque chercheur. Pour chaque permanent, chaque doctorant et chaque post-doctorant dont le financement est sans accompagnement, nous avons pu préserver une "part chercheur", légèrement inférieure à 2k€ (pour un expérimentateur et 2/3 de cette somme pour un théoricien). Ces sommes sont gérées par les chefs d'équipe, et la tradition veut que les bénéficiaires de contrats financent leurs activités prioritairement sur ceux-ci, autorisant de ce fait ceux qui n'en ont pas (ou pas encore) d'avoir un peu plus de marge de manœuvre. Cela joue un rôle très important pour la gestation d'activités novatrices pas encore mûres pour une agence de financement.

Subventions spécifiques. À cette dotation de nos tutelles s'ajoutent des contributions spécifiques pour des achats de gros équipements par le CNRS (anciennement appelé "mi-lourd") ou par le fond recherche de l'ENS de Lyon. Au cours du quinquennal, ces deux sources de financement ont permis, en complément de financements sur fonds propres, d'acquérir la table tournante Perpet, une caméra infrarouge, une salle blanche, un microscope électronique à balayage. Notons que les deux derniers équipements ont été financés et seront utilisés en partenariat étroit avec le laboratoire de chimie. À ces contributions, il faut rajouter également plusieurs financements plus modestes en provenance du pôle recherche de l'ENS de Lyon ou du CNRS, notamment sous la forme de Projets Exploratoires Premier Soutien (PEPS) en Physique Théorique et Interfaces (PTI) ou en Bio-Maths-Info (BMI), ainsi que des financements partiels mais indispensables de l'ENS de Lyon pour l'organisation des nombreuses conférences organisées par des membres du laboratoire. Enfin, depuis 2012, le Plan Pluriannuel d'Investissement (PPI ou jouvence) de l'ENS de Lyon a permis de remplacer des équipements devenus obsolètes.

Agences de financement. En dehors de ces financements par les tutelles, le laboratoire a obtenu au cours de la période un excellent taux de succès en réponse aux appels à projets. On retiendra notamment plusieurs gros contrats européens: 3 contrats European Research Council (ERC) auxquels on peut ajouter Euhit, le contrat consacré aux infrastructures européennes en turbulence, et Dynanets, celui à la dynamique sur réseaux. Une autre source très importante de financement provient de l'Agence Nationale de la Recherche (ANR) puisque le laboratoire a bénéficié de 46 contrats ANR sur les 5 ans. Si on y ajoute les deux Fonds Unique Interministériel (FUI), la demi-douzaine de financements de la région Rhône-Alpes, plusieurs contrats industriels, et les trois contrats attribués par le Plan d'Avenir Lyon-Saint Etienne (PALSE), on a un aperçu des moyens dont dispose le laboratoire. Le personnel du laboratoire a fortement augmenté mais le financement qu'il a réussi à obtenir des agences en proposant des projets de qualité a lui aussi augmenté de façon spectaculaire. Le budget annuel du laboratoire était de 1M€ en 2005, 1,6M€ en 2010 et a atteint 3,1M€ en 2014.

Mécanismes de répartition. Cet aperçu cache cependant un effritement important de la dotation de la part des tutelles (improprement qualifié de récurrent), utilisée principalement pour les charges collectives; ces dernières sont, dans les faits, en croissance significative puisque le succès auprès des agences de financement a fortement augmenté le nombre de membres du laboratoire sur contrat temporaire, et donc automatiquement les charges afférentes. Face à ce constat, le conseil de laboratoire a voté en 2012 à l'unanimité la mise en place d'un prélèvement sur les parts hors salaires des contrats afin de permettre le fonctionnement adéquat des services communs. Il permet principalement d'assurer de façon correcte le financement:

– des gratifications de stage qui sont donc prises en charge directement par le laboratoire, pour un budget qui a dépassé les 20k€ en 2014. C'est un prix tout de même conséquent pour soutenir la formation par la recherche à laquelle nous sommes très attachés.

– d'une petite somme offerte aux nouveaux permanents pour leur installation et le démarrage de leurs activités scientifiques.

– d'un contrat à durée déterminée comme en 2012 et 2013 pour le secrétariat qui a dû faire face à une brusque augmentation de sa charge de travail.

– du BQR interne du laboratoire qui permet de fournir jusqu'à 15k€/an pour des initiatives scientifiques. Le principe est de soutenir des idées intéressantes et ambitieuses, plus risquées. La priorité est donnée aux demandes collectives.

– enfin, à partir de l'année 2014, un soutien financier plus conséquent à un projet scientifique interne. À nouveau, la priorité sera donnée aux initiatives regroupant plusieurs chercheurs du laboratoire.

La direction a également mis en place en concertation avec les porteurs de projet ERC une répartition de la part de l'overhead qui revient au laboratoire (5% du total) et des salaires des chercheurs permanents impliqués, également reversés au laboratoire. Si une partie, typiquement inférieure à 20%, peut être utilisée par le porteur pour financer les charges non éligibles du contrat, la moitié de la part correspondant aux salaires revient à l'équipe à laquelle appartient le porteur tandis que la seconde moitié et les overheads reviennent au laboratoire. Les équipes ont pour l'instant essentiellement utilisé ces sommes pour acheter des équipements prioritairement collectifs, tandis qu'au niveau du laboratoire, les sommes ont financé principalement des thèses de manière à suivre la recommandation AERES de former davantage de doctorants. Plusieurs années de suite, le conseil de laboratoire a validé le choix d'un sujet de thèse à l'automne précédant le recrutement. En attirant l'attention sur ce sujet, cette procédure a permis à plusieurs reprises d'attirer d'excellents étudiants et, en leur assurant un financement quel que soit le résultat de leur demande de bourse, d'éviter leur départ pour un laboratoire qui disposerait d'un sujet de thèse dont le financement serait assuré.

G. Organisation

L'unité est structurée en quatre équipes, dont les contours scientifiques ont été mentionnés dans la section A, auxquelles viennent s'ajouter les **services techniques**. Ces derniers sont au nombre de quatre:

- le service *Gestion et Secrétariat*, sous la responsabilité de N. Clervaux, regroupe quatre gestionnaires. Elles ont l'importante charge de la gestion des multiples contrats et commandes ainsi que les très nombreuses missions des membres du laboratoire ou des fréquents visiteurs. Grâce à leur dévouement, le service a brillamment pu faire face à l'augmentation impressionnante du nombre de contrats, au cours du quinquennal. La qualité de leur travail a été reconnue en 2013, puisque ce service a été choisi comme l'un des deux groupes de gestionnaires pilotes pour la dématérialisation des factures des unités CNRS, pour préparer la réforme SCTD.

- le *Service informatique*, sous la responsabilité de B. Louis-Lucas, administre tous les ordinateurs du laboratoire de physique ainsi que ceux du groupe théorique du CRAL, localisé sur le site l'ENS, auxquels il faut ajouter tous les équipements informatiques des départements d'enseignement de physique, chimie, sciences de la vie et de géologie. La gestion à deux personnes d'un parc de près de 600 machines (dont 400 dans notre laboratoire) à laquelle il faut ajouter l'assistance aux utilisateurs ainsi que l'administration des services dont ils ont besoin (données, impression, calcul, ...) en fait un service pivot du laboratoire.

- *L'Atelier de mécanique* de l'ENS de Lyon consacre une grande part de son activité au laboratoire de physique. Ce service a été récompensé par le cristal du CNRS 2013 décerné à son responsable, M. Moulin. Ce cristal récompense bien évidemment la qualité et l'expertise du récipiendaire, mais plus largement aussi le travail fourni par l'atelier: la proximité et la qualité de l'écoute sont des conditions pour une meilleure compréhension du besoin des chercheurs, permettant ainsi de proposer des solutions innovantes, souvent astucieuses. L'expertise de ses quatre membres est reconnue, souvent recherchée, et toujours regrettée par les expérimentateurs qui ont quitté le laboratoire.

- *le Bureau d'Études Électroniques*, enfin, conçoit et construit les réponses techniques (en électronique analogique ou numérique) qui répondent aux exigences des chercheurs. Conduite par P. Metz, l'équipe a proposé au cours de ce quinquennal de multiples solutions et développé plusieurs capteurs innovants. On peut aussi noter les nombreuses collaborations du bureau d'études en électronique avec l'atelier de mécanique. La très appréciable proximité de ces deux services est une vraie valeur ajoutée.

L'**animation scientifique** est soutenue par l'organisation de nombreux séminaires. Le colloquium du lundi matin regroupe l'ensemble du laboratoire le temps d'un séminaire général. Ce rendez-vous hebdomadaire attire une fraction importante des étudiants du M2 dont l'emploi du temps a été aménagé à cet effet. Deux séminaires plus thématiques, intitulés *Physique expérimentale et modélisation* le mardi et *Physique théorique* le jeudi, sont deux autres rendez-vous importants. Viennent s'y ajouter des séminaires additionnels, généralement le vendredi, à l'occasion de visites impromptues ou de visites de candidats à un recrutement. Les nouveaux membres permanents du laboratoire sont systématiquement invités à donner un séminaire général. Les responsables des séminaires invitent de temps en temps certains plus anciens à présenter leurs activités. Il existe en outre deux rendez-vous très réguliers : le groupe de travail *matière condensée* se réunit tous les lundis après-midi et, depuis 2012, un séminaire par et pour les doctorants théoriciens du laboratoire est organisé tous les quinze jours. Enfin, il existe un grand nombre de plus petits groupes de travail qui se réunissent de façon plus irrégulière. L'ensemble de l'offre est très riche, sans même parler de la participation de certains membres du laboratoire à des séminaires des laboratoires voisins, notamment ceux de mathématiques et du laboratoire Joliot-Curie, ainsi que les séminaires et workshops du Centre Blaise Pascal.

La responsabilité de la **communication** du laboratoire vers l'extérieur a été prise en charge en 2011 par M. Castelnovo et N. Plihon. Grâce à leur travail, la liste des communiqués de presse nationaux CNRS ou d'actualités scientifiques INP CNRS, repris sur le site web de l'ENS de Lyon et décrivant les travaux de recherche effectués au laboratoire, est passée de un seul en trois ans à cinq pour la seule année 2013. Ils ont pris en charge aussi la définition d'une plaquette du laboratoire, publiée tous les 2 ans: cette dernière décrit les activités de certains chercheurs soit à l'occasion d'un prix, soit par l'intermédiaire d'un focus spécial sur leurs activités. La plaquette, imprimée à 1000 exemplaires, est largement distribuée au niveau national ainsi qu'à tous les visiteurs, et lors de manifestations organisées par les membres du laboratoire. Ces deux actions ont considérablement augmenté la visibilité du laboratoire non seulement au sein des communautés nationales et internationales, mais aussi localement. Un site web, sous la responsabilité de N. Garnier, reporte les informations principales pour le laboratoire et les quatre équipes, et dirige vers les pages individuelles des chercheurs. Outre la présentation de nos activités scientifiques, le site du laboratoire permet de diffuser tous les communiqués de presse, les prix reçus par des membres du laboratoire, les annonces de soutenance de thèse ou d'habilitation, mais aussi les propositions de thèse ainsi que la liste complète de tous les doctorants avec leurs sujets de recherche. Cela s'est avéré une très bonne méthode pour attirer de nouveaux étudiants, en stage ou en thèse.

L'**hygiène et la sécurité** sont deux éléments importants de la politique du laboratoire. Devant l'augmentation du personnel et la dispersion dans différents bâtiments, un second assistant de prévention (AP) s'est formé pour épauler F. Vittoz qui assurait cette responsabilité, seul, depuis de nombreuses années. M. Tanase est nommé depuis le printemps 2013. Ils continuent à identifier et analyser les risques encourus au laboratoire, en collaboration avec le responsable du service technique, le médecin de prévention de l'ENS de Lyon et l'inspecteur régional d'hygiène et sécurité du CNRS. En concertation avec le directeur, les deux AP se sont adjoints l'aide de plusieurs chercheurs pour les aider à repérer les risques et dangers dans les différents locaux. Il est à noter qu'en 2014, le laboratoire s'est muni, pour l'évaluation des risques, du logiciel EVRP développé par l'AMUE.

Des dispositions particulières sont mises en œuvre pour informer les membres du laboratoire, les visiteurs ou les stagiaires, des éventuels dangers encourus en son sein. Un registre d'hygiène et sécurité est à disposition du personnel au secrétariat du laboratoire pour recueillir des observations et suggestions relatives à la prévention des risques professionnels et à l'amélioration des conditions de travail. Des dispositions relatives au travail isolé ont été clairement établies. Au laboratoire, il doit rester exceptionnel, et être consacré exclusivement à des tâches ne présentant pas de risques. Au cours de la période, un seul incident, heureusement sans gravité, a été répertorié: l'éblouissement avec un laser sur une expérience de microscopie à force atomique. En revanche, V. Bergeron a été victime d'un très grave accident de la circulation sur le trajet domicile-travail en février 2013. Il devrait être en mesure de revenir au laboratoire dans un proche avenir.

Le laboratoire sollicite un organisme extérieur pour assurer chaque année une formation pour l'utilisation des machines-outils de l'atelier de mécanique des chercheurs, appelé plus communément "petit atelier". Tous les utilisateurs, qu'ils soient permanents ou (post-)doctorants, doivent suivre cette formation minimale avant d'accéder au petit atelier. Des formations plus spécifiques sont menées par le service hygiène et sécurité de l'ENS de Lyon. On peut donner les exemples des formations sur les risques liés aux lasers ainsi que la session d'habilitation électrique, toutes les deux organisées début 2014. Enfin, nous avons réalisé des travaux pour une mise aux normes en application de la réglementation de 2010 sur les rayonnements optiques artificiels et plus particulièrement le risque laser. En 2013, nous avons utilisé une partie importante des moyens octroyés par le CNRS au titre de l'infrastructure du laboratoire pour sécuriser plusieurs expériences ou postes de travail.

H. Tutelles et partenaires

Tutelles. Le laboratoire a des liens étroits et fréquents avec ses deux tutelles principales que sont le CNRS et l'ENS de Lyon, grâce à des liens de confiance établis avec les Directeurs Adjoints Scientifiques du CNRS et le Pôle recherche de l'ENS de Lyon. Si les liens sont moins fréquents avec la direction scientifique de l'Université, les échanges sont d'excellente qualité. Enfin, le soutien et la bienveillance de la délégation Rhône-Auvergne du CNRS sont très précieux dans de nombreux aspects: financier, ressources humaines, communication, valorisation, hygiène et sécurité,...

Lyon. Au niveau scientifique, le laboratoire est très impliqué dans la fédération de physique (FRAMA) qui regroupe les laboratoires de physique de Lyon, et notamment nos principaux partenaires locaux: l'Institut Lumière Matière (ILM), l'Institut de Physique Nucléaire (IPN) et le Laboratoire des Matériaux Avancés (LMA). Cette structure, dirigée par F. Vallée (ILM) avec A. Pumir comme adjoint, a vu son rôle singulièrement renforcé au cours du quinquennal puisqu'elle joue un rôle important dans la dynamique de structuration du site tant par la définition des profils d'enseignants-chercheurs que par son soutien à l'émergence de nouveaux projets de recherche, prioritairement entre laboratoires. On peut citer notamment les financements d'activités sur le bruit thermique avec le LMA, sur des mesures des fluctuations de courant dans les nanofils ou de l'achat d'une caméra infra-rouge avec l'ILM, ou le soutien financier à une série de séminaires sur dualité et intégrabilité en théorie des cordes avec l'IPN. Une nouveauté dans la période sous évaluation est l'apparition du LabEx iMUST (institute for Multiscale Science and Technology) qui a pour objectif de soutenir les initiatives à l'interface entre physique, chimie et ingénierie. Si nous regrettons que des projets regroupant seulement des physiciens ne soient pas éligibles, cette nouvelle structure a notamment permis le développement de nombreux projets: l'étude expérimentale de la ventilation d'un appartement du nouveau quartier Lyon-Confluence avec le Centre d'Energétique et de Thermique de Lyon (CETHIL), la compréhension de la dynamique d'un plasma forcé avec le laboratoire de Mécanique des Fluides et d'Acoustique (LMFA), les écoulements diphasiques dans les milieux poreux avec le Laboratoire de Génie des Procédés Catalytiques (LGPC) ou bien le mélange de colloïdes par des mécanismes turbulents ou chaotiques avec l'ILM et le LMFA.

ENS de Lyon. Il faut aussi rappeler le rôle très important du tissu des relations scientifiques au sein de l'École normale supérieure. La fusion des ENS scientifique et littéraire en 2010 a renforcé les liens avec les laboratoires du site Descartes, notamment avec les géographes du laboratoire Environnement Ville et Société, les membres du laboratoire Triangle consacré au domaine de l'action et de la pensée politiques ainsi que les sociologues du Centre Max Weber. Cependant, nos activités scientifiques continuent de profiter principalement de l'interaction avec des chercheurs issus des autres laboratoires scientifiques du site Monod. Il y a de très nombreuses collaborations, discussions et parfois même publications avec les laboratoires de chimie, biologie (LBMC, LJC, IGFL, RDP, Virologie), géophysique (LGL), informatique (LIP) ou mathématiques (UMPA). On peut noter deux faits marquants: le renouvellement récent mais complet de l'équipe de probabilités de l'UMPA (après les départs successifs de V. Beffara, C. Bernardin, A. Guionnet et C. Villani), associé au départ de notre laboratoire pour promotion de F. Toninelli a fragilisé des liens tissés patiemment au cours des années. Une nouvelle dynamique concertée est cependant relancée avec les nouveaux. Par ailleurs, les initiatives ayant conduit à la construction de la salle blanche et à l'acquisition du microscope électronique à balayage ont singulièrement rapproché les laboratoires de chimie et de physique au cours de ce quinquennal. Enfin, le laboratoire a des liens privilégiés avec trois structures scientifiques hébergées sur le site de l'ENS de Lyon: le Centre Blaise Pascal (CBP), l'Institut Rhône-Alpin des Systèmes Complexes (IXXI) et le Pôle Scientifique de Modélisation Numérique (PSMN), dirigés respectivement par R. Everaers, P. Jensen et E. Lévêque, tous trois également membres du laboratoire de physique. Que cela soit pour la description des systèmes complexes, la modélisation ou le calcul numérique, l'accueil et l'organisation de conférences, notre proximité avec ces structures est absolument essentielle.

En **France**, le laboratoire a des partenaires multiples. La cinquantaine de projets ANR a été obtenue en collaboration avec les principaux laboratoires français de nos thématiques. Au cours de la période, les membres du laboratoire ont assisté à des sessions de 25 Groupements de Recherche (GDR, *cf.* VII E 4), donnant par là même un aperçu de l'importance de ces structures mais aussi de la diversité thématique au laboratoire. Plusieurs chercheurs ont par ailleurs recours aux grands instruments de recherche, notamment l'IDRIS pour les gros utilisateurs de moyens de calculs ou bien les sources de rayonnement que sont l'ESRF et l'ILL en France, le Bragg Institute à Sydney ou la Swiss light source du Paul Scherrer Institute en Suisse, à l'étranger.

Quant aux **partenaires européens et internationaux**, le très important réseau de collaborations (*cf.* VII E 7) tissé au cours des années est très précieux. Plusieurs membres du laboratoire sont professeurs associés dans des universités étrangères, et trois Projets Internationaux de Coopération Scientifique (PICS) ont été signés au cours de la période avec l'Institute of Physics de Kiev (Ukraine), l'Université de Hertfordshire (UK) ou bien le MIT à Cambridge (USA). Le GDR International franco-russe, et les contrats officiels avec l'Argentine, Chili, le Japon ou la Tchéquie correspondent à la partie officielle (*cf.* VII E 8) des très nombreux échanges qui ne sont pas (encore) formalisés et qui permettent notamment d'attirer de très nombreux visiteurs ou (post-)doctorants pour des séjours prolongés.

II. RÉALISATIONS DE L'UNITÉ DE RECHERCHE

A. Rayonnement et attractivité académiques

La visibilité du laboratoire se traduit avant tout par la qualité de ses près de 800 **publications scientifiques** avec notamment 56 PRL, 38 EPL, 14 du groupe Nature, 5 PNAS, 4 Science, 4 Physics Reports, 1 IEEE TIT, 4 IEEE TSP, 2 monographies et une dizaine de brevets.

Plusieurs membres du laboratoire ont reçu des **récompenses** prestigieuses (*cf.* VII E 1 a): P. Flandrin a été élu membre de l'Académie des Sciences en 2011, un aboutissement après avoir obtenu la médaille d'argent du CNRS en 2010. A. Pumir s'est vu décerner le Prix Gay-Lussac Humboldt en 2013, tandis que M. Moulin a obtenu le cristal du CNRS 2013. Au cours du quinquennal, cinq des dix-neuf enseignants chercheurs ont été nommés à l'Institut Universitaire de France (IUF): D. Bartolo (2012), S. Manneville (2010), T. Roscilde (2013), H. Samtleben (2010) en tant que membres juniors et P. Holdsworth (2010) comme membre senior. P. Abry a été élu IEEE Fellow en 2011, M. Castelnovo a reçu le prix Jeune Equipe de Recherche de la Fondation Del Duca décerné par l'Institut de France en 2009, S. Joubaud a bénéficié d'une chaire CNRS et Q. Berger a reçu en 2013 le prix de thèse Jacques Neveu de la Société de Mathématiques Appliquées et Industrielles qui récompense les thèses en probabilités ou statistique. En ce qui concerne les projets, rappelons les trois succès obtenus à l'ERC par S. Manneville (2010), S. Ciliberto (2011) et F. Bouchet (2013) ainsi que la cinquantaine de projets financés par l'ANR (*cf.* VII G). On peut ajouter que dix membres du laboratoire ont été recrutés et vingt-huit promus (*cf.* VII E 1 c) lors de cette période de cinq années, alors que plus de la majorité des (enseignant-)chercheurs a été récipiendaire de la prime d'excellence scientifique (PES). Ces différents éléments, individuels ou portés à plusieurs, répartis à travers toutes les équipes et toutes les catégories de personnels, prouvent que l'excellence est une valeur partagée au laboratoire et reconnue à l'extérieur.

La visibilité du laboratoire se traduit aussi à travers les près de 400 **conférences internationales**, souvent très prestigieuses, auxquelles ont été invités ses membres (*cf.* VII E 6); par exemple S. Ciliberto fut conférencier plénier à StatPhys24 à Cairns en Australie en 2010. Plus de 60 conférences ou écoles (Les Houches, Banff, Cargèse) ont été organisées aussi par des membres du laboratoire (*cf.* VII E 5). On peut ainsi mentionner que K. Gawędzki a été membre du très prestigieux comité scientifique du congrès international de physique mathématique (ICMP12) ou bien rappeler *Complexity in Physics* (2009) et *Out-of-Equilibrium Physics* (2013) organisées par le laboratoire en l'honneur des soixantièmes anniversaires de A. Arneodo et B. Castaing pour la première, et de S. Ciliberto pour la seconde. Ce furent deux occasions exceptionnelles pour accueillir à Lyon un panel d'invités renommés et enthousiastes à l'idée de célébrer la carrière de nos collègues. Enfin, l'European Turbulence Conference (ETC14), et ses plus de 650 participants, organisée en 2013 par le laboratoire à l'ENS de Lyon, fut une véritable réussite.

Le laboratoire est impliqué dans de nombreux **comités éditoriaux** de journaux scientifiques (*cf.* VII E 2). K. Gawędzki est ainsi éditeur-en-chef des *Annales Henri Poincaré*, alors que, par exemple, B. Castaing est membre du comité éditorial d'*Europhysics Letters*, tandis que A. Arneodo et J.-F. Pinton sont membres du comité éditorial de *European Physical Journal* et A. Pumir de celui de *Physical Review E*.

Le laboratoire accueille un flux constant de **visiteurs** de courte à longue durée. Grâce aux postes de professeurs invités à l'ENS de Lyon, à l'Université Lyon 1 ou de chercheurs invités CNRS, nous avons notamment pu accueillir plus d'une trentaine de collègues sur des séjours prolongés (*cf.* VII E 9). Parmi les plus prestigieux, on peut citer C. Meneveau (Baltimore) ou S. Ruffo (Florence) qui a passé plus de deux années au laboratoire, alors qu'il était président de la commission de physique statistique de la IUPAP. Sans oublier l'honneur que nous a fait M. Fisher (prix Wolf 1980 et médaille Boltzmann 1983) d'accepter d'être en 2013 le premier Docteur Honoris Causa en physique de l'ENS de Lyon. Inversement, de très nombreux membres du laboratoire (*cf.* VII E 10) ont été invités pour des séjours prolongés dans des institutions prestigieuses comme le KITP de Santa Barbara, le MPIPKS de Dresde, le NII de Tokyo, le AEI de Postdam ou le CNLS à Los Alamos.

Le laboratoire s'est remarquablement investi dans le **pilotage de structures de recherche** au cours de la période évaluée (*cf.* VII E 3a): il a fourni trois vice-présidents de l'ENS de Lyon (2 chargés de la recherche et 1 de l'enseignement), un directeur de l'INstitut de Physique du CNRS, 2 présidents de section et plusieurs membres du CoNRS, 8 directeurs d'unité CNRS (dont CCSD, IXXI, LJC, 3 GDR), 2 chargés de missions au niveau d'instituts du CNRS... Cette forte sollicitation pour des responsabilités nationales est une importante nouveauté pour notre laboratoire. Plus généralement, une très grande part des chercheurs du laboratoire a été sollicitée pour participer à la définition ou l'évaluation de la stratégie scientifique à travers de très nombreux comités scientifiques (*cf.* VII E 3 b) ou jurys (*cf.* VII E 3 c).

Enfin, nous sommes toujours enthousiasmés par le flux et la qualité des stagiaires, (post-)doctorants, et lauréats aux concours CNRS, qui souhaitent rejoindre notre laboratoire, autant de promesses pour le futur.

B. Interactions avec l'environnement social, économique et culturel.

Les interactions du laboratoire avec l'**environnement culturel** sont très nombreuses et très variées (*cf.* VII F 1). Le laboratoire participe notamment de manière très active à la traditionnelle Fête de la Science qui est organisée sur le site de Gerland et pilotée au niveau du laboratoire par A. Steinberger. Expériences démonstratives voire ludiques, discussions endiablées avec des collégiens, ces rencontres sont souvent enthousiasmantes. Les doctorants du laboratoire jouent également un rôle très important lors de cette manifestation. Cet investissement se prolonge à travers de nombreuses interventions dans des lycées, collèges, écoles primaires de la région, souvent ponctuelles, parfois récurrentes. On peut citer par exemple l'investissement, prolongé à travers les années, de A. Naert dans un collège du quartier de l'ENS. R. Volk parraine, quant à lui, l'atelier scientifique d'un collège, en aidant à monter et exploiter des expériences. En gagnant la finale académique du concours Cgénial à chacune de ses participations, l'atelier a été sélectionné et primé lors de la finale nationale qui se déroule au palais de la découverte. Le laboratoire accueille enfin très régulièrement des stagiaires, collégiens ou lycéens. Passant une demi journée dans plusieurs groupes expérimentaux ou théoriques, découvrant les services techniques, parfois même le côté enseignement, ils finissent leur semaine de stage au laboratoire généralement enchantés.

Plusieurs membres du laboratoire ont, par ailleurs, été invités à présenter leurs travaux dans des manifestations culturelles de vulgarisation sur des sujets pointus, et parfois sur des débats de sociétés (le climat, la révolution numérique et la gouvernance, ...). Ils interviennent aussi à travers des articles dans des journaux de vulgarisation scientifique, quelquefois à travers des chroniques régulières comme celles de P. Jensen dans *La Recherche* ou *Le Monde Diplomatique*. Enfin, les travaux scientifiques ont bien entendu fait l'objet de très nombreux articles parus dans des périodiques français ou étrangers, grâce aux huit communiqués de l'Institut de Physique du CNRS en deux ans. On peut terminer en citant des participations plus ponctuelles à des émissions de radio ou un film documentaire en l'honneur d'Henri Poincaré, *L'harmonie et le chaos*, tourné en 2012 avec cinq mathématiciens dont C. Villani, puis diffusé sur France 3 et dans plusieurs festivals scientifiques.

En ce qui concerne l'**environnement social**, donnons quelques exemples emblématiques. Une équipe de chercheurs du laboratoire s'intéresse à l'étude et à la modélisation du système de vélopartage lyonnais, Vélo'V, dans un contexte de recherche fortement interdisciplinaire, mariant physique statistique, traitement du signal, informatique, sociologie, géographie et économie des transports. Les travaux de recherche sont actuellement conduits dans le cadre de l'ANR Vel'Innov et réalisés en étroite collaboration avec le Grand Lyon et Cyclocity (JCDecaux), les opérateurs public et privé du système. Le laboratoire entretient également des liens étroits avec les Hospices Civils de Lyon, notamment à travers deux projets phares. D'une part, dans l'ANR FETUSES sont développés des outils d'analyse statistique avancée (invariance d'échelle) de séries temporelles destinés à caractériser le rythme cardiaque foetal et ainsi assister les médecins du département d'obstétriques de l'Hôpital Femme-Mère-Enfant pour la détection précoce de l'acidose du foetus en phase d'accouchement. D'autre part, par une approche transdisciplinaire de la réponse mécanique d'éléments figurés du sang, est proposée une modélisation mathématique pour la mise en place d'un outil diagnostic du cancer, innovant pour le contexte hospitalier. Des expérimentations couplant optique et rhéofluidique sont en cours d'installation au centre d'hématologie de l'Hôpital de Lyon Sud.

Au niveau de l'**environnement économique** (*cf.* VII F 2), on peut retenir que le laboratoire a développé des partenariats féconds avec de nombreuses entreprises (AXA, BioMérieux, Boiron, L'Oréal, Rhodia-Solvay, Total,...), ce qui a permis de financer des projets de recherche et des (post)-doctorants. La nomination de N. Plihon comme correspondant valorisation a permis de renforcer significativement le suivi des étapes de dépôts de brevets et les relations avec les différents services de valorisation (ENS de Lyon, INP CNRS, délégation régionale, LyonSciencesTransfert). Une dizaine de brevets a été déposée durant la période évaluée, et deux recherches de partenaires industriels ont été initiées pour des brevets qui ne bénéficient pas encore de licence. Par ailleurs, deux autres brevets déposés dans la période antérieure ont désormais une licence et sont exploités. Le premier, proposant des particules instrumentées pour mesurer la vitesse, la température ou la pression, est développé par SmartInst, une startup issue du laboratoire. Le second, le logiciel Lokeo, propose des localisations appropriées pour l'implantation de nouveaux commerces, en combinant des concepts de la géographie et de la physique. Il a été développé en collaboration avec la Chambre de Commerce de Lyon et l'entreprise AID Observatoire, obtenant en 2011 le Prix Curie de l'innovation décerné par le Ministère de la Recherche. Enfin, deux FUI (Fonds Unique Interministériel) ont été signés au cours du quinquennal: i) PATVAX, qui développe des microcapteurs innovants pour un meilleur suivi en temps réel de la fabrication de vaccins et produits biothérapeutiques en partenariat avec Merial, Sanofi Pasteur et Smartinst. ii) FUILaBS, qui a permis de mettre au point un logiciel basé sur la méthode Boltzmann sur réseau pour simuler les écoulements, en lien étroit avec Renault et Airbus Industrie notamment. Ce rapide panorama montre que, si notre mission principale est de faire progresser les connaissances, notre capacité à valoriser nos résultats a été renforcée de façon significative.

C. Faits marquants

Expressément demandé par le HCERES, cet exercice de ne mettre en avant qu'un très faible nombre de réalisations marquantes après cinq années de travail d'un laboratoire regroupant cent-cinquante personnes s'avère périlleux et potentiellement source de frustration pour les membres du laboratoire. Comment extraire sereinement cinq publications majeures du quinquennal parmi les près de 800 publiées sur les sept thèmes, chacun assez vaste ? La sélection des faits marquants présentée ci-dessous a été effectuée collégialement par les chefs d'équipes et le directeur pour donner un aperçu de la qualité et de la diversité des activités scientifiques. La liste ci-dessous ne peut cependant pas représenter à elle seule l'excellence scientifique du laboratoire.

1. Cinq résultats majeurs obtenus par l'entité

   - **Première mesure de l'énergie minimale nécessaire pour inscrire un bit informatique**. Cette expérience liant théorie de l'information et thermodynamique a été réalisée pour la première fois par une équipe du laboratoire, 50 ans après que Landauer en ait posé le principe [697]. Aux cotés du Boson de Higgs, ce résultat remarquable a été classé par Physics World dans les 10 avancées scientifiques majeures en 2012.
   - **Développement du formalisme de l'optique quantique électronique**, en collaboration fructueuse avec plusieurs groupes expérimentaux, et résultant en particulier dans l'observation de la séparation spin/charge dans les canaux de bords de l'effet Hall quantique et dans la démonstration d'interférences à deux particules entre électrons uniques [421].
   - L'**identification de communautés dans un réseau**, c'est-à-dire la meilleure partition d'un graphe en groupe de noeuds fortement connectés, a pu être renouvelée grâce à une approche originale, multiéchelle sur graphes [666]. Cette approche ouvre la voie à une analyse conjointe de la dynamique du réseau et des signaux qu'il transporte.
   - Le **dispositif d'imagerie ultrasonore ultrarapide** développé dans le cadre du projet ERC USOFT a permis une analyse résolue en temps et en espace de la compétition entre l'instabilité hydrodynamique classique dite de "Taylor-Couette" et une instabilité élastique typique des fluides viscoélastiques au sein d'une solution diluée de tensioactifs formant des micelles géantes [132].
   - **Construction d'une q-déformation intégrable de la théorie des cordes sur** $AdS_5 \times S^5$. La première étape nécessaire pour construire une discrétisation intégrable de la réduction de Pohlmeyer de cette théorie des cordes, centrale pour la correspondance AdS/CFT, a aussi été menée [328].

2. Cinq publications majeures de l'entité

   - A. Bricard, J.-B. Caussin, N. Desreumaux, O. Dauchot, D. Bartolo, *Emergence of macroscopic directed motion in populations of motile colloids*, Nature 95, 503 (2013).
     Bancs de poissons, colonies bactériennes et cytosquelette présentent des mouvements collectifs coordonnés à grandes échelles malgré l'absence de meneur. La mise au point d'un système microfluidique a permis de comprendre quantitativement l'émergence spontanée d'un mouvement unidirectionnel dans une population de plusieurs millions de particules colloïdales autopropulsées.
   - F. Bouchet, A. Venaille, *Statistical mechanics of two-dimensional and geophysical flows*, Physics Reports 515, 227-295 (2012).
     Cette revue est une présentation très complète de l'auto-organisation des écoulements turbulents à deux dimensions ou en géophysique. Elle met en valeur comment les méthodes de mécanique statistique permettent de comprendre la dynamique et la physique de ces phénomènes, tout en considérant des applications à la troposphère de Jupiter et aux tourbillons ou jets océaniques.
   - M. A. Cazalilla, R. Citro, T. Giamarchi, E. Orignac, M. Rigol, *One dimensional bosons: From condensed matter systems to ultracold gases*, Reviews of Modern Physics 83, 1405-1466 (2011).
     Les modèles de bosons à une dimension en interaction sont de première importance en matière condensée et pour la description des gaz quantiques ultra-froids. Cette revue donne une perspective très complète des résultats théoriques et expérimentaux les plus récents pour ces systèmes tout en dégageant plusieurs pistes de développement futurs.
   - V. Vidal, M. Ripepe, T. Divoux, D. Legrand, J.-C. Geminard, F. Melo (2010), *Dynamics of soap bubble bursting and its implications to volcano acoustics*, Geophysical Research Letters, 37, L07302 (2010).
     Ce travail d'intérêt géophysique a permis de quantifier les signaux acoustiques émis lors de l'explosion de bulles géantes sur les volcans. Il montre en particulier que la méconnaissance du temps de rupture peut conduire à une estimation erronée de la surpression dans la bulle avant son explosion et expliquer la faible partition d'énergie entre les signaux acoustiques et sismiques.

- A. Arneodo, C. Vaillant, B. Audit, F. Argoul, Y. d'Aubenton-Carafa, C. Thermes. *Multi-scale coding of genomic information: From DNA sequence to genome structure and function,* Physics Reports 498, 45 (2011).
  L'invitation à rédiger cette revue couronne cette démarche interdisciplinaire vers la biologie. Ce travail démontre la pertinence du concept d'invariance d'échelle afin de décoder certains aspects de l'information génétique fondamentaux pour la régulation de la (dé)condensation de l'ADN intervenant dans de nombreuses fonctions nucléaires.

3. Cinq documents majeurs produits par l'entité

- **LaBS, un logiciel de simulation de dynamique des fluides**. Fondé sur la méthode Boltzmann sur réseau et développé en lien étroit avec Renault et Airbus Industrie, notamment dans le cadre du FUI Labs, ce logiciel est le premier outil commercial pour une simulation directe en aéroacoustique. Ses applications ciblent notamment les industriels des transports (routier, ferroviaire, aérien) et intègrent les derniers développements académiques en turbulence.
- **Lokéo, un logiciel pour une implantation optimale de nouveaux commerces.** Développé en collaboration avec des acteurs économiques (chambre de commerce de Lyon, entreprise AID) et des chercheurs de différentes disciplines, il a reçu le "Trophée du transfert de technologies" du Ministère de la Recherche en 2011.
- **Deux monographies en physique statistique**. Une très belle introduction à la physique statistique des systèmes complexes, tout particulièrement utile pour les doctorants ou chercheurs issus de biologie, informatique, économie ou des sciences sociales. Ainsi qu'un livre sur la dynamique et la mécanique statistique des systèmes avec interactions à longue portée qui offre un panorama unique des méthodes et des systèmes physiques concernés (*cf.* VI A).
- **Vélocimètre pour un fluide électriquement conducteur** (Brevet FR1054250) : l'opacité et la forte réactivité chimique des métaux liquides rend caduques de nombreuses méthodes classiques de mesure de vitesse. Nous avons développé un nouveau capteur local multi-composantes pour ces fluides, sans contact, simple à mettre en oeuvre et validé sur des écoulements turbulents de gallium et sodium liquide.
- **Un violon qui joue tout seul** (Brevet FR1260891) : si l'acoustique musicale des instruments de la famille du violon fait intervenir de nombreux phénomènes au niveau des cordes et chevalet pendant le jeu, la réponse de la table et de la caisse de l'instrument en est largement décorrélée. Nous avons développé un système permettant de caractériser ces éléments exclusivement, utile au luthier dans la réparation comme dans la création, mais aussi capable de faire jouer l'instrument seul pour une maturation accélérée.

4. Cinq faits illustrant le rayonnement ou l'attractivité académiques de l'entité

- **Élection de P. Flandrin à l'Académie des Sciences**, dans la section des sciences mécaniques et informatiques (2011), **Cristal CNRS de M. Moulin (2013)** et **Prix Gay-Lussac Humbolt de A. Pumir (2013)**.
- **5 enseignants chercheurs** (D. Bartolo, P. Holdsworth, S. Manneville, T. Roscilde, H. Samtleben), **nommés à l'Institut Universitaire de France** (IUF) au cours des quatre dernières années.
- **3 ERC et 46 ANR** ont permis de financer l'activité des soixante chercheurs du laboratoire au cours de la période. Viennent s'ajouter à cela de très nombreux accords internationaux bilatéraux (3 PICS, 2 JSPS, 2 CONICET, 1 LIA,...).
- Organisation de 61 conférences dont **ETC14, European Turbulence Conference**, organisée en 2013 par le laboratoire à l'ENS de Lyon avec plus de 650 participants.
- **Doublement en 5 ans du nombre de doctorants** et de celui des postdoctorants au sein du laboratoire.

5. Cinq faits illustrant les interactions de l'entité avec son environnement socio-économique ou culturel

- Une équipe de chercheurs s'intéresse à l'étude et à la **modélisation du système de vélopartage lyonnais, Vélo'V**, dans un contexte de recherche fortement interdisciplinaire. Les travaux de recherche sont réalisés en étroite collaboration avec le Grand Lyon et Cyclocity (JCDecaux), les opérateurs, respectivement, public et privé du système.

- **Liens très étroits avec les Hospices Civils de Lyon**, à travers deux projets phares. Le développement d'outils d'analyse statistique de séries temporelles destinés à caractériser le rythme cardiaque fœtal et ainsi d'assister les médecins en phase d'accouchement. L'étude de la réponse mécanique d'éléments figurés du sang pour la mise en place d'un outil diagnostique innovant.
- Participation au **film-documentaire de 53' diffusé par France 3** et plusieurs festivals scientifiques. Tourné avec cinq mathématiciens, dont C. Villani, il a été tourné en l'honneur du centième anniversaire de la disparition d'Henri Poincaré: *L'harmonie et le chaos* (2012).
- Le FUI Patvax a permis le **développement de microcapteurs innovants** pour un meilleur suivi en temps réel de la fabrication de vaccins et produits biothérapeutiques en partenariat avec Merial, Sanofi Pasteur et Smartinst.
- Développement avec L'Oréal de **nouvelles techniques de formulation de microcapsules** permettant de produire des mousses et émulsions ultra-stables. Une coque est créée autour de bulles ou de gouttelettes soit par recouvrement avec des nanoparticules, soit par déclenchement d'une réaction de polymérisation à l'interface.

6. Indiquer les principales contributions de l'entité à des actions de formation

- **Le Master Sciences de la Matière**, une des formations phares du PRES de Lyon, proposant une formation au meilleur niveau en physique fondamentale, et d'excellents débouchés tant pour les thèses expérimentales que théoriques. Les membres du laboratoire sont très impliqués dans le pilotage, les enseignements et l'accueil des étudiants en stage.
- **Le Master 2 Modélisation des Systèmes Complexes**, piloté par des membres du laboratoire, représente l'exemple le plus abouti de parcours interdisciplinaire. Regroupant des étudiants d'Informatique, Mathématiques, Sciences de la matière ou de la vie, il permet d'acquérir une culture interdisciplinaire sur la modélisation des systèmes complexes en biologie, santé ou sciences sociales.
- **Le Master Erasmus Mundus Atosim**, piloté par R. Everaers, est un master international issu d'une collaboration entre l'ENS Lyon, des universités à Rome et Amsterdam et le réseau CECAM. Atosim met l'accent sur l'articulation étroite entre les concepts fondamentaux et la modélisation numérique en physique et chimie.
- **L'implication forte des chercheurs CNRS aux côtés de leurs collègues enseignants-chercheurs** dans l'enseignement à l'ENS de Lyon au sein d'une action concertée entre le laboratoire et le département d'enseignement. Cela a permis d'alléger la charge d'enseignement des enseignants-chercheurs, leur permettant de consacrer le temps libéré à la recherche. Les deux effets sont bénéfiques à la formation par la recherche délivrée aux étudiants.
- **L'école d'été de traitement du signal et des images de Peyresq**, créée à l'initiative de P. Flandrin en 2006, a un très fort impact sur la communauté. Organisée chaque année sous l'égide de GRETSI, cette école joue pleinement son rôle de lien entre les jeunes chercheurs et les experts assurant des cours avancés sur les développements récents de sujets d'actualité, tout en encourageant les interactions futures: http://www.gretsi.fr/ecole-d-ete-de-peyresq.php.

7. Points précis sur lesquels l'unité souhaite obtenir l'expertise du comité

- **Comment gérer au mieux la maturité du laboratoire ?** Le laboratoire a un grand potentiel de formation de (post-)doctorants et est très attractif en termes de recrutements ou de mutations de chercheurs. Avec des locaux saturés et un laboratoire de taille déjà imposante, comment éviter le risque de perdre souplesse, réactivité et dynamique collective ?
- **Difficultés à recruter dans les sections non rattachées à l'INP.** Depuis la séparation en instituts du CNRS, nous avons découvert des difficultés pour que des chercheurs admis dans des sections ne relevant pas de l'INP soient affectés dans l'unité. Les principaux exemples sont pour nous les activités traitement du signal et mécanique des fluides, relevant des sections 7 et 10. Comment assurer que les équipes dont l'activité principale relève d'un institut autre que l'INP puissent néanmoins bénéficier de recrutement par l'INSII ou l'INSIS ?
- **Personnel technique en imagerie**. Le laboratoire conduit de nombreuses activités expérimentales qui mettent en jeu l'acquisition et l'analyse par traitement d'images numérisées: acquisition via des caméras optiques, instruments ultrasonores, AFMs,... D'autre part, le laboratoire vient de s'équiper d'un microscope électronique à balayage (MEB), sans véritable expert dans ses rangs. Nous souhaitons recruter un(e) spécialiste pour épauler les chercheurs dans l'utilisation et le partage de ces outils. Quel niveau de qualification (T, AI, IE, IR) et compétences initiales viser ?

III. IMPLICATION DE L'UNITÉ DANS LA FORMATION PAR LA RECHERCHE

L'enseignement de la physique à l'ENS de Lyon est organisé par le département de physique qui est dirigé par P. Holdsworth depuis 2002. Les membres du laboratoire de physique, enseignants-chercheurs et chercheurs, jouent un rôle clef dans les différents parcours qui composent la formation *Sciences de la Matière*

- Les années L3 et M1 du programme *Sciences de la Matière* dont l'effectif est supérieur à 50 étudiants par an regroupe les élèves normaliens ainsi qu'un nombre équivalent d'étudiants avec un statut universitaire, issus des classes préparatoires ou des meilleures universités françaises ou étrangères.
- La filière M2 *Physique, Concepts et Applications*, proposant une formation au meilleur niveau en physique fondamentale, et d'excellents débouchés tant pour les thèses expérimentales que théoriques.
- La filière M2 *Modélisation de Systèmes Complexes*, axée sur une formation pluridisciplinaire englobant notamment les mathématiques, la physique et l'informatique.
- La filière M2 *Modélisation Numériques*, (partie du master Erasmus Mundus Atosim regroupant Lyon, Amsterdam et Rome) qui met l'accent sur l'articulation étroite entre les concepts fondamentaux et la modélisation numérique en physique et chimie.
- La filière M2 professionnel, *Métier d'Enseignement*, issue de l'ancienne préparation à l'agrégation.

Ces cursus répondent à l'une des missions principales de l'ENS de Lyon, la formation des étudiants au plus haut niveau pour les métiers d'enseignant et chercheur dans les secteurs public et privé. Deux éléments sont fondamentaux dans la réussite de cette mission: une disponibilité suffisante des enseignants-chercheurs pour faire de la recherche grâce à l'aménagement d'un service d'enseignement approprié; l'engagement du corps des chercheurs CNRS dans les activités d'enseignement, renforçant par là même le lien du laboratoire avec les étudiants mais aussi intensifiant leur formation par la recherche. En collaboration avec la direction de l'ENS de Lyon, le département a développé un service d'enseignement de 140 à 150 heures équivalent TD devant les étudiants pour les enseignants-chercheurs actifs en recherche; c'est un élément indispensable pour que le niveau des activités de recherche de l'équipe des enseignants-chercheurs soit très élevé. En retour, le département bénéficie d'un investissement considérable de la part des chercheurs CNRS non seulement au niveau de l'enseignement sous toutes ses formes (cours magistraux, travaux dirigés, travaux pratiques), mais aussi au niveau de la responsabilité de certaines formations. Le département a mis en place un appel d'offre, ouvert à tous les cours, TD et TP, proposés dans les formations, avec des services pour les membres du laboratoire rattachés au CNRS allant jusqu'à 64 heures équivalent TD. Sur les cinq dernières années, trois quarts des chercheurs CNRS rattachés au laboratoire ont été fortement impliqués (pour une moyenne de 40h par an et par chercheur, et un total d'environ 1200h/an, *cf.* VII H 5). Cette pratique est soutenue et financée par l'ENS sous la forme d'heures complémentaires. Comme indicateur de la réussite de cette politique d'intégration, on peut remarquer que le Master Sciences de la Matière a été classé A^+ par le dernier comité de visite AERES en 2010. Par ailleurs, le Master pro-enseignement continue à afficher d'excellents classements à l'agrégation de physique, malgré une forte chute du nombre de postes mis au concours. On notera que H. Gayvallet est vice-président du très important *concours de l'ENS de Lyon* depuis 2008, une position stratégique pour maintenir la qualité du recrutement en amont. Enfin, de très nombreux membres du laboratoire sont aussi impliqués dans des formations à l'extérieur (*cf.* VII H 6) ou bien dans des écoles internationales (*cf.* VII H 7). On peut notamment citer l'organisation par P. Flandrin de l'école d'été en traitement du signal et des images à Peyresq (France) chaque année depuis 2009 ainsi que l'implication de R. Everaers dans les écoles en physique numérique du centre de Physique des Houches (France).

Toutes les responsabilités liées aux enseignements de physique à l'ENS de Lyon sont assurées par des membres du laboratoire, dont quelques unes par des chercheurs CNRS. Les principales, liées à la formation par la recherche, sont résumées ci-dessous.

- Directeur *des études de l'ENS Lyon*, M. Peyrard (2006-2009)
- Directeur du *Département de physique*, P. Holdsworth (2002-) avec comme adjointe F. Chillà (2010-)
- Responsable Formation *Sciences de la Matière* (L3 + Master), F. Chillà (2009-2011), S. Manneville (2011-)
- Responsable M2 *Physique, Concepts et Applications*, T. Dauxois (2005-2011), L. Bellon (2011-)
- Responsable M2 *Modélisation de Systèmes Complexes*, P. Jensen (2009-)
- Responsable parcours physique du M2 *Systèmes Complexes*, E. Bertin (2009-2013), P. Borgnat (2013-)
- Responsable M2 *Métiers de l'Enseignement* (prépa. agrég.), E. Freyssingeas (2007-2011), P. Odier (2011-)
- Coordinateur Master *Atosim Erasmus Mundus* (Lyon/Rome/Amsterdam), R. Everaers (2007-)
- Responsabilité des *stages en L3 et M1*, C. Moskalenko (2009-2011), S. Joubaud (2011-)

Le laboratoire accueille un nombre considérable de stagiaires, notamment d'avril à juillet. Au cours des cinq dernières années, le laboratoire a accueilli 150 stagiaires (*cf.* VII H 4) répartis schématiquement en 20%, 35% et 45% aux niveaux L3, M1 et M2 respectivement. Si la grande majorité d'entre eux est issue des formations locales, nombreux sont ceux pour lesquels une gratification est requise. Pour en assurer le financement, le laboratoire réserve à cet effet une enveloppe de 20k€ chaque année. Chaque permanent du laboratoire a donc la possibilité d'encadrer un stagiaire sans avoir de contrat personnel pour le rémunérer. Cela permet au laboratoire de remplir sa mission de formation par la recherche à la hauteur de l'ambition qui est la sienne.

Au niveau doctoral, le laboratoire est uniquement lié à l'École Doctorale de PHysique et ASTrophysique de Lyon (ED Phast), regroupant tous les laboratoires de physique et d'astrophysique de Lyon, auxquels on doit ajouter, depuis deux années, le laboratoire de géologie (LGL). Cette ED était dirigée par F. Delduc jusqu'à la fin de l'année 2009, avant que C. Dujardin, Professeur à l'Université Lyon 1 et rattaché à l'ILM ne le remplace. Il est assisté par H. Samtleben. Le fonctionnement de l'ED est extrêmement satisfaisant. Les contrats doctoraux sont choisis lors d'un concours à la fin du mois de juin, à travers un classement qui tient compte des résultats scolaires des candidats, de la qualité de leurs auditions et des priorités des laboratoires. Nous avons bénéficié chaque année de 2 à 3 contrats doctoraux de l'ED Phast; c'est évidemment beaucoup trop faible mais malheureusement classique dans le système français qui fournit ainsi de l'ordre de 17 contrats/an pour tous les laboratoires de l'ED. C'est cette dernière qui administre l'ensemble des doctorants du laboratoire qu'ils soient recrutés sur des financements du ministère et donc sélectionnés par l'ED, ou par l'intermédiaire des contrats ANR, industriels, de la région, ... Les anciens élèves normaliens, titulaires de contrats doctoraux, sont aussi rattachés à l'école doctorale avec tous les droits et tous les devoirs correspondants. Ils sont sélectionnés par une commission ad-hoc de l'ENS de Lyon, dirigée depuis 2012 par E. Freyssingeas. Nous bénéficions en moyenne de 5 contrats doctoraux réservés aux normaliens par année. La proportion des différentes sources de financement sur l'ensemble des thèses soutenues ou en cours du dernier quinquennal se répartissent sous la forme suivante: 40% ENS, 20% ED, 40 % financements sur contrats (ANR, ERC, Région,...). On peut noter que 55% des étudiants sont issus du master Sciences de la Matière, 25% des autres masters français, et finalement 20% des étudiants viennent de l'étranger (*cf.* VII H 1 et VII H 2).

Depuis 2011, le laboratoire sélectionne chaque automne un sujet de thèse assuré, pour la rentrée suivante, d'être financé sur fonds propres. Le directeur procède à la sélection, mais celle-ci est toujours présentée au conseil de laboratoire pour validation. Plusieurs critères de choix du sujet entrent en ligne de compte: que le directeur de thèse soit à un moment charnière de sa carrière, la thèse l'aidant dans sa prise d'indépendance; le soutien à une thématique qui pourrait disparaître après un départ à la retraite; la promotion des femmes... Le candidat retenu est cependant encouragé à postuler à tous les financements auxquels il peut prétendre, permettant alors l'utilisation de la somme pour une autre opération.

Le laboratoire a accueilli une centaine de doctorants au cours de la période évaluée. Dans le même temps, soixante thèses ont été soutenues. Toutes sont financées avec un minimum strict de 1450€ net/mois en 2014 (coût total employeur: 2500€) avec, dans certains cas, un complément pour atteindre ce seuil apporté par le contrat ou l'équipe de rattachement. La très grande majorité des doctorants qui le souhaitent ont accès au monitorat.

Autant que l'on puisse en juger, les doctorants semblent vivre leurs années au laboratoire dans d'excellentes conditions. Si les membres permanents du laboratoire s'investissent avec conviction dans cette mission de formation par la recherche, il est clair qu'en retour les doctorants apportent un dynamisme exceptionnel et une efficacité en recherche absolument essentielle au laboratoire. Cela est particulièrement visible lors de la *journée des thésards*, organisée par les doctorants (apéritif et repas compris) au début du mois de juin. La qualité des exposés permet d'avoir une excellente vue d'ensemble des activités développées au sein du laboratoire.

Les doctorants développent des activités collectives propres. On peut donner deux nouveaux exemples de ce quinquennal: - Le séminaire de théorie des doctorants, un rendez-vous bi-mensuel créé en 2012 au sein du laboratoire, qui a pour but de permettre à tous ceux qui le souhaitent de présenter de manière informelle une partie de leurs travaux de recherche. Plutôt orienté théorie, le séminaire est ouvert à tous les doctorants. - "Les après-midi des doctorants de l'ED Phast", initiés en 2013, dont la dernière séance a eu lieu au mois de mai 2014 dans les locaux de notre laboratoire. Enfin, malgré l'exiguïté des locaux, le laboratoire a également proposé d'offrir une partie d'une salle pour accueillir les expériences du laboratoire junior intitulé *Initiation à la Dynamique des Fluides Planétaires*, créé en 2011 par une petite dizaine d'étudiants de doctorat ou de master (géo)physiciens. Ce laboratoire junior essentiellement tourné vers la géophysique a été renouvelé au début de l'année 2014 pour deux ans. Il développe des expériences et supports pour le web, tout particulièrement à destination des milieux scolaires et du grand public.

Outre les très nombreuses rencontres informelles, une rencontre plus formelle entre le directeur et chaque doctorant est systématiquement organisée en fin de première et deuxième années. Cela permet de brièvement faire le point sur l'avancée du projet et de commencer à évoquer le futur. Suite à une proposition de l'ED Phast à tous les laboratoires, C. Moskalenko a également été nommée référente auprès des doctorants en 2012, offrant ainsi une possibilité supplémentaire de dialogue en cas de nécessité.

À la fin de leur thèse, une part conséquente des doctorants s'oriente vers l'enseignement, mais la grande majorité poursuit en post-doctorat dans des institutions souvent prestigieuses, comme indiqué dans le tableau VII H 1. Des statistiques sur la période précédente sont plus représentatives de leur emploi à terme. Sur les 55 étudiants listés dans le rapport 2005-2009 précédent, la répartition est la suivante: 10 sont actuellement enseignants-chercheurs (dont 6 à l'étranger), 13 chargés de recherche (dont 12 au CNRS), 7 enseignants (4 en CPGE, 2 PRAG), 8 ingénieurs (Rhodia, IFPEN, SFR,...), 13 sont encore en post-doctorat (12 n'ayant soutenu qu'après 2010), 4 divers (conservateur de musée scientifique, artisan, mère au foyer). La formation par la recherche au laboratoire de physique est manifestement une excellente préparation pour la suite.

IV. RAPPORT SCIENTIFIQUE

T1R. Hydrodynamics and Geophysics: *Report*

Permanent Members: P. Borgnat, F. Bouchet, B. Castaing, L. Chevillard, F. Chillà, T. Dauxois, E. Freyssingeas, K. Gawedzki, J.-C. Géminard, S. Joubaud, E. Lévêque, S. Manneville, P. Odier, N. Plihon, A. Pumir, J.-F. Pinton, S. Roux, N. Taberlet, A. Venaille, V. Vidal, R. Volk

Post-docs: E. Calzavarini, M. Creyssels, L. Ducasse, L. Fiabane, J. Munroe, C. Nardini, X. Riedinger, J. Salort, H. Scolan, F. Seychelles, H. Touil, A. Venaille, M. Vosskuhle

PhD students: G. Bordes, B. Bourget, C. Brouzet, A. Cahuzac, E. Horne, O. Liot, N. Machicoane, M. Mercier, S. Miralles, B. Percier, E. Rusaouen, C. Sánchez, T. Tangarife, J.C. Tisserand, G. Varas, G. Verhille, M. Vosskuhle, R. Zimmermann

Many activities of the laboratory involve fluids or complex matter flows. Some of these activities relate to fundamental hydrodynamics, whether experimental, theoretical or numerical. Following the new technical developments on particle tracking, a group in our laboratory has designed experiments to study the dynamics of particles in a turbulent flow, while other groups tackled the same issue via theoretical stochastic approaches. Another research axis has been focussing on mass or heat turbulent transport, studying ice melting or gravity currents dynamics, as well as forced turbulent convection. Finally, pursuing our solid tradition in statistical physics, several groups have been working on statistical turbulence, using multifractal or conformal invariance theory, and turbulence modeling, developing new Large Eddy Simulations (LES) approaches. Others activities are dedicated to, inspired by, or might be of potential applicability in the geophysical context. Regarding oceanic and atmospheric applications, the main focusses have been on energy transfer by internal gravity waves, as well as statistical approaches of large scale flows. Following the success of the VKS experiment, various new results have also been obtained on the behavior of a dynamo generated magnetic field and its coupling with the magnetohydrodynamics (MHD) flow. Other groups have concentrated their efforts of multiphase flows, working on the formation of ripples on roads, the discharge of a grain silo or the motion of gas bubbles through complex material. Regarding the complexity of all the considered phenomena in the geophysical context, we think that progress in these fundamental studies would be of primary interest to the understanding of field observations.

A. *Turbulent transport*

Particle dynamics in turbulent flows (ANR DEPSET and TEC, M. Bourgoin, LEGI, J. Bec, OCA, M. Lance LMFA)

Experimental studies of particle dynamics. Modern experimental techniques make possible nowadays to resolve the dynamics of small material particles in highly turbulent flows. Using Extended Laser Doppler Velocimetry, we have focused experimentally on the dynamics of small neutrally buoyant particles with sizes larger than the dissipative scale of the flow, and observed that not only their variance of acceleration decreases as $(D/\eta)^{-2/3}$ (following pressure increments), but also the intermittency of their dynamics [98]. These results compare qualitatively well with a Faxen model of material particle dynamics we implemented in a DNS simulation of homogeneous and isotropic turbulence [17, 18]. More recently we investigated the possible clustering of neutrally buoyant material particles, and compared the results with what was obtained for inertial particles with same Stokes number in a homogenous and isotropic turbulent flow [105]. We observed that if large neutrally buoyant particles share common properties with inertial particles, they do not exhibit clustering in homogeneous isotropic turbulence [34, 35]. Tracking the dynamics of painted spheres with diameters of the order of the integral length of the flow (L) allows for 6 dimensional tracking of both position and orientation in the whole flow volume of a turbulent von Kármán flow. We observed both translation and rotation dynamics are still very intermittent for these large scale objects, with strong coupling between the two through a lift force [104]. We also observed a transition in the dynamics of very large particles which become trapped in the large scale structures of the underlying flow, leading to non-homogeneous sampling [45].

Theoretical studies of particles dynamics. From the theoretical point of view, these studies raise questions about the statistical properties of the orientation of objects transported by the flow. In this spirit, we have proposed a very simple model of rotating sphere in a turbulent flow, and obtained explicit results about the dynamics of decorrelation of the orientation [101], which can be formally understood in terms of irrational quantum numbers. We have also demonstrated the alignment of small rods in the flow with the fluid vorticity [67]. A generalization of this study concerns the deformation of more complex objects, such as triangles in turbulent flows [68].

It has been noticed for many years that turbulence leads to an enhanced collision rate between (heavy) particles suspended in the flow. Using direct numerical simulations in the limit where the size of the particles is very small compared to the smallest length scale of the flow, we have demonstrated that the "sling effect" [29], whereby inertial particles slung by vortices acquire a velocity which is very different from the flow velocity, plays a much more important role than preferential concentration in the enhancement of collision rates, and prevents unexpected multiple collisions between pairs of particles, which we observe when particles are simply following the flow [100].

Tracking the motion of several particles following a turbulent flow allows us to obtain important information on the structure and on the dynamics of turbulence. In particular, varying the overall size of the set of particles leads to a systematic characterization of the flow properties on scale. Among the results obtained recently, we have determined the alignment properties between vorticity and the rate of strain tensor as a function of scale. Remarkably, we find an (essentially) self-similar behavior in the so-called inertial range of scales [64]. We have also demonstrated that the dynamics of alignment between vorticity and the rate of strain tensor can be understood in terms of elementary physical properties, such as angular momentum conservation [103].

Theoretical studies of velocity gradients dynamics, Application to particles. Following general developments aimed at modeling the velocity gradient dynamics along lagrangian trajectories in turbulent flows, we have applied this stochastic approach to diverse problems including the short-time dynamics [22] and the very peculiar structure of the pressure Hessian [21]. More recently, we have shown that this model was able to give a realistic picture of the rotation rate of rods in turbulence, whereas the level of fluctuation of discs remains an open problem [23]. Also, in a different but related context, we have shown in [43] how to use the short-time dynamics of the Euler equations to get new and realistic closures for the subgrid stress tensor entering the momentum equation of the filtered velocity field (also called Large Eddy Simulations).

Ergodic properties of inertial particles. In [38] the simplest model of massive inertial particles in turbulent flow was analyzed using the theory of stochastic equations with hypoelliptic generators. The rigorous results obtained were confronted with earlier numerical predictions of Bec-Cencini-Hillerbrand about the algebraic tails in the distribution of relative velocity differences of close particles. They confirmed the numerical predictions in two dimensions but also established the algebraic decay of the distribution and the values of the corresponding exponents in three and higher dimensions where the numerical analysis did not provide definite answers.

Turbulent mixing

Turbulent heat transfer. A particle larger than the dissipative scale cannot follow the fluid motion, and an important slip velocity between the particle and the flow is present which can enhance heat or mass transfer from the particle to the flow. We have studied the melting dynamics of large ice balls in a turbulent von Kármán flow, and compared the results obtained with attached particles to the ones obtained with freely transported particles in the whole flow (Fig. 1). Using an optical shadowgraphy setup, we recorded the time evolution of particle sizes which gives access to the Nusselt number Nu as a function of the particle Reynolds number Re_D. For the fixed particle case, we observed that the Nusselt number behaves as $Nu \propto {Re_D}^{0.8}$, an exponent smaller than the one obtained for freely advected ice balls, for which $Nu \propto Re_D$, compatible with what is expected in the ultimate regime of forced convection [44].

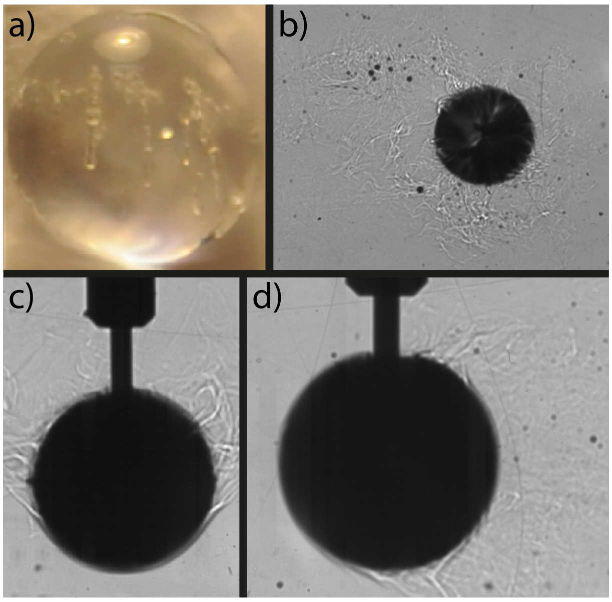


Figure 1: (a) Ice ball from a spherical mold. (b) Ice ball (14 mm diameter) freely advected by a counter-rotating von Kármán flow. (c) Ice ball (18 mm diameter) fixed at the center of a counter-rotating von Kármán flow, and melting under the effect of turbulent fluctuations only. (d) Ice ball (18 mm diameter) fixed at the center of a von Kármán flow with a single rotating disk, melting due to a strong mean shear and weak turbulent fluctuations.

Turbulent gravity currents. The entrainment and mixing properties of a turbulent gravity current was studied experimentally. Particle Image Velocimetry and Laser Induced Fluorescence were used to obtain a simultaneous measurement of the velocity and density fields. We showed that vertical fluxes of momentum and density display a quadratic correlation with vertical gradients of velocity and density, respectively [58]. We explained this correlation using a mixing length model. In addition, we characterized the entrainment of ambient fluid by the current, showing that it depends not only on the Richardson number (representing the shear/stratification balance) but also on the Reynolds number, a parameter often neglected in entrainment parametrizations used for ocean dynamics numerical simulations [57].

(ANR Gimic, J.-P. Hulin, FAST, J. Magnaudet, IMFT; Region CIBLE).

One fundamental point in the highly turbulent thermal convection is the understanding of the role of the boundary layers versus the bulk, as well as their interaction [25]. We performed separate experimental measurements and modelizations of the bulk and boundary layers.

Our model system to study the bulk is a square channel (5×5 cm^2), vertical or inclined, connecting two chambers, a hot one at the bottom and a cold one at the top, filled with water. We measure the temperature gradient along the channel and the velocity field, using PIV (Particle Image Velocimetry). These measurements, which allow severe cross-checks, have been very fruitful, evidencing a laminar regime and a turbulent regime, separated by an intermittent one [69]. The laminar regime was interpreted in details, almost without adjustable parameters [71]. In the turbulent regime, the birth of an inertial range was clearly visible. The evolution of the velocity profile with the tilt angle of the device could be traced back to the growing influence of the stratification on turbulent mixing [73], an often neglected or underestimated effect. We recently built a larger channel (20×20 cm^2) to reach the turbulent regime even at large tilt angle.

On the other hand, we studied the influence of a well-controlled roughness on the heat transfer between a plate and the fluid, and on the flow. This roughness consists in square blocks of height h_0, $d \times d$ horizontally, arranged in a square lattice of period $2d$. In our Rayleigh-Bénard cells, the hot plate is rough and the cold one is smooth. Their heat transfer behaviors are approximately independent. The rough plate heat transfer becomes more efficient when the thermal boundary layer is smaller than h_0. Doubling the d and h_0 values, we showed that this efficiency enhancement saturates in the neighborhood of 70%, larger than the surface enhancement (naive argument). Our first interpretation attributed the enhancement to the convection of the notch between two blocks [79]. However, we realized that a large part is due to the top of the block, where the boundary layer is much thiner. This was shown by temperature profile measurements close to the plate and confirmed in a air cell 6 times bigger, at Ilmenau University, within the European Initiative EuHiT.

We also used a smart lagrangian particle, able to measure and communicate the instantaneous temperature. It can work continuously 20 hours, which allows detailed statistical studies both lagrangian and eulerian. The goal is to evidence an asymmetry due to the difference between the plates, rough and smooth. This asymmetry seems very subtle, in agreement with the apparent independence of the plates.

Multifractal. Our findings in the context of the multifractal modeling of Eulerian and Lagrangian velocity fluctuations in turbulent flow were gathered and explained in a review article [23] (see also [24]). We have furthermore added some new extensions allowing to take into account in a realistic way the asymmetry of the densities that are consequences of the energy transfers.

Recently, in collaboration with mathematicians [20], we have succeeded to build up a realistic incompressible homogeneous and isotropic random vectorial field able to mimic non trivial properties observed in simulations and experiments, in particular the preferential alignment of vorticity and the energy transfers.

Large Eddy Simulations (LES). In engineering and environmental contexts, numerical simulations are increasingly used to investigate complex flow phenomena, and accurately account for the time-dependent behavior of the large-scale motions ; this refers to large-eddy simulations (LES). When combined with computationally-efficient algorithms such as the Lattice Boltzmann method (LBM), LES opens a path to more and more trustworthy simulations. Our contributions on this topic have been both fundamental and applied. First, we have developed a shear-improved variant of the Smagorinsky model that allows us to address the LES of strongly non-homogeneous and unstationary turbulent flows. This innovative modeling relies on physical arguments combined with signal processing techniques (adaptive Kalman filtering) [15, 16]. A second contribution has been achieved within the industrial project LaBS (since 2010). The LBM, originally designed for regular flows on sufficiently-fine uniform lattices, has been extended to handle turbulence modeling on coarse non-uniform lattices [80] (Fig. 2). This study has been applied to the commercial solver LaBS, marketed since july 2013 and already used by Renault for aero-acoustics R&D.

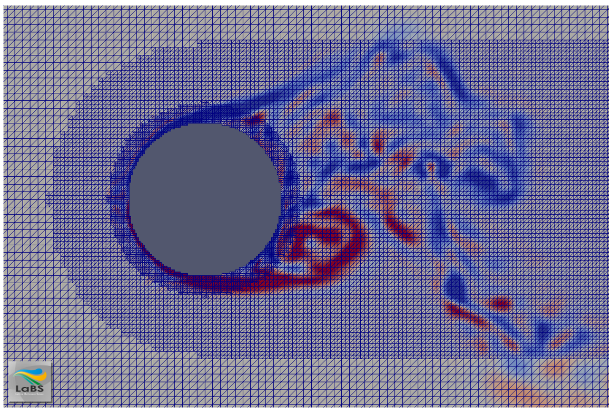


Figure 2: LES of the flow past a cylinder in the subcritical turbulent regime on a multi-resolution lattice (colormap of axial vorticity).

2D turbulence. Seemingly without intermittency, the inverse energy cascade of two-dimensional Navier-Stokes turbulence offers more hope for analytical solution than the intermittent three-dimensional direct energy cascade. The numerical discovery of conformal invariance of the zero-vorticity lines statistics (of the SLE type) pointed to the presence of a conformal sector in the inverse cascade regime. We undertook a study of the influence of 2D curvature on the inverse cascade. Surfaces with different curvatures are locally conformally equivalent so the comparison of inverse cascades in different background curvatures should exhibit the conformal sector of 2D turbulence. By studying the Navier-Stokes turbulence on a hyperbolic plane, (a surface with constant negative curvature) we unraveled a spontaneously broken asymptotic long-distance conformal symmetry of the Navier-Stokes equation in that geometry. We also showed that the presence of negative curvature speeds up the energy transfer on scales longer than the radius of negative curvature, an effect that could be searched for in the soap-film flows. This work [32] opens new perspectives in the study of 2D turbulence.

D. *Geophysical fluid dynamics*

Internal gravity waves in stratified fluids (ANR PIWO, C. Staquet, LEGI, F. Auclair, POC, ANR ONLITUR, F. Moisy, FAST, CNRS PICS, T. Peacock, MIT)

The study of internal waves (IW) is of great interest owing to the evolving appreciation of their role in many geophysical systems. In addition to their particularly intriguing properties from a fundamental point of view, these waves play an important role in dissipating barotropic tidal energy in the ocean, are an important means of momentum transport in the atmosphere, while IW activity also impacts modern-day technology. However, many unanswered questions remain, particularly regarding the fate of internal waves and how much mixing they generate in the ocean and via what processes.

To tackle some of these questions, we have developed a *new wave generation* in stratified fluids. This innovative mechanism [10], which involves a tunable source composed of oscillating plates, generates well defined propagating plane wave beams, as shown in the left panel of Fig. 3. This generator has been used (and also copied in several laboratories throughout the world) for several studies described below.

For example, our study of the scattering of a low-mode internal tide by finite-amplitude gaussian topography allowed to support the belief that finite-amplitude topography produces significant reflection of the internal tide and transfers energy from low to high modes. Using this device, we have also evidenced the production of a robust horizontal mean flow induced by internal gravity waves, when a wave beam is forced at the lateral boundary of a tank. The key ingredient for the existence of these horizontal mean flows is the concomitant existence of variations

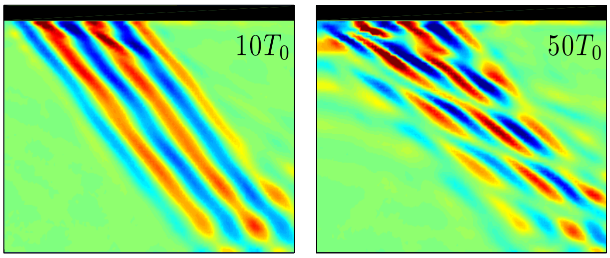


Figure 3: Snapshots of the experimental vertical density gradient field for 10 and 50 primary wave periods.

of the wave amplitude in both horizontal directions. In the transverse direction, the variations are simply due to the fact that the wave generator is localized in a segment smaller than the tank width. In the longitudinal direction, the variations of the wave amplitude are due to viscous attenuation

However, the study which has attracted most attention was related to another important way through which large-scale oceanic internal waves transfer their energy to small-scales, possibly inducing mixing: the parametric subharmonic instability (PSI). Using this novel generator, we were indeed able to provide the first experimental verifications of this nonlinear resonant interaction through which a primary wave (plane waves or vertical modes) excites pairs of waves whose frequencies and wave numbers add up to the frequency and wavenumber, respectively, of the primary wave [14]. The right panel of Fig. 3 presents how the initial beam is destabilized and emits secondary waves out of the beam, since the unusual dispersion relation of IW implies a different angle of propagation when the frequency is modified.

Interestingly, we discovered that the disconnect between theory, which assumes the waves are periodic in space and time, and reality in which waves are transient and more importantly spatially localized, modifies drastically the result. We have thus shown theoretically, numerically and experimentally that the width of the internal wave beam is a key element, a feature totally overlooked previously, despite numerous numerical simulations. In particular, we have reported dramatic consequences on the triad selection mechanism. The subharmonic plane waves that are theoretically unstable can only extract energy from the primary wave if they do not leave the primary beam too quickly. This finite-width mechanism has two opposite consequences on the wave energy dissipation: it can hinder the PSI onset (reducing transfer and therefore dissipation), but when PSI is present it enhances the transfer towards small wavelengths, more affected by dissipation.

We have also shown that PSI unexpectedly destroys the coherence of an internal wave attractor in a confined fluid domain [75]. The triadic resonance appears to be, moreover, a very efficient energy pathway from long to short length scales. This work provides an explanation of why attractors may be difficult or impossible to observe in natural systems subject to large amplitude forcing. Finally, let us stress also that we have also provided an experimental study of PSI in the very similar context of inertial waves in a rotating homogeneous fluid.

We studied internal solitary waves first by revisiting the deadwater phenomenon when a boat evolving on a two-layer fluid feels an extra drag due to waves being generated at the interface between the two layers whereas the free surface remains still. Second, we generated quasi-two-dimensional internal wave beam impinging on a pycnocline, resulting in the generation of internal solitary waves at this interface. These experiments were inspired by observations of internal solitary waves in the deep ocean from synthetic aperture radar (SAR) imagery.

In addition to above fundamental studies, we have started to study more realistic situations in which the different mechanisms studied separately occur simultaneously. The most challenging issue was related to the complex double-ridge system in the Luzon Strait in the South China Sea, which is one of the strongest sources of internal tides in the oceans. We have developed a large-scale laboratory experiment performed at the Coriolis platform in Grenoble. It was carefully designed so that the relevant dimensionless parameters closely matched the ocean scenario. The results [47] advocate that a broad and coherent weakly nonlinear, three-dimensional, diurnal internal tide, which is shaped by the overall geometry of the double-ridge system is radiated into the South China Sea and subsequently steepens; it explains one of the strongest sources of internal tides in the oceans, associated with which are some of the largest amplitude internal solitary waves on record.

Statistical mechanics of oceanic and atmospheric large scale flows (ANR Statocean, J. Sommeria, LEGI, X. Carton, LPO)

A striking property of oceanic and atmospheric flows is their propensity to self-organize into robust large scale coherent structures, which are major features explaining weather and climate (cyclones, anticyclones and jets). This robust self-organization involves a huge number of degrees of freedom coupled via complex nonlinear interactions. Statistical mechanics is a very powerful theory that allows us to reduce the complexity of the system down to a few thermodynamic parameters. Statistical mechanics approaches to the large scales of geophysical fluid dynamics can be decomposed into three classes. First, equilibrium statistical mechanics, following the pioneer works of Miller Robert and Sommeria(MRS) in the 90', applicable for 2d Euler flows and quasi-geostrophic models. Second, kinetic theory approaches, developed during the last ten years, allowing for taking into account effects of forcing and dissipation in a close to equilibrium framework. Third, the use of large deviation theory to deal with far from equilibrium problems. Here we present applications of the first and the second approaches, see also [13]. More fundamental aspects and the large deviation approach are discussed in section IV T7R D.

Over these last five years we have applied the equilibrium theory to several problems of oceanic relevance [13]. For instance, we have shown the existence of a formal analogy between bubble formation and the emergence of mesoscale (300 km) oceanic rings, which are observed everywhere in the oceans. This theory explains many of the observed properties of mesoscale ocean vortices [89]. We have then shown that bottom intensified anticyclonic recirculations above topographic bumps such as the observed Zapiola anticyclone are close to an equilibrium state [85] and we have more generally provided a statistical mechanics interpretation for the vertical structure of oceanic flows, including the barotropization problem [87].

For atmospheric and oceanic flows at planetary scales in a statistically stationary regime, the long time effect of forces and dissipation is crucial. We have developed a kinetic theory for the description of planetary zonal (east-west) jets. It was developed in a inertial limit, when there is a clear separation of time scales between the rapid evolution of the fluctuations of the velocity field and the slow evolution of the zonal jets. This is relevant to describe for instance multiple zonal jet on Jovian atmosphere. The theory predicts the jet velocity profile and the turbulence statistics, with a systematic expansion improving the justification of previous approaches based on quasi-linear approximations or cumulant expansions [12].

E. *Magnetohydrodynamics and the dynamo effect*

(ANR VKS-dynamo, S. Fauve, LPS, F. Daviaud, SPEC, CEA Saclay; PICS Russie, P. Frick, Perm)

Induction, dynamo and turbulence at low magnetic numbers. Experimental investigations of MHD flows at moderate magnetic Reynolds number ($R_m \sim 5$) have been developed in a von-Kármán gallium flow (the flow is driven by fast rotation of counter-rotating disks inside a cylinder) with characteristic size 10 cm and velocity 1 m/s. Our recent studies are a follow-up of previous investigations and were focussed on three items: (i) the effect of high conductivity and/or high permeability solid rotating parts on magnetic inductions mechanisms [93], (ii) the characterization of the dynamics of the Bullard-von Kármán flow - a simple synthetic experimental dynamo incorporating turbulent fluctuations and an external amplification - and in particular the occurence of on/off intermittency [76, 94], and (iii) the transition from hydrodynamic turbulent regimes to MHD turbulent regimes obtained with a high amplitude, externally applied magnetic field which modifies the flow [91]. Other investigations have also been developed, which are detailed in T8R.

Dynamos at high magnetic numbers: the VKS experiment. The VKS experiment is a joint experiment run by ENS Lyon, ENS Paris, and CEA Saclay consisting in a large scale von-Kármán flow driven in liquid sodium. Following the observation of self generation of the magnetic field, achieved in 2006 as well as dynamical regimes relevant to astrophysical situations, a detailed characterization of the generation mechanisms and the dynamics of these dynamos have been lead. The various dynamics and bifurcations are summarized in [6, 53] and include bistability between stationary and oscillating dynamos [5], and observation of localized dynamos [37]. Generation mechanisms were shown to be localized close to the high permeability driving impellers [8]. The statistical analysis of the response to an external forcing shed light on the influence of the conductivity and/or magnetic permeability on the dynamo threshold [51].

F. *Instabilities in 2- and 3-phase flows*

Washboard road (FRAMA, V. Langlois, LGL). The tendency of unpaved road surfaces to develop lateral ripples (washboard or corrugated road) is annoyingly familiar to drivers on dry gravel roads. Similar ripples are well known on railroad tracks and many other rolling or sliding, load bearing surfaces. Our approach combined laboratory experiments and soft-particle direct numerical simulations. In previous studies we have shown that the onset of the ripple pattern exhibits a sharp threshold as the speed is varied. The ripple pattern appears as small patches of travelling waves which eventually spread to the entire circumference (Fig. 4). The ripples move slowly

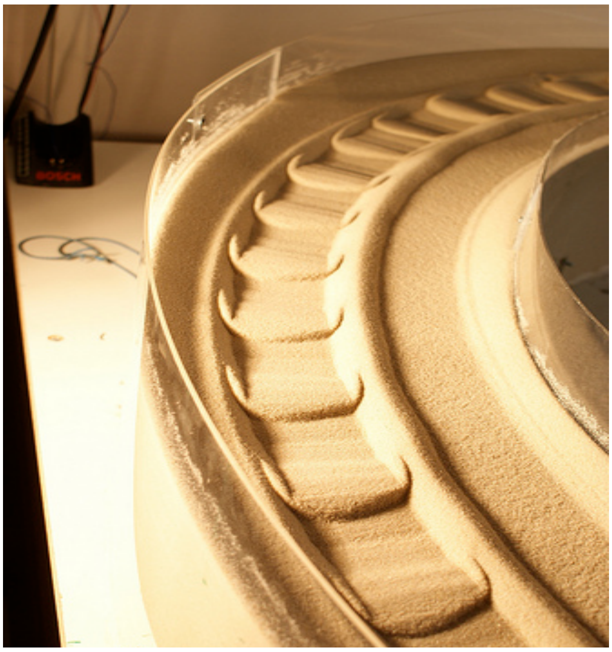


Figure 4: Washboard Road at the laboratory scale. A ripple pattern appears spontaneously due to the repeated passing of a wheel on a sandbed.

in the driving direction. Interesting secondary dynamics of the saturated ripples were observed. Based on empirical laws for force acting on a wheel, a linear stability analysis near onset was developed and recovers all experimental features. In more details we have performed measurements of the drag and lift forces experienced by a blade dragged at constant velocity at the surface of a sandbed. In order to probe the frequency response of the system, tests were carried out where the blade was forced to oscillate on a flat bed, or where a horizontal motion of the blade was imposed over a sinusoidal sandbed [60]. These measurements are the keystone of the linear stability analysis presented in [61]. The key results of this work are the prediction of a critical velocity for the onset on the instability and of the wavelength of the pattern.

Silo discharge Flows of granular media through orifices present interesting features that have been intensely studied in the last 50 years. Among them, the most peculiar is that the flow-rate from an orifice does not depend on the height of the granular column above it. Even if the flow-rate is well accounted for by empirical laws, the underlying physics is still not well understood and questions remain open.

In this context, using the discharge of a 2D horizontal silo [3] or measuring the stress profile at the base of a vertical 3D silo [62], we discussed the (in)dependence of the flow-rate on the local stress in the outlet region. In addition, we studied the discharge of a silo when the material is slightly cohesive. For small grains, Van der Waals forces or humidity indeed lead to sticky grains. We observed that the dynamics inside the silo (interesting by itself) does not significantly alter the flow-rate which still obeys the classical empirical law, but that the flowing particles are not individual grains but rather clusters of grains whose typical size depends on the humidity [36].

Degassing through complex fluids In many natural systems, gas rising through complex materials is at the origin of a wide variety of behaviours. Understanding the dynamics of such systems is of crucial importance in the mitigation of natural hazards. Flow regimes in saturated granular media, for instance, can go from homogeneous seepage (fluid percolation) to piping and partial failure. This last case plays a major role in soil liquefaction, mud volcanism and diapirism, and hydraulic fracture. Experiments were set up in the laboratory to model two main processes encountered in natural phenomena, and quantify the mechanisms that govern their dynamics.

First, we focused on gas venting at the seafloor. The experiment consists of a 2D or 3D cell, filled with a granular medium immersed in water. The grain size and polydispersity are varied, as controlled parameters. Air is injected at the bottom of the cell through a nozzle, at constant flow-rate. This, apparently simple, experiment exhibits a complex dynamics, from percolation to fracture when the air crosses the medium, as well as the formation of a fluidized zone whose characteristics were fully determined [81, 84]. Application to seismic microevents produced by gas expulsion at the seafloor in the sea of Marmara was performed [77]. Second, we modeled the degassing in a volcanic conduit by injecting air at the bottom of a complex-fluid column. The fluid is viscoelastic, with yield strength, to mimic the lava rheological properties. The dynamics alternates between successive bubbles and continuous degassing, and may be at the origin of the intermittent behavior observed on some volcanoes [27, 96, 124].

Hydrodynamics and Geophysics: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
G. Bordes	Ondes en milieu stratifié	16 jul. 2012	T. Dauxois, J.-B. Flor
B. Bourget	Ondes internes, de l'instabilité au mélange. Approche expérimentale	01 jul. 2014	T. Dauxois, P. Odier
A. Cahuzac	Aspects cinétiques et acoustiques en simulation numérique des grandes échelles, et application à l'étude du contrôle de l'écoulement de jeu en turbomachines	19 jul. 2012	E. Leveque, M. Jacob
N. Machicoane	Particules matérielles en écoulement turbulent. Transport, dynamique aux temps longs et transfert thermique	18 jul. 2014	R. Volk, J.-P. Pinton
M. Mercier	Étude expérimentale de la génération de structures non-linéaires (solibores et solitons) en milieu stratifié	29 jun. 2010	T. Dauxois
S. Miralles	Magnétohydrodynamique, effet dynamo et turbulence en champ fort	11 oct. 2013	N. Plihon, J.F. Pinton
B. Percier	Instabilité tôle ondulée	28 jun. 2013	N. Taberlet
J.-C. Tisserand	Convection thermique : transport et mélange	16 dec. 2010	B. Castaing, F. Chillà
G. Varas	Air rise through an immersed granular bed-bulk and surface dynamics	17 nov. 2011	V. Vidal
G. Verhille	Études expérimentales en magnétohydrodynamique : effet dynamo, turbulence et induction	14 sep. 2010	J.-F. Pinton, N. Plihon
M. Vosskuhle	Collisions de particules dans des écoulements turbulents: effets des écoulements à grande échelle	13 dec. 2013	A. Pumir, E. Lévêque
R. Zimmermann	Instrumentation Lagrangienne en turbulence, application au mélange	13 jul. 2012	J.-F. Pinton

Main contracts

3 european: ERC TRANSITION (50%), EuHIT, Eswirp
8 ANR: GIMIC, PIWO, ONLITUR, DESPET, VKS, TEC2, DYNAMO, STRATIMIX
2 FUI: LABS, PATVAX
Companies: IFPEN

Editorial responsabilities

Castaing Bernard:
Europhysics Letters, Member of the editorial committee.
Chevillard Laurent:
Comptes Rendus Académie des Sciences, Editor of the volume on turbulence.
Leveque Emmanuel:
Journal of Turbulence, Associate editor.
Pinton Jean-François
European Journal of Physics E, Member of the editorial committee.
New Journal of Physics, Member of the editorial committee.
Lecture Notes in Physics, Member of the editorial committee.
Pumir Alain
Physical Review E, Member of the editorial committee.
Journal of Physica A, Member of the editorial committee.
Journal of NonLinear Science, Member of the editorial committee.

Organized conferences

Bouchet Freddy, Venaille Antoine: *Geoturb*, CBP/ENS de Lyon (France), October 2013
Chillà Francesca, Bernard Castaing: *High Rayleigh Number Convection*, Les Houches (France), January 2010
Dauxois Thierry: *Topographical Internal Waves*, Cargèse (France), November 2010
Geophysical and Astrophysical Internal Waves, Les Houches (France), February 2011
Nonlinear Effects In Internal Waves Conference, Université de Cornell (USA), June 2014
Lévêque Emmanuel: *Superfluid Turbulence from the perspective of numerics*, Lyon (France), Décembre 2012
Pinton Jean-François, Pumir Alain, Chevillard Laurent, Volk Romain.
European Turbulence Conference ETC 14, Lyon (France), September 2013
Plihon Nicolas: *Turbulent transport in plasmas and conducting fluids*, Les Houches (France), March 2011
Dimensionnality of turbulence, Coventry (U.K.), May 2014
Taberlet Nicolas: *Workshop on numerical modelling of grain/fluid flows* Lyon (France), November 2013
Vidal Valérie: *Deformation, Flow and Rupture of Soft Matter*, Lyon (France), July 2010
Soft Matter Physics and Solid Earth Sciences: Unifying Concepts, Tokyo (Japan), June 2012

105 publications in RICL: see T1B.

T2R. Soft Matter : Multi-scale Mechanics, from Measurements to Models: *Report*

Permanent Members: D. Bartolo, L. Bellon, V. Bergeron, E. Bertin, S. Ciliberto, C.Crauste Thibierge, R. Everaers, E. Freyssingeas, J.-C. Géminard, T. Gibaud, S. Joubaud, S. Manneville, C. Moskalenko, P. Oswald, J.F. Palierne, S. Santucci, A. Steinberger, N.Taberlet

Post-docs: C. Crauste, T. Divoux, M.-A. Fardin, T. Gibaud, C. Guerra, J. Laurent, M. Leocmach, S. Malik, A. Modlinska, M. Nespoulous, R. Perez-Aparicio, F. Tapia

PhD students: F. Aguilar, B. Blanc, M.-J. Dalbe, N. Desreumaux, C. Devailly, T. Divoux, M. Geitner, V. Grenard, J. Hou, R. Jeanneret, T. Li, B. Levaché, A. Methani, Z. Mokhtari, C. Perge

Over the last five years, we have developped a wide range of studies in the field of Soft Condensed Matter Physics, combining *experimental work* with *theory* and *numerical simulations*. Our research interests have focused on the *mechanical and rheological properties* of a large variety of so-called *"Soft Materials"*, such as liquid crystals, melted polymers, elastomers, emulsions, gels, foams, granular and biological materials. In order to understand and establish links between the microscopic structures of such materials and their macroscopic physical properties (as for instance aging, flow, resistance to rupture), we haved combined experimental and theoretical tools used in many different fields of physics and engineering (optics, acoustics, non-linear and statistical physics). Thanks to the development of model systems and state-of-the-art instrumentation, we apply those tools on a wide range of scales - from the nano/microscopic constituents, through the coarse-grained mesoscopic level, and up to the macroscopic scale of the systems considered. This *multi-scale approach* constitutes the cornerstone of our work, highlighted in the following detailed description of our studies: from the nano-mechanics of viruses or carbon nanotubes, to the design of self-assembled structures, and the deformation, fluidization up to the failure of both brittle and ductile heterogeneous materials. Finally, we want to underline that a strong effort is placed on bridging the gap between fundamental studies and real-world applications, as witnessed by various active industrial collaborations (L'Oréal, Solvay, Bluestar). We are therefore conducting a multi-disciplinary approach, which as a result stimulates many collaborative efforts within the various teams of our laboratory, transverse to the various themes presented in this report, and also active exchanges with numerous world renowned institutes, national and international.

A. *Nano-mechanics*

Passive micro-rheology: from k_BT to $G(\omega)$ (Coll. LMA, ERC OutEFLUCOP) – At equilibrium, thermal fluctuations generate spontaneous random deformations in all materials, fluids or solids. The fluctuation-dissipation theorem directly links this thermal noise to the dissipative (imaginary) part of the associated susceptibility, *i.e.* the inverse of the linear viscoelastic modulus $1/G(\omega)$. Applying the Kramers-Krönig relations to this component yields the conservative (real) component. $G(\omega)$ can thus be fully determined from the measurement of the thermally excited deformations. We apply this strategy to many different systems:

- A μm-sized fiber glued to an Atomic Force Microscope (AFM) tip is dipped into a (possibly opaque) liquid to measure its viscosity.
- One or two μm-sized beads are inserted into a medium, and their Brownian motion is optically tracked (one-point or two-point micro-rheology). The resulting viscoelastic modulus compares well with that directly measured with a high-frequency piezo-rheometer on actin networks [187].
- The thermal noise driven waves at the medium-air interface are optically recorded using surface fluctuation specular reflection (SFSR) spectroscopy. After elimination of gravity and surface tension effects, the obtained viscoelastic modulus agrees with that directly measured on polymeric systems [173].
- AFM cantilevers with a metallic or dielectric coating (thicknesses from 10 to 500 nm) present $1/f$ thermal noise in deflection at low frequency, a signature of the viscoelasticity of the coating layer. Using an ultra-sensitive interferometer, we access to $G(\omega)$ with only a 10^{-4} relative incertitude over a 4 decade frequency range [151, 169].

All these methods allow assessing the viscoelastic properties of a material by probing its equilibrium mechanical fluctuations, on a much wider frequency range than conventional techniques, and in a true zero stress limit.

Nano-mechanics of single objects (Coll. JP. Aimé CBMN, A. Ayari ILM, ANR HiResAFM) – AFM can be used to apply mechanical stress on single nanoscale objects to study their mechanical response (stiffness, adhesion. . .). We use such an approach on systems ranging from viruses to carbon nanotubes with commercial as well as home made AFMs (see section Imaging and Instrumentation). Nano-indentation measurements are for example performed on retroviruses (HIV-1) or small icosahedral viruses (AAV) to study their mechanical properties at thermodynamic equilibrium and their stability as a function of the environment (temperature, pH, osmotic pressure) and/or genome (RNA, ss-DNA or ds-DNA). In other experiments, single wall carbon nanotubes, grown directly at the AFM tip apex, are pressed against a flat substrate. The quasi-static force vs distance curves are characteristic of processes of adhesion and peeling during retraction, leading to quantitative measurements of the adhesion energy (Fig. 5). In parallel, the nano-contact thermal noise

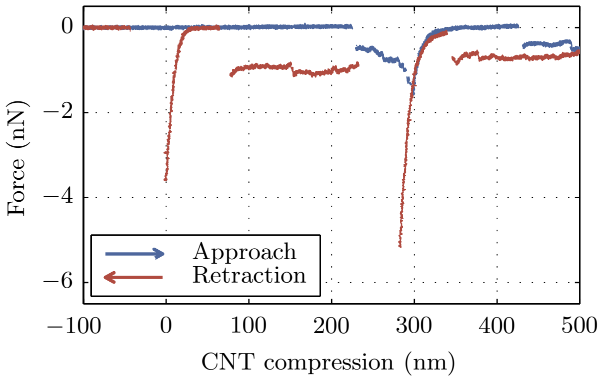


Figure 5: We push a single wall carbon nanotube (CNT) against a flat substrate and record the force vs the compression. The interaction is attractive and strongly hysteretic, showing force plateaux signaling the absorption of the CNT and a peeling process during retraction. The value of the plateau is a quantitative measurement of the adhesion energy per unit length: $E_a = 1\,\mathrm{nJ/m}$ for this CNT on graphite [113].

leads to the intrinsic stiffness of the nanotube [113]. This process is a close nano-scale analog to the macro-scale peeling of adhesive tapes (see section IV T2R C).

Stress relaxation in entangled polymer melts (ANR CompPhysSoftBioMat) – Understanding the role of entanglements in the dynamics of high molecular weight polymeric liquids is a classical subject of polymer physics. We perform extensive computer simulations of the equilibrium and relaxation dynamics of entangled model polymer melts and explore the shear relaxation modulus, $G(t)$, into the plateau and into the terminal relaxation. Using the known (Rouse) mobility of unentangled chains and the melt entanglement length determined via the primitive path analysis of the microscopic topological state of our systems, we perform parameter-free tests of several different tube models. We find excellent agreement for the Likhtman-McLeish theory using the double reptation approximation for constraint release, if we remove the contribution of high-frequency modes to contour length fluctuations of the primitive chain, demonstrating that the primitive path analysis of the microscopic *structure* endows the tube model with predictive power for *dynamical* processes [142].

B. *Self-assembled systems*

We have a long-standing expertise in the self-assembled phases of soft matter including liquid crystals, surfactants, colloids, and polymers. The challenge in understanding, or in devising, self-assembled molecular structures consists in linking the macroscopic properties of a material to the symmetries of the interactions between its molecules via the formation of self-assembled ordered structures at mesoscale. Over the last five years we have been devoting efforts to colloidal self-assembly. Compared to molecular systems, colloidal phases offer a unique opportunity: their structures can be probed not only by scattering techniques to achieve high statistics and high temporal resolution [181], but also by optical imaging to gain a direct and quantitative insight into their structure and their slow dynamics. We shall focus here on two prototypical studies.

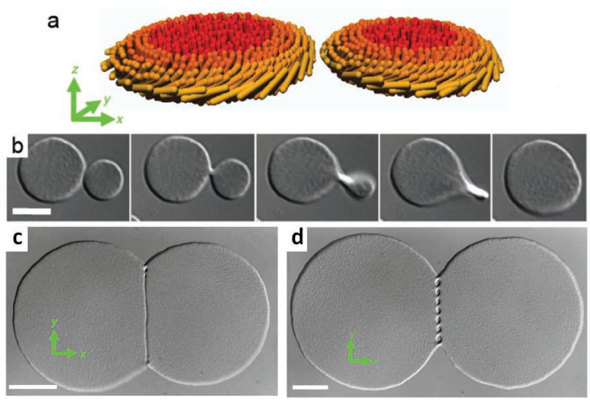


Figure 6: (a) Schematics of two chiral colloidal membranes. The twist of the colloidal rods at their edges leads to atypical coalescences: (b) coalescence by twist, (c) line defects formed through incomplete coalescence, (d) alternating pores and line defect also formed through incomplete coalescence. Scale bars: 10 μm.

Chiral Coalescence (ANR HARB) – We use colloidal-rod droplets as a proxy to address generic coalescence mechanisms which govern the equilibrium behaviour in various systems ranging from intercellular transport to planetary formation. We studied the coalescence pathways of circularly shaped 2d self-assembled colloidal membranes, which are one rod-length-thick liquid-like monolayers of aligned rods. We characterized pathways that do not proceed to completion but instead produce partially joined membranes connected by line defects (Fig. 6). Using laser tweezers we have shown the possibility to create and manipulate the line defects, leading to a robust on-demand method for imprinting networks of channels and pores into colloidal membranes [184],

Microbubbles that live longer – From an applied perspective, colloids at interfaces have been used to stabilize foams for decades. This so-called Pickering method is a well-established laboratory experiment. However, carrying out the process on an industrial scale is limited by the need to chemically modify the particle's surface and to establish a viable protocol for large-scale production and post processing. For practical applications including medical diagnostics, wastewater treatment, food and cosmetics, microbubbles need to be encapsulated to extend their lifetime. Our work has focused on creating new microbubble encapsulation techniques that overcome these limitations. The basis of the method resides in the use of ionic surfactants that adsorb to the

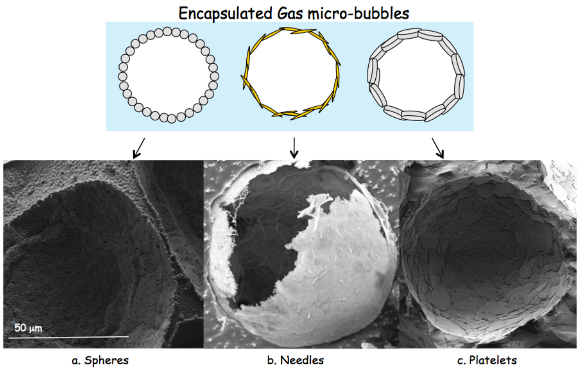


Figure 7: Cross-sectional schematic illustrations (top) and corresponding Scanning Electron Microscope images (below) of microbubbles encapsulated with nanoparticles of various geometrical shapes.

gas-liquid interface of the microbubble. They play two roles: i) they lower the surface tension, which decreases the energy needed to create microbubbles and diminishes the Laplace pressure, and ii) their ionic nature supplies the bubble surface with a residual charge that will induce electrostatic interactions. Choosing oppositely charged nanoparticles leads to a strong attraction of the particles to the bubble surface - the particles "stick" to the bubble surface and form a coherent encapsulating layer. This simple process is completely general and can be applied to a wide range of systems. We have demonstrated the method with particles having different geometrical forms (e.g. spheres, platelets, needles) (Fig. 7), and shown that the microbubbles can last for over a year (that led to pending patents in collaboration with L'Oréal).

C. *Deformation and instabilities*

In the previous section, we aimed both at inventing new materials from the self-assembly of microscopic constituents, and at characterizing the original physical properties of the resulting microstructures at rest. Here, we consider the behaviours of soft complex materials driven far from mechanical equilibrium. Not only does this question raise difficult fundamental issues but it is also of prime practical importance, as deformation is involved in virtually any everyday-life application of soft materials. In order to address the problem, we combine experimental and theoretical skills from many different fields in physics and engineering, *e.g.* microscopy and acoustics, rheology and mechanics, nonlinear and statistical physics, etc. The challenge lies in understanding how an external deformation couples to the material structure and possibly leads to highly nonlinear behaviours, instabilities or even collective phenomena. In the following we highlight our most important discoveries in the field.

Mechanics of liquid crystals – The effects of a temperature gradient, of a rotating magnetic field, or of an electrical field on the texture of liquid crystals have been systematically addressed, leading respectively to a better knowledge of the thermomechanical Lehmann effect in cholesterics with a profound questioning of the Leslie theory [160] (Fig. 8(a), to a better modeling of surface viscosity and yield torque at the nematic-substrate interface [164], and to the discovery of a new electro-capillary instability (Fig. 8(b)). We also initiated a study of smectic liquid crystals doped with gold nanoparticles which were shown to be responsible for a strong hardening of the smectic phase and could be used to improve the lubricant properties of the phase [166].

Creep of granular matter driven by temperature changes (ANR Internationale MicmacGrains) – Even minute temperature changes due to the associated dilation of the grains can lead to the destabilization of granular packings. Thus, subjected to temperature cycles, a granular column compacts slowly. We assessed the phenomenon experimentally [109] and numerically, in more [171] or less [110] model systems. The study reveals a critical amplitude of the temperature variations which separates rest from creep and around which the system flows erratically, alternating between rest and sudden flow events. Rest periods are characterized by temporal correlations whereas memory effects are absent in flow periods.

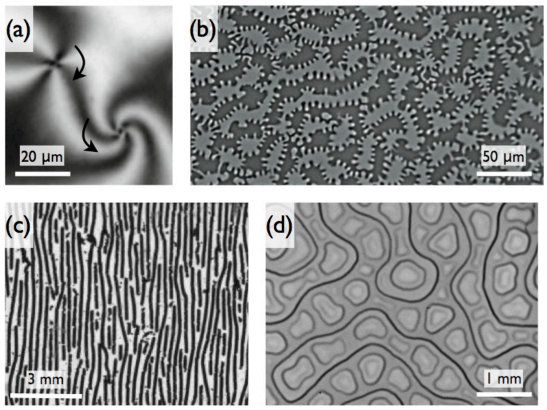


Figure 8: (a) Lehmann rotation of the extinction branches of two disclination lines observed between crossed polarizers in a planar cholesteric sample. (b) Electro-capillary instability of a nematic-isotropic interface. (c) Shear-induced structuration into vorticity-aligned rolls in a carbon black dispersion. (d) Wrinkle pattern in a confined layer of protein gel.

Instabilities in confinement (ERC USOFT) – Confinement often leads to original, unexpected effects in physical systems. When a homogeneous assembly of attractive particles is sheared between two walls with a gap distance comparable to the particle or aggregate size, a striking instability is observed in the microstructure: the system separates into log-rolling aggregates aligned perpendicular to the shear direction [139]. We have shown that this instability occurs not only in Brownian systems such as carbon black dispersions (Fig. 8(c)) but also in non-Brownian suspensions of attractive glass beads. Besides shear-induced structuration, we have studied thin layers of protein gels confined between two non-adhesive walls and discovered an original instability whereby, upon slow acidification of the initially stable protein suspension, a gel layer forms that progressively swells and wrinkles as shown in Fig. 8(d).

Fluidization dynamics of yield stress materials (ERC USOFT) – Yield stress materials such as concentrated emulsions or colloidal gels show solid-like properties at rest but flow easily when submitted to an external stress larger than some characteristic "yield" stress. We have shown that some model microgels display long-lived transient shear localization in the vicinity of the yield stress and that the timescales for full fluidization follow critical-like scalings with the applied stress or shear rate, raising the question of universality in yielding dynamics [126].

Elastic instabilities and shear banding (ERC USOFT) – Entangled polymer solutions develop strong normal forces under flow that lead to a rich phenomenology, akin to classical inertial instabilities in Newtonian fluids such as the Taylor-Couette instability. Combining ultrasonic imaging to rheometry, we compared the case of polymers to that of viscoelastic surfactant systems forming wormlike micelles. In the latter, strong flow–microstructure coupling drives shear-induced structures and/or shear banding, which affects elastic instabilities and the transition to elastic turbulence [132].

Strain localization in cohesive granular matter (Coll. F. Melo, Chili) – Cohesive granular materials (fine powders, wet grains) constitute another class of materials exhibiting instabilities due to their peculiar mechanical response. We revealed experimentally the formation of a complex fracture pattern in a stretched layer of cohesive granular material (Fig. 9(a)) and proposed a mechanism based on the *stretch-thinning* nature of the response to strain[106].

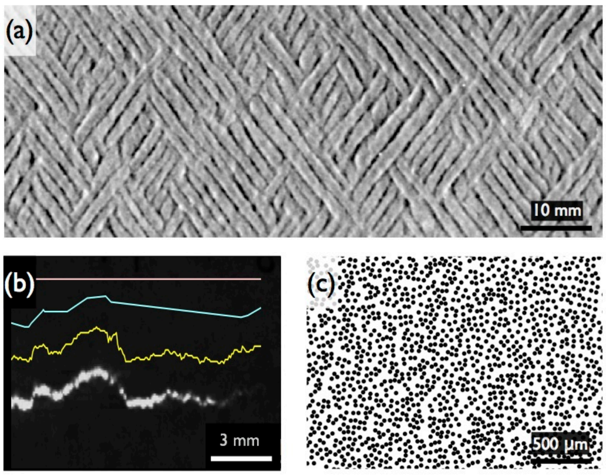


Figure 9: (a) Fracture pattern at the surface of a stretched layer of cohesive granular matter. (b) Analysis of a crack path in paper. (c) Droplet configuration in a confined emulsion submitted to a periodic flow.

Fracture of soft & heterogeneous materials (Coll. L. Vanel, O. Ramos, ILM, FRAMA CRACKS & ERC USOFT) – We characterize experimentally the mechanical instabilities during the deformation and failure of various heterogeneous materials. The main goal is to get a better understanding of those mechanical instabilities in order to control and prevent catastrophic rupture events. First, we have characterized the avalanche dynamics observed during the subcritical thermally activated slow crack growth in paper sheets (Fig. 9(b)) [182]. Thanks to high frequency acoustic monitoring, we have shown the existence of temporal correlations between rupture events, similar to aftershocks for earthquakes [177]. These correlations have an impact on the value of the exponent characterizing the distribution of the energy of avalanches, which is a crucial parameter for the prediction of catastrophic events. Second, we have found that acid-induced protein gels display creep deformation followed by the nucleation and growth of fractures when submitted to an external shear stress. The detailed rupture scenario of these soft biogels is strikingly reminiscent of brittle failure in hard materials and shows excellent agreement with the most recent fiber-bundle models.

Grains and compressible interstitial fluid – Dry granular materials have been widely studied, but the effect of the interstitial gas is generally neglected. However, due to complex interactions between the solid grains and the fluid, fine powders exhibit very surprising behaviours. For instance, droplets of such materials climb slopes when they are vertically vibrated [170]. A strong influence of the interstitial air is also clearly evidenced by the study of the acceleration signals from an instrumented sphere impacting into a granular medium, which leads to a cavity collapse as observed in fluids.

Stick-Slip peeling (Coll. L. Vanel, ILM, P.-P. Cortet, FAST, M. Cicotti, ESPCI, ANR StickSlip) – The crackling sound heard when unwinding quickly an adhesive tape is a direct manifestation of the jerky advance of the peeling front, moving at a speed that alternates between slow (stick) and fast (slip) phases. This rupture instability results from the coupling between the elastic tape and the nonlinear rheology of the adhesive. Our experiments show that the peeling angle is a control parameter of the instability [116] and unveil the crucial role played by inertial effects [117].

Collective behaviors in microfluidic flows – We have used emulsions as a proxy to investigate a broad class of hydrodynamically coupled objects. We showed that the combination of short-range collisions and long-range hydrodynamic interactions results in the propagation of density waves even though neither inertia nor potential interactions participate to the droplet dynamics [121]. When driven periodically and despite the reciprocal nature of the hydrodynamic couplings, emulsions undergo a nonequilibrium first-order phase transition where reversibility is collectively lost through structural (dis)organization of the droplet ensemble (Fig. 9(c)) [143]. We also addressed theoretically the emergence of collective motion in confined swimmer suspensions, demonstrating that homogeneous isotropic states are generically unstable and that the swimmers self-organize to display coherent motion at arbitrarily large scale [111].

Soft Matter: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
F. Aguilar	Interferometría de alta resolución para AFM	25 sep. 2013	L. Bellon, F. Melo
B. Blanc	Température et milieux granulaire	16 oct. 2013	J.-C. Géminard
T. Divoux	Bruit et fluctuations dans les écoulements de fluide complexe	23 jun. 2009	J.-C. Géminard
V. Grenard	Dynamique de gel attractif	02 jul. 2012	N. Taberlet, S. Manneville
J. Hou	Dynamics of Primitive Path Meshes in Entangled Polymer Liquids	24 jul. 2012	R. Everaers
R. Jeanneret	Auto-organisation, écho et trafic microfluidique	15 jan. 2014	D. Bartolo
B. Levaché	Dynamiques d'imbibition en milieux confinés	03 mar. 2014	D. Bartolo
T. Li	Adhesion and dissipation at nanoscale	10 oct. 2013	L. Bellon, Z. Sun
A. Methani	Déposition et réenvol de spores fongiques: contribution à la comprehension du risqué nosocomial aéotransmis	21 dec. 2012	V. Bergeron
C. Perge	Imagerie ultrasonore dans les matériaux mous	03 jul. 2014	S. Manneville

Main contracts

2 european: USOFT, OutEFLUCOP (50%)
9 ANR: Mitra, FSCS, StickSlip, NANOFLUIDYN, HiResAFM, MicmacGrains, HARB, ALBEDO, WHIFF
Companies: Total, Rhodia-Solvay, BioMérieux, L'Oréal.

Editorial responsabilities

Géminard Jean-Christophe:
Papers in Physics, Member of the editorial committee.
Frontiers, Member of the editorial committee.
Santucci Stéphane:
Frontiers, Member of the editorial committee.

Organized conferences

Ludovic Bellon, Moskalenko Cendrine: *Forum des microscopies à sonde locale*, Lyon (France), March 2011
Everaers Ralf: *First school in computational physics - soft matter*, Les Houches (France), June 2011
Journée CECAM-FR en l'honneur de Jean-Pierre Hansen, Paris (France), December 2013
Manneville Sébastien:
Ultrasonic Doppler Methods for Fluid Mechanics and Fluid Engineering, Göteborg (Sweden), April 2010
Santucci Stéphane.
Materials' Deformation: Fluctuations, Scaling, Predictibility, Les Houches (France), January 2012
Materials' Deformation: Fluctuations, Scaling, Predictibility. 2nd Ed., Les Houches (France), February 2013
Crack Patterns, ENS-Lyon, Lyon (France), April 2014

79 publications in RICL: see T2B

T3R. Physics of Biological Systems: *Report*

Permanent Members: F. Argoul, A. Arnéodo, B. Audit, M. Castelnovo, R. Everaers, C.Faivre-Moskalenko, E. Freyssingeas, N. Garnier, J.-C. Géminard, M. Peyrard, C. Place, A. Pumir, C. Vaillant

Post-docs: N. Becker, S. Digiuni,G. Drillon, A. Fahys, M. Iazykov, D. Jost, L. Marsella, S. Meyer, P. Milani, L. Palmeira

PhD students: A. Baker, J. Bernaud, R. Boulos, G. Chevereau, N. Haddad, J.-G. Hagmann, S.Hu, D. Jost, H. Julienne, B. Laperrousaz, S. Meyer, T. Roland, L. Streppa, C.M. Torres, J. Valle-Orero, T. Verdier, J. Xu, L. Zaghloul

We have an intense activity in the field of biological physics, where we study physical principles and mechanisms by which living organisms survive, adapt, and grow. Our interests span a broad range of length and time scales: from nucleic acids and proteins to cell nuclei, and from single cells to organisms. The projects often combine experimental work, the analysis of massive amounts of experimental data, and physical modeling using both analytical and numerical techniques. An increasing number of projects is carried out in collaboration with (mostly experimental) colleagues from biology laboratories at ENS de Lyon and elsewhere.

A. *Nucleic acids and proteins*

The interplay of proteins and nucleic acids is central to biological organisms. Proteins typically fold into a specific three-dimensional globular structure determined by their amino acid sequence. They act as catalysts and molecular machines or perform a structural role by assembling into cytoskeletal filaments or viral capsids. DNA's primary role is to store genetic information in the nucleotide sequences of the complementary strands of the double helix.
At low temperatures proteins exhibit a universal dynamical transition to a glassy state and there was evidence that this behavior is reproduced by one of the simplest physical models, the frustrated Gō model. We have investigated the incoherent neutron-scattering structure factor, the transitions among energy states at low temperatures, and the transient violation of the fluctuation–dissipation theorem in non-equilibrium fluctuations after a sudden temperature quench and found, that the equilibration in the Gō model follows Arrhenius behavior [220].
DNA shows different elastic behavior on different scales, crossing over from the nano-scale elasticity [194] of the double-helix to a kinked [273] worm-like chain [193] on large scales (ANR CompPhysSoft-BioMat). Some proteins binding to specific DNA sequences do so by probing the mechanical properties of the double helix ("indirect readout"). We have explored the nano-scale structure, elasticity, and fluctuations of the double helix as a function of sequence and temperature in the framework of the rigid base-pair model [240]. This allowed us to apply a standard exercise in mechanical engineering to high-resolution structures of DNA-protein complexes: the inference of external forces and torques on the DNA from its given static shape and its known elastic properties [195]. The revealed nanomechanical interaction patterns provide a new view on DNA-protein binding that complements structural analysis.

Key biological and nano-technological processes require the partial or complete association and dissociation of complementary DNA and RNA strands. We have developed a variant of the Poland-Scheraga model for DNA melting, which reproduces experimental data for melting temperatures over the full experimental range of strand length, strand concentration, and ionic strength of the solution [227]. For RNA we have shown how to systematically predict complex folded structures such as multiloops and pseudoknots from a lattice model for the conformational entropy of folded RNA, which avoids popular ad hoc generalizations of the Jacobson–Stockmayer loop entropy [229]. Bubbles or open loops also exist in the DNA double-helix. For long chains, the cooperativity of the melting transition and the different thermal stability of GC and AT base pairs lead to the successive step-wise opening of more and larger domains. The open sites introduce flexible joints that strongly reduce the DNA persistence length on approaching the melting transition [273]. The size of the closed regions can also be probed through neutron scattering [282]. We have measured a local melting profile of designed sequences and have shown that, at biological temperature, the fluctuations of AT-rich regions influence the local conformation of base pairs up to 10 base-pair away [208]. While correlations between *thermal* melting properties and the biological information content of genomic DNA can be used for *ab initio* gene finding [228], we found a much stronger signal when analyzing *mechanical* opening of superhelically stressed DNA where bubbles open with finite probability and are frequently located directly upstream of transcription start sites [225, 230].

B. *Chromatin*

The chromatin fiber constitutes the first step in the hierarchical packing of DNA in the nuclei of eukaryotic cells. Typically 80% of genomic DNA is bound inside of nucleosome core particles, where 147 base pairs of DNA tightly wrap around a "spool" formed by a histone octamer. The nano-mechanical analysis clearly reveals the dominant forces, which are exerted on the DNA at regularly spaced backbone-histone contact sites where the minor grove faces the histone octamer [196]. The remaining 20% form "linkers" between the core particles. Through interaction with the histone H1/H5 the linker DNA can further condense into a nucleosomal "stem." We have investigated the stem structure by combining the nano-scale description of the DNA structure and elasticity with results of biochemical footprinting and cryo-electron-micrography of reconstituted mono-, di- and tri-nucleosomes [239, 272]. Our results suggest that the stem should be viewed as a dynamic, polymorphic, hierarchically organized structure whose formation stabilizes and facilitates the formation of dense chromatin fibers.

As an important actor in the regulation of nuclear functions, the nucleosomal organization of the 10 *nm* chromatin fiber is the subject of increasing interest. Recent high-resolution mapping of nucleosomes along various genomes ranging from yeast to human, have revealed a patchy nucleosome landscape with alternation of depleted, well positioned and fuzzy regions. A recurrent question is to what extent the genomic sequence dictates and/or constrains nucleosome positioning and dynamics [275]? Combining single-molecule AFM measurements of the conformation of surface deposited "designed" DNA chains and 2D "worm-like chain" models with sequence-dependent elastical properties [247–249], we were able to show that long-range correlations (LRC) present in genomic DNA [186] can favour "mesoscopic" bending of naked DNA chains and reduce the mechanical cost of nucleosome formation (ANR DNAnucl (CGM-CNRS)).
To describe nucleosome positioning along the chromatin fiber, we developed a simple thermodynamical Tonks-gas model that accounts for both sequence specificity of the histone octamer and for nucleosome–nucleosome interactions [186, 205]. While

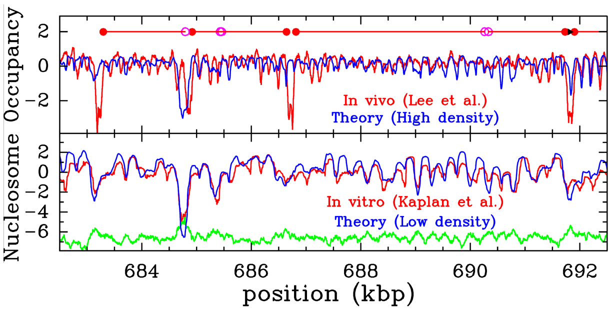


Figure 10: Comparison of predicted nucleosome occupancy (log_2) profile along the yeast chromosome II genome with *in vivo* and *in vitro* profiles.

the good agreement with genome-wide *in vitro* data demonstrates the reliability of the model, the comparison to *in vivo* data reveals the action of external factors including transcription factors, ATP-dependent chromatin remodelers [243, 274] and histone chaperones [215] (see Fig. 10). We experimentally confirmed this sequence-induced statistical positioning mechanism by AFM measurement of nucleosome distribution along *in vitro* reconstituted nucleosomal arrays [241].

While the preferred position of the histones along the DNA is sequence-dependent, cells can influence the fiber structure by locally recruiting histone variants. We have combined experiments and modeling to investigate this effect [246] as well as the consequences of the activity of chromatin remodeling proteins. In particular, we have shown [245] that RSC remodeling of oligosome templates results in the packing of the nucleosomes at the edge of the template with large stretches of nucleosome depleted regions in the center. This feature of RSC may be used by the cell to actively overcome barriers imposed by the presence of nucleosomes.

C. *Large-scale functional and structural organization of genomes*

(ANR HUGOREP (CGM-CNRS,IBENS,IBCP), ANR REFOPOL (IBENS,CEA,CGM-CNRS), ANRS LEDG-VIH-1). Chromatin displays a rich structure beyond the nucleosome scale and we try to elucidate the underlying physical mechanisms On the highly studied *S. cerevisiae* organism, we showed the implications of the highlighted "positioning via excluding" mechanism on the structure and function of yeast genes [205, 206, 241, 276]. The generalization of our modeling to other organisms such as humans has further provided new insight on the close relationship between the primary nucleosomal structure and the genome organization and function (replication [188], viral integration [236], gene activation [243]). In particular, analysis of *in silico* and *in vivo* nucleosome landscapes revealed that "master" replication origins in human cells were enriched in intrinsic nucleosome free regions as a signature of an open chromatin state [188].
In previous work, we had shown how to identify the likely location of replication origins from the analysis of DNA strand compositional asymmetry (skew) profiles [186, 526]. We found that the corresponding replication domains are closely related to (i) genome evolutionary dynamic [203, 204, 233], (ii) gene organization [285], (iii) epigenetic signaling [188, 231, 232], and (iv) chromosome 3D architecture [192, 244, 528, 555] These observations raise a number of interesting physical questions.

Concerning the influence of replication, we have proposed a global model for the spatio-temporal program of DNA replication in mammals [223]. Its central parameter is the replication polarity which measures the mean directionality of the DNA polymerase as a function of position. Both the skew resulting from mutational asymmetries associated with replication [190, 191] and the derivative of experimental replication timing profiles [192, 217] are shown to be proportional to replication polarity. We propose that replication initiates at the "master" origins located at borders of the observed megabase sized replication domains with characteristic N-shaped skew profiles [535] and corresponding U-shaped replication timing profiles [192, 529, 530]. Secondary origins are remotely activated by the approach of a center oriented DNA polymerases, allowing replication to progress faster than the known speed of a single fork [217].

Secondly, we have asked how cells self-organize and maintain the epigenetic marking allowing them to exhibit different stable phenotypes from the *same* DNA sequence. We have developed a stochastic model that describes the dynamics of epigenetic marks along a given DNA region [226]. In particular, we showed the emergence of bistable epigenetic states from the cooperative recruitment of modifying enzymes. Thirdly, we have further investigated a simple physical mechanism explaining the ubiquitous intra-chromosomal looping, the spatial organization in terms of domains, and the existence of chromosome territories. Similarly to macroscopic strings tied into knots, chromatin fibers can slide past each other, but their backbones cannot cross. With relaxation times for their topological state of the order of centuries, large chromosomes exhibit the same "territorial" behavior as corresponding *equilibrated*, *un*-entangled *ring* polymers. The crumpled state is characterized by randomly branched looping on the entanglement scale (100 kbp for chromatin) and the formation of locally compact domains on the scale of 10 entanglement lengths (or 1 Mbp of DNA) [269] (see Fig. 11). The model quantitatively predicts the generic form of the available experimental FISH and HiC data for distances, mobilities and contact probabilities of (pairs of) specific genetic loci [268].

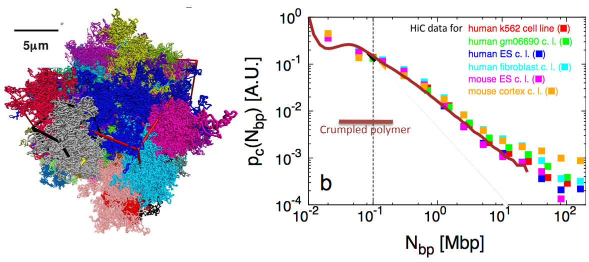


Figure 11: Crumpled polymers as a model for interphase chromosomes. L.h.s. The territorial behavior of crumpled polymers. Systems are comparable in size to human cell nuclei. R.h.s. Comparison of model predictions to experimental data for the generic, sequence-averaged contact probability as a function of genomic distance [268, 269].

The question of compaction of genetic material is not only relevant to higher organisms, but also to viruses. Again the mechanisms involve the association with proteins, but here in the form of a viral shell. Bacteriophages are viruses that infect bacteria. Their DNA is actively packaged inside a viral protein shell called the capsid. During the infection, phages inject their genome across the bacterial cell membrane. Using Isothermal Titration Calorimetry, we were able to measure the energy stored by genome compaction inside phage Lambda as it is externalized, and to relate this quantity to existing models of DNA packaging [224]. Similarly, we quantified the maximal amount of DNA to be filled inside an infectious phage, and we correlate this result to the efficiency of molecular motor performing the packaging[255]. Most viruses are incorporated as a whole into their target cells. They need to be completely disassembled upon cell entry and reassembled upon cell exit. Hence our interest to study formation and stability of viral protein shells (Prix Fondation Del Duca, ANRS HIV-AD). We investigated the Human Immunodeficiency Virus (HIV-1), which is responsible for AIDS. For the assembly of HIV-1, we isolated viral particles produced by transfected cells and imaged them at high resolution using an AFM. We observed quantitatively the size distribution of viral particles and found that mean size and polydispersity is larger for shells encompassing the viral genome. The analogy to molecular self-assembly suggests that this observation is explained by general entropic arguments [201, 202, 213]

The structures we have discussed above range from the nm to the μm scale. The associated complex dynamics involves an even wider range of time scales. Progress in cellular biology based on fluorescent microscopy techniques and the use of an original light scattering experimental device allow to study the the global internal dynamics of the nucleus of *living* cells. We found evidence that the dynamics is dominated by two different and independent kinds of relaxation that are well separated in time and specific to the phase of the cell cycle [271].

D. From cells to tissues

Swimming bacteria propelled by helicoidal flagella display an oriented circular motion near surfaces. This motion is antagonist to the run and tumble chemotactic behavior of bacteria in the bulk, since circling confines bacteria to a definite space. The dynamics of swimming is driven by hydrodynamic interactions and was theoretically predicted to be dependent of the slipping properties of the interface. We experimentally demonstrated by direct videomicroscopy (ANR CONE, Pasteur Institute), that the orientation is anti-clockwise at a clean air water-interfaces [234] and clockwise at non-slippery solid surfaces [235] . Interestingly, the orientation may change as a consequence of bacterial secretions modifying the surface properties, thereby freeing the bacteria from the trap on the surface and restoring the possibility of chemotaxis.

All the adult life long, two types of cells insure the permanent renewal of the bone material: the osteoclasts, which resorb the bone, and the osteoblasts, which secrete new material replacing the old one. The adhesion of these cells with substrates involves the formation of local structures, the podosomes, in the contact region. Individual podosomes consist of a dense polymerized-actin core surrounded by an actin cloud, whose dynamics we have modeled at the molecular level [221]. Depending on the substrate and on the differentiation stage, podosomes assemble and form clusters, rings or belts. We have shown experimentally, that these assemblies move collectively, dragging along the osteoclast cells, which catch up in rapid jumps whenever the posterior edge detaches from the substrate [222].

In tissues there is a dynamic mechanical equilibrium between cells exerting contractile stresses and the resisting extracellular matrix surrounding them. We have studied the mechanical adaptation of plant [242] or mammalian [216, 238] cells to an external constraint (ANR MECHASTEM, RDP) and the complex oscillatory dynamics in asymmetric division in C-elegans [265]. We found that the force balance is essentially dynamic and that cells control the velocity of their response to stress by recruiting a highly specialized assembly of molecular motors.

To some extent tissues resemble foams: the cell walls form an array of flexible membranes, which enclose the cytosol. However, the situation is more complex, because the cell cytoskeleton is a network of semiflexible actin proteins with the characteristics of a gel [187]. We have proposed a model for the viscoelastic behaviour of soft tissues [254] and have validated it for different soft organs[250, 251]. The model combines the elastic response of the cell walls, the newtonian behaviour of the inner fluid and the power-law time-dependent gel-like response of the cytoskeleton; it also accounts for the shear-thickening due to the low extensibility of cytoskeleton fibers, a characteristics opposite to the shear-thinning displayed by entropic polymer chains.

Finally, we are using non-linear physics approaches to study rhythm generation and synchronization in various biological tissues. The synchronization of biological activity with the alternation of day and night (circadian rhythm) is performed in the brain by a group of neurons, constituting the suprachiasmatic nucleus (SCN). We showed that both the period and strength of the external signal, and the coupling between the sensory and the oscillating neurons in the SCN are crucial in determining the synchronization of the system [283]. Similarly, the appearance of cell synchronization in the uterus before delivery is not really understood, given that none of these cells taken in isolation spontaneously oscillate. Instead, it had been noticed that the cellular coupling very significantly increases shortly before delivery, and that birth could be hindered by interfering with this increase in cellular coupling. This has led us to investigate assemblies of muscle and passive cells electrically coupled together, and to study the role of the coupling in the dynamical regimes occurring spontaneously [284]. Using simplified models of muscle cells, we have shown that increased coupling may indeed generate rhythmic activity in the system, and that, at sufficiently high values of the coupling, the activity is synchronized [270]. More recent results, using realistic models of uterine muscle cells, show

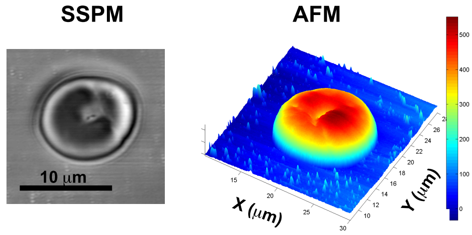


Figure 12: Scanning surface plasmon microscope topographic image of a smeared erythrocyte and its 3D height (in nm) image captured with atomic force microscopy.

that the transition towards synchronized activity occurs in the physiologically observed range of coupling values at delivery time.
Cardiac arrhythmias, which are due to a lack of synchronization of the organ, are the leading cause of death in the industrialized world. Our study has been aimed at understanding why the only method capable of restoring cardiac rhythm, cardiac defibrillation, requires extremely high electric fields, and how to reduce the energy necessary to re-synchronize the heart. We have developed an understanding of the interaction between the electric field and heterogeneities acting as “virtual electrodes”, allowing us to propose a method which can reduce the energy necessary to defibrillate by 80-90% [214, 237].

E. Technical advances

Surface plasmon microscopy is widely recognized for its high sensitivity to nanoscale structures and interaction. Thanks to the coupling of this evanescent wave plasmonic excitation to high numerical aperture objective lenses, we pushed its resolution down to the diffraction limit (ANR BIOPLASMOSCOPE), allowing the detection of nanoscale objects, such as isolated single nucleosomes for instance [267, 286, 287]. We have also developed a complete modeling of the response of this system to explain how it can detect such small objects while most other microscopies are constrained by the diffraction limitation [209, 211]. Being a scanning method, surface plasmon microscopy is particularly efficient for cellular imaging since it spans nano- to submicroscales, affording more than four decades of scales [185, 197, 198, 266]. In the last two years we have both experimentally and theoretically demonstrated that from a set of images captured by this microscope, the topography and index of cells and soft objects can be retrieved. [200, 210, 774].

The understanding of biological systems requires a multi-scale approach. We have developed a concurrent multi-scale scheme for complex fluids, which is formulated in terms of a global Hamiltonian [259, 260]. Within the H-AdResS scheme molecules, or parts of them, can cross boundaries between areas at different resolution, while maintaining the overall thermodynamic equilibrium.

Physics of Biological Systems: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
A. Baker	Le programme spatio-temporel de réplication de l'ADN et son impact sur l'asymétrie de composition: d'une modélisation théorique à l'analyse de données génomiques et épigénétiques	08 dec. 2011	A. Arnéodo
G. Chevereau	Thermodynamique du positionnement des nucléosomes	01 oct. 2010	A. Arnéodo, C. Vaillant
J.-G. Hagmann	On the thermodynamics and dynamics of coarse-grained protein	14 sep. 2009	M. Peyrard
S. Hu	Mécanique et dynamique de l'adhésion cellulaire	29 oct. 2010	J.-C. Géminard, X. Wang
D. Jost	Physique statistique du repliement et de la dénaturation des acides nucléiques	23 jun. 2010	R. Everaers
H. Julienne	Plasticité du programme spatio-temporel de réplication au cours du développement et de la différenciation cellulaire	08 dec. 2013	A. Arnéodo
S. Meyer	Etude multi-échelle des états excités des nucléosomes	28 sep. 2012	R. Everaers, R. Lavery
T. Roland	Localized Surface Plasmon Imaging : a non intrusive optical tool to cover nanometer to micrometer scales in biological systems	02 nov. 2009	F. Argoul
J. Valle Orero	The thermal denaturation of DNA studied with Neutron Scattering Techniques and Differencial Scanning Calorimetry	01 jun. 2012	M. Peyrard
J. Xu	Dynamics and synchronisation in biological excitable media	03 dec. 2012	N. Garnier, A. Pumir
L. Zaghloul	Transcriptional activity, chromatin state and replication timing in domains of compositional skew in the human genome	30 nov. 2009	B. Audit, A. Arneodo

Main contracts

10 ANR: MECHASTEM, HUGOREP, DNAnucl, ProPhyT, BIOPLASMOSCOPE, DNAnucl, LEDG-VIH-1, CompPhysSoftBioMat, HIV-AD, CONE
Companies: Boiron

Editorial responsabilities

Audit Benjamin
BMC Bioinformatics, Member of the editorial committee.
Peyrard Michel
Journal of Biological Physics, Member of the editorial committee.

Organized conferences

Alain Arneodo: *On the Frontiers of Molecular Genetics, Biophysics and Medecine*, Perm (Russia), June 2012
Audit Benjamin: *Journées Interface Physique-Biologie du GdR Phenix*, Lyon (France), November 2009.
Everaers Ralf:
Physics of DNA assembly and applications, Les Houches (France), May 2009
Coarse-Grain Mechanics of DNA: Bases to Chromosomes, Lyon (France), June 2010
Coarse-Grain Mechanics of DNA: Part II From Electrons to Oligomers, Lausanne (Switzerland), Sept. 2011
Genome Mechanics at the Nuclear Scale, Lorentz-center, Leiden (Netherlands), December 2012
3rd school in computational physics - DNA, from molecules to evolution, Les Houches (France), May 2013

103 publications in RICL: see T3B

T4R. Mathematical Physics and Fundamental Interactions: *Report*

Permanent Members: F. Bouchet, F. Delduc, K. Gawedzki, E. Livine, M. Magro, J.M. Maillet, G. Niccoli, H. Samtleben, V. Terras , F. Toninelli

Post-docs: F.E. Borja, A. Le Diffon, J. Tambornino, R. Wimmer

PhD students: V. Bonzom, Q. Berger, C. Charles, M. Dupuis, N. Grosjean, D. Lévy-Bencheton, C. Tauber, T. Ortiz

The main fields of research within the mathematical physics group include: rigorous methods in statistical physics, integrable models, conformal field theory, string theory, supergravity, and quantum gravity. Work at the interface between statistical physics and probability theory involves strong ties with mathematicians and has led to rigorous results in disordered systems and problems of relaxation to equilibrium for stochastic dynamics of spin systems. Integrable systems are thoroughly studied in the group ever since its creation, with many important results concerning in particular the asymptotics of correlation functions. In conformal field theory, the ongoing work involves the use of new mathematical tools – gerbes – and unfolds obstructions to the construction of gauged Wess-Zumino models. Supergravity has been a topic of intense activity in the last five years, with many original results concerning gauged, extended and higher-dimensional supergravities and supersymmetric field theories. The classical aspects of strings in a maximally symmetric background using integrable methods is a relatively recent subject in the group. Last but not least, considerable work has been devoted to quantum gravity, which is a subject of utmost importance in high energy theoretical physics.

Our results have given rise to 123 publications in international refereed journals. Before describing in more details the results obtained over the last five years, we would like to highlight the following main achievements:

– Form factor approach to asymptotic behavior of correlation functions in critical models.
– Classification of global gauge anomalies in gauged 2-dimensional sigma models with Wess-Zumino terms.
– Proof of inviscid damping for the linearized two–dimensional Euler equations.
– Proof of disorder relevance for the 1+1-dimensional disordered polymer pinning model.
– Construction of an integrable q-deformation of the $\mathrm{AdS}_5 \times S^5$ superstring action.
– Construction of the E_n-covariant form of the full eleven-dimensional supergravity.
– Quantization and coherent states for discrete twisted geometries (with curvature & torsion).

A. *Integrable systems and conformal field theory*

Integrable systems: (ANR DIADEMS, IMB, Dijon, CNRS GDRI) Integrable systems are ubiquitous in modern theoretical physics appearing both in statistical mechanics and field theory with applications ranging from condensed matter to string theory. They provide unique possibility to obtain non-perturbative and exact results for strongly correlated systems that cannot be obtained by other methods; among others, it leads to invaluable benchmarks used in numerics for more general cases. Besides the computation of spectrum, scattering matrices and partition functions the main challenge in this domain concerns the exact computation of the form factors and correlation functions that connect to measurable physical quantities in such systems. Our group was at the origin of several significant breakthroughs in these problems along the last 15 years, starting from the resolution of the so-called quantum inverse scattering problem for spin chains that led to the computation of their form factors and correlation functions in the framework of the Algebraic Bethe Ansatz (ABA). Among the works done in the last five years we would like to emphasize the following three most promising directions :

- Extension of the above method to models associated to elliptic quantum algebras like the solid-on-solid (SOS) model, which is the archetype of the class of so-called *face* models with the XYZ model as the main future goal. We obtained determinant representations for the finite-size form factors of local operators [376] and multiple integral representations for the local height probabilities in the thermodynamic limit [377].

- Development of a new method to tackle the large distance and large time asymptotic behavior of correlation functions for interacting critical models starting from their form factor expansion, hence deriving from first principle their conformal properties in the thermodynamic limit for two point functions [365, 367] and then for arbitrary n-point functions. This also led to the exact derivation of the so-called X-ray edge singularities for the 1D Bose gas at arbitrary positive coupling and the computation of its correlation functions at low temperature [371, 372]. One of the goals of the method is to give a microscopic and physical approach to conformal field theories starting from lattice models.

- Setting up the resolution of the quantum inverse problem and the computation of correlation functions in the framework of the separation of variable (SOV) method to consider general integrable systems not solvable by ABA; the first examples worked out have been the lattice Sine-Gordon field theory [354] and the Chiral Potts model [355].

Conformal field theory: We continued to develop a geometric approach to 2- and 3-dimensional field theory models based on the theory of gerbes and their modules. In particular, we applied this approach to classify global gauge anomalies in gauged 2-dimensional sigma models with Wess-Zumino terms on worldsheets without boundary [343] and with boundaries or/and defects [344]. In the case of coset models of conformal field theory, an almost complete classification of the anomalous cases was obtained [320].

B. *Exact results in statistical physics and dynamical systems*

Our work is at the interface between statistical physics and probability theory. Among the topics of research are the rigorous study of disordered systems (spin glasses, polymers in random environment) and problems of relaxation to equilibrium for stochastic dynamics of spin systems.

Polymers in random environment: The random pinning model is one of the simplest disordered models exhibiting a phase transition. It is also an ideal testing ground to give mathematical basis to the so-called Harris criterion, that gives predictions on when disorder changes critical exponents (disorder relevance). The work [346] considers the case of the pinning models in dimension $1 + 1$, where disorder is "marginal" in terms of Harris criterion. In that work it is proven that the critical point is modified by disorder w.r.t. the homogeneous case (and that, for weak disorder, the critical point shift is smaller than any power of the disorder intensity). This proves a conjecture by Derrida, Hakim and Vannimenus ('92).

Stochastic dynamics and relaxation to equilibrium: Stochastic Markov evolutions of Glauber type are naturally associated to discrete statistical mechanics models (e.g. the Ising model). Classical question is how (and how quickly) the dynamical process converges to the equilibrium measure. These questions are particularly challenging at low temperature, where energy barriers between different thermodynamic phases dramatically slow down dynamics. In [312], sharp bounds on the time of relaxation to equilibrium for the zero-temperature dynamics of the three-dimensional Ising model were proven (Fig. 13).

Inviscid damping in fluid mechanics and stochastic partial differential equations: (ANR SYSCOM, LEGI, LPO) Turbulent flows are obviously irreversible. Less obviously this irreversibility is probably independent of the microscopic dissipation processes, and formally time reversible dynamics, like the two–dimensional Euler equations, have a macroscopic irreversible behavior. In a recent work we have shown that this is indeed the case, proving

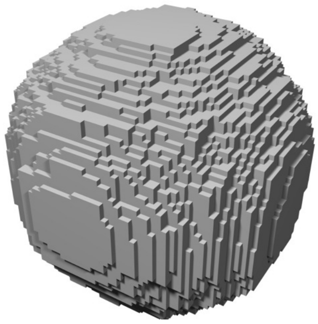


Figure 13: An initially cubic droplet of "minus" spins in a sea of "plus" spins for the 3D Ising model, evolving according to the zero-temperature Glauber dynamics, is eroded as time goes on. For the continuous-time evolution, an $L \times L \times L$ droplet takes a time approximately L^2 to disappear [312].

inviscid damping for the linearized two–dimensional Euler equations [307]. This phenomenon is analogous to the non-linear Landau damping, recently studied by Cédric Villani and Clément Mouhot. Moreover, the study of the non-linear inviscid damping for the two-dimensional Euler equations is a current hot subject in the mathematical physics community.

Related to the stochastic two dimensional Navier–Stokes equations, deep collaborations have been developed with mathematicians specialists of stochastic partial differential equations.

C. *String theory and supergravity*

String theory is a theory to describe nature at the smallest length scales, which replaces the concept of point-like elementary particles by extended strings. Its consistency requires supersymmetry and the presence of ten space-time dimensions. At low energies, and after compactification of the extra dimensions, the theory gives rise to supersymmetric effective field theories, the so-called gauged supergravities. Central themes of our research have been the classification and construction of supersymmetric field theories, the use of integrable methods in the study of string theory on $AdS_5 \times S^5$, and the holographic dualities.

Integrability and $AdS_5 \times S^5$ string theory: (PICS DIGEST, Hertfordshire) Integrability plays a key role in the context of the AdS/CFT correspondence between four-dimensional $\mathcal{N} = 4$ superconformal Yang-Mills theory and type IIB superstring theory on the ten-dimensional $AdS_5 \times S^5$ background. During the last five years, two important results have been obtained. The originality of the approach consists in focusing on the algebraic structure sustaining integrability at the classical hamiltonian level.

In this context, the first steps of the Faddeev-Reshetikhin approach developed in 1986 for the SU(2) principal chiral model have been extended to the $AdS_5 \times S^5$ superstring [325]. We succeeded in determining the generalised Faddeev-Reshetikhin Poisson bracket for this theory. Unlike the case of the principal chiral model, this procedure does not completely do away with the non-ultralocality in the canonical Poisson bracket of the Lax matrix. However, it leads to an alleviation of the non-ultralocality. Indeed, the generalised Faddeev-Reshetikhin Poisson bracket of the Lax matrix can be regularized and leads to a well defined lattice algebra of the general quadratic form identified by Freidel and Maillet in 1991. It has also been shown that the Faddeev-Reshetikhin procedure leads naturally to performing a Pohlmeyer reduction of the superstring. This has therefore revealed an unknown link between these two approaches.

The generalised Faddeev-Reshetikhin Poisson bracket has also been used to construct an integrable q-deformation of the $AdS_5 \times S^5$ superstring action [328]. The properties of this deformation are the following. Its integrability is guaranteed from the very outset. The global $PSU(2,2|4)$ symmetry is broken to its Cartan subgroup $[U(1)]^6$. However, it admits a q-deformed symmetry, which is the classical analog of $U_q(psu(2,2|4))$. The action is invariant under κ-symmetry. The deformation interpolates between the $AdS_5 \times S^5$ and $dS_5 \times H^5$ spaces.

The original motivation related to these two results comes from the AdS/CFT correspondence. However, the methods have been developed within the general framework of integrable σ-models. For instance, in the case of the deformation, we have recovered in this way the Yang-Baxter σ-model introduced by Klimcik. This also generalises results obtained for the squashed S^3 σ-model.

Supersymmetric field theories: (ANR Chaire d'excellence) Understanding the detailed structure of the effective 6d theory of multiple M5-branes remains one of the important longstanding issues of string/M-theory. On general grounds this should be a (2,0) superconformal theory of non-Abelian chiral tensor supermultiplets. Such structures show similarity with concepts of higher gauge theories, Q structures, and non-abelian gerbes extended to higher degree forms. This is analysed in current work with mathematicians at ICJ, UCBL. In [403] explicit six-dimensional superconformal models with non-abelian gauge couplings for multiple tensor multiplets have been constructed. A crucial ingredient in the construction is the introduction of three-form gauge potentials which communicate degrees of freedom between the tensor multiplets and the Yang-Mills multiplet, but do not introduce additional degrees of freedom. In later work [404], we have classified the general gauge group structure of these models and extended the construction to the presence of hypermultiplets which complete the field content to that of superconformal (2,0) theories.

Supergravity: Supergravity theories arise as low-energy effective field theories of string compactifications with applications in the holographic description of gauge theories. In [396] the unique maximally supersymmetric theory in two dimensions with gauge group $SO(9)$ was constructed. The theory is expected to describe the low-energy effective action upon reduction on the D0-brane near-horizon geometry, dual to the supersymmetric (BFSS) matrix quantum mechanics. The existence of this theory has been a long-standing conjecture based on its field content and higher-dimensional analogies. Unlike all the other maximal supergravities relevant for the higher-dimensional holographic dualities whose construction has been accomplished in the 1980's, the construction of this theory had to await modern tools. Its construction is based on selecting the proper embedding of the gauge group into the infinite-dimensional symmetry group of the ungauged theory.

Another natural application of supergravity theories is the construction of globally supersymmetric field theories on curved spacetime. Such theories have attracted increased attention with the advent of localization techniques that allow for numerous exact results for supersymmetric gauge theories, such as the computation of indices, partition functions and Wilson loops, providing in many cases checks of highly non-trivial dualities. In recent work, the rigid supersymmetric theories in four-dimensional Riemannian spin manifolds have been classified [405]. The conditions for supersymmetry translate into set of conditions on the torsion classes of a suitable SU(2) or trivial G-structure. Later work has extended this analysis to interacting vector and tensor multiplets on six-dimensional Riemannian spin manifolds.

In further work, we have constructed and analyzed solutions of supergravity theories in various contexts (wrapped branes, AdS flux compactifications, black p-brane intersections, BPS black holes, warped AdS, rotating branes).

Exceptional field theories: Eleven-dimensional supergravity reveals large exceptional symmetries upon reduction, in accordance with the U-duality groups of M-theory, but their higher-dimensional geometric origin has remained a mystery. In [357, 360] and subsequent work, D=11 supergravity has been extended to a form which is fully covariant under the exceptional groups $E_{n(n)}, (n = 6, 7, 8)$. In this covariant formulation the exceptional symmetries acquire a geometric realisation in terms of a higher-dimensional 'exceptional spacetime'. Remarkably, this formulation likewise comprises the IIB theory.

D. Quantum gravity

(ANR LQG09, CPT, LPT Orsay, LPTA) A very interesting axis of development of the research activities of the mathematical physics group is quantum gravity. This is a huge challenge for theoretical physics. The goal is to produce a theory describing the gravitational interaction at all scales of length and energy, from the Planck scale at $10^{-35}m$ to astrophysical and cosmological scales. It should provide a unified framework for quantum field theory, particle physics and general relativity. There are a few solid and fruitful approaches to this longstanding issue. We distinguish string theory, loop gravity, dynamical triangulations, exact renormalization group techniques and non-commutative geometry. Although inspired from different perspectives, they often lead to comparable pictures.

The quantum gravity team of the laboratory focuses on loop quantum gravity and its associated spinfoam path integral framework. The theory defines quantum states of geometry and their dynamics is described by transition amplitudes given by spin foam models. The goal is to understand and analyze the quantum fluctuations of geometry and apply the results to extreme gravitational fields for which quantum gravity should cure the ill-behavior of general relativity, but we also aim to study the coarse-graining and renormalization flow of the quantum dynamics in order to recover the standard laws of gravity at our scale in a semi-classical regime and to derive consistently quantum corrections, which could be tested in cosmology, astrophysics or in the phenomenology of particle physics. Over the past five years, the team has produced a large array of relevant results among which one can emphasise the following:

Spinfoams: correlations, asymptotics & dynamics: In both 3 and 4 space-time dimensions, we have studied the properties of spinfoam transition amplitudes and correlations on quantum states, especially focusing on their large-scale asymptotics and recursion relations. On the one hand, beside powerful analytical results on asymptotics and new methods to derive the quantum corrections to the classical leading order, we have performed in collaboration with Canadian colleagues the first numerical simulations showing that we recover the r^{-2} behavior of Newton's law for classical gravity at large distances (see Fig. 14) while having completely regularized correlations at the Planck scale [316].

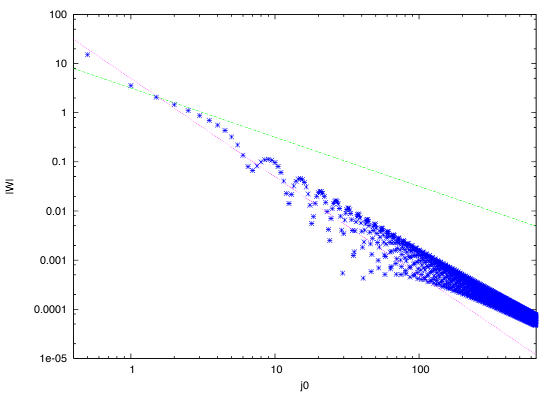


Figure 14: Numerical evaluation of the 2-function of 3d quantum gravity in terms of the scale parameter j_0: on the log-log plot, the green dashed line is the leading order reproducing the classical gravity law, the next-to-leading order in blue with the oscillations takes into account the path integral corrections.

On the other hand, recursion relations are not only very useful numerical tools to compute the spinfoam amplitudes but also reflect the existence of symmetries satisfied by those amplitudes. Having explored this relation for 3d gravity, we have interpreted spinfoam amplitudes for coherent states as generating functions for the amplitudes in the standard spin basis and shown how to convert the recursion relations into differential equations reflecting the Hamiltonian constraints of the theory.

Non-commutative geometry: Formulating spinfoams in terms of group field theory, which generalizes matrix and tensor models, they are interpreted as non-commutative quantum field theories that leads to deformed special relativities with possible experimental signature in particle physics [353]. From a physical viewpoint, it amounts to working with a curved momentun space. From the mathematical perspective, we formalized this non-commutative geometry in terms of $\star$-products and a group Fourier transform and showed it is related to a Moyal-Voros product.

Spinor networks & coherent states: We introduced a new parametrization of the phase space of loop gravity in terms of spinors. These spinor networks clarify the interpretation of the quantum states as discrete (twisted) geometry with torsion, also simplifying the analysis of the constraint algebra. They allow a direct quantization and the definition of well-behaved coherent states of geometry (see e.g. [341]). These have all become standard mathematical tools for loop quantum gravity and spinfoams. In particular, spinfoam amplitudes are now all naturally expressed as path integrals over these spinorial coherent states, which allows a more direct link with Regge calculus ofr discretized general relativity. We further generalized these tools to twistorial networks, which are covariant under Lorentz transformations and account explicitly for the extrinsic curvature of our 3d space into the 4d space-time.

Quantum cosmology: Cosmology is the main arena for potential tests of quantum gravity. We have developed a framework for homogeneous quantum cosmology from loop gravity and computed the spinfoam transition amplitude between cosmological coherent states. This allowed to derive modified FRW equations for the evolution of the universe[385], predicting a Big Bounce replacing the Big Bang singularity. We hope to extend these group quantization and coherent state techniques to dealing with inhomogeneities.

Side-products: mathematics & quantum information: Research in quantum gravity often requires deeper studies in geometry and quantum mechanics, leading to results relevant for pure mathematics (especially discrete geometry and knot theory) or other fields of physics. In particular, we have ad many interactions with the field of quantum information and we would like to put forward a work defining unitary N-designs [319].

Mathematical Physics and Fundamental Interactions: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
A. Le Diffon	Supergravités jaugées et symétrie locale d'échelle	23 jun. 2010	H. Samtleben
V. Bonzom	Géométrie quantique dans les mousses de Spins : de la théorie topologique BF vers la relativité générale	23 sep. 2010	E. Livine, C. Rovelli
Q. Berger	Polymères en milieu aléatoire : influence d'un désordre corrélé sur le phénomène de localisation	15 jun. 2012	F. Toninelli
M. Dupuis	Modèles de mousses de spin pour la gravité quantique et leur régime semi-classique	16 dec. 2010	E. Livine
N. Grosjean	Séparation des variables et facteurs de forme des modèles intégrables quantiques	25 jun. 2013	J.-M. Maillet
D. Levy-Bencheton	Algèbre de Yang-Baxter dynamique et fonctions de corrélation du modèle SOS intégrable	22 oct. 2013	V. Terras
T. Ortiz	Two dimensional maximal supergravity, consistent truncations and holography	07 jul. 2014	H. Samtleben

Main contracts

5 ANR: LQG09, DIADEMS, STOSYMAP, CHAMU, DUALSUGRASTRING

Editorial responsabilities

Gawędzki Krzysztof
Annales Henri Poincaré, Editor-in-Chief.
Livine Etera
Sigma, Editor of the volume "Loop Quant. Grav. and Cosmo" (2011-13).
Maillet Jean-Michel
Annales Henri Poincaré - AHP, Member of the editorial committee.
Toninelli Fabio
Communications in Mathematical Physics, Member of the editorial committee.
International Journal of Mathematics, Member of the editorial committee.

Organized conferences

Livine Etera: *Spinfoam & Cosmology*, Lyon (France), November 2013
Maillet Jean-Michel:
ICMP 2012 - session "integrable systems and operator algebra, Aalborg (Denmark), August 2012
Samtleben Henning:
Workshop on Gauge Theories, Supersymmetry, and Mathematical Physics, Lyon (France), April 2010
Journées de Physique Mathématique: Loop quantum gravity, Lyon (France), September 2011
Journées de Physique Mathématique: AdS/CFT, Supersym. and Integrability, Lyon (France), Sept. 2012
Journées de Physique Mathématique: Topological Insulators, Lyon (France), September 2013
Recent Developments in Supergravity Theories, Istanbul (Turkey), June 2014
Toninelli Fabio:
Session Spin Glasses, IMS Annual Meeting, Gothenburg (Sweden), August 2010
Session Disordered Systems, World Congress in Probability, Istanbul (Turkey), July 2012

123 publications in RICL: see T4B

T5R. Condensed Matter: *Report*

Permanent Members: A. Alastuey, D. Carpentier, B. Castaing, L. Chevillard, P. Degiovanni, A. Fedorenko, K. Gawedzki, P. Holdsworth, E. Leveque, J.-M. Maillet, E. Orignac, T. Roscilde

Post-docs: P. Delplace, D. Ferraro, L. de Forges de Parny, C. Petitjean

PhD students: P. Adroguer, J. Bertolaccini, M. Faulkner, M. Fruchart, C. Grenier, A. Harman-Clarke, L.-P. Henry, L. Jaubert, D. Malpetti, G. Paulin, E. Thibierge, S. Villerot, D. Wendland

Condensed Matter embraces a wide range of different physical systems, whose common denominator is a complex behaviour emerging from either strong interactions, or quantum statistics, or the conjure of both. Our recent activities have covered a broad spectrum of subjects, ranging from the physics of bulk solids to that of nano-structures, quantum fluids, and dilute quantum gases. A pervasive theme in modern condensed matter is that of *emulation and emergence*, whereby the collective behaviour of a complex system (the "emulator") can exhibit the distinctive features of a widely different physical system, *a priori* unrelated to the emulator's elementary constituents. As an example of such a principle, semiconductors can reproduce the physics of relativistic fermions; magnetic materials can mimic the physics of classical and quantum electrodynamics admitting magnetic monopoles, or the physics of correlated Bose fluids; diluted quantum gases can mimic the physics of dense materials (becoming therefore a subject of condensed matter physics) both in equilibrium and far from equilibrium. On a different note, the *electron waves* in mesoscopic conductors can be used as a coherent probe of the solid environment in which these waves travel: electron waves can unveil the decoherence mechanisms at play in a quantum Hall bar, whose edges define an electron interferometer; and they can probe the complex spin pattern inside a spin glass. Finally *quantum fluids* exhibiting turbulent flow, or ionised to form a plasma, unveil the impact of quantum effects in extreme conditions.

A. *Emergence and topology*

ANR IsoTop, Univ. Bordeaux; FCAR, M. Gingras (Univ. Waterloo); ENS, F. Mila (EPFL).

The last decade has experienced an explosion of interest in materials whose low energy sector consists of "relativistic" excitations: Dirac fermions in graphene, topological insulators and Weyl fermions in semimetals. Dirac point engineering, relevant for cold atoms in optical lattices, microwave experiments on photonic crystals and the organic conductor α-(BEDT-TTF)$_2$ I$_3$ have also given access to diverse topological transitions. We have studied the effects of disorder on these excitations and transitions. In [447] we have studied 2D Dirac fermions in the presence of long-range correlated random potentials. The density of states and full counting statistics for fermionic transport at low energy have been investigated. In [430] the effect of disorder on the topological transition from a semi-metal to a band insulator due to merging of two Dirac points was studied.

We have studied geometrical and topological properties of energy band structures in crystals, with a particular interest in topological insulators and semimetals. Recently, in close collaboration with an experimental group in Grenoble, it was shown that the surface states originating from these topological properties can extend way beyond the expected energy range [433]. In parallel, we have clarified the notion of Berry curvatures in band structures, and their physical relevance (Fig. 15).

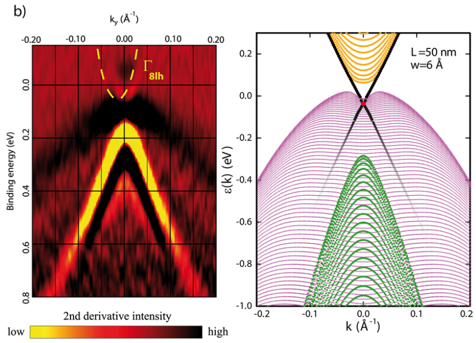


Figure 15: Dispersion relation of topological surface states of HgTe as observed in ARPES (left) and in a numerical k.P description (right). From [433].

The emergence of magnetic monopole quasi-particles as low temperature excitations of spin ice materials is an exciting development in frustrated magnetism. In these extraordinary materials, the monopole vacuum is an extensive and quasi-degenerate band of states whose spin configurations are slave to an emergent U(1) gauge field. Consequences of the gauge field constraint include symmetry breaking transitions outside the usual Landau-Ginzburg-Wilson description and thermally induced topological sector fluctuations up to the mesoscopic scale. Analysis of the emergent electrostatics and stochastic dynamics of the Coulomb fluid shows regimes of monopole crystalization [426] (Fig. 16) and point towards non-Ohmic conduction via the Wien effect (see IV T7R B).

Adding quantum fluctuations to spin ice endows its gauge-field description with intrinsic quantum dynamics, and it leads to an emergent compact quantum electrodynamics with gapped electric and mag-

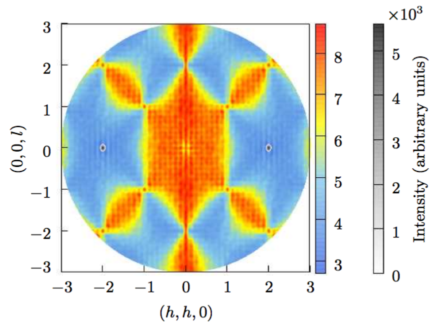


Figure 16: Simulated neutron scattering pattern from spin ice in a monopole crystal state. The moments fragment into two parts showing long range order (grey scale) and diffuse scattering characteristic of a Coulomb phase (color scale) [426].

netic monopoles and a gapless photon excitation. These features characterise a *U(1) spin liquid* phase, whose realization in realistic models and experiments remains challenging. Our recent efforts have focused on two-dimensional spin ice in a transverse field, providing quantum fluctuations, and a realistic Hamiltonian for frustrated Ising models realised *e.g.* in the context of trapped ions. A spin-wave analysis [457] has shown that the transverse field is not able to lift the exponential ground state degeneracy at the harmonic level. Anharmonic quantum fluctuations have been addressed via a novel quantum Monte Carlo scheme, which allows sampling of different topological sectors of the gauge theory, revealing a low-temperature *thermal* U(1) spin liquid phase.

B. *Quantum simulators: from cold atoms to condensed matter*

ANR ArtiQ; ENS, M. Boninsegni (U. Alberta); CNRS PEPS-PTI.

Quantum simulation, proposed in 1982 by Feynman, represents a rapidly developing subject, with potential implications for any physical domain whose models are susceptible to be implemented experimentally via synthetic quantum systems such as ultracold gases, trapped ions, superconducting circuits, etc. Our recent theoretical activities on the subject of quantum simulation have followed two main themes: 1) prediction of fundamental quantum many-body effects within realistic reach of experimental quantum simulation; 2) "calibration" of quantum simulators, in direct interaction with experiments. In particular our activity has focused on two classes of controllable quantum systems, which can be viewed as quantum simulators of fundamental quantum many-body models: (a) ultracold gases, and (b) quantum magnets.

In the case of ultracold gases, a significant part of our activity has been devoted to the study of the *equilibrium* properties of one-dimensional (1d) bosons and fermions [431]. In particular we have provided a comprehensive study of the experimental signatures of the localised Bose-glass phase for 1d bosons with on-site interactions in a random and quasi-periodic potential, addressing both its compressibility [480, 481], finite-size scaling [440] and its gapless spectral features [484] (Fig. 17). Moreover we have extended this study to the case of bosons with long-range dipolar interactions, unveiling the fate of the exotic Haldane insulator and the critical line separating it from the Mott insulator in the presence of strong disorder [441, 442]. Our investigations have also focused on the study of equilibrium properties of bosonic mixtures, reconstructing the complex phase diagram of binary hardcore-boson and fermion mixtures with mass [434, 478] and population [434, 479] imbalance, which features liquid and crystalline phases of dimer and trimer bound states, as well as finite-momentum (Fulde-Ferrell-Larkin-Ovchinnikov) pairing. For one-dimensional mixtures, a bosonization description was used to obtain the expressions of response [471, 473] and spectral functions [474]. In parallel to the study of equilibrium properties, we have also devoted our attention to strongly *out-of-equilibrium* systems, focusing in particular on *quantum quenches* (abrupt Hamiltonian changes) and their subsequent Hamiltonian evolution. In particular we have shown how a quantum quench can give rise to supersolidity [468] or to Anderson localization [460] in a strongly imbalanced Bose mixture trapped in a species-dependent optical lattice; and we have investigated crossovers between adiabatic and non-adiabatic correlations as a function of distance [419] (Fig. 17). Finally, we have used our theoretical tools to validate an actual quantum simulation of the Lieb-Liniger model in a trap via ultracold Rb-87 trapped on an atom chip [462].

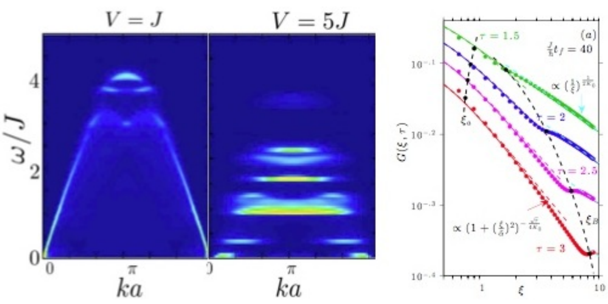


Figure 17: *Left:* Dynamic structure factor of a 1d lattice Bose gas undergoing localization due to a quasi-periodic potential. [484] *Right:*. Correlation function of 1d lattice bosons after a slow interaction quench. [419]

With respect to cold atoms, a complementary realization (or quantum simulation) of interacting degenerate Bose gases is provided by quantum magnets possessing an uniaxial symmetry, in which Bose-Einstein condensation (BEC) of magnetic quasiparticles (corresponding to spontaneous magnetic order) can be induced by an applied magnetic field. Advances in the synthesis of magnetic insulators have provided remarkable examples of magnetic BEC compounds, with quasi-1d magnetic interactions (such as $(C_5H_{12}N)_2CuBr_4$ - Hpip for brevity) or more markedly 3d ones (such as $NiCl_2 \cdot 4SC(NH_2)_2$, DTN for brevity). Our collaboration with different experimental groups has led to two main results. We have been able to establish that Hpip in a field realises a system of coupled Luttinger liquids, developing true condensation at low temperature due to the residual 3d coupling [424, 490]. We have also shown that field-induced magnetic quasiparticles in Br-doped DTN form a well-controlled realization of the long-sought Bose-glass state in 3d, and of its quantum phase transition to a BEC state [495, 497, 498] (Fig. 18).

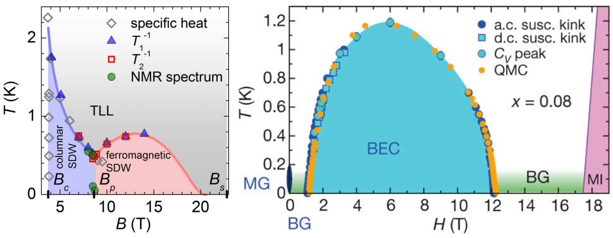


Figure 18: Phase diagram of $BaCo_2V_2O_8$ (left) and of Br-doped DTN [497] (right), comparing experimental and theoretical data.

Further work on magnetic insulators includes the study of quantum order by disorder, in which quantum fluctuations lift a classical degeneracy, giving a long-range ordered state. We have recently shown that the planar, frustrated antiferromagnet $Er_2Ti_2O_7$ provides the first clear cut example of this counter-intuitive phenomenon [499], which has proved elusive for decades. We have also established that the quasi-one-dimensional antiferromagnet $BaCO_2V_2O_8$, featuring dominantly Ising intrachain interactions and frustrated interchain couplings, exhibits a field-induced Luttinger liquid behavior, in which the frustrated couplings between the Luttinger liquids are modulated by the field. The low-temperature ordered phase is an incommensurate spin density wave, with a transition induced by the field between a columnar and a ferromagnetic ordering in the transverse direction.

C. *Coherent transport*

ANR 1-shot, LPA (ENS Paris), CPT Marseille; ANR Mesoglass, NEEL Grenoble.

Coherent transport is a regime observed in samples whose size is smaller than the inelastic mean-free path. Electrons then remain coherent over the sample, giving rise to quantum deviations from classical transport theory. Our group has considered coherent transport in (1) quantum Hall edges, with the goal of realizing the equivalent of fiber quantum optics with electrons (2) quantum spin Hall and topological insulators, with the aim of characterizing remarkable properties of these novel states of matter.

Electron quantum optics : In nanophysics, there is a growing interest in the ultimate regime of quantum electronics involving single electron excitations. This regime is called electron quantum optics by analogy with its optical counterpart. Its accessibility arises from the recent availability of single electron sources in ballistic conductors acting as wave guides for electrons. However, electron quantum optics goes beyond the mere reproduction of optical setups using electron beams. Electrons differ from photons firstly because of their fermionic statistics which, in metals, implies the presence of the Fermi sea. Secondly, as charged particles they experience strong Coulomb interactions. Single electron manipulations in quantum

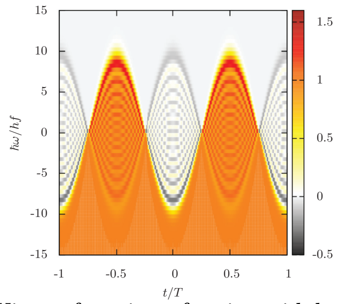


Figure 19: Wigner function of a sinusoidal electrical current at zero temperature. Image selected by Phys. Rev. B editors [448].

conductors have been the subject of intensive research in the recent years and important milestones such as the demonstration of Hanbury-Brown and Twiss [423] as well as Hong-Hu-Mandel experiment [420] have been achieved. Our group has played a key role in these developments by constructing the theoretical framework for electron quantum optics, thereby transposing basic quantum optics concepts and tools to electronics [453, 454]. This work is the result of a very fruitful collaboration with several leading experimental groups [436, 443, 452], leading in particular to the observation of spin/charge separation in quantum Hall edge channels at filling fraction 2 [421]. Our work provides a simple and unified framework for all the recent single and two particle interferences effects demonstrated in quantum nano-electronics over the last decade [422]. Supplemented by non perturbative computations of electronic decoherence [435], it opens the way to a quantum-signal-processing approach to electronic coherence [448] (Fig. 19).

Topological insulators : In Quantum Spin Hall systems, there are two counterpropagating edge states carrying opposite spins that are mapped to each other by time reversal symmetry. Those edges are protected by a topological invariant, and cannot be backscattered into each other by phonons or non-magnetic impurities. Our group has analyzed the

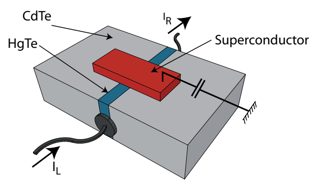


Figure 20: The setup of the superconducting barrier on a Quantum spin Hall edge realized in an HgTe/CdTe quantum well.

effect of a superconducting barrier, as the one represented on Fig. 20 on such edge states [411]. The absence of backscattering has remarkable effects: normal reflection and crossed Andreev reflection are completely suppressed leaving only transmission and normal Andreev reflection. In particular, in a sufficiently long superconductor, a perfect Andreev reflection takes place at each interface giving a total $G = 4e^2/h$ conductance without current noise. In shorter samples, Fabry-Perot resonances of the Bogoliubov quasiparticles inside the superconducting barrier are expected to give rise to perfect transmission of electrons at special energies.

Coherent Transport in Spin Glasses : Spin Glasses are amorphous magnetic phases. In a collaborative effort with an experimental group from Grenoble, we proposed to probe their physics through coherent transport of electrons at the micron scale. Among the initial results, we can mention a unique and original measure of the distribution of internal fields in a spin glass phase from monitoring the amplitude of conductance fluctuations. The evolution of the electronic dephasing rate as a function of a magnetic field allows to deduce the distribution of effective fields active on the various magnetic moments in the sample [427]. This technique should provide direct access to overlaps between spin configurations.

D. *Quantum fluids*

ANR Shrek, CEA et NEEL (Grenoble), CEA Saclay.

Our investigations on quantum fluids have mainly focused on two aspects: quantum (or superfluid) turbulence (QT), and quantum plasmas/ interacting Bose gases.

As far as turbulence is concerned, two different and complementary approaches have been carried out. i) Firstly, QT is studied within the framework of a two-fluid model that obeys coupled Navier-Stokes and Euler dynamics for a (thermally excited) normal fluid and a (ground state) superfluid respectively. The coupling originates from the interaction of the superfluid quantised vortices with the normal (viscous) fluid. Based on numerical simulations, it is argued that the energetics of QT shows similarity with classical turbulence at large scales (as usually admitted) but that some discrepancies are observable at small scales of motion where dissipation by mutual coupling prevails [477, 486, 487]). The influence of boundary conditions on the onset of turbulence is also investigated through Lattice Boltzmann simulation of the two-fluid model. ii) The second approach focuses on the microscopic structure of Helium, taking into account the roton minimum as measured in the dispersion law of the excitations [492] (Fig. 21). We have shown that the depth and position of the roton gap governs completely the density close to the singularity. Furthermore, in this zero temperature limit, we make use, theoretically and numerically, of the non local Gross-Pitaeviskii equations to understand the internal structure of the vortices. Let us also mention a parallel experimental investigation [485] taking place in Grenoble in which we are involved.

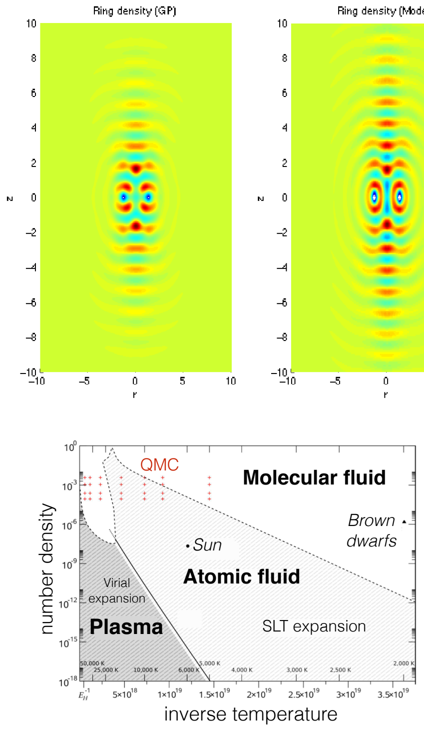


Figure 21: *Upper panel:* Superfluid density of a vortex ring in cylindrical coordinates. Left: Gross-Pitaeviskii simulation. Right: our model based on the roton gap [492]. *Lower panel:* Phase diagram of quantum plasmas, showing the validity domains of our Scaled Low Temperature (SLT) expansion (hatched region) and of the virial expansion (shaded region) [416]. Quantum Monte Carlo (QMC) results, as well as state points of Sun photosphere and of Brown dwarfs atmospheres, are also shown.

A proper treatment of recombination in quantum plasmas at equilibrium has been a long standing problem for many years. The combination of diagrammatic methods with path integrals allowed us to build a screened cluster representation [413] which is well suited for handling both recombination and screening. In particular, this formalism provides the equation of state of the hydrogen plasma in the partially ionised atomic regime, with a very good accuracy as shown through comparisons with quantum Monte Carlo calculations [416]. The effects of interactions on the condensation of a Bose gas is another central question which, despite numerous works and experiments, remains still debated. In particular, the persistence of off-diagonal long range order in the one-body density matrix, has been proven rigorously only within the familiar Kac limit which amounts to consider both infinitely weak and infinitely long-ranged two-body interactions. Using the hierarchy equations for the imaginary-time evolved Green functions, we have recovered the result that the mean-field approach becomes exact in that limit, and we have shown that the contributions of fluctuations invalidate the familiar Hartree-Fock approximation for large but finite interaction ranges [417].

Condensed Matter: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
P. Adroguer	Propriétés de transport électronique des isolants topologiques	15 feb. 2013	D. Carpentier, P. Degiovanni
C. Grenier	Optique quantique électronique	30 jun. 2011	P. Degiovanni
A. H. Adam-Clarke	Topological Constraints and Ordering in Model Frustrated	01 nov. 2011	P. Holdsworth, S. Bramwell
L.P. Henry	Classical and quantum two-dimensional ice: Coulomb and ordered phases	29 nov. 2013	T. Roscilde
L. Jaubert	Topological constraints and constraints in spin Ice	23 sep. 2009	P. Holdsworth
G. Paulin	Electronic transport and Spin Glasses	22 jun. 2010	D. Carpentier
S. Villerot	Vortex dans l'hélium superfluide en présence d'interactions non-locales	27 nov. 2012	L. Chevillard, B. Castaing

Main contracts

6 ANR: MesoGlass, IsoTop, SemiTopo, SHREK, 1shot, ArtiQ

Editorial responsabilities

Holdsworth Peter
Journal of Physics, Condensed Matter, Member of the editorial committee.
Scientific Reports, Member of the editorial committee.
Orignac Edmond
European Physical Journal: Special Topics, Editor of the volume
Roscilde Tommaso
Novel quantum phases and mesoscopic physics in quantum gases, 217 (2013).

Organized conferences

Carpentier David: *Topological Insulators and Quantum Spin Hall effect*, Lyon (France), Decembre 2009
Carpentier David, Bertin Eric, Orignac Edmond, Holdsworth Peter:
Glasses : Recent experimental results and perspectives: Lyon (France), April 2011 Degiovanni Pascal.
Degiovanni Pascal:
Réunion plénière du GDR de Physique Quantique Mésoscopique, Aussois (France), Décembre 2009
Holdsworth Peter:
Geometrically Frustrated Magnets: From Spin Ice to Kagomé Planes, Paris (France), May 2005
Orignac Edmond, Roscilde Tommaso.
Lyon BEC 2012: Theory of Quantum Gazes and Quantum Coherence, Lyon (France), June 2012
Roscilde Tommaso.
4th School on Comp. Physics: from Quant. Gases to Strongly Corr. Syst., Les Houches (France), June 2014
BEC 2014: Quantum Gases and Quantum Coherence, Levico (Italy), May 2014

89 publications in RICL: see T5B

T6R. Infophysics, Signal and Systems: *Report*

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Data analysis and signal processing play central roles in physics, as well as in many other fields beyond physics. From its early days, the Physics Laboratory has chosen to devote a specific activity deeply connecting Physics to Signal Processing and, more broadly, Information Sciences. This "infophysics" research effort gathers thus a twofold objective: On the one hand, methodological contributions are conducted per se, with applications relevant to many different domains, including physics; On the other hand, problems, as well as methods and approaches, stemming from physics, are nurturing and suggesting new methodological signal processing developments. In addition, extracting information contained in experimental data from various systems such as biological or medical applications, social and complex systems, computer networks, calls for advanced methods in signal and image processing and/or physics. These back and forth interplays between signal and physics constitute the leading theme of the "infophysics" activity within the laboratory, covering topics ranging from multifractal analysis, multifractal vector fields (cf. IV T6R A), nonstationary approaches (cf. IV T6R B), multiscale studies of genomic data, heart rate variability analysis, fMRI data of the brain (cf. IV T6R E), social or transportation data (cf. IV T6R F), Internet traffic analysis (cf. IV T6R G), with thus a strong multidisciplinary flavors, from (statistical) signal and image processing to physics, mathematics or computer science. The success of this research line is made visible through the obtention of several funding competitive at the national level, as well as by publications in international top ranked journals both in signal processing, mathematics or physics and in leading journals in application fields. The "infophysics" theme also sustains numerous local, national and international well-established collaborations either with other signal processing teams, or with partners of other fields and world-reknowned experts in applications, thus making the results described below part of the fore-front international research effort on those subjects.

A. Scale invariance for multivariate signals and fields: theory and applications

Multivariate scaling signals. (V. Pipiras, UNC, USA) Theoretical definitions and practical synthesis of multivariate non Gaussian processes whose marginal distributions and covariance function are a priori and jointly prescribed has been achieved both via non linear pointwise transformations f of a suitable Gaussian process, whose covariance function depends both on the targeted covariance and on the Hermite polynomial expansion of f [606, 607, 657], and via optimal transport, a technique borrowed from image processing, that displaces alternatively and iteratively the time and frequency contents of a well chosen Gaussian seed [543]. This has notably been used to obtain long range dependent non Gaussian processes, with same covariance and marginals with yet different joint distributions. It has also been extended to multivariate fields [608]. Multifractal Random Walk, a close relative, yet with additional multifractal properties, has also been thoroughly studied theoretically, aiming at defining the range of parameters within which the process is well defined [509].

Multifractal and anisotropic image textures. (ANR AMATIS, S. Jaffard, Paris Est, H. Wendt, IRIT Toulouse, B. Vedel, Bretagne Sud, M. Clausel, UJF, Grenoble). Multifractal Analysis, based on wavelet Leaders, has been extended to isotropic fields. This required notably careful analyses and understanding of the role of Hölder global regularity and of the use of fractional integration [512, 612, 658, 675, 676, 678]. The interplay between self-similarity and anisotropy in image textures has been carefully studied, yielding an accurate estimate of the selfsimilar parameter despite anisotropy. This disentangling of selfsimilarity from anisotropy has been made possible by the use of the 2D Hyperbolic Wavelet Transform, that permits anisotropic dilations [501, 648, 652].

Multifractal vector fields. (ANR CHAMU, V. Vargas, ENS Paris, C. Garban, ENS Lyon, R. Rhodes, Paris 7) Motivated by the analysis the physical mechanisms for 3D fluid turbulence, modeled by Euler or Navier-Stokes equations (energy cascade and vorticity stretching,...), random vector fields that combines scaling (multifractal) properties and geometrical constraints have been defined and studied [20]. Their exact statistical characterization is challenging as it amounts to generalizing multiplicative chaos. A first step has been achieved in [559], that showed that such random vector fields defined from exponential of long range dependent processes are well defined mathematical objects, whose covariance and higher order moments are analytically tractable.

Further advances in multifractal analysis. (ANR AMATIS, S. Jaffard, Paris Est, H. Wendt, IRIT Toulouse). Have also been studied: The estimation of the Long Memory parameter for non Gaussian processes [511], the multifractal properties of non Gaussian self similar processes [673], and the relevance of a bayesian framework for estimation of the multifractality parameter [672, 677]. The segmentation of image textures into pieces with homogeneous local regularity (as measured from wavelet leaders) has been investigated; it relies on the use of proximal methods for functional minimization [642, 783].

Fractal analysis in Applications.

Ionosphere. (CNRS PICS, P. Sauli, Atmospheric Phys. Dept., Prague) The Ionosphere electron concentration fluctuations measured across several mid-latitude European stations have been shown to have correlation both in seasonal trends and within scaling behaviors, at short time scales, and they were related to the Geomagnetic activity [70, 651].

Astrophysics. The 2D Wavelet Transform Modulus Maxima Method has been used to detect and extract coronal loops in ultraviolet images of the solar corona [627] and to disentangle in solar magnetogram data the multifractal properties in active regions from the surrounding monofractal quiet-Sun field [620].

Art Investigations. (MoMA, NYC, Van Gogh Museum, Amsterdam) Scaling analysis in image textures was used for art work investigations, tending to show that copies, replica and forgeries show lesser irregularities (at very fine scales, below the millimeter) than originals [504, 506, 510]. The extend to which this betrays creation processes will be investigated.

B. *Non-stationarity*

Data-driven decompositions. Besides pointwise practical issues (e.g., sampling [646]), the data-driven technique of Empirical Mode Decomposition (EMD) has been investigated in four different directions:

1) Model-free disentanglement of nonstationary signals into a trend and a fluctuation [630, 632, 633].

2) Gap-filling in data with missing samples [631].

3) Limitation of "mode mixing" effects in a noise-assisted way, thanks to an improvement upon conventional Ensemble EMD that presents the two-fold advantage of increasing coherence of the averaging while guaranteeing a perfect reconstruction [569, 659, 663].

4) Reformulation in analogy with the "texture-geometry" decomposition problem in image analysis, taking advantage of recent advances in optimization and proximal methods [560, 639]: a new framework has been proposed, that gets rid of the loosely controlled "sifting" process that is involved in classical EMD, and replaces it by an optimization problem with constraints reflecting what EMD modes are supposed to be [640, 643]. This proved effective for signals and led to natural extensions to images [660].

Time-frequency methods. Fundamentals in time-frequency have been followed in two directions:

1) Construction of sparse energy distributions from a "compressed sensing" approach [586].

2) Exploitation of phase information in Short-Time Fourier Transforms, with new phase-magnitude relationships [531], an improved reassignment scheme [532] and new results on (reassigned) spectrogram geometry [583, 587]. This has also been explored within the framework of "synchrosqueezing" [679], with comparisons to both EMD and reassignment [533].

Characterizing and analysing nonstationarities. Apart from pointwise contributions to an alternative definition of instantaneous frequency [578, 579], multitapering in cepstral analysis [653], and an entropy-based method for counting components [656], most efforts have been devoted (within ANR StaRAC) to revisiting the concept of stationarity from an operational perspective:

1) It has first been argued that stationarity should only been considered in a relative sense, including an observation scale in the definition as well as in the analysis [585, 589, 636].

2) It has been shown that any signal, stationary or not, can be transformed in a "surrogate" stationary signal via a proper randomization of its phase spectrum [543, 547, 548].

3) A general methodology has been settled for testing stationarity on the basis of such surrogates used as elements of reference for the null hypothesis of stationarity [549, 572, 573, 645]. In the specific case of a non homogeneous process, an alternative stationarity test has been proposed by searching for an optimal partition thanks to a network flow algorithm [605].

4) Surrogates have been given a "machine learning" interpretation, leading to testing procedures as well as characterizations of different types of nonstationarities [514, 515, 552, 638].

C. *Graph signals and complex networks*

Signal on graphs and networks.

For sensor networks, cycles (e.g., daily, yearly) and trends are important. Using nonstationary tools, we show how to compute cycles, residuals and correlations for Live E! data (environmental sensors in Japan) [539, 540]. We have used also EMD to detect anomalies in sensor network of energy consumption in building, [592, 593].

Not restricted to signals on networks, we study complex networks. Using modularity, [597] studies communities in networks with correlated data. Revisiting multi-scale modularity with spectral graph wavelets a multi-scale community detection method detects relevant network structures in communities and their scales [666–668], as displayed on Fig. 22. This method is a wavelet-based clustering and we have shown how to use it on large networks with wavelet transform of random vectors as features [665].

Complex network dynamics. To study dynamical properties of networks, we have proposed new descriptors and a model for the dynamics of mobility networks [550], before adopting a signal processing approach. Leveraging on the transform of graphs in signals, we propose "time-frequency"-like analyses of dynamic networks [600, 601, 603]. This has been applied to the network of bike sharing system

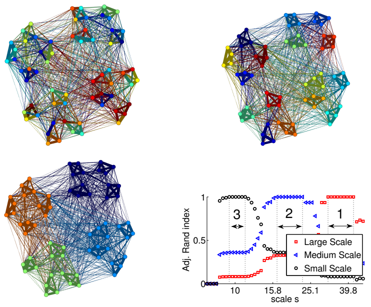

Figure 22: The 3 stable partitions obtained by multiscale community detection using wavelets on a Sales-Pardo graph (nodes in the same community share the same color). An index of recovery of each partition is also displayed, as function of the scale.

(cf. IV T6R F). Relying on nonnegative matrix factorization, features of temporal networks are exhibited along with the periods they are active, opening a new approach to the study of dynamical networks [602].

D. *Statistical physics and signal processing*

A PhD thesis explored how interactions between tools and concepts of Statistical Physics and Signal Processing can help to analyze and understand situations and models (inspired from Statistical Physics) where usual convergence theorems fail. Studies of independent random variables raised to a power depending on the sample size were shown to yield non standard limit distributions for the maximum [520, 541]. For sums, it provided a link between linearization effect in moment estimation and glass transition in statistical physics [518, 521, 524]. In addition, it formalized the existence of an intrinsic critical moment order for a multifractal process [524], thus comforting earlier results [534]. A critical moment estimator has been defined and studied for a class of independent (yet with intricate marginal distribution) random variables [518]. A class of random variables with intricate correlation has been studied, whose joint distributions is written as a product of matrices and which can have long range correlations. This model can also be recast into the framework of Hidden Markov Chain models, leading to theoretical design and actual synthesis [519, 522]. The limit behavior of the sum of such random variables has been characterized, both using rescaled limit distributions [523] and large deviations [517].

E. *Biological, genomic and biomedical signal and image processing*

Multiscale and multivariate methodologies for genomic data analysis (ANR REFOPOL, O. Hyrien, ENS Paris, C. Thermes, CGM, Gif/Yvette, A. Goldar, CEA/Saclay) Multiscale and multivariate concepts and methodologies are necessary to account for the complexity of genome organization accommodating the tradeoff between DNA compaction and gene accessibility (as reviewed in [186, 526]). We developed multiscale wavelet-based algorithms providing us with original clues about the mammalian DNA replication program [186, 192, 203, 217, 526, 528–530, 535]. These signal-processing tools have now been accepted as *bona fide* molecular biology protocols [529]. Using a wavelet-based multiscale pattern recognition framework, we described megabase sized replication domain covering about 1/3 of the human genome as N-shaped regions in DNA strand compositional asymmetry (skew) profiles [186, 526, 535]. Determination of genome-wide replication timing profiles [204] provided us with the experimental confirmation of that skew N-domain border are active replication origins [203, 528]. Further multiscale analysis of replication timing profiles lead us (i) to describe replication U-domains that display a characteristic U-shaped replication timing profile as the counter part to skew N-domains [192, 529] and (ii) to compute space-scale maps of effective DNA replication speed [217]. These latter measurements are central to our modeling of DNA replication kinetic in mammalian genome (cf. T3R) [223]. Using PCA, the apparent complexity of a dataset of 13 epigenetic marks was reduced to 4 epigenetic states [231, 232]. Each states correspond to a well defined replication timing window so that the progression of the replication along U-domains corresponds to a directional path across the four chromatin states. These results sheds a new light on the epigenetic regulation of the spatio-temporal replication program in human and provides a framework for further studies in different cell types, in both health and disease. Finally, in a preliminary work using a graph representation of high throughput chromatin conformation capture data, we showed that replication domain borders are hubs of the chromatin conformation interaction network [554, 555].

Microscopy image analysis (PEPS PROMIS, L. Condat, GIPSA-lab, J. Boulanger, Institut Curie) Structured illumination microscopy increases fluorescence microscopy resolution without constraint on protein marking. This modality is based on the acquisition on several low resolution modulated images followed by a post-processing that aims at reconstructing the high resolution image. The first contribution concerns the estimation of the modulation parameters from the low resolution modulated images [570] while the second contribution aims at providing an efficient reconstruction procedure based on non-smooth convex optimization [641]. Such a framework allows us to deal with a variational approach where the data fidelity term and the regularization term are fitted to the degradation model (Poisson noise) and to the data (filaments that models actin and microtubules, spots such as single molecules or vesicles) [553].

Biomedical signal processing

Heart Rate Variability (ANR FETUSES, M. Doret, HCLyon, P. Goncalves, LIP ENS Lyon.) Heart rate variability analysis is revisited using fractal variability, with the aim of assisting obstetricians to perform early detection of fetal acidosis during labor. Fractal attributes have been shown to well characterize intrapartum fetal heart rate and to permit to decrease

False Positive detection rate, hence the number of non necessary operative deliveries (whose consequences are potentially dramatic of the mother and the newborn) [500, 503, 505, 507, 564, 565, 576, 604]. Dynamics in adult baroreflex regulation have also been investigated [516, 577], with notably a methodology for defining a time-frequency coherence function [634].

NeuroSciences (ANR SCHUBERT, P. Ciuciu, N. Zilber, V. Van Hassenove, NeuroSpin, CEA Saclay) Scaling in infraslow brain activity, considered before as noise, is now regarded as crucial. Wavelet Leader based multifractal analysis showed that scaling properties in fMRI data are modulated when subjects achieve tasks [567, 568] and that scaling is affected by multi-sensory perceptual learning [680, 681].

F. *Analyses of social and human activities*

The avalanche of digital data tracing social activities opens the way to combine data analysis and modeling with social science studies.

Human face-to-face interaction network. Using active RFID tag and a dedicated experimental apparatus, data of time-resolved person-to-person interaction networks were collected at conferences, schools, hospital wards to analyze their dynamics [558, 611]. Behavioral characteristics were studied, for instance in a school to quantify interaction between children [662]. To understand how the dynamics of contact networks affect infectious disease propagation, SEIR infection models were run on these networks, showing that the daily durations has to be accounted for [661]. The effect of time ordering of contacts on propagations was studied [536]. Hospital-acquired infections were studied by direct measurement in hospital wards [670]. Finally, having only one realization of these networks, we developed a bootstrapping method using constrained graphs to probe with statistical confidence the behavior of a group in such a network [664, 669].

Social systems and human behaviour

Developing new sociological concepts. (Médialab, Sciences Po, Paris) A naive approach of social systems by physicists would be to start with interacting "social atoms" to probe collective phenomena, "emerging" from the microscopic level. However, for social systems, isolated ("atomic") individuals do not exist. Therefore we argue in [623] that it is more interesting to use "collecting" entities instead of individual and collective levels, and develop this idea through the use of heterogeneous networks.

Scientometrics. This approach is tested on scientometric data (scientific articles). Mapping of scientific institutions was developed [599], for instance for ENSL and CNRS. The interdisciplinary practices of 600 laboratories were studied through their publications [616]. Scientometrics is also useful to study scientific fields, for instance the "complex systems" domain [598], showing that it does not arise from a single universal theory, but from shared computational methods and concepts on self-organization. A study carried out on 7000 CNRS scientists regarding their public engagement activities, was propagated with a Special Issue in *Public Understanding of Science* [537].

Model for conference submission behavior. An empirical study of several datasets has revealed some 'universal' features in the temporal process of electronic submissions to conferences, leading to the proposition of a simple predictive model [580–582].

Collective Free Improvisation offers a situation of human interactions without any *a priori* reference frame. For musical production process, a model and studio experiments were done to gain a better understanding of emerging collective structures [556, 557].

Study of Vélo'v data and transportation. (LIRIS (INSA), LET (Lyon 2), CMW et EVS (ENS Lyon)). From 2008 on, we had access to data about uses of Lyon's Vélo'v system of shared bicycles, the first large scale bike sharing system (BSS) of Europe, and studied the mobility with BSS. In [542, 545], we studied the rhythms of use and statistical model for that. This was combined with spatial analysis of the trips to draw pictures of their use in the city [544, 551]. The data show that bicycles compete with the car in terms of speed in downtown Lyon [619]. The work goes on in a ANR project VEL'INNOV. Other works model part of the use of the system [629], or discuss the need for mapping tools to display the data [647]. Relying on network theory, we exhibited the different rhythms of the stations [635]. Finally, in a paper on spatial networks (such as transportation networks), it was shown that a spatial hierarchy can emerge in network as a large-scale consequence of local cost-benefit considerations [626].

G. *Internet traffic and network*

(K. Fukuda, K. Cho, H. Esaki, R. Fontugne from the NII, IJJ and Univ. Tokyo (Japan), CNRS-JSPS program) Signal processing is a great asset to study the communications over the Internet network (e.g., see the coordinated Special Issue [624]). Accurate host-level traffic classification is made possible by relying on statistical features describing traffic of a host, e.g. from the Multi-Scale Gamma Model [609], or from traffic patterns reminiscent of traffic graphlets [575, 610]. Leveraging on previous works, using sketches and multi-resolution analysis, we prove that long memory is a robust property in traffic, as shown on seven years of collected traffic [546]. We re-investigated the relationship between long memory (modeled as self-similarity) and heavy-tailness of flows, theoretically (Taqqu's theorem) [508], also questioning the respective roles of the flow and session levels [644], and experimentally on a grid [625], proving that long memory is a stable feature of Internet traffic (vulgarisation article in [502]). Finally, lacking methods to characterize and benchmark anomaly detectors, we used graph analyses to compare them, and we validated that by annotating the anomalies in the MAWI traffic database [590, 591].

Infophysics, Signal and Systems: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
F. Angelleti	Corrélations et événements extrêmes en physique statistique et traitement du signal	06 dec. 2012	E. Bertin, P. Abry
S. Grauwin	Exploring Social Phenomena with Complex Systems Tools	01 jul. 2011	P. Jensen
N. Mallick	Invariances d'échelle dans la fracture des matériaux fragiles désordonnées	26 feb. 2010	S. Roux, L. Vanel

Main contracts

1 european: DYNANETS
6 ANR: FETUSES, AMATIS, REFOPOL, StaRAC, ASTRES, Vel'Innov
Companies: AID Observatoire

Editorial responsabilities

Abry Patrice
IEEE Transactions on Signal Processing, Member of the editorial committee 2009.
IEEE Signal Processing Society and Method committee, 2004-2010 & 2014-.
Arneodo Alain
The European Physical Journal B, Member of the editorial committee.
International Journal of Fractals, Member of the editorial committee.
International Journal of Bifurcation and Chaos, Member of the editorial committee.
Signal Processing, Member of the editorial committee.
Journal of Difference Equations & Applications, Member of the editorial committee.
Applied and Comp. Harmonic Analysis, Member of the editorial committee.
Borgnat Pierre
Traitement du Signal, Member of the editorial committee.
Telecommunication Systems, Editor for one volume.
Flandrin Patrick
IEEE Transactions on Signal Proc., Member of the editorial committee (09-11).
Applied and Computational Harmonic Analysis, Member of the editorial committee.
Journal of Fourier Analysis and Applications, Member of the editorial committee.
Advances in Adaptive Data Analysis, Member of the editorial committee.
EURASIP Journal of Applied Signal Processing, Editor of the volume "Recent Advances in Theory and Methods of Nonstationary Signal Processing" (2011).
IEEE Signal Processing Magazine, Editor of the volume "Time-Frequency Analysis and Applications" (2013).
IEEE Signal Processing Magazine, Member of the editorial committee.

Organized conferences

Abry Patrice.
Multifractal Analysis: From Theory to Applications and Back, Banff (Canada), February 2014
Borgnat Pierre.
Graphical models for the charact. of information flow in complex networks, Grenoble (France), Juil. 2013
Journées SIERRA : Signal et Images En Région Rhône Alpes, (France), 4 journées par an depuis 2012
Flandrin Patrick.
4ème à 9ème École d'Été en Traitement du Signal et des Images, Peyresq (France), July 2009 à 2014
Jensen Pablo.
Réseaux sociaux : des structures à la politique, Lyon (France), November 2011
Penser les transformations, Lyon (France), November 2012
La politique des données personnelles : big data ou contrôle individuel ?, Lyon (France), Décembre 2013
Le tout et les parties, Sciences Po, Paris (France), May 2013
La gouvernance et la révolution numérique, Lyon (France), April 2014

93 publications in RICL and 89 proceedings of conferences: see T6B

T7R. Statistical Physics: *Report*

Permanent Members: A. Alastuey, D. Bartolo, L. Bellon, E. Bertin, F. Bouchet, S. Ciliberto, T. Dauxois, A. Fedorenko, K. Gawedzki, J.C. Geminard, P. Holdsworth, P. Jensen, S. Joubaud, A. Naert, A. Petrosyan, M. Peyrard, S. Santucci, A. Steinberger, A. Venaille.

Post-docts: G. Chevereau, H. Jacquin, J. Laurie, R. Lemoy, R. Planet

PhD students: A. Bricard, A. Berut, A. Caussarieu, J.B. Caussin, M. Champion, J.Y. Chastaing, X. Clotet, M. Corvellec, R. Gomez-Solano, V. Kaiser, R. Lemoy, D. Lopes Cardozo, C. Nardini

By vocation and design our laboratory covers a vast range of research topics. Statistical mechanics has traditionally been the cornerstone of this diversity, providing connecting links across the board, from mathematical and high energy physics, to hard and soft condensed matter, to applications in biology, geology, astrophysics, turbulence and complex systems applied to the macroscopic world. The present five year report is no exception, as we present a large array of research themes where strong fluctuations, confinement, disorder and absence of controlled equilibrium were key elements, providing exciting challenges for those seeking a statistical description. The laboratory made important theoretical contributions to the theory of active particles in these five years. A new theme is that of their experimental study, developed for the first time through a new protocol to motorize colloidal beads. This experimental simulator of active dynamics is providing an important link between numerical and theoretical work and biological systems driven by collective dynamics. Conversely, long-range interactions continue to be an active and innovative field of study in which the laboratory has played a leading role, as witnessed by the extensive reviews and text book produced during the report period. Applications from both the macroscopic and microscopic world include gravitating systems, hydrodynamic flow and Coulombic systems driven out of equilibrium by an applied field. Statistical approaches to disordered systems and non-equilibrium phenomena appear in projects from condensed matter to avalanche dynamics and the overlap in techniques used here and in statistical descriptions of turbulence is striking. In the search for effective thermodynamic descriptions of model driven systems progress was made in understanding how effective temperatures can depend on observables. The scope of effective thermodynamics is pushed still further in this report, with the development of analogies for free energy and intensive control parameters such as chemical potential in the study of social networks. Pinning centers are shown to play a key role in the non-linear physics of disordered systems, leading to multi fractal statistics in flux lattices, and intermittent dynamics for domain walls and interfaces strongly reminiscent of those observed in turbulent flow. Fluctuation theorems have underlaid much recent progress in stochastic thermodynamics, providing a vital link between equilibrium and non-equilibrium problems. Below we report spectacular results from both theoretical and experimental studies. In particular it was shown that a particle evolving out of equilibrium with Lagrangian dynamics appears to obey detailed balance when viewed from its Lagrangian reference frame, while in a ground breaking experiment, Landauer's bound on available work extracted from a two level system was confirmed using colloidal particles in a double well potential. This experiment, considered one of the ten most important results of 2012 by Physics World was extended to show the connection between the Landauer bound and Jarzynski's equality. The proposed projects maintain this wide range of themes. Projects include developments of existing research as well as new ventures such as "confinement and fluctuations" and "modeling social systems", or "large deviations and computation of rare events for turbulent flows related to climate dynamics and solar system dynamics", providing a bright future for this eclectic domain of research.

A. *Active particles*

Physicists have been looking for a unified framework to account for collective motion as observed in a number of animal groups for almost 20 years. We made significant contributions to this vivid field. From a theoretical perspective, flocking can be considered as a nonequilibrium phase transition in an assembly of self-propelled, or active, particles. We introduced an effective kinetic-theory framework to model assemblies of motile individuals and account for their large-scale behavior [693]. Starting from a prototypical microscopic model of pointwise motile particles interacting via binary collisions that promote either polar or nematic alignment, we established continuous equations for the density and the orientational order fields [691, 693, 760]. Motivated by recent observations on birds flocks, the case of interactions between topological neighbors defined by a Voronoi tesselation has also been successfully considered [762]. In agreement with numerical simulations of agent-based model, these non-linear equations correctly capture all the salient features of polar and nematic active matter. Among other results we analytically demonstrated that ensembles of self-propelled particle that align with their (metric) neighbors support non-linear excitations in the form of band-like swarms responsible for the first order nature of the transition toward collective motion [111].

From an experimental perspective, we took advantage of an overlooked electrohydrodynamic instability to motorize colloidal beads, which we turned into self-propelled rollers [111]. This unique system makes it possible to handle and visualize pop-

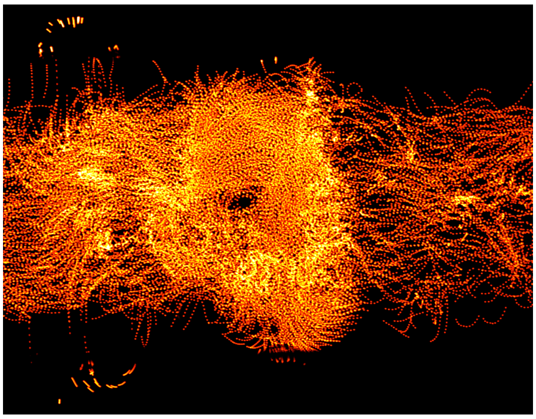

Figure 23: Collision between two herds of colloidal rollers propelling along opposite directions in a microfludic channel. Superimposed pictures. Colloid diameter: 5 μm. Duration of the collision 0.1 s.

ulations of millions of colloids on a single microfluidic chip (Fig. 23). Combining experiments and theory we demonstrated that the short-range hydrodynamic couplings between the rollers result in effective velocity-alignment interactions, and revealed the first homogeneous polar-liquid phase of synthetic active matter (ANR Mitra, collaboration Gulliver ESPCI).

B. *Systems with long range interactions*

(ANR LORIS (S. Ruffo), IUF, EPSRCF with Max Planck and UCL London). For systems with long-range interactions, the two-body potential decays at large distances as $V(r) \sim 1/r^\alpha$, with $\alpha \leq d$, where d is the space dimension. Examples are: gravitational systems, two-dimensional hydrodynamics, two-dimensional elasticity, charged and dipolar systems. Although such systems can be made extensive, they are intrinsically non additive: the sum of the energies of macroscopic subsystems is not equal to the energy of the whole system. Moreover, the space of accessible macroscopic thermodynamic parameters might be non convex. The violation of these two basic properties of the thermodynamics of short-range systems is at the origin of ensemble inequivalence.

We have presented a comprehensive review [708], and more recently a book, on the recent advances on the statistical mechanics and out-of-equilibrium dynamics of solvable systems with long-range interactions. It consists in the detailed presentation of the concept of ensemble inequivalence, as exemplified by the exact solution, in the microcanonical and canonical ensembles, of mean-field type models.

Gravitational interactions were studied for hard spheres within a stationary state described by the microcanonical ensemble. Introducing a new scaling limit, we showed that the system locally thermalize spontaneously as a consequence of both extensive properties and smallness of fluctuations. The derivation sheds light on the mechanisms which ensure that local equilibrium in infinite systems is entirely controlled by hard-core interactions, while gravitational interactions can be treated at the mean-field level.

Generalizations to models [720] with both short and long-range interactions, and to models with weakly decaying interactions [684], show the robustness of the effects obtained for mean-field models. We have also studied [753] needle-shaped three-dimensional classical spin systems with purely dipolar interactions in the microcanonical ensemble. We have observed and analytically explained spontaneous magnetization for different finite cubic lattices and first order transition from paramagnetic to ferromagnetic phases. Long-range interacting systems display an extremely slow relaxation towards thermodynamic equilibrium and, what is more striking, the convergence towards quasi-stationary states. The study of the effect of noise on this kind of systems is very important but is only at its infancy. We have studied long-range interacting systems driven by external stochastic forces [756] that act collectively on all the particles constituting the system, showing that it reaches a stationary state where external forces balance dissipation on average. These states have an invariant probability that does not respect detailed balance, and are characterized by non-vanishing currents of conserved quantities.

In weak electrolytes in moderate to high electric fields, deviations from Ohm's law can be cast in a universal form using Onsager's celebrated theory of the second Wien effect. This theory has been applied to a wide variety of scenarios, including photocurrents in solar cells, proton transport in water ice, and magnetic monopoles in spin ice (see Condensed Matter Emergence and Topology). The Wien effect was recently simulated for the first time using a lattice electrolyte [742]. The simulations provide direct access to the correlations and hierarchy of time and length scales driving the phenomenon in a simple model system.

C. *Model systems, disorder, and pinning*

Non-equilibrium and disordered systems are on the new frontiers of statistical physics and have important applications. The laboratory is strongly involved in developments based both on models systems that can be studied in depth and on experiments carried in parallel with theoretical analysis.

Among non-equilibrium systems, stationary states are the simplest. They allow us to revise basic concepts. When temperature is defined through fluctuation-dissipation theorems it may depend on the observable. We have related this to the non-uniformity of the phase space distribution [752].

We analyzed dissipation-induced non-Gaussian energy fluctuations and were able to equate the non-Gaussian order parameter fluctuations in model equilibrium systems at criticality with energy fluctuations in dissipative systems if there is macroscopic energy transfer from large to small scales [695].

Disordered systems have numerous applications from domain walls in ferromagnets to liquid crystals. Open questions concern their equilibrium structure, their aging and long term evolution. A key observable in diffraction experiments is the translational correlation function which was so far known only within a Gaussian approximation. To go beyond this, we developed a new method based on functional determinants and functional renormalization group [724]. We discovered multifractal structures in the Bragg glass made by the Abrikosov lattice in disordered superconductors and studied the surface scaling behavior [447]. The method allowed us to compute some class of diagrams which appear in the perturbative determination of Konishi amplitudes and thus brings together three different physical communities working on superconductors, multifractality and AdS/CFT.

Time dependence was studied for trapped electrons in resistive switching phenomenon in MgO-based tunnel junctions. Including the statistical distribution of the trap potential barrier heights leads to a power-law resistance as a function of time, under a constant bias voltage, in accordance with experiments [694].

When submitted to slow external driving, out-of-equilibrium heterogeneous systems respond by a complex intermittent dynamics, in the form of collective excitations or avalanches with scaling properties analogous to the ones observed close to critical phase transition. This occurs for a large variety of systems and length scales, from a few nanometers during the jerky motion of domain walls in magnetic systems, up to the geological scale during the fault dynamics for earthquakes. We studied the spatiotemporal dynamics of interfaces driven through random media, focusing our attention on the slow crack front propagation along a weak heterogeneous interface and on the imbibition dynamics of a fluid front slowly invading a laboratory model of an open fracture of variable aperture (Fig. 24). In both cases, with our high-resolution experiments, we characterized both the self-affine morphology [767] and the intermittent dynamics of these interfaces [763, 769]. We demonstrated that their propagation results from localized bursts that fulfill scaling relations expected close to critical depinning transition [745]. We have shown that the fluctuations of the global front velocity $V_l(t)$ spatially averaged at scale l follow asymmetric non-Gaussian distributions, either due to finite-size effects and long range spatial correlations [763], or to the diverging variance of the underlying local front velocity distribution [769]. We have also exhibited a broken time-reversal symmetry in the avalanche dynamics, which emerges from the local nature of the interaction kernel mediating the avalanche dynamics [744].

At the mesoscale friction occurs through the breaking and formation of local contacts. We showed that this phenomenon can be described by a master equation [704]. We examined the effect of temperature and aging of the contacts by replacing individual contacts by "macro-contacts" which describe collective effects. Their aging leads to the Gutenberg-Richter law, which relates the probability of occurrence of earthquakes to their magnitude [706].

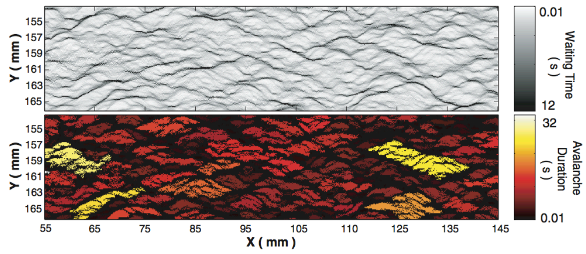

Figure 24: Top: Waiting time fluctuations of an oil/air interface slowly invading a model disordered medium (Hele-Shaw cell with a fluctuating gap spacing) obtained by the superposition of 10^4 interfaces for a forced-flow experiment performed at V = 0.134 mm/s. Bottom: corresponding spatial distribution and duration of avalanches.

A model for electrical conduction has been considered. The exact solution of the corresponding Boltzmann equation in an external accelerating field provides useful insights on out-of-equilibrium stationary states. For a strong applied external field, the stationary conduction state is far from equilibrium, so the conductivity is no longer given by linear response theory. Nevertheless, the diffusion coefficient is still related to the velocity correlations through a Kubo-like formula, while the relaxation processes are governed by hydrodynamic modes similarly to the close to thermodynamical equilibrium case [682].

D. Statistical mechanics and turbulence

(ANR Statocean, with LEGI and LPO. ANR Stosymap, with Polytechnique, Cergy and ENS-Cachan). Several researchers have independently studied aspects of two dimensional turbulence through statistical mechanics approaches. A first work related to cascades on the hyperbolic plane is described in section IV T1R C. Another project concerns the connection between the statistical physics of disordered systems and turbulence. We applied a version of functional renormalization group (FRG) originally developed for disordered systems to decaying Burgers turbulence and then generalized it to study the Navier-Stokes equation [725]. We solved numerically the FRG flow equation for the decaying 2D Navier-Stokes turbulence. We found an inverse cascade with explicit results both for large and small distances in agreement with the Batchelor scaling. Finally several works were led in the framework of the equilibrium statistical mechanics of two dimensional and geophysical flows [13], as described further below.

Several studies dealt with the theoretical bases (properties of the invariant measures, generic properties of phase diagram) of the equilibrium statistical mechanics of two-dimensional and geostrophic turbulence. Monte Carlo simulations, based on the Creutz algorithm, have also been designed, allowing the prediction of a phase transitions. The equilibrium statistical mechanics has also been extended to the three dimensional axisymmetric Euler equations [770].

An emphasize has also been put on the development of large deviation theory in order to describe the dynamical properties of phase transitions in turbulent flows. A first work described large deviations in dynamical systems with a connected set of attractors, as is the case for the two-dimensional Euler equations and the quasi-geostrophic dynamics.

E. *Complex systems*

In a famous model in the literature of social modeling, Thomas Schelling showed that the relationship between agents' individual characteristics (micro level) and global states of the system (macro level) is far from trivial. Using the tools of statistical physics [732, 733], we could link analytically the two levels, extending the notion of free energy to systems driven by individual dynamics. We have then studied in which systems this extension of the free energy was possible [734]. The interest of this approach lies on the one hand on the possibility to easily describe segregation through standard methods used in the context of phase separation, and on the other hand in the connection it brings between socio-economic modeling and statistical physics tools like the free-energy. Going further in this direction, we managed to connect the socio-economic concept of utility to the thermodynamic concept of chemical potential [748]. Other directions have also been explored in the context of simple models of social systems studied through statistical physics methods, like the location of retail stores [622], opinion models [735], dynamical decision models [743] or urban housing markets [747].

F. *Stochastic thermodynamics and fluctuation theorems*

We have studied both experimentally and theoretically the problem of the thermodynamics of small out of equilibrium systems where fluctuations cannot be neglected. We have considered systems slowly evolving toward equilibrium and systems driven by external forces. The instrumentation to perform these experiments has been designed and mounted in our laboratory and the main features are described in T8R

Two review papers on the fluctuation theorem [714, 717] and a book chapter [746] discuss our results of the injected and dissipated power on an harmonic oscillator coupled with an heat bath. We have also studied the power fluctuations produced by an oscillating field applied to Liquid Crystals close to the Freedericksz transition [739]. This is an interesting example of a spatially extended system in which only a fluctuating macroscopic variable is measured. Recently we have established both theoretically and experimentally a new formulation for the heat flux produced by fluctuations in an electric system coupled with two thermal baths. This work has given the first experimental evidence of this kind of flux [715, 716].

In work on the Fluctuation Dissipation Theorem (FDT) it was shown [713] that non-equilibrium Langevin dynamics respects detailed balance when viewed in the Lagrangian frame of its mean local velocity rather than in the laboratory frame. This explained the relation between measurements [729] in both frames for a driven colloidal particle. In the context of a colloidal particle driven out of equilibrium we have experimentally verified other formulations of FDT in out of equilibrium [730, 731].

FDT has been also studied in relaxing gels both after mixing [738] and after a temperature quench [728]. In the last case we have shown the connection between heat flux in the systems and the violation of the equilibrium formulation of FDT. These questions have been experimentally analyzed in the context of a quench at a critical point [740] where the critical slowing down induces an extremely slow relaxation towards equilibrium, making the dynamics very similar to aging of amorphous materials.

It has been shown that the Landauer bound can be experimentally reached in an erasure procedure performed using a colloidal particle in a double well potential [697]. We have also shown the strong relationship between the Landauer's bound and the Jarzynski equality applied to this process [696].

In optimization studies following from the above, the least dissipative finite-time protocol for the memory erasure was found using the Monge-Kantorovich optimal mass transport as a special case of the finite-time refinement of the 2nd Law of Stochastic Thermodynamics established in [683] and reviewed in the wider context of fluctuation relations in not yet published lecture notes.

Some experiments have been built that allow measurements on granular gases, as examples of macroscopic dissipative thermostats. Parallels are drawn with usual statistical mechanics, by verifying some exact results out of their range of validity: in dissipative systems, where $kT_{\text{eff.}} \sim 10^{-7}$ J, and far from the thermodynamic limit.
– The FDT and the Gallavotti-Cohen Fluctuation Theorem have been shown to coincide with a harmonic oscillator coupled with this reservoir [755].
–Fluctuation relations hold for an asymmetric rotor experiment in a granular gas even if the angular velocity distribution of the rotor is double-peaked due to a symmetry breaking in the granular gas [741].
– The Hatano-Sasa relation that generalises Clausius inequality has been verified with a very high precision [754] in transitions between several states.
– The transport between two such systems at distinct $T_{\text{eff.}}$ is studied. It shows very specific intermittent and asymmetric statistics for the fluctuations. This asymmetry reveals the irreversibility of transport, and verifies the Gallavotti-Cohen relation for the first time between macroscopic dissipative systems far from the thermodynamic limit.

Statistical Physics: *Indicators*

Defended PhD Thesis

NOM	Titre	Date	Encadrants
A. Bricard	Émergence de mouvements collectifs dans des populations de colloïdes autopropulsés	01 jul. 2014	D. Bartolo
A. Caussarieu	Fluctuations dans les systèmes critiques	12 dec. 2012	S. Ciliberto
X. Clotet	Imbibition in a model open fracture. Capillary rise, kinetic roughening, and intermittent avalanche dynamics	11 jul. 2014	S. Santucci
M. Corvellec	Ecoulements turbulents 2D et géophysique	10 jan. 2012	F. Bouchet
J.-R. Gomez-Solano	Fluctuations hors-équilibre d'une particule Brownienne	08 nov. 2011	S. Ciliberto, A. Petrosyan
R. Lemoy	The City as a Complex System Statistical Physics and Agent-Based Simulations on Urban Models	06 oct. 2011	P. Jensen, C. Raux
C. Nardini	Energy landscape, equilibrium and out-of-equilibrium physics of long and short-range interacting systems	22 fev. 2013	T. Dauxois, L. Casetti

Main contracts

2 european: OutEFLUCOP (50%), TRANSITION (50%)
3 ANR: DYCOACT, STATOCEAN, LORIS
Companies: AXA

Editorial responsabilities

Alastuey Angel
Journal of Statistical Mechanics, Member of the editorial committee.
Bouchet Freddy
Journal of Statistical Mechanics, Member of the editorial committee.
Ciliberto Sergio
Journal of Statistical Mechanics, Member of the editorial committee.
Dauxois Thierry
Journal of Statistical Mechanics, Editor of "Long-range interactions".
Gawędzki Krzysztof
Journal of Statistical Physics, Member of the editorial committee.
Peyrard Michel
Nonlinearity, Member of the editorial committee.

Organized conferences

Bartolo Denis.
Flowing Soft Matter: Bridging the gap between stat. phys. and fluid mech. Udine (Italy), July 2014
Bellon Ludovic, Dauxois Thierry, Joubaud Sylvain, Santucci Stéphane. *Out-of-equilibrium physics and its applications*, Lyon (France), June 2013
Bertin Eric.
Physique statistique des particules actives, Lyon (France), May 2012
Bouchet Freddy.
Computation of transition trajectories and rare events in non-equilibrium systems, Lyon (France), June 2012
Ciliberto Sergio, Abry Patrice, Audit Benjamin, Manneville Sébastien, Roux Stéphane
International Conference on Complexity in Physics, Lyon (France), June 2009
Dauxois Thierry.
Long-Range Interacting Systems, Lyon (France), October 2011
International School on Nonlinear Dynamics in Complex Systems, Yaoundé (Cameroon), November 2011
Equilibrium and out-of-equilibrium properties of systems with long-range int., Lyon (France), August 2012
Statistical mechanics of self-gravitating particles, Fondation les Treilles (France), October 2012
Santucci Stéphane.
Avalanches and Intermittency, Courmayeur (Italy), January 2014

91 publications in RICL: see T7B

T8R. Instrumentation and imaging: *Report*

Permanent Members: F. Argoul, L. Bellon, V. Bergeron, F. Chillà, S. Ciliberto, S. Manneville, A. Naert, A. Petrosyan, J.-F. Pinton, N. Plihon, A. Pumir, N. Pustelnik, S. Santucci, A. Steinberger, R. Volk

Our laboratory has a strong tradition in developing new instrumentations combined with specific signal or image analysis including theoretical developments. This activity covers many fields in physics, from atomic force microscopy to acoustical or optical imaging in complex flows. Several results described in the other sections have been obtained because of the good performance of the instruments designed in the laboratory. It is important to stress that these technical developments are only possible thanks to the excellent competence of the staff working in the mechanical shop of the ENSL and in the electronic shop of the laboratory. In this section we describe several instruments and imaging techniques, which have been either developed or improved in the last five years and which have played an important role for getting new scientific results. Note that several technological developments have led to patents and industrial contracts.

A. *Imaging*

Ultrasonic imaging coupled to rheometry (ERC USOFT): We developed an ultrafast ultrasonic scanner to image the deformation and flow of complex fluids sheared within concentric cylinder geometries of gap widths 1 to 5 mm. This scanner is coupled to a commercial rheometer so that the technique records simultaneously standard spatially-averaged rheological data and the local flow field with a spatial resolution of 50-100 microns and frame rates of up to 20,000 fps [776].

High resolution surface plasmon microscopy (ANR EMMA): Two Scanning Surface Plasmon Microscopes (SSPM) have been constructed, which can be operated in linear, radial and azimuthal polarizations. The first SSPM includes a fibered heterodyne interferometer [773], compacted inside a close box, coupled to an inverted microscope (fluorescence imaging) on which we have also installed an atomic force microscope head. The second SSPM operates at two wavelengths, namely 633 nm and 1500 nm, with two separate laser paths aligned on the imaging plane of a high aperture objective lens, it includes two distinct heterodyne interferometers. For both these systems we have also implemented a 3D adaptive scanning software that compensates the sample tilt and improves their sensitivity to nanoscale objects [774].

Fast imaging techniques for particle tracking in complex flows (ANR LTIF, LMFA/OCA/LEGI): We developed a technique to track simultaneously the position and orientation of painted particles in turbulent flows [789]. Recording images of particles with two independent views, and comparing images to a collection of synthetic images, this technique allows for a 6 dimensional tracking of spheres larger than 5 mm with resolution 7,000 fps at high Reynolds numbers.

Fast image acquisition for trapped particle tracking: We developed a fast image acquisition and processing program based on Labview and C++. The program allows us to follow the trapped particles x and y positions in real time at 1600 fps with a spatial resolution about of few nanometers (nm).

Creation of multiple traps with holographic techniques: We developed Labview programs to create phase patterns (holograms) on a spatial light modulator. In this multi tweezers we are using an infrared laser which is more suitable biological objects.

3D structure of liquid foam (PSI - SLS (Switzerland), LPMC, IPR): We have developed a new fully-automated method for segmenting and labelling the void space in cellular materials, and applied it successfully to reconstruct the 3D structure of liquid foams imaged by X-ray tomography [778].

Compressed sensing for tomography (TOTAL/IMS-IMB Bordeaux): Considering sparse data, the compressed sensing proposes a theoretical framework allowing to acquire less data with similar reconstruction performance. In a tomography framework it leads to the reduction of the view number. We have developed an efficient greedy algorithm that provides an upper bound of the maximal sparsity for which a given measurement matrix allows exact reconstruction through a ℓ_1-minimization [775].

B. *Instrumentation*

Atomic Force Microscopy (AFM) with ultra-high force resolution (ERC OutEFLUCOP): Our home built AFM [781] is constantly upgraded to maintain a cutting edge force resolution to probe nanomechanics and thermal fluctuations. In its current design, the spectral resolution in the measurement of the cantilever deflection is of the order of a few $\mathrm{fm}/\sqrt{\mathrm{Hz}}$ from 1 Hz to 1 MHz, a world leading result. Moreover, thanks to the quadrature phase interferometric approach, this resolution is constant on a few μm input range, giving this single instrument a 9 orders of magnitude dynamics. This AFM has been duplicated so as to operate in a variety of environments: controlled atmosphere, regulated temperature ($[15-120]$°C). Its unique characteristics have been used to demonstrate a precise calibration of AFM cantilevers through a mapping of the spatial distribution of the thermal noise on standard [782] or functionnalized [777] cantilevers. In recent developments, such a functionnalization replaces the tip by a cylindrical probe of a few μm in diameter and a hundred of μm long. This probe can be partially dipped in a fluid to perform microrheology measurements (including in opaque liquids), as well as interfacial mechanics and wetting measurements.

Holographic/dynamic multiple tweezers: We have developed and constructed a two-in-one switchable multi tweezers that combine fast scanning optical tweezers based on an acousto-optic deflector (AOD) and holographic optical tweezers. The AOD can scan the laser beam very fast. It allows to modulate or change the traps position at about 100 kHz rate. Moreover, with holographic optical tweezers, which are much slower ($\sim$ 20 Hz) to use for measurements of dynamics, we can create the controllable 3D static traps with different shapes. In order to create a given pattern on the focal plane of the focusing objective we are using a commercial SLM from Hamamatsu.

Two beam optical tweezer with large dynamic range: We developed and made a versatile modular multi tweezers based on visible laser with wavelength 532 nm. In that model we use two spatially separated orthogonally polarized beams. Having two separated beams is important for the measurements correlation. We can easily implement an AOD or a beam shaping optics. We can do the particle position tracking with a fast camera or with a position sensitive detector.

FractoLuminescence - when fractures dazzle particle detectors (SNOLAB Queen's (Canada), ILM, MATEIS): The quest for ultra-rare particle events demands the most rigorous exclusion of background noise in detectors. However, we have shown that fractures due to mechanical stresses occurring in scintillator crystals – used as particle detectors – could produce enough light to reduce their sensitivity [786]. We have built a specific device to compress scintillator crystals up to failure, and simultaneously measure light and acoustic emissions at a very high frequency (streaming at 2MHz for several hours). Using radioactive sources, we were able to accurately calibrate the energy emitted by the scintillator and quantify the fraction of elastic energy converted into light during the fracturing process.

Joint heat flux-velocity probe for turbulent flows (EuHit WP 21: Ins. Neel, IMUST Denvib: Cethil): The understanding of turbulent thermal convection currently lacks local experimental heat flux data. In particular, the turbulent contribution to the advected heat flux is unknown. It requires a joint measurement of local velocity and temperature, which is a challenge for the experimentalist. We investigate a novel kind of sensor, based on state-of-the-art silicon microtechology, to make this type of measurement possible. The new probe is a micromachined 1.2 micron-thick 375 x 50 microns cantilever. The elongation induced by the flow velocity is measured with a strain gauge patterned in a thin nickel-chrome layer sputtered on the beam. This gives access to a signed local velocity component. A thin thermometric layer is sputtered on the tip of the beam to get the local temperature at the same position.

Acceleration measurements using instrumented particles (FUI PATVAX, Sanofi/Merial/Leti/smartINST/Cyberstar): Smart particles are instrumented device whose role is to gather measurements in the Lagrangien reference frame. For an industrial partner FUI PATVAX, we developed new sensors for conductivity and reflectance measurements with low consumption. These devices can be mounted in smart particles currently used for industrial applications. We also tested acceleration measurements against position-angle tracking with cameras, and found new estimators for acceleration moments and correlations that are insensitive to the rotation of the particle [787, 788].

Velocimetry in electrically conducting fluids (ANR VKS): Usual water flow measurement techniques are usually restricted to media transparent to optical wavelengths and thus do not apply in opaque liquid metals which require very specific techniques.
- *Potential probes in highly turbulent flows (PICS ICMM):* The method relies on linking the potential difference measured between two electrodes to the local velocity field characteristics in presence of a permanent magnetic field. We developed a miniature potential probe allowing to probe fast dynamics of a spin-down flow driven inside a torus filled with liquid gallium [780], not accessible with usual methods in a water prototype.
- *Magnetohydrodynamic turbulent electromotive force:* The development of a 3-dimensional potential probe coupled with magnetic field measurements allowed for the first measurement of the turbulent electromotive force in regimes of interest for astrophysical modeling of the dynamo instability [784].
- *A new concept: the magnetic distortion probe*: We developed a new local velocity measurement method based on the interpretation of the magnetic induction from a conducting fluid flow in the presence of a localized magnetic field [779] (Fig. 25). This work led to the patent [FR10 54250] and several industrial actors showed a strong interest in the technology.

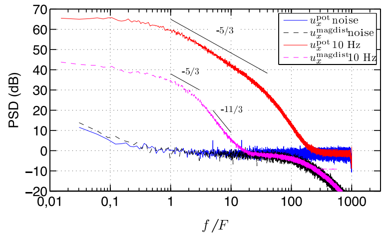

Figure 25: Turbulent spectra of velocities measured with a reference potential probe and the newly-developed magnetic distorsion probe in a liquid gallium flow.

Physics of the violin (C. Macabrey): To characterize a musical instrument of the family of the violin (viola, cello, etc.), it must be submitted to a perturbation that does not affect bridge and strings. The important point is that these last elements have a strong but irrelevant response. A system has been developed that measures the response to a broadband perturbation [patent FR12 60891]. The response function is very sensitive with a high signal to noise ratio. This might become very helpful for the stringed-instrument maker, in repair as well as construction. It can also be used to artificially play the instrument, and improve its quality this way.

17 publications in RICL: see T8B

V. STRATÉGIE ET PERSPECTIVES SCIENTIFIQUES DE L'UNITÉ

Comme cela est expressément demandé par le HCERES, la partie perspective de ce rapport commence par une auto-évaluation des activités passées, en terme de Forces, Faiblesses, Opportunités et Risques (FFOR ou SWOT en anglais). Vient ensuite une présentation de la stratégie et des perspectives scientifiques que le personnel de l'unité envisage de mettre en oeuvre dans l'avenir.

A. Auto-évaluation

Forces *(éléments internes qui soutiennent la stratégie scientifique)*

- Qualité, quantité et impact des publications dans les disciplines de référence et leurs applications.
- Complémentarité des profils chercheurs en terme de sujets de recherche, d'approches et de méthodologies.
- Interaction expérience-théorie au sein du même laboratoire.
- Fort taux de succès aux appels à projet.
- Très forte attractivité en termes de (post-)doctorants ou de candidats et lauréats aux concours CNRS.
- Symbiose entre recherche et enseignement permettant d'attirer d'excellents étudiants en stage/doctorat.
- Services communs très compétents et dynamiques.
- Dynamique collective propice à la maturation de projets et à la prise d'indépendance des juniors.
- Echanges importants entre enseignants et chercheurs

Faiblesses *(éléments internes qui pourraient fragiliser la stratégie scientifique ou les perspectives)*

- Exiguïté extrême des locaux gênant le développement du laboratoire malgré sa forte attractivité.
- Difficultés persistantes des promotions pour le personnel technique.
- Perspectives de promotions difficiles pour les maîtres de conférences.
- Effritement des dotations annuelles indispensables pour le fonctionnement du laboratoire.

Risques *(éléments externes de nature à contrarier la stratégie scientifique)*

- Coloriage plus étroit des appels à projets ANR
- Difficulté à recruter des chercheurs CNRS hors de l'INP alors que nos thématiques vont bien au delà.
- Complexification de la gestion financière avec la multiplication des sources de financement.
- Multiplication des appels à projets conduisant à une explosion du temps consacré à les rédiger/évaluer.
- Explosion des tâches administratives.

Opportunités *(éléments externes de nature à faciliter la stratégie scientifique ou améliorer les perspectives)*

- Perspectives pour 2017 d'obtention d'espaces supplémentaires permettant de désengorger les locaux.
- Multiplication des sources de financement.
- Relations étroites avec les laboratoires de Lyon en physique et dans d'autres disciplines sur Gerland.
- Réseau très dense de collaborations européennes et internationales.
- Salle blanche et MEB, sources potentielles d'interactions fortes avec les laboratoires de chimie et géologie.
- Interactions avec des partenaires industriels, notamment du tissu lyonnais.

B. Stratégie scientifique

Dans les années qui viennent, le laboratoire estime avoir les moyens de poursuivre ses activités scientifiques au plus haut niveau international. Les éléments du rapport d'activité sur les cinq dernières années nous incitent évidemment à l'optimisme. Cependant, il est du devoir de la direction d'anticiper pour prévenir les risques et offrir des conditions de travail optimales pour le développement des projets des membres actuels du laboratoire, tout en exploitant les opportunités d'étendre les activités. Amélioration des conditions de travail, incitation à la prise de risques et exploitation des opportunités sont donc les trois axes de notre stratégie scientifique. Ceci est d'autant plus important que le laboratoire a désormais atteint une certaine maturité et que, dans la situation actuelle, on peut anticiper une croissance ralentie à cause des contraintes immobilières et budgétaires. Nous sommes aussi convaincus que contrôler la taille en moyens humains du laboratoire est essentiel pour préserver la dynamique collective.

L'obtention de nouveaux espaces de travail est un élément clé pour atteindre les objectifs élevés qui sont les nôtres. Les limites sont largement dépassées dans les locaux actuels. Les mezzanines accueillant les (post-)doctorants sont trop nombreuses et trop denses: nuisances sonores, chaleur due aux nombreux ordinateurs de bureaux ou pilotant les expériences, sans même évoquer les risques laser, sont vraiment problématiques. Le fait que nous soyons également obligés de regrouper plus de quatre doctorants théoriciens dans le même bureau gêne les discussions entre eux ou avec leurs encadrants. C'est une solution acceptable de manière temporaire mais il est urgent de trouver une alternative pour pouvoir à nouveau offrir des bureaux aux visiteurs et aux stagiaires, sans que cela soit un casse-tête permanent. La perspective d'obtenir des locaux supplémentaires en 2017 est de nature à nous rendre optimistes, même si l'échéance semble perpétuellement repoussée. Cela permettra une réorganisation cohérente des activités, tout en permettant de réintroduire quelques espaces de discussion supplémentaires à l'intérieur du laboratoire, des éléments précieux pour une véritable dynamique collective.

Notre capacité à financer nos projets sera, dans un environnement compétitif, un élément décisif du futur. Pour notre laboratoire, la situation financière actuelle est florissante, dans une large mesure grâce au taux de succès aux appels à projets de l'ANR ou de l'ERC. Dans une période *a priori* moins favorable dans les années qui viennent au niveau de l'ANR étant donnés le coloriage plus fort des appels à projets et une somme globale inférieure, nous aurons à poursuivre notre quête de financement au niveau européen. Un défi que nous avons les moyens de relever avec plusieurs projets de recherche indéniablement ambitieux et novateurs. En la matière, la direction continuera à inciter, à encourager et à aider les chercheurs en mesure de déposer des projets.

Préserver la liberté de recherche est bien sûr aussi notre devoir, afin de préparer les projets phares de demain. Il est de notre responsabilité d'offrir des conditions d'accueil et de soutien favorables au développement de thématiques à potentiel et à la gestation d'idées nouvelles. Le soutien à tous les chercheurs sera amplifié: le BQR interne, le soutien plus conséquent pour des projets collaboratifs et l'importante marge de manœuvre que permettent les overheads des ERC sont trois outils de choix en la matière. En ces temps où le financement des activités scientifiques est contraint, nous devons tout faire pour proposer les conditions idéales aux chercheurs, en évitant un management trop directif, sauf situations exceptionnelles. Un point essentiel est le bénéfice tiré du collectif. De notre point de vue, si les avancées se font parfois de manière individuelle, la recherche reste une belle activité collective. Le large spectre scientifique du laboratoire est une richesse qu'il faut faire fructifier.

Nous souhaitons continuer à **développer des activités de recherche au meilleur niveau international, tout en gardant un spectre très large d'activités.** Le laboratoire est, de ce point de vue, unique dans le paysage scientifique français: nous sommes persuadés que cette originalité fait aussi notre force car elle permet de créer des ponts ou des liens inattendus. Nous continuerons à aborder ces multiples activités à travers les approches expérimentales, numériques et théoriques. Comme indiqué auparavant, cela n'empêche aucunement une dynamique collective à l'échelle du laboratoire. Nous continuerons d'ailleurs à privilégier, quand cela sera possible, les décisions qui permettent de renforcer les liens entre les thématiques. Notons que si les thématiques du laboratoire émargent principalement à l'institut de physique (INP), l'institut principal de rattachement du laboratoire au CNRS, les thématiques traitement du signal d'une part et hydrodynamique d'autre part, sont rattachées respectivement à la section 7 (INS2I) et à la section 10 (INSIS). Le rattachement de ces deux composantes très importantes du laboratoire a été fragilisé, au cours du quinquennal, par le découpage du CNRS en dix instituts. Par les temps actuels où le nombre de postes est faible, les instituts pourraient avoir tendance à se concentrer sur le cœur dur de leurs laboratoires, ainsi que sur le cœur dur de leurs thématiques. Il est pourtant essentiel que le laboratoire puisse profiter, de temps en temps, de recrutements dans ces thématiques. L'activité signal, du fait du besoin relativement modeste en enseignement en traitement du signal, doit compter sur les recrutements CNRS en section 7 pour renforcer les travaux associés à la discipline. De façon similaire, il semble que la mécanique des fluides n'apparaisse plus à sa juste place dans les mots clés des sections INP malgré les contributions importantes et reconnues de physiciens notamment sur les thématiques à haut Reynolds et sur les liens avec la mécanique statistique. À ce titre, nous souhaiterions un signal clair relatif au recrutement en section 7, relevant de l'INS2I, avec une affectation dans le laboratoire de physique. Nous militerons également pour qu'une mutation d'un chercheur relevant de la section 10 au laboratoire soit considérée comme positive par l'ensemble des acteurs. Ces deux éléments sont essentiels pour préserver le spectre large de nos activités.

Notre capacité à **offrir des perspectives aux nouvelles générations** à travers des postes permanents ou à long terme est le second levier capital pour atteindre nos objectifs. Comme rappelé dans la discussion des aspects formation par la recherche (*cf.* III), les dernières années ont montré que travailler au laboratoire était une excellente préparation: quatre post-doctorants actuellement au laboratoire sont ainsi sur les listes d'admissibilité du CNRS du printemps 2014. Comme le laboratoire a atteint une certaine maturité et une taille respectable, les opportunités de recrutement en son sein seront vraisemblablement moins nombreuses dans le futur. Nous continuerons d'être vigilants sur le devenir des jeunes que nous avons formés. En retour, nous espérons qu'une fois installés dans leur nouvel environnement, académique ou privé, le souvenir de leur formation par la recherche dans nos murs sera source de liens utiles, tant pour eux que pour le laboratoire. Il en est de même au niveau des permanents qui quittent le laboratoire pour promotions ou mutations. Nous pouvons encore améliorer le suivi des anciens membres du laboratoire.

Au **niveau institutionnel**, même si la tendance bien française à créer des structures supplémentaires ne peut l'assurer, nous pensons que les différents réseaux à la disposition du laboratoire sont largement suffisants pour lui permettre de poursuivre son épanouissement. Nous souhaitons poursuivre et renforcer les liens avec les différents partenaires du laboratoire qu'ils soient sur le site de l'ENS de Lyon, membres de la fédération de physique FRAMA ou bien membres du Labex iMUST. De toutes les façons, le laboratoire a toujours su saisir les opportunités offertes par le maillage des différentes structures et entend bien continuer à le faire. Être en mesure de **soutenir les nombreuses collaborations, internationales** notamment, est l'un des objectifs majeurs de notre politique scientifique. Une recherche sans lien fort à l'international n'a plus de sens de nos jours, si elle en a jamais eu un. Être en mesure d'attirer au laboratoire des doctorants ou post-doctorants issus des plus grandes universités étrangères est une clé du succès. De même, nous nous efforcerons d'accueillir, sur un rythme soutenu, des collègues étrangers pour des séjours de moyenne et longue durée.

Enfin, nous souhaitons **maintenir l'importante implication du laboratoire dans le département de physique**. Une page se tourne, puisqu'après un engagement de tous les instants et une vision de l'avenir vraiment exceptionnelle pendant les douze années à la tête du département, P. Holdsworth va quitter la direction du département à la rentrée 2014. La réussite du Master Sciences de la Matière est en tout point exemplaire et force le respect tant sur Lyon, qu'à l'extérieur. La symbiose entre laboratoire et département a permis d'atténuer légèrement les différences de statuts. Nous continuerons à exploiter au mieux cette dynamique concertée.

C. Introduction aux perspectives scientifiques

Dans les sections suivantes, nous avons décliné les principales perspectives scientifiques, d'ores et déjà identifiées, dans les sept thèmes et dans l'axe transversal (*cf.* T1P à T8P): huit directions de recherche que nous souhaitons poursuivre à l'identique. La liste des contrats académiques qui seront encore en cours en 2015, présentée en V D, met en perspective qu'un soutien financier approprié existe déjà pour les premières années. Il est important aussi d'insister sur le fait que plusieurs objectifs ont été préparés ces toutes dernières années par les acquisitions d'un microscope électronique à balayage (2013), d'une plateforme tournante (2012), de caméras infrarouge (2014) ou ultrarapide (2014) et de la construction d'une salle blanche (2014). Autant d'outils dont nous avons souhaité nous munir afin de développer certaines expériences en matière molle ou condensée, en hydrodynamique ou géophysique, et en physique statistique ou des systèmes biologiques, expériences que nous n'aurions pas été en mesure de développer auparavant. Le microscope et la salle blanche, acquis en partenariat étroit avec le laboratoire de chimie, ont permis de singulièrement rapprocher les deux laboratoires; les premières collaborations qui en découlent déjà en sont la preuve. Quant à la table tournante, elle a permis de renouveler les collaborations avec le laboratoire de géologie. Ce sont autant de preuves qu'une dynamique collective et concertée permet d'agir de façon très efficace sur les interactions scientifiques.

Dans le même esprit, la réorganisation des locaux sur l'ensemble du site Monod annoncée pour 2017 devrait conduire à un rapprochement géographique avec les trois structures suivantes: le CBP, l'IXXI et le CRAL. Pour les deux premières, cela permettra de renforcer encore notre dynamique commune, concertée, renforçant probablement aussi au passage les liens déjà forts avec le LIP. Un rapprochement du CRAL est scientifiquement bienvenu étant donné les nombreuses thématiques (instabilités dans les fluides, physique statistique d'objets denses,...) sur lesquelles nous pourrions interagir davantage. Enfin, les liens avec l'UMPA font toujours l'objet d'une attention toute particulière, notamment suite au renouvellement quasi-complet en quelques années de son équipe de probabilités.

Au cours du prochain quinquennal, par l'intermédiaire des recrutements et des départs, nous aurons l'occasion de redessiner par petites touches le panorama embrassé par nos thématiques. Nous avons profité de la rédaction de ce rapport pour discuter les priorités scientifiques que nous souhaitons développer ou renforcer dans le futur et avons défini en conseil de laboratoire les principales priorités en terme de recrutement pour le prochain quinquennal. Les profils envisagés, non ordonnés, sont les suivants:

- Le laboratoire développe de nombreuses études de la physique de la matière molle, au sens large, en considérant les écoulements de fluides complexes (gels, polymères, granulaires, mousses, ...), les comportements collectifs, le transport, les effets thermomécaniques, le vieillissement, les instabilités mécaniques, la rupture,... ainsi que des propriétés physiques de la matière biologique. Le laboratoire souhaite renforcer, par l'apport de nouvelles compétences théoriques, cette activité, portée essentiellement par des expérimentateurs en ce qui concerne la matière molle et sous-critique en approche théorique pour la physique des systèmes biologiques.

- De nombreux problèmes de physique et de turbulence jouent un rôle fondamental dans les écoulements géophysiques (atmosphère, océans, dynamique interne des corps célestes. . .) eux mêmes au cœur du système climatique. De part ses outils spécifiques (physique statistique, turbulence, modélisation), une approche interdisciplinaire climat-physique sera de plus en plus pertinente dans le futur, pour aider à résoudre certains problèmes fondamentaux des sciences du climat. Ces approches nécessitent souvent des approches numériques spécifiques, distinctes et complémentaires des modèles traditionnels de circulation globale. Au delà de ces applications au climat, des compétences en simulations numériques d'écoulements seraient pertinentes en lien avec plusieurs de nos approches expérimentales. Le laboratoire grâce à ses compétences en turbulence, mécanique statistique, et dynamique des fluides géophysiques, serait un lieu idéal pour développer ces approches novatrices.

- Le laboratoire mettra l'accent dans ses recrutements à venir sur les candidatures, dont les travaux et sujets de recherches fourniront des terrains naturels d'interactions avec la thématique infosignal, entre physique et traitement du signal, que ce soit à travers l'exploitation de données expérimentales dont l'interprétation requiert des méthodes d'analyse originales, non-standard et avancées, ou à travers la confrontation de concepts formels de physique statistique ou théorique versus modélisation statistique de l'information.

- Construire une théorie consistante de la gravitation dans le régime quantique est un des problèmes clé de la physique théorique moderne, tant sur le plan conceptuel (mise en cohérence de la gravitation et de la mécanique quantique) que pour les applications (cosmologie primordiale, trous noirs en particulier). Le laboratoire souhaite renforcer en son sein cette activité, très dynamique au niveau international et très attractive pour les étudiants. Le développement de ce sujet pourrait aussi avoir des interactions intéressantes avec plusieurs autres thèmes présents au laboratoire comme la théorie des cordes, la supergravité ou la physique statistique tant au niveau des objets étudiés que des méthodes.

- Nous réfléchissons enfin à la possibilité d'attirer un physicien expérimentateur travaillant sur des questions physiques où les effets quantiques sont importants. Plusieurs pistes sont envisagées et notamment en optique quantique, atomes froids, décohérence quantique,... Cet axe, totalement nouveau pour le laboratoire apporterait une diversification très intéressante, susceptible de créer de nouvelles collaborations que cela soit avec les théoriciens ou les expérimentateurs, mais aussi avec les spécialistes en traitement du signal. Il serait nécessaire cependant que cette nouvelle activité puisse être développée avec un soutien technique mesuré. Nous souhaitons construire cette initiative en concertation avec la fédération de physique de Lyon.

Ces priorités serviront de cadre pour définir les recrutements futurs, mais bien évidemment il faudra les ajuster aux opportunités de recrutements de chercheurs travaillant sur des thématiques reliées ou complémentaires de celles existantes ou aux nouveaux besoins créés suite à de l'apparition de nouvelles thématiques prometteuses. Nous aurons une attention particulière pour les thématiques concernées par les départs en retraite présents et à venir à l'échelle de ce projet quinquennal.

En ce qui concerne la visibilité du laboratoire et son rayonnement, il est difficile d'anticiper complètement les points forts des années futures. Gageons néanmoins que le projet déjà bien avancé de monographie sur les systèmes coulombiens, rédigée par A. Alastuey en collaboration avec P. Martin (EPFL), devrait faire date. Par ailleurs, on peut noter deux manifestations de très grande envergure qui seront organisées dans les prochaines années:

\- **GRETSI 2015**: ce colloque est le lieu de rencontre privilégié de la communauté francophone du traitement du signal et des images. P. Abry sera le coprésident du comité d'organisation de cette conférence qui sera organisée à l'ENS de Lyon et qui attend près de 600 personnes en septembre 2015.

\- **STATPHYS 2016**: la prochaine édition de la plus grande conférence internationale de physique statistique est portée par A. Alastuey, T. Dauxois, P. Holdsworth, M. Peyrard, N. Taberlet. Cet évènement accueillera près de 1500 participants en juillet 2016 dans le cadre exceptionnel du centre des congrès de Lyon.

Ces deux colloques prestigieux, organisés successivement par notre laboratoire, permettront de très bien mettre en valeur nos activités en traitement du signal d'une part et en physique statistique d'autre part, tout en accroissant le rayonnement académique du laboratoire dans son ensemble.

D. Projets contractualisés encore en cours en 2015

Projets ERC
- OUTEFLUCOP (S. Ciliberto) sur les fluctuations hors équilibres dans les transitions de phases confinées.
- TRANSITION (F. Bouchet) sur grandes déviations, événements rares, applications au climat et syst. solaire.
- USOFT (S. Manneville) sur les techniques ultrasonores pour les matériaux mous.

Projets ANR Jeunes Chercheurs
- ARTIQ (T. Roscilde) sur les systèmes artificiels de spins quantiques de physique atomique.
- DYNAMO (N. Plihon) sur la dynamique d'un plasma turbulent et induction avec le LMFA et le LPP.
- HIRESAFM (L. Bellon) sur la mesure à haute résolution des forces d'adhésion.

Projets ANR
- AMATIS (P. Abry) sur l'analyse multiraciale en collaboration avec Creteil, Paris Est.
- ASTRES (P. Flandrin) sur les analyses pilotées par les données en collaboration avec le LJK, IREENAV.
- FETUSES (P. Abry) sur l'analyse du rythme cardiaque foetal avec le LIP et HCL de Lyon.
- FSCS (R. Everaers) sur les fluctuations dans les fluides coulombiens structurés, l'IRI, PMMH, IPhT.
- GRAPHSIP (P. Borgnat) sur le traitement de signaux sur graphes avec Caen, GIPSA-lab et Marne la Vallée.
- MITRA (D. Bartolo) sur les écoulements microfluidiques en collaboration avec le PPMH.
- NANOFLUIDYN (A. Steinberger) sur la dynamique des fluides à nanoéchelle avec CEMES, CBMN, IMFT.
- ONLITUR (P. Odier) sur les écoulement tournants et stratifiés en collaboration avec le FAST.
- SEMITOPO (D. Carpentier) sur les propriétés topologiques du HgTe en collaboration avec le LETI.
- STICKSLIP (S. Santucci) sur l'instabilité de rupture dans les polymères avec l'ILM, le FAST et l'ESPCI.
- STOSYMAP (K. Gawędzki) sur les systèmes stochastiques avec le Cergy, Cachan-Bretagne.
- STRATIMIX (A. Venaille) sur le mélange des fluides stratifiés en collaboration avec le LMFA.
- TEC2 (A. Pumir) sur la turbulence et les changements de phase avec le LMFA, Nice et le LEGI.
- VEL'INNOV (P. Borgnat) sur l'étude de Vélo'v avec le LET, CMW, LIRIS, Grand Lyon, Cyclocity.
- 1 shot reloaded (P. Degiovanni) sur l'optique quantique électronique avec le LPA et le CPT Marseille.

IUF
- D. Bartolo sur les phénomènes collectifs.
- P. Holdsworth en physique statistique.
- S. Manneville en rhéologie.
- T. Roscilde sur les simulations quantiques.
- H. Samtleben en supergravité.

PALSE
- FUA (T. Roscilde) sur les atomes ultrafroids frustrés.
- MORIN (R. Volk) sur les méthodes optiques pour industrie et recherche avec le LHC LMFA, IFPEN, CRAL.
- NOGELPO (N. Taberlet) sur la rhéologie des électrolytes liquides polyioniques avec le laboratoire de chimie.
- RHEOPLASMOSCOPE (F. Argoul), un système combinant optique et microfluidique avec les hôpitaux.

Autres Projets
- Projet européen EuHIT (F. Chillà, A. Pumir, R. Volk) sur les infrastructures européennes en turbulence.
- Projet de l'ANRS HIV-AD (C. Moskalenko) sur l'assemblage et le désassemblage du virus HIV-A.
- Projet cancer-Inserm MECANSTEM (F. Argoul) sur l'impact de contraintes sur la résistance des cellules.
- Projet Labex iMUST GLIFSO (V. Vidal) sur les écoulements gaz-liquides dans les poreux avec le LGPC.
- Projet PICS DIGEST (F. Delduc) sur les systèmes intégrables avec l'université d'Hertfordshire (UK).

T1P. Hydrodynamics and Geophysics: *Perspectives*

Permanent Members: P. Borgnat, F. Bouchet, B. Castaing, L. Chevillard, F. Chillà, T.Dauxois, K. Gawedzki, J.-C. Géminard, S. Joubaud, S. Manneville, P. Odier, N. Plihon, A. Pumir, J.-F. Pinton, S. Roux, N. Taberlet, A. Venaille, V. Vidal, R. Volk

Several technical developments in our laboratory are opening new research axis in experimental fluid dynamics : a plasma experiment and a rotating table have been built, allowing new developments in MHD and geophysical fluid dynamics. Some features of the climate such as bistability and rare events will also be tackled using statistical mechanics tools. Another main direction will be focused on turbulent transport of particles, momentum, or scalar quantities as well as on the different role of bulk and boundaries in thermal convection. Finally the multi-phase experimental activities will be carried on, aiming at more advances on the washboard road instability and degassing through complex media.

1. Dynamics of turbulent plasmas and magnetic induction

(ANR JCJC DYNAMO; Labex iMUST DYPFORC, W. Bos, LMFA). The velocity field / magnetic field coupling strongly depends on the physical parameters and in particular on the magnetic Prandtl number (P_m, the ratio of the kinematic viscosity over the magnetic diffusivity). While P_m is always very low in liquid metals, it may vary over several orders of magnitude in plasmas thanks to modifications of collisional processes between ions and electrons. We have developed an experimental setup in which the plasma is created by energetic electrons accelerated in a 13.56 MHz electromagnetic field. A large-scale plasma flow is then created thanks to a Lorentz force. On the mid-term views, a von-Kármán like flow will be created. The scientific issues to be addressed will be the following: (i) large scale forcing and control of plasma flows, (ii) magnetic induction and turbulence in the presence of sheared flows, (iii) interaction of drift waves with plasma flows. Applications and modeling of practical or astrophysical situations will benefit from our fundamental studies in controlled laboratory situations.

2. Geophysical fluid dynamics

Internal gravity waves in stratified fluids. (ANR STRATIMIX, L. Gostiaux, LMFA). One of our projects is to extend our experimental careful study of the parametric subharmonic instability (PSI) in the presence of rotation, with and without stratification. We recently acquired a 2-meter rotating table, which will allow to tackle these issues. The study of internal waves generation by interaction of a mean flow with a topography, in the rotating case, is another research axis we would like to explore. In acquiring this table, we also planned to develop joint projects with teams external to our laboratory. This process has already started with a group at Laboratoire de Géologie de Lyon on penetrative convection in rotation and another at Laboratoire de Mécanique des Fluides et d'Acoustique on a wave generating jet in rotation.

From the analytical point of view, we expect to better understand the interesting dynamics of the coupled amplitude equations of the primary and secondary waves appearing the PSI mechanism, again with rotation and/or stratification. Moreover, internal waves generation of mean flows in a three dimensional setting is still a question which drives interests and we have ideas to tackle it. Finally, from a more fundamental point of view, PSI modifies significantly the energy transfer between scales and must be appropriately taken into account in all analysis of geophysical wave turbulence. Theoretical analysis and experimental studies of wave turbulence, in particular using the internal wave attractor which provides an efficient transfer mechanism to smaller scales, are our main mid-term goal, taking advantage of our combined expertise in hydrodynamics and statistical physics.

Statistical mechanics for turbulent flows and climate. Several issues related to the turbulent flows at the core of the climate system can be studied using statistical mechanics approaches. For instance, many turbulent flows display a bistable behavior, in which rare and abrupt dynamical transitions occur between two attractors. The most prominent natural examples are probably the Earth magnetic field reversals, the Kuroshio bistability, or the Dansgaard-Oeschger events that have affected the Earth climate during the last glacial period, probably caused by ocean dynamics. Our research project aims at predicting attractors of those turbulent flows, transition paths between attractors, and transition probabilities using large deviation theory. The related theoretical program is described in V T7P 6.

Large deviation theory will also be used in order to devise dedicated algorithms aimed at computing rare events. A first application will be to sample extreme heat wave statistics using general circulation models of the Earth atmosphere dynamics. Using these algorithms, we will be able to describe the statistics, but also the dynamics leading to these rare events, going way beyond direct empirical observations or direct numerical simulations. A similar approach will be used to sample extreme values of drags and torques on objects embeded in turbulent flows.

Another project focuses on the parametrization of small scale turbulent processes. They play a crucial role in the energetics of the climate systems and their parameterization is a key aspect, sometimes a weakness, of the current climate model. We will study energy dissipation through gravity wave in the Shallow Water and primitive equations models, using equilibrium statistical mechanics approaches.

3. Turbulent transport

Dynamics of a single particle. (ANR LTIF, I. Vinkovic, LMFA, N. Mordant, LEGI). Using Particle Tracking Velocimetry, we plan to address the question of one-particle dispersion in turbulent flows. Following tracers or inertial particles for a very long time with good temporal resolution, we will measure the first moment of the one-particle probability density function $P_1(r, t; r', t')$, a quantity that plays a central role in the Taylor dispersion problem. We also intend to study energy differences along lagrangian trajectories, to understand the time symmetry breaking observed in preliminary studies, and the relation between these observations and other properties of turbulent flows, and potentially with stochastic thermodynamics.

Multi particle statistics. The development of resolved optical methods allows us to address experimentally issues regarding the dynamics of an ensemble of particles. We will focus on the problem of relative dispersion (2 particles), and on the preferential concentration exhibited by inertial particles. Theoretical studies of dispersion of more than 2 particles, in particular of 3 particles (triangles) will be performed theoretically, in particular to generalize previous results obtained with simple stochastic models.

Rotation rate of discs in turbulence. We will study more precisely the dynamics of discs in turbulence. To do so, specially devoted experiments will be designed. For the modeling part, we will consider improvements of the already cited velocity gradients dynamics in order to reproduce the high level of fluctuations of the rotation rate of discs in turbulence.

Chaotic and turbulent mixing. (Labex iMUST Maximix & Actimix, F. Raynal, LMFA, C. Ybert, ILM). We plan to investigate the mixing of colloids in chaotic and turbulent flows when salt gradients are present. In such a case one expects diffusiophoretic effects to cause a drift velocity between the colloids and the fluid that is proportional to the log of the salt concentration. The measurements will be performed by means of Light Induced Fluorescence in laser planes to investigate the influence of diffusiophoresis onto the statistics of the mixed scalar.

4. Turbulent thermal convection

To follow up the separate characterization of the bulk and the boundary layers we will continue with the analysis of a rough Rayleigh-Bénard cell and a convective channel. In the first case further investigations are needed to understand the role of the roughness. One fundamental question remains open about the role of the periodicity on the increase of the heat flux. To answer this question we plan to make measurements with a roughness of the same height than previous cases, but with a double periodicity. We plan to perform both global and local measurements.

On the other side we want to continue to explore the bulk behavior using the same fundamental idea of the boundary layers analysis : what is the answer of the flow to artificial modifications ? We have already used stratification, the next step will be the introduction of polymers in the fluid. Predictions exist on the increase of heat flux due to the action of polymers on the bulk of a turbulent convective flow. We plan to add polymers in the channel and monitor the heat flux. Moreover we want to address the question of the interaction boundary layer/bulk. We plan to achieve it using 3D Particle Tracking Velocimetry.

5. Statistical turbulence and modelling

Further analytic studies of simple models of inertial particles, encompassing the large deviations regime of the statistics and its bearing on the transport properties, will be conducted. We also project to continue the study of 2D turbulence in curved backgrounds, in particular seeking a confirmation by numerical analysis of the theoretical prediction.

6. Instabilities in 2- and 3-phase flows

Washboard road. The Washboard Road instability shows similarities not only with other granular rippling phenomena (for instance wind- or water-driven ripples) but perhaps more surprisingly with an instability occurring on steel rail tracks known as rail corrugation. This indicates that the granular nature of sand is not a key element of the phenomenon but that instead it may occur with a number of deformable materials. In order to investigate this, we plan on studying the formation of ripples on complex fluids whose rheological properties are well-known. In particular using silly-putty, a model visco-elastic fluid, should shed some new light on the formation of washboard road over a deformable material.

Gas bubbles in liquid-solid systems. (Labex iMUST, R. Philippe, LGPC, CPE Lyon). The study of gas rising through an immersed granular bed will be pursued and extended to situations closer to geophysical and industrial phenomena. In particular, we will focus on the transition between a gas bubble which remains trapped in the medium, or rises through it. The density difference between the grains and the fluid will be varied from a sedimented layer to a suspension. This last case is particularly relevant for industrial applications such as catalytic reactors. Based on experimental techniques in 2D and 3D, we will characterize the global and local hydrodynamics and quantify (i) the effects of heterogeneities in the medium; (ii) the change in the erosion mechanism due to the presence of gas bubbles; (iii) the influence of external forces; and (iv) the consequences on the dynamics of a chemical reaction between the gas and the fluid or the solid.

T2P. Soft Matter: Multi-Scale Mechanics, from Measurements to Models: *Perspectives*

Permanent Members: D. Bartolo, L. Bellon, V. Bergeron, S. Ciliberto, C. Crauste Thibierge, R. Everaers, E. Freyssingeas, H. Gayvallet, J.-C. Géminard, T. Gibaud, S. Manneville, C. Moskalenko, P. Oswald, J.-F. Palierne, S. Santucci, A. Steinberger, N. Taberlet

Within the next years, we will obviously pursue and develop our current research on *"Soft Matter"* following the same guiding line, based on the mechanical and rheological study of various systems over a wide range of scales, combining many different experimental and theoretical tools - a characteristic strength of our work. Below, we provide some important illustrative examples of collaborative work plans; we also highlight new projects that started recently with the recruitment of a CNRS researcher and a Professor within this Theme. We follow the same "bottom-up" presentation proposed for the description of our research activity, from the nano-mechanics of micro-capsules and viruses up to the macroscopic flow and deformation of soft heterogeneous materials (gels, emulsions, cohesive granular assemblies, adhesive tapes, polymer sheets).

1. *Mechanics of nano/micro-objects*

Microcapsules & Viruses (S. Parola, F. Chaput, Chimie, ENS-Lyon) – We will produce our own nanoparticles to create various encapsulating shells of microbubbles or oil droplets. The goal will be then to perform a systematic study of the influence of the size, shape and bulk material of these nanoparticles on the stability and mechanical properties (using for instance micro-indentation measurements) of the capsules. Moreover, with the goal of understanding the link between the mechanical properties of viruses and their biological activity, we will develop in-situ AFM nano-indentation measurements to monitor, at high resolution, the fate of a single viral capsid undergoing disassembly under a controlled environment.

Thin layers (LMA) – We will apply our method to characterize the viscoelasticity and thermal noise of coatings on micro-cantilevers on a wide variety of dielectric layers (see section IV T2R A). The goal is to improve the mechanical properties of dielectric coatings involved in the mirrors of gravitational interferometers (like VIRGO), by choosing the best materials, coating and post-processing methods. This study will probe the dissipation at cryogenic temperatures, as the next generation of gravitational wave detectors will follow this track in order to reduce the thermal noise limitations.

Nanotube peeling & Contact line dynamics (A. Ayari, ILM, ANR HiResAFM & CEMES/CBMN/IMFT, ANR NanoFluiDyn) – Using our high force resolution AFM, we will continue to probe various open questions on nanoscale contacts. The peeling of carbon nanotubes for instance presents a nice framework to study adhesion, but also dissipation and friction at nanoscale. Sliding the nanotube parallel to the surface, or shaking its anchoring point perpendicularly to the surface will lead to a better understanding of the dynamical behavior of the contact line. A natural extension of this approach to other nano-objects (nanowires, AFM tips subject to capillary adhesion) will be explored. Thus, we are developing a hanging-fiber AFM technique where a single nanofiber can be partially dipped in a liquid. The capillary force, dissipation and elasticity of the nanomeniscus will be probed with a ultra-high resolution using one of our home-built AFMs. This nano-level study, where the pinning of the contact line on individual nano-defects can be investigated, has natural links with other projects at larger scales related to the imbibition dynamics in porous media and to the mechanics of humid granular matter.

The smaller the faster... – Since rheometers cannot be much faster than the diffusion time of vorticity in the measured sample, the route of choice for faster measurements consists in reducing the sample physical dimension d. Samples with one small dimension (thin slabs) allow measurements in the millisecond range in the piezorheometer already in use in the lab, where $d \sim 50\mu m$. Reducing the size in three dimensions is done in optical tweezers experiments: the rheometer is a hard micronic sphere, that is either moved into the sample or allowed to fluctuate freely, thus shearing the sample outside the sphere over a distance that compares with its radius. Such techniques hold a promising future in giving access to faster deformation mechanisms.

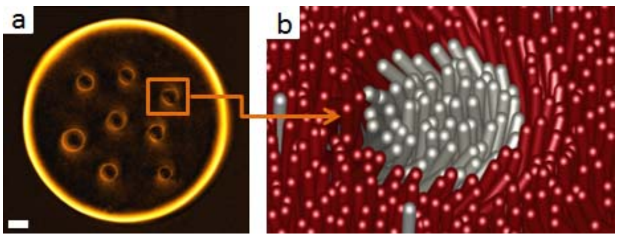

Figure 26: Colloidal membrane and micro-phase separation - preliminary results. By mixing short and long attractive rods we can self-assemble monolayers of aligned rods where the small rods form rafts. a. Microscopy image, scale: 2 μm. b. Sketch of the membrane raft.

Reconfigurable hierarchical self-assembly of colloidal rods (ANR HARB) – Using genetic engineering of the fd-virus, a simple phage virus, we will synthesize a library of monodisperse stiff colloidal rods with controlled aspect ratio (length from 0.3 to 1.3 μm and a diameter of 7 nm) and chirality. We will use those colloidal rods as minimalist building blocks, first to self-assemble new soft materials and then to mimic biological structures. As compared to biological building block such as lipids, the colloidal nature of our rods allows us to up-scale the size and slow down the dynamics of the resulting self-assembled structure for a better visualization, manipulation and modelization. We will mainly focus on colloidal membranes, monolayers of aligned rods that mimic lipid bilayers, and study coalescence, crystallization, phase separation and membrane rafts (Fig. 26). In terms of applications we plan to solidify those colloidal membranes to develop solid monolayers with pores of the diameter of the rods, i.e. 7 nm, to use them either as a membrane or a vessel to carry small molecules.

2. Deformations, instabilities & flow

Glass transition under mechanical forcing – This project is currently developped in the framework of an industrial research contract with Solvay. We are studying the effect of the mechanical deformation of a polymeric material on its glass transition. Specifically, we analyze the evolution of the dielectric properties of polycarbonate sheets under a pure tensile load; and we compare this dielectric response to the one due to temperature variations, to subsequently quantify the fraction of polymer chains with increasing mobility during the plastic flow.

Lehmann effect – Within the next years, the Lehmann problem will continue to be studied in three directions. First, new experiments using the photobleaching of fluorescent probes will be designed to evidence hydrodynamic flows in the cholesteric droplets when they are rotating under the action of the temperature gradient. Second, the temperature gradient will be replaced by a dc electric field to evidence the electric Lehmann effect. Third, the temperature gradient will be replaced by a gradient of chemical potential in order to study the chemical Lehmann effect, in particular in ferroelectric smectic $C^\star$ freestanding films. We will investigate the diffusion of “small” molecules like water across the film. The inverse effect will be also studied by rotating the chiral molecules of the film with an external magnetic field. In this case each molecule of the film should act as a nano-pump.

Imbibition dynamics & Liquid fragmentation in model porous media – For this work, we will take advantage of our expertise to prepare systems where we can control and systematically modify with great accuracy the microstructures of model open fractures and model porous media (thanks to a new micromilling machine and microlithography techniques available now in the laboratory). On one hand, in collaboration with the University of Barcelona, we will pursue our experimental studies of the invasion of model open fractures by a viscous wetting fluid, focusing on the effect of the medium heterogeneities on the intermittent imbibition dynamics, and specifically the avalanche shape. On the other hand, we will study the fragmentation process into an emusion when a resident oil is pushed by a low viscosity fluid in a model porous media. Typical phenomena that we plan to characterize and explain concern (i) the fragmentation statistics and (ii) the traffic dynamics of the oil droplets in a “living” fluidic network. The geometry of the fluidic network is indeed continuously evolving as more droplets are formed from the immobile liquid. This process turns out to be relevant in reservoir conditions and this research will be funded by the oil company TOTAL.

Humid granular matter – While dry or immersed granular matter has attracted much attention, humid granular materials remain poorly considered. However, they belong to the class of cohesive materials, like fine powders, which exhibit very peculiar mechanical properties. For instance, they are almost incompressible, due to the rigidity of the grains, whereas they easily dilate, thanks to the weakness of the liquid bridges that glue the grains together. We already showed that the negative sensitivity to stretching leads to a mechanical instability and then, to fracturing. Many questions remain open: Where do the liquid bridges form? Is the condensation process able to alter the texture of the contact network between the grains? What is the resulting heterogeneity of the distribution of liquid? What are the links with the macroscopic properties of the materials? We will continue our effort to understand the mechanisms at play in such materials that interestingly exhibit a highly non-linear mechanical response.

Granular rheology – We shall focus on the basic mechanisms that can put the granular matter in motion. We will consider temperature variations that have been proven to induce creep and mechanical vibrations that can be used to introduce “thermal” energy in the system and to reduce the flow threshold. Not only the relations between macroscopic stress and strain, but also the local dynamics, will be studied. In particular, we will focus on the early formation of organized structures like shear-bands.

Taming Stick-Slip peeling (L. Vanel, ILM, P.-P. Cortet, FAST, M. Cicotti, ESPCI, ANR StickSlip) – We will study the influence of defects (morphological or adhesive) on the triggering and eventually confining (at microscales) of the stick-slip instability during the peeling of adhesives. Here again, we will take advantage of our ability to tailor-make substrates with controlled heterogeneities.

Ultrasonic forcing on soft materials (ERC USOFT) – We intend to probe the effects of high-intensity ultrasound on soft materials. This study will be performed along two different directions. First we will use classical techniques such as dynamic light scattering, confocal microscopy and rheology to quantify the influence of ultrasound on various systems, including colloidal gels and surfactant systems, at the scale of the microstructure. Second we will develop soft systems designed specifically to be highly responsive to ultrasound (e.g. bubbly yield stress fluids) in an effort to trigger strong effects at macroscopic scales, such as acoustically-induced bubble migration, which should lead to dramatic changes in the mechanical properties of the material.

T3P. Physics of Biological Systems: *Perspectives*

Permanent Members: B. Audit, M. Castelnovo, R. Everaers, C. Faivre-Moskalenko, E. Freyssingeas, N. Garnier, M. Peyrard, C. Place, A. Pumir, C. Vaillant

We plan to consolidate and extend our research in the field of biological physics, stressing and analyzing the intrinsic multi-scale nature of the emergent behavior and further developing the tight collaboration between theory and experiment, both internally and externally with biologists and clinical physicians.

1. Nucleic acids, proteins and their interactions

The sequence of nucleic acids is known to influence their mechanical properties. This is reflected for example in the sequence-dependent positioning of nucleosomes. In order to address quantitatively the relation between the sequence and its flexibility, one of our projects involves neutrons and X-rays scattering experiments on designed sequences. This work will be done at ILL (Grenoble) and Bragg Institute (Sydney). In collaboration with colleagues from Lyon and Lausanne we will further develop a range of nanoscale models of DNA and their application to DNA-protein complexes. In particular, we are now working on implicit solvent models and on the inclusion of electrostatic effects into the otherwise mechanical description (ANR FSCS (IRI, PMMH, IPhT)). Experimentally, we plan to study the interaction between nucleic acids and proteins via the technique of DNA curtains, which allows to observe thousands of long (100 kb), surface anchored DNA molecules as they are elongated in hydrodynamic flow fields. Our goal is to study the dynamic binding and unbinding of Hox proteins, which are important transcription factors controlling the body plan of embryos along the head-tail axis. The same technique allows to determine the static position of nucleosome arrays and to extract maps with epigenetic marks for large native chromatine molecules.

2. Chromatin and epigenetics

All cells of a multicellular organism share the same genome, but as a result of a differentiation processes they are highly specialized in the functions they fulfill. Epigenetic inheritance involves transmission of information beyond the DNA sequence, such that the same sequence can be induced to different functional states that can be stably propagated through cell division. Recent biochemical experiments have revealed that genomes of eukaryotes are partitioned into domains of structurally and functionally distinct epigenetic chromatin states. Many mechanisms of epigenetic control appear to be based on modifications of the structure and dynamics of chromatin. Locally, the binding of nucleosomes modulates the accessibility of genes and regulating sites. On large scales, spatial co-localization allows for the co-regulation of genes. So far, our models for the nucleosome occupancy only account for sequence effects, while we have stressed the role of topological and kinetic constraints for the large scale structure. Our first results for the epigenome dynamics were obtained for mean-field like effective discrete states models (e.g. Active vs Inactive). In collaboration with experimentalists from the IHG-CNRS in Montpellier, we plan to combine these three lines of research and to develop more realistic models of the molecular structure and dynamics of specific chromatin states under the influence of chromatin regulators Remarkably, recent studies indicate that the one dimensional epigenomic chromatin domains tend to fold into three dimensional topologically associated domains forming specialized active vs repressive nuclear chromatin compartments. Here, we want to address the question of the coupling between chromatin folding and epigenome in the framework of a block copolymer model that accounts for local epigenomic information. As a key insight, this model provides a physical basis for the existence of multistability in epigenome folding at subchromosomal scale. Understanding the role of specific long-range interactions of chromatin segments requires a detailed understanding of the physics of crumpled polymers and poses interesting question about the evolved role of quenched and annealed disorder in the biological systems.

3. The spatio-temporal program of DNA replication

In copying their (epi)genome, dividing cells follow specific replication timing programs, which are correlated with the level of gene expression, the epigenetic state and the three-dimensional structure of chro-

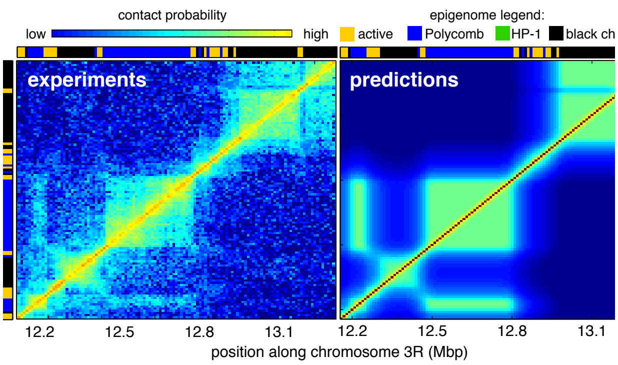

Figure 27: Contact probabilities between sites in the yeast genome. The left panel presents HiC experiments, while the right one shows predictions of a copolymer model with attractive interactions between sites having the same epigenetic state (Jost and Vaillant, 2014)

matin. Replication timing profiles can hence be analyzed as a proxy for other, less accessible aspects of the nuclear structure. We are involved in the development of a new technique for measuring replication timing profiles, which is based on massive sequencing of Okazaki fragments, which are transient nucleic acid products of replication. In particular, we propose to develop replication-based epigenetic profiling into a diagnostic tool of tumoral progression. The underlying idea is the observation that changes in replication timing are associated to chromosomal rearrangements, which in turn are a hallmark of many cancer genomes. In collaboration with teams in Lyon and Paris, we will investigate several cancer cell lines and primary cultures. From the modeling point of view, we are interested in a better understanding of the impact of nucleosome occupancy along the chromatin fiber on the spatio-temporal replication program in human nuclei. Building on our physical model of nucleosome positioning, the numerical and experimental nucleosome occupancy profiles will be compared to genome-wide replication data (origin mapping and timing profiles) in different human cell types. The extreme plasticity of the replication program during differentiation will be analyzed in relation with changes in the theoretical and experimental nucleosome occupancy. A particular focus will be put on the so-called *master* replication origins located at replication domain borders that we showed to be determinants of cell-fate commitment.

4. The physics of viruses

To obtain a more quantitative view of the general mechanisms of viral infection, we plan to extend our investigations of the physical properties of viruses into several directions. First, several steps of HIV-1 replication cycle can still be quantified by combining *in vitro* experiments and modeling: self-assembly of viral proteins at bilayer membranes, maturation of viral capsid, role of drugs on the physical properties of viral particles. In particular, we want to use AFM to test, if virus disassembly is induced by the reverse transcription of viral RNA into DNA, a process which is initiated inside *intact* particles (Fig. 28). Furthermore, we initiated investigations on a new family of viruses, the parvoviruses. One particular virus from this family, the Adeno Associated Virus (AAV), is a human non-pathogenic virus which is extensively used as a transfer vector in gene therapies. Unlike most viruses, this virus exhibits exceptional stability with respect to environmental changes (temperature, pH). Moreover, the process of genome uncoating is not well characterized and understood. Our project is therefore to identify *in vitro* the environmental conditions responsible for AAV genome release, and to correlate these observations with measurements of its physical properties.

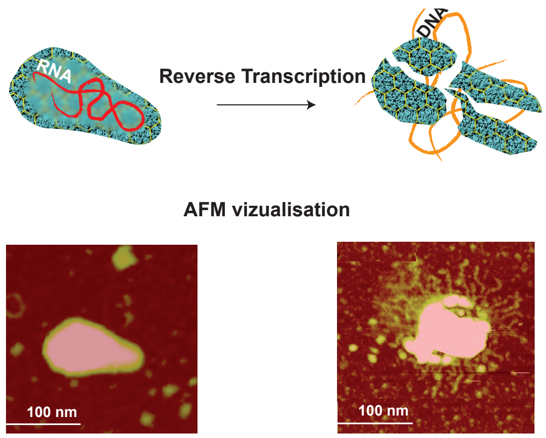

Figure 28: The effect of RNA reverse transcription into DNA inside the HIV-1 virus. (Moskalenko & Castelnovo, unpublished)

T4P. Mathematical Physics and Fundamental Interactions: *Perspectives*

Permanent Members: F. Bouchet, F. Delduc, K. Gawedzki, E. Livine, M. Magro, J.M. Maillet, G. Niccoli, H. Samtleben

During the next period, the study of integrable systems will remain one of the main directions of research in the mathematical physics group. The group comprises specialists at an international level in this subject, and also collaborates with physicists throughout France, many of which have been formed in Lyon. Future studies will include the link between integrable systems and conformal models, which themselves will be applied to condensed matter problems. Supergravity also will be an important subject, with a particular emphasis on disclosing the fundamental exceptional symmetries underlying maximal supergravity as well as the study of particular solutions and holographic applications. We also plan to further develop the growing subject of strings on curved backgrounds, in relation with the AdS/CFT correspondence, over the next years. Finally, Quantum Gravity is expected to remain a subject of intense activity, in loop quantum gravity on the one side, and in spin foams on the other side. Like any other program of fundamental research, ours is of course also to a certain extent unpredictable, and we cannot exclude some changes of direction depending on the evolution of the various fields.

1. Integrable Systems and Conformal Field Theory

Within the next five years, Integrable Systems will continue to be an important topic in the theme. We intend to pursue the following directions :
- Building up the precise links between our form factor approach to critical models and their conformal field theory properties in the thermodynamic limit; it should connect to both combinatorics, the theory of tau functions and the AGT relation.
- Form factors and correlation functions within the separation of variable (SOV) approach : thermodynamic limit problem, integrable systems associated to higher rank algebras, and in particular models of physical interest like the Hubbard model, general (integrable) boundaries cases.
- Integrable discretisations of the sigma models in relation to the AdS/CFT correspondence.

We shall study the application of conformal field theories to systems out of equilibrium, as junctions or networks of quantum wires at different temperatures and potentials. We also plan to further explore the relations that we recently discovered between the equivariant WZW sigma models and topological insulators.

2. String theory and supergravity

The q-deformation of the $AdS_5 \times S^5$ superstring action has immediately sparked interest and many interesting questions will in fact be very shortly answered. One aspect, which will probably require more time is the following. The $AdS_5 \times S^5$ deformation is defined for q real. One important question is whether it is possible to fully extend the deformation for q complex. This would enable to make contact with the S-matrix that interpolates between the S-matrices obtained either in the light-cone gauge or by performing the Pohlmeyer reduction.

On another front, our results on the Faddeev-Reshetikhin procedure have indirectly shown that one may be able to discretize symmetric and semi-symmetric space sine-Gordon theories. We plan to go back to this long standing and very challenging problem. The first step corresponds to finding a classical integrable lattice model whose lattice Poisson algebra is of the form identifed in our earlier work and the continuum limit of which reproduces the classical generalized sine-Gordon model. If we succeed in constructing such classical integrable lattice discretizations, the next step will be to quantize them.

In the study of supergravity theories, we plan to extend our collaboration with mathematicians in order to pin down the mathematical structure underlying the non-abelian vector and tensor gauge fields appearing in generic supergravity theories. Proper translation of the tensor hierarchy of the gauge sector of supergravity theories into the framework of Leibniz and L-infinity algebras may in particular allow to make further progress in the construction of the non-abelian supersymmetric tensor theories underlying the dynamics of M-branes. The recent advances in the construction of three-dimensional superconformal Chern-Simons theories that underlie the dynamics of M2-branes have given new momentum to these questions and triggered a wealth of new results and possibilities as well as raised new questions. Recently developed superspace techniques as well as recent progress in the understanding of the couplings of non-dynamical degrees of freedom may lead to new insights in these directions. Finally, any result on the M2-brane spectrum beyond the string theory approximation would constitute a major progress in the understanding of M-theory.

Another topic of future research are the exceptional field theories recently constructed in [357, 360, 361]. In this covariant formulation the exceptional symmetries of supergravity acquire a geometric realisation in terms of a higher-dimensional 'exceptional space-time'. These constructions may just be the first hints of a radically different underlying generalized geometry that may change our geometrical perspective on supergravity theories. We plan to spend further effort on the study of these theories.

A straightforward task is the extension of exceptional field theories to the fermionic sector. This will yield further insight into the spin structure, connections and curvature of the exceptional geometry. Another fascinating prospect is the generalization of the presently known exceptional field theories to include higher-derivative M-theory corrections along the lines of the recent results on double field theory. Mathematically, this would entail a deformation of the generalized Lie derivatives and other structures. If possible, this would give a scheme to compute the α' corrections of type II string theories and the higher-derivative M-theory corrections in a unified manner. Perhaps the most intriguing, but also most involved question is about a genuine relaxation of the section constraint, which currently defines/restricts the exceptional geometry, that would truly transcend the framework of supergravity. A concrete starting point for such attempts is the construction of a generalized Scherk-Schwarz ansatz embedding particular lower-dimensional and "non-geometrical" theories. The characterisation and study of BPS solutions within exceptional geometry is another interesting task for investigation.

Among the more 'applied' topics in supergravity is the study of exact solutions of M-theory and ten-dimensional string theory with holographic field theory duals. The geometrical properties of such backgrounds give information about the dual QFT, such as marginal and mass deformations, RG flows and the spectra of protected operators. We further intend to construct novel consistent truncations on various internal spaces, focusing in particular on the possibility of keeping in the truncated theory some massive modes. These new constructions considerably widen the spectrum of dual field theories one can study.

3. *Quantum Gravity*

Within the next five years, quantum gravity will go on being an active topic within the mathematical physics team. We will pursue four main axis. First, the coarse-graining of the dynamics of the quantum states of geometry in loop gravity is a crucial issue. It is the key to understanding the semi-classical regime of loop quantum gravity and how to keep under control the quantum fluctuations of gravity when flowing the theory from our scale to the Planck scale. We plan to look especially into the truncations of the full theory to isotropic cosmology and black holes, in order to better study their dynamics and the quantum correction to general relativity in those cases. Second, we would keep on developing mathematical tools for loop gravity and spinfoams, especially focusing on the quantum deformation of group structures to account for a cosmological constant in general relativity, and on analyzing further the relation between recursion relations, exact evaluations of spinfoam amplitudes and the symmetries of the path integrals. Third, tensor model techniques are the most recent breakthrough in spinfoams reformulated as group field theories. We see two hot topics: the study of their large N limit (similarly to matrix models) and its application to the large-scale (cosmological) structure, and the renormalisability of group field theories with its consequences for the spinfoam programme. Finally, a big project is to apply techniques from statistical physics and condensed matter to the analysis of spinfoams, derive the mean field approximation of the amplitudes and study the various phases of these quantum gravity models. The laboratory at the ENS Lyon seems to be a perfect setting for such state-of-the-art interdisciplinary research.

T5P. Condensed Matter: *Perspectives*

Permanent Members: A. Alastuey, P. Borgnat, D. Carpentier, B. Castaing, L. Chevillard, P. Degiovanni, A. Fedorenko, K. Gawedzki, P. Holdsworth, E. Leveque, E. Orignac, T. Roscilde

In the near future we plan to continue our investigations of complex systems in condensed matter. In particular we plan to advance our understanding on the following subjects: relativistic fermions in semiconductors; emergent electrodynamics in spin-ice systems; cold atoms in artificial gauge fields and driven out of equilibrium; Bose fluids induced by a magnetic field in disordered quantum magnets; electronic coherence in electron waveguides; thermodynamics of small quantum systems; transport properties of three-dimensional semi-metals; vortex recombination in superfluids, recombination in quantum plasmas; and condensation in interacting Bose gases.

1. *Emergence and Topology.*

ANR ArtiQ; ANR TERATOP, Univ. Montpellier (under review); UCL London; MPIPKS Dresden; OIST Okinawa.

We plan to study disorder and transport properties of Dirac fermions in graphene and topological insulators, Weyl fermions in semimetals and Kane fermions, discovered recently in zinc-blende crystals. The topological characterization of both three-dimensional semi-metallic phases and driven dynamical states will be studied.

Future work on spin ice materials will include investigations of thin film samples. Recent experiments and numerical work suggest that the long-range interactions contrive to radically change the characteristics of spin ice in confined geometry. Projects on quantum spin ice and related lattice gauge theories will address the case of three-dimensional models, searching for the U(1) spin liquid ground state, and its most salient thermodynamic and spectral features accessible to the experiments. Parallel work will involve the extension of numerical approaches to other lattice gauge theories with a finite chemical potential, of fundamental interest as well as of relevance to recently proposed realizations via lattice quantum gases.

2. *Quantum Simulators: from Cold Atoms to Condensed Matter.*

ANR ArtiQ; Université de Grenoble (LPMMC, NEEL, LCMI); Univ. Geneva; Univ. Bonn and Hannover, Univ. Salerno, Pisa, and Trieste; Univ. Ljubjana; IOTA Palaiseau; NHMFL Los Alamos; U. Sao Paulo, Renmin U. of China, Univ. Hamburg, LENS Florence, USC Los Angeles.

Our future activities on quantum simulators will maintain our attention focused on the complementary opportunities offered by ultracold atoms on the one side, and by magnetic insulators on the other. On the cold-atom side we plan to invest a significant effort in the study of the phenomena induced on ultracold bosons by *artificial gauge fields*, which have been recently introduced in the experiments. Such fields induce frustration in the kinetic part of the Hamiltonian, leading to the appearance of (quasi-)degeneracies in the single-particle spectrum. In this situation, interactions can have potentially a very strong impact, leading either to chiral superfluidity – breaking multiple continuous and discrete symmetries – or to exotic non-condensed states (Bose metals, or incompressible quantum liquids such as spin liquids or fractional quantum Hall liquids). The detection of these phases will necessitate to develop new diagnostic tools, and we will investigate the use of noise (in real space or in momentum space) to reveal the different forms of order of the chiral condensates, and potentially the long-range entanglement properties of the non-condensed phases. We also plan to pursue the study of interaction quenches in cold atoms. Interaction quenches raise important questions on the possibility of reaching a thermalised steady state that are closely related with integrability and quantum chaos. Besides, interaction quenches from an initially gapped state with finite correlation length to a gapless phase with divergent correlation length also raise important question on the evolution of the correlation length as a function of time, in particular whether the time evolution of the correlation length can be understood as generation of topological defects in the gapped phase.

In the context of magnetic insulators we will continue our investigations of the Bose-glass phase induced by disorder in Br-doped DTN and other compounds. Our focus will be particularly set on spectral functions, expected to exhibit the presence of Anderson-localised excitations at low energy.

3. *Coherent Transport.*

ANR TERATOP, Univ. Montpellier (under review); ANR OPROBE, UJF (under review); ANR 1-shot, LPA (ENS Paris), CPT Marseille; NEEL Grenoble.

From quantum optics to quantum thermodynamics. Our research project in electron quantum optics is two fold: first, we will develop a toolbox for the efficient reconstruction of single electron coherence (quantum tomography) in close collaboration with experimentalists. This will imply a collaboration with the signal processing group to develop a compressed sensing approach quantum signals. Next, we shall study higher-order electronic coherences in relation with entanglement and waiting time statistics, as well as the connection between electronic and photonic coherences. Since electron quantum optics provides a simple way to understand coherence propagation at the single quasi-particle level, it is now possible to explore the flow of charge, energy and information in a ballistic quantum conductor.

These questions are indeed extremely general: understanding them amounts to understanding the thermodynamics of mesoscopic systems. We have started a collaboration with further theory teams on the thermodynamics of mesoscopic systems whose purpose is to understand the flow of energy and information in mesoscopic quantum systems (ballistic conductors & superconducting nanocircuits). Even if the thermodynamics of classical mesoscopic system is well understood, quantum systems are different: the stochastic dynamics of the system basically depends on the measurements performed in the environment to determine thermodynamical quantities such as the heat and work. How these features express themselves on real systems is still an open question.

Transport properties of three dimensional semi-metals. The remarkable transport properties of graphene originates from the relativistic description of its low energy excitations. Recently, analogous semi-metallic phases have been discovered in three dimensions. We plan to study their transport properties, similarities with graphene and specificity.

4. Quantum Fluids.

CEA et NEEL (Grenoble); CEA Saclay; UTINAM Besançon; Univ. Varsovie; EPFL.

Following previous investigations [492], we plan to study the interaction of two quantised vortices in a superfluid. Let us mention that vortex reconnection is, as far as we know, the main mechanism entering in the dissipation of quantum turbulence at zero temperature. To do so, we are planning to perform numerical simulations of two closed vortex lines. A single rectilinear vortex can be considered as a stationary solution of the Gross-Pitaevskii equations, whereas two vortices at sufficiently short distance will interact. This numerical study is original because we consider two-body interaction in a non local way, which allows low-energy excitations at finite wavelength, known as *rotons*. We will then follow in time the energy transfer from the set of vortices to the background flow. Similarly, we will study the velocity of vortex rings. From an experimental perspective, we are involved in the Shrek collaboration, whose aim is the measurement of the turbulent characteristics of the two phases of liquid Helium, above (HeI) and below (HeII) the superfluid transition temperature. We will focus on the analysis of the experimental signals and their modeling.

The screened cluster representation provides unambiguous definitions for the partition function of any recombined entity in a quantum plasma, like the hydrogen molecule or the helium atom, which only depend on temperature. Suitable Monte Carlo algorithms need to be introduced for accurate estimations of such partition functions. These quantities are essential ingredients in low-temperature asymptotic expansions for the equation of state of the hydrogen-helium mixture, which have a wide range of applications in astrophysics, in particular for determining the internal structure of the Sun. The investigation of condensation in an interacting Bose gas within the imaginary-time hierarchy is quite promising, and the role of fluctuations beyond the mean-field approach will be studied in that framework.

T6P. Infophysics, Signal and Systems: *Perspectives*

Permanent Members: P. Abry, B. Audit, P. Borgnat, L. Chevillard, P. Flandrin, N. Garnier, P. Jensen, J.F. Pinton, N. Pustelnik, S. Roux

Infophysics, the association of information science and physics, is a foremost research theme of the Physics Lab., constantly aiming at contributing at the highest international research level both for the methodologies in physics and signal processing, and for selected and relevant applications, be they from physics or other fields. While structuring themes such as scale invariance, multifractal (cf. V T6P 2) and nonstationary analyses (V T6P 1) will be pursued with renewed directions and efforts, under on-going or starting ANR grants (AMATIS, ASTRES), new directions will benefit either from recent efforts and interdisciplinary interactions or from recent recruitment and will be at the core of future funding efforts: graph signal processing and complex network science (cf. V T6P 4) and proximal optimization (cf. V T6P 3). The revisit of entropies with focus on actual estimation will renew the interactions between information theory and statistical physics (cf. V T6P 5). While historical applications, such as Internet Traffic analysis are naturally fading, efforts will be devoted to biomedical applications (genomics, heart rate variability, neuroscience) (cf. V T6P 6) and to social networks and human behaviors (cf. V T6P 7). Multidisciplinary collaborations, local and international, will continue to ground this research theme targeting international and theoretical and applied top-ranked journal publications.

1. *Nonstationarity*

(LJK and GIPSA-lab (Grenoble), IREENA (Nantes), APC (Paris), ANR ASTRES)

a. Data-driven representations. Studies on EMD will be continued in three directions: 1) on-line implementation of the algorithm for 1D signals (coll. R. Fontugne); 2) comprehensive, optimization-based approach for 2D images and multivariate signals, aimed at a local, oriented AM-FM description [660]; 3) extension of the EMD principle to graph structures.

b. Phase-based approaches. Besides EMD and the post-processing of its extracted modes, the need for a sparse and efficient disentanglement of nonstationary multicomponent signals into physically meaningful, AM-FM-type components triggered a revival of phase-based methods such as reassignment and "synchrosqueezing" [584]. The objective is to broaden the application range of the existing approaches and to explore promising trails dealing with generalized frameworks [533], geometry [587] and reconstruction (e.g., from phase only or magnitude only data [532]). In this respect, the synchrosqueezing transform can be considered as a breakthrough for time-frequency analysis of multicomponent signals, but it relies on strong assumptions that still limit its use. Enlarging its applicability will be envisioned by considering situations such as strong modulations and noisy observations, as well as multidimensional extensions.

2. *Scale Invariance for Multivariate Signals and Fields, and Applications*

(C. Garban, ENS Lyon, H. Wendt, S. Jaffard, B. Vedel, France, R. Leonarduzzi, Argentina, V. Pipiras, G. Didier, USA, ANR AMATIS). Future developments in multifractal analysis will focus on multivariate signals and fields.

a - p-Leaders, a new theoretical quantity, will ground multifractal analysis on L^p norms ($p > 0$). Benefits are expected at the theoretical (negative regularity exponent, oscillating singularities [513], lacunary singularities,...) and practical (improved estimation performance) levels. p-leaders may also permit to better frame Bayesian estimation for the multifractal parameter (relevant for isotropic image texture).

b - Expanding on multivariate fractional Brownian motions, the definition of multivariate multifractal processes will be investigated and their properties studied. This should enable to better address the question of Fractal Connectivity [674] and to frame it precisely into a multifractal setting.

c - Tailoring Hölder regularity to local anisotropy will permit to investigate theoretically and practically anisotropic texture multifractal analysis [649].

d - Random vector fields combining prescribed geometrical and multifractal properties will be theoretically studied using multiplicative chaos theory, integrated against a Wiener measure, with aim at better matching turbulence phenomenology. A starting postdoctoral internship will focus on the numerical simulation of such random fields.

e - Multifractal analysis for art investigation will be pursued, notably via the study of a collection of several hundreds of mid-20th century art photography paper texture, provided by MoMA, in close collaboration with art experts.

3. *Optimization and inverse problems*

(L. Condat, GIPSA-Lab, N. Dobigeon, H. Wendt, IRI-Toulouse, ISIS-Jeune Chercheur) Efficient algorithms have been recently designed for minimizing non-smooth convex criteria [639], thus solving inverse problems. Yet, computational performance is far from real-time computation. We will propose efficient on-line strategies for multiple change-point detection, crucial for real-time evaluation of fetal heart rate local regularity. Also, efficient strategies will be developed for dealing with non-Lipschitz functionals such as the Kullback-Leibler divergence, particularly useful for the reconstruction of Poisson noise corrupted data, as can be encountered e.g., in structured illumation microscopy. The challenging automated selection of the regularization parameter inherent to any variational approaches will be investigated using hybrid Bayesian-variational procedures.

4. *Graph signals and complex networks*

(S. Achard, O. Michel, GIPSA-lab). Elaborating on our introductions of tools for complex networks (e.g. dynamical ones) or signals on graphs, we will pursue methodological and applied works. A first issue is how the estimation of graphs interacts with analysis methods of these networks. For studying brain networks from fMRI data, the combination of Graphical lasso and bayesian methods [571] will be revisited with a multiresolution point of view. Applications of the multiscale network community analysis with graph wavelets of [666, 667], are studied for genomic studies of V T6P 6 and social studies of V T6P 7.

A second objective is to revisit and improve the emergent network science, currently taking its roots in physics and computer science, with the point of view of signal processing and statistical data analysis. The challenges are to tackle dynamics of networks (for which signal processing has a lot to offer with non-stationary approaches), to study data at large scale (multiresolution methods being a way for that) and to propose statistically sound analyses and models for which statistical methods are paramount.

5. *Statistical Physics and Information Theory*

(N. Fourcaud-Trocme, N. Buonviso, CRNL, Lyon) Entropy creation and exchange in non-equilibrium systems is parallel to Information creation, stockage and interactions in dynamical systems. In particular, biological systems are on one side fluctuating and creating information, while on the other side they interact not only with external thermostat and therefore noise, but also with other (possibly similar) systems. We will develop theoretical and actual practical estimation tools to quantify information as well as information fluxes between biological systems. Notably, we will use these tools to decipher not only functional connectivity maps, but also effective connectivity and produce directed graph of interacting systems.

6. *Biological, Genomic and Biomedical Signal and Image Processing*

Graph theory for the genome. Recently, a novel challenge from experimental biology has emerged with the appearance of high throughput chromatin conformation capture data. In contrast to the genomic characterizations produced so far, these new data are no longer 1D profiles along the chromosomes, but positive matrices capturing the 3D co-localization frequency within the nucleus of all pairs of genome loci. In a preliminary study, we observed that replication U-domains are fundamental units of the nuclear organization [192] and, using a graph representation, we showed that replication domain borders are hubs of the chromatin conformation interaction network [554, 555]. However further computational developments are necessary to fully extract the principles of chromosome organization. We propose to use graph signal processing tools to analyze chromosome interactions. Using graph wavelet multiscale network community analysis [666, 667], will also allow us to reconsider these data chromosome 3D organization, for instance through the analyses of epigenetic profiles. These new methodologies will be combined with our model of genome organization based on replication domains and with our multiscale 1D framework to analyze genomic data to progress in the understanding of tumoral progression, of the genomics of mechanotransduction and of stem cells response to their micro-environment.

Heart Rate Variability (Y. Yamamoto, Tokyo University) Multifractal analysis will be applied to a massive (several tens of thousands - 24h long) database of Adult Heart Rate variability, collected in Japan, with aim at diagnosing pathologies and quantifying survival chances after congestion heart failure. **NeuroSciences** (P. Ciuciu, V. van Hassenove, NeuroSpin, CEA, B. He, NANDS, NIH, USA) Aim is to perform a challenging mutivariate brain data analysis to test the concept of (multi-)fractal connectivity - *Do different Brain regions show strong coherence even in scaling ?* -, and to evaluate how this contributes to functional connectivity (elaborating on [566]. Multivariate fractal models will be tailored to account for cross-frequency coupling, thus reconciling scale-free with oscillatory behaviors. The challenging question of how a network with non linear spatial dynamics may generate (multi-fractal) temporal dynamics will be investigated.

7. *Analyses of Social and Human Activities*

(Médialab (Paris), ANR Vel'Innov (Lyon), QUT (Brisbane), Sociopatterns (Marseille, Turin)).

A priority is to develop formal tools able to extract information on social systems from digital data. For this, we will focus on the understanding of the *dynamics* of social networks. Working with sociologists, we will develop tools adapted to social networks, e.g., a new "bridgeness" measure able to differentiate networks' global bridges from local ones, which the usual "betweenness" fails to do. This will be applied to scientometric graphs. Many institutions (CNRS, French research ministry, iMust Labex, Grenoble's Idex, ...) have demanded maps to better describe their inside.

A second aspect aims at analyses and modeling of data for specific human or social activities. In transportation, the work on Bicycle Shared Systems will continue with researchers in geography, sociology and transport, aiming both at comparing BSS across the world and at simulating Lyon's BSS. Also, a study on car movements is beginning within a new collaboration with QUT, Brisbane (Australia) (coadvised PhD thesis) with the innovative use of BlueTooth data [628]. Finally, the collaboration with the Sociopatterns project will be reinforced for the study of human contact networks, especially with RFID technologies and methods for dynamical network.

T7P. Statistical Physics: *Perspectives*

Permanent Members: A. Alastuey, D. Bartolo, L. Bellon, F. Bouchet, S. Ciliberto, C. Crauste Thibierge, T. Dauxois, A. Fedorenko, K. Gawedzki, P. Holdsworth, P. Jensen, A. Naert, A. Petrosyan, M. Peyrard, S. Santucci, A. Steinberger, A. Venaille.

1. Active particles

Collective motion of biological objects is commonly observed in heterogeneous environments. At large scales one might think about human crowds in urban landscapes, at the micro scales bacteria colonies develop in organs or in soils, and at even smaller scales the highly coherent motion of the cytoskeleton occurs in heterogeneous cytoplasms. Conversely, the overwhelming majority of active-matter studies have hitherto focused on idealized homogeneous media.

Combining experimental, numerical and analytical tools our we aim at describing the phases and the fluctuations of active matter in disordered structures. The two following questions give the gist of our research project : (i) How disorder can prevent the formation and/or the propagation of flocks? In the language of statistical mechanics the question could be: do the band-shaped density waves of polar active matter undergo a localization transition when when cruising through random obstacles? To address this questions we are studying populations of colloidal rollers interacting with ensembles of micro-fabricated scatterers. (ii) The second class of systems we are interested in, concern active fluids flowing through random networks. We are both interested in understanding the statistics of the individual trajectories (escape time from a network/maze), together with the statistical properties of the spontaneous flows. Again the experiments will be conducted with rollers cruising in microfluidic channels of (controlled) random geometries. These experiments will be complemented by analytical and numerical studies based on minimal systems, inline with our recent theoretical research.

2. Systems with long range interactions

Important features of astrophysical self-gravitating systems are expected to be incorporated in simple models described by the micro-canonical ensemble. The validity conditions of the familiar hydrostatic approach, which we have recently derived, are currently tested against a solvable one-dimensional model of hard rods with gravitational interactions. As expected, the hydrostatic approach fails for almost collapsed states where the mass density varies too rapidly in the region close to the core. Another requirement for the validity of the hydrostatic approach, namely the weak gravitational coupling at the local level, is not fulfilled in globular clusters, where the formation of binaries stars needs to be taken into account. A suitable mass action law providing the ratio of binaries and single stars is under consideration. Further studies will concern the effects of rotation and self-confinement.

Charge correlations and temporal fluctuations related to the Wien effect will be studied in systems of finite extent with varying boundary conditions. In the context of spin ice, where kinetic constraints prevent dc currents and a steady state, the AC Wien effect will be studied.

3. Disordered systems

The functional renormalization group (FRG) is a powerful tool for studying diverse disordered elastic systems and spin models. The aim of our long-term project is to study different aspects of the static and dynamic behavior of these systems in the classical and quantum limits. In particular we plan to apply the FRG to study many-body localization in disordered quantum systems. The number of papers covering this subject is rapidly increasing, however, most works are restricted either to low dimensional systems where efficient numerical methods can be applied or to mean-field models. We hope that the FRG will help us to understand the mechanism of many-body localization in finite-dimensional systems and its relation to glassy dynamics, ergodicity breaking and the infinite randomness fixed point picture. We also plan to study how avalanche statistics in disordered elastic systems depends on long-range correlations in disorder distributions that may be relevant for experiments.

We will pursue our experimental studies of the complex spatiotemporal dynamics of interfaces driven through random media. In experiments on both slow crack growth and imbibition we will focus our attention on the effect of disorder on the intermittent burst-like dynamics of the fronts. We will take advantage of our ability to prepare systems where we can control and systematically modify the heterogeneities with great accuracy. For the imbibition dynamics of a viscous fluid front, we are developing a theoretical framework to relate the critical dynamics at different scale of observation; more specifically, the dynamic critical exponents characterizing the scaling laws of the local and global avalanche dynamics. We are currently designing a new experimental strategy and setup to study avalanche dynamics at the critical pinning point, but with a non-zero velocity, using the destabilizing force of gravity.

4. Modeling social systems

Two directions are now followed in the modeling of social systems inspired by statistical physics. First, we build a conceptual model similar to Schelling's, but including an important ingredient from the point of view of sociology, namely the evolution of individual characteristics during the simulation. Indeed, economic models generally fix arbitrarily the nature of individual characteristics, while we let agents' characteristics evolve as the simulation goes on, which is more realistic but also much more complex to analyze. We are collaborating with mathematicians in order to develop new tools adapted to this new problem. Second, when tackling social systems with simple models inspired from statistical physics, an important step to ensure their relevance is to try to fit empirical data. In an ongoing collaboration [737], we have shown how a simple opinion model could be adapted to lead to the emergence of an opinion "field", which is stable in time and shows logarithmic decay in space. This feature is also present in the empirical data gathered from voting at national elections in many countries. We are now working to add socio-economic individuals' characteristics which are known to influence voting behavior and see whether the patterns subsist.

5. *Driven systems out of equilibrium*

In order to study non-equilibrium fluctuation dissipation relations, we will experimentally and theoretically study a model system small enough to have discrete degrees of freedom but large enough to have a non-uniform temperature: a micro-cantilever subject to a heat flux. This situation should be simple enough to perform a direct comparison between measurements and analytical results, so we expect a fruitful insight into the statistical physics of non-equilibrium steady state systems.

We will also pursue the study of granular gases as archetype of dissipative systems. We want to take advantage of the simplicity of our experimental system to address profound and central questions on statistical physics. The study of transport can be completed. It can evolve to the study of non-stationary dissipative systems. We also plan to investigate other macroscopic dissipative systems, keeping in mind the technical simplicity of our experiments.

6. *Large deviation theory and rare events*

Computing entropy or free energy of equilibrium systems is often considered as solving them. Indeed, they encode the most probable states, the fluctuation statistics (small or large), the phase transitions. The modern formalism of statistical physics sees entropy and free energy of macroscopic states as large deviation rate functions. For non-equilibrium systems the computation of such rate functions was up to now feasible only for extremely academic models.

We will develop several research projects aimed at computing large deviation rate functions. The key theoretical idea is to compute large deviation rate functions for simple models, for instance by analogy with the recent results in macroscopic fluctuation theory. We expect anytical results either in perturbative regimes or close to bifurcations. For instance, we will compute them for systems with long range interactions and for a large class of semi-realistic models of turbulent flows.

Moreover, we will develop efficient numerical algorithms for computing the corresponding rare events. The idea is to adapt classical rare event simulations algorithms based on either importance sampling, of selection-pruning algorithms, in order to study the statistical mechanics of non-equilibrium systems.

Applications of these tools to turbulent flows and the climate (prediction of multiple attractors and their transition probabilities like abrupt climate changes, computations of probability and dynamics of extreme heat waves, and computation of extremes in turbulent flows are described in section V T1P 2). Application to the long time evolution of the solar system are also foreseen (ERC TRANSITION).

These works are directly connected to some of the most recent advances in mathematics (stochastic partial differential equations, large deviation theory).

7. *Fluctuations and Confinement*

This project aims at studying experimentally the out of equilibrium fluctuations in strongly confined fluids. Four main problems are analyzed : a) The effects on the dynamics when the fluctuations are confined in a volume smaller than the spatial correlation length; b) The fluctuations of the injected and dissipated power in out of equilibrium highly confined systems, where extreme events may produce an instantaneous "negative work". c) The questions: Are non-equilibrium fluctuations a limiting factor for applications ? Might they be useful ? d) The development of generalized thermodynamic protocols for critical Casimir phenomena allowing access to this universal physics for all second order phase transitions. In particular we envisage magnetic systems in which the nano-technology of thin films is highly developed, yet for which, at present there are no experimental measurements of the critical Casimir effects. We have developed and numerically tested a suitable protocol, which could be further developed to study many other kinds of system.

These four problems are of great current interest, both for fundamental and applicative points of view. Applications of confined fluids range from tribology, geology, biology, to nano- and micro-fluidic. Our strategy is to study them by enhancing the role of fluctuations and correlations working close to the critical point of a second order phase transition. Specifically we work at the critical point of mixing of either a binary mixture of fluids or a polymer blend, whose microscopic time scales and correlation lengths are much longer than those of binary mixtures of simple fluids. This allow us to follow the dynamical relaxation over many scales with resolution both in space and time from the microscopic up to the macroscopic scale.

T8P. Instrumentation and Imaging: *Perspectives*

Permanent Members: P. Abry, L. Bellon, V. Bergeron, F. Chillà, S. Ciliberto, D. Bartolo, S. Manneville, A. Naert, A. Petrosyan, J.-F. Pinton, N. Plihon, N. Pustelnik, S. Santucci, A. Steinberger, R. Volk

In this section we describe the topics, linked with instrumentation and imaging, on which we will focus during the next five years. As will be seen in the following, these subjects are intimately linked to projects described in the other sections.

1. *Imaging*

Particle sizing in turbulent flows (ANR TEC, Coll. LMFA/OCA/LEGI): For turbulent dissolution/evaporation studies, it is often needed to measure the size of the particles along their trajectories. To do so, we plan to couple particle tracking and holographic technique for simultaneously resolving both the size and position of the particles. We will also develop fast algorithms for orientation tracking of anisotropic particles recording the shadows of objects with the ombroscopic particule tracking velocimetry technique.

Non-smooth optimization techniques for particule tracking: We will focus on particule tracking using image denoising techniques in order to improve the estimation of the particule location but also the particule monitoring. The main difficulty of this subject is the large amount of data due to video registration.

Velocimetry in plasmas: In order to study the coupling between magnetic and velocity fields in plasmas, space and time-resolved velocity measurements are required. We plan to develop electrostatic as well as optical methods to probe velocity fields in plasmas.

Analysis of fracture patterns by means of the local regularity estimations (Projet Jeunes Chercheurs GdR ISIS, Coll. IRIT, Toulouse): A preliminary work on the local regularity estimation in images has been proposed in [783]. We proposed an efficient strategy in order to identify the areas having a similar local regularity (i.e., segmentation) by using total variation based optimization procedure. In a future work, we will study the fracture patterns by means of such local regularity tools.

Quantitative force sensing in a Scanning Electron Microscope: We just acquired a Scanning Electron Microscope (SEM). This instrument will be used beyond basic electron imaging to study mechanical systems with in situ nm-scale imaging during deformation of materials: fracture of single cellulose fibers, peeling of carbon nanotube, deformation of nano fibers, etc. We will therefore implement our unique differential interferometer in the measurement chamber to perform dynamic high resolution force measurements in parallel to the SEM imaging. This apparatus will lead to the knowledge of the system spatial configuration during solicitation, pointing for example at the role of defects, buckling, adhesion, plastic deformations, etc. on the shape and hysteresis of force curves.

2. *Instrumentation*

Instrumented particles for magneto-hydrodynamics studies: We plan to build instrumented particles capable of simultaneous measurements of acceleration and magnetic fields. An internal memory will make these particles suitable for turbulent magneto-hydrodynamics studies in liquid metals.

Sub-shot noise interferometry: In our quest to push always further the limits of the quadrature phase interferometer used in the force sensor of our home made AFMs, we will implement a new technique that will allow us to break the shot noise floor for stationary measurements. The preliminary results (Fig. 29) are very encouraging and we hope to reach a two orders of magnitude lowering of this background noise, leading us to the sub fm/$\sqrt{\mathrm{Hz}}$ range !

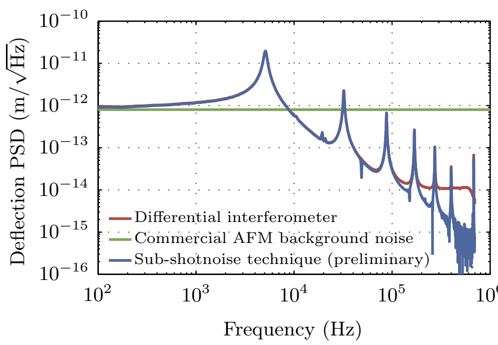

Figure 29: Power Spectrum Density of the thermal noise driven deflection of a raw Silicon Cantilever in air, measured with our differential interferometer (laser power: 10 mW at 532 nm). The detection limit at 10^{-14} m/$\sqrt{\mathrm{Hz}}$, due to shot noise, is 2 order of magnitude lower than that of a commercial AFM. The new sub-noise technique allows us to gain at least an extra order of magnitude in resolution.

Active measurements with a high resolution AFM: We will implement active measurements with a lock-in amplifier on one of our home built-AFM in order to complement the current passive, thermal-noise-based measurements for microrheology, wetting and interfacial mechanics experiments.

Instrumentation for trapping non-transparent micron size particle: In some cases we need to trap a non-transparent micron size particle, for example paramagnetic or Janus particles. Usually for such particles we are using a donut shape laser beam created by a spatial light modulator (SLM). With such a beam shape we can

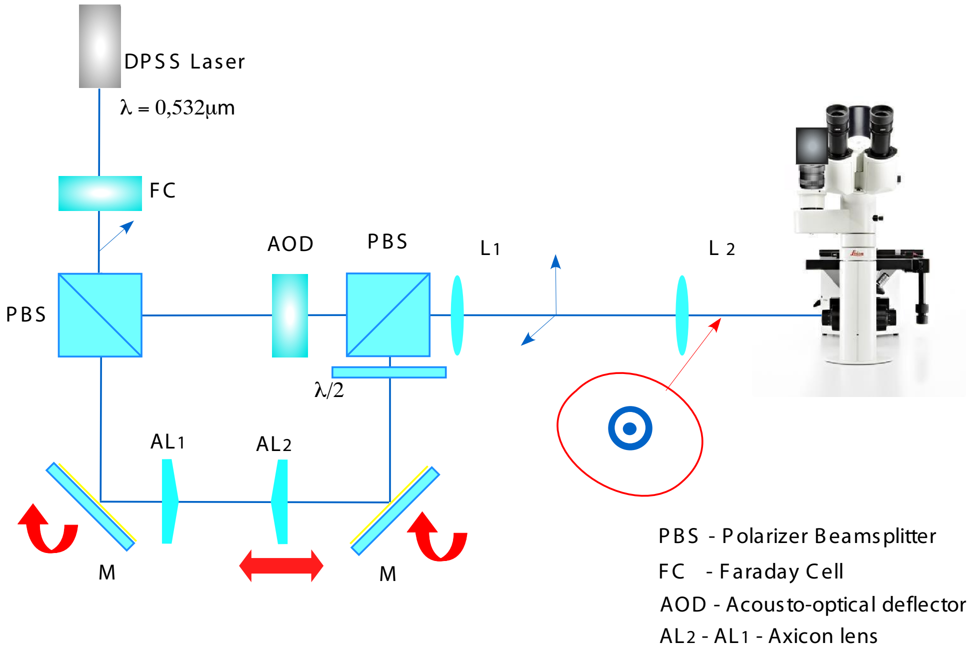

Figure 30: Optical Axicon to create a beam with annular intensity distribution.

decrease the scattering force, which has important contribution for reflecting or absorbing particles. This method has many disadvantages, low hologram refreshment rate, wavelength dependency, and high cost of the SLM. Another way to keep a micron size particle in the trap is to use two counter propagating laser beams focused with two microscope objectives. In this method we need to have two perfectly aligned counter propagating beam, which complicates optical setup. Our idea is to develop a simple optical system based on an optical axicon (Fig. 30). Axicon can be used to create a beam with annular intensity distribution. Such an optical system has another advantage - we can use a long focal distance microscope objective to trap a micron size particle. It is very important for experiments performed in liquids at temperatures above 37^{o}C, because of the microscope objective thermal limitation.

Joint heat flux-velocity probe for turbulent flows: The idea for the future is to make the probe good for several kind of fluids as air, water or low temperature helium. A study will be performed in order to maximize the sensitivity for every fluid. Afterwards we will work to obtain a small rack of probe on the same mount in order to measure spatial correlations of the velocity and/or temperature.

Physics of the violin: The aim in the near future is to build a prototype to promote the process for industrial applications as well as progress in the scientific study of the instrument. Also, reproducible tests on more violins would then be possible. From the physical point of view, we are particularly interested by a phenomenon called 'wolf tone', presumably resulting from interferences between modes of the strings and body. Extension to viola or cello will be considered.

Microfabrication, rapid prototyping and microfluidics: A clean room has been built at ENSL in Jan 2014. This facility shared by the physics and chemistry laboratories already makes possible to produce micro-patterned surfaces by means of UV-lithography and soft lithography techniques. It should be fully operational by sep. 2014. In the spirit of a fab lab, we have also recently setup several prototyping machines: a micromilling machine, precision vinyl cutters, and several coating apparatuses. The combination of these new equipments is intended to devise a broad class of model substrates with controlled geometries and surface chemistry at the micron scale. Two prominent applications concern the fabrication of microfluidic devices, and the fabrication of computer-designed disordered materials. Virtually all the experimental groups should benefit from this novel advanced toolbox.

VI. PRODUCTION SCIENTIFIQUE

A. Monographies

A Concise Introduction to the Statistical Physics of Complex Systems, E. Bertin, Springer (2011).

Physics of Long-Range Interacting Systems, A. Campa, T. Dauxois, D. Fanelli, S. Ruffo, Oxford University Press (2014).

B. Livres édités

Scaling, Fractal and Wavelets, P. Abry, P. Gonçalvès, J. Lévy Vehel (Eds), Wiley (2009).

Peyresq Lectures on Nonlinear Phenomena, vol 3, B. Audoly, F. Bouchet, J.A. Sepulchre (Eds), World Scientific (2012).

Long-Range Interacting Systems, T. Dauxois, S. Ruffo, L. Cugliandolo (Eds), Oxford University Press (2009).

C. Chapitres de livres

A Dynamical Network View of Lyon's Velo'v Shared Bicycle System P. Borgnat, C. Robardet, P. Abry, P. Flandrin, J.-B. Rouquier, N. Tremblay, in "Dynamics on and of Complex Networks, Volume 2", N.Ganguly, A. Mukherjee, B. Mitra, F. Peruani, M. Choudhury (Eds), Springer (2013).

Heart rate variability analyses E. Pereira de Souza Neto, P. Abry, J. Frutoso, P. Flandrin, C. Gharib in "Monitorage des Paramètres Physiologiques en Situation Critique", J. J. Lehot, M. Cannesson (Eds), Arnette (2012).

Applications of Equilibrium Statistical Mechanics to Atmospheres and Oceans F. Bouchet, A. Venaille in "Peyresq Lectures on Nonlinear Phenomena, vol 3", B. Audoly, F. Bouchet, J.A. Sepulchre (Eds), World Scientific (2012).

Non-equilibrium statistical mechanics of the stochastic Navier–Stokes equations and geostrophic turbulence F. Bouchet, C. Nardini, T. Tangarife in "5th Warsaw School of Statistical Physics", B. Cichocki, M. Napiorkowski, J. Piasecki (Eds).

Function spaces vs. scaling functions: Tools for image classification S. Jaffard, P. Abry, S. G. Roux, in "Mathematical Image processing", M. Bergounioux (Ed), Springer (2011).

On the impact of the number of vanishing moments on the dependence structures of compound Poisson motion and fractional Brownian motion in multifractal time B. Vedel, H. Wendt, P. Abry, S. Jaffard, in "Dependence in Probability and Statistics", P. Doukhan, G. Lang, G. Teyssière, D. Surgailis (Eds), Springer (2010).

The contribution of wavelets in multifractal analysis S. Jaffard, P. Abry, H. Wendt, S. Roux, B. Vedel, in "Series in contemporary applied mathematics", A. Damlamian, S. Jaffard, L. T. Tsien (Eds), World scientific publishing (2009).

Wavelet decomposition of measures: Application to multifractal analysis of images P. Abry, S. Jaffard, S. Roux, B. Vedel, H. Wendt, in "Proc. NATO-ASI Conf. on Unexploded Ordnance Detection and Mitigation", J. Byrnes (Ed), Springer (2009).

Fractals and Wavelets : what can we learn on transcription and replication from wavelet-based multifractal analysis of DNA sequences? A. Arneodo, B. Audit, E.-B. Brodie of Brodie, S. Nicolay, M. Touchon, Y. D'Aubenton-Carafa, M. Huvet, C. Thermes in "Encyclopedia of Complexity and Systems Science", R. A. Meyers (Ed), Springer (2009).

Measuring out of equilibrium fluctuations L. Bellon, J. R. Gomez-Solano, A. Petrosyan, S. Ciliberto in "Nonequilibrium Statistical Physics of Small Systems: Fluctuation relations and beyond", C. Jarzynski, R. Klages, W. Just (Eds), Wiley (2013).

Time-Frequency Learning Machines For NonStationarity Detection Using Surrogate P. Borgnat, P. Flandrin, C. Richard, A. Ferrari, H. Amoud, P. Honeine, in "Data Mining and Machine Learning for Astronomical Applications", K. Ali, A. Srivastava, J.D. Scargle, M.J. Way (Eds), CRC Press (2012).

Physics of viral infectivity: matching genome length with capsid size A. Evilevitch M. Castelnovo in "Emerging topics in physical virology", P. Stockley (Ed), World Scientific Publishing (2010).

Internal Waves in Laboratory Experiments B. Sutherland, T. Dauxois, T. Peacock in "Atmospheric and Oceanic Flows: Insights from Laboratory Experiments and Numerical Simulations", T. von Larcher, P. Williams (Eds), AGU Books (2014).

Des signaux stationnaires en quel sens ? P. Flandrin in "Le traitement de l'information en interaction avec les mathématiques et la physique", A. Appriou, O. Macchi (Eds), CNRS Éditions (2010).

Écrire un article P. Flandrin in "Écritures : sur les traces de Jack Goody", É. Guichard (Ed), Presses de l'ENSSIB (2012).

Nonstationary signal analysis with kernel machines P. Honeine, P. Borgnat, C. Richard, P. Flandrin in "Handbook of Research on Machine Learning Applications and Trends: Algorithms, Methods and Techniques", E. Soria, J. D. Martin, R. Magdanela, M. Martinez, A.J. Serrano (Eds), ICI Global (2012).

Une fréquence peut-elle être instantanée ? P. Flandrin in "Produire le temps", H. Vinet (Ed), Hermann (2014).

The Physics of Turbulence E. Lévêque in "Structure Formation in the Universe", G. Chabrier (Ed), Cambridge University Press (2009).

Towards a Covariant Loop Quantum Gravity E.R. Livine in "Approaches to Quantum Gravity: Toward a New Understanding of Space, Time and Matter", D. Oriti (Ed), Cambridge University Press (2009).

Apport de techniques couplées (diffusion de rayonnements, résonance magnétique, vélocimétrie ultrasonore) à la rhéologie E. Peuvrel-Disdier, S. Manneville, G. Ovarlez, F. Pignon, S. Rodts in "La mesure en rhéologie: des avancées récentes aux perspectives", J.-L. Grossiord, A. Ponton (Eds), EDP Sciences (2013).

A Lagrangian view of turbulent dispersion and mixing B. Sawford, J.-F. Pinton in "Ten chapters in Turbulence", P.A. Davidson, Y. Kaneda, K.R. Sreenivasan (Eds), Cambridge UP (2013).

Publications du laboratoire

Seuls les articles publiés dans des revues à comité de lecture ont été retenus.

T1B. Hydrodynamics and Geophysics: *Publications*

[1] Claudia Adam and Valérie Vidal. Mantle Flow Drives the Subsidence of Oceanic Plates. *Science*, 328(5974):83–85, Apr 2 2010.

[2] Claudia Adam and Valérie Vidal. Response to Comment on “Mantle Flow Drives the Subsidence of Oceanic Plates”. *Science*, 331(6020), Feb 25 2011.

[3] M. A. Aguirre, J. G. Grande, A. Calvo, L. A. Pugnaloni, and J-C. Geminard. Pressure Independence of Granular Flow through an Aperture. *Physical Review Letters*, 104(23), Jun 11 2010.

[4] Maria Alejandra Aguirre, Juan Gabriel Grande, Adriana Calvo, Luis A. Pugnaloni, and Jean-Christophe Geminard. Granular flow through an aperture: Pressure and flow rate are independent. *Physical Review E*, 83(6, 1), Jun 30 2011.

[5] M. Berhanu, B. Gallet, R. Monchaux, M. Bourgoin, Ph. Odier, J. F. Pinton, N. Plihon, R. Volk, S. Fauve, N. Mordant, F. Petrelis, S. Aumaitre, A. Chiffaudel, F. Daviaud, B. Dubrulle, and F. Ravelet. Bistability between a stationary and an oscillatory dynamo in a turbulent flow of liquid sodium. *Journal of Fluid Mechanics*, 641:217–226, Dec 25 2009.

[6] M. Berhanu, G. Verhille, J. Boisson, B. Gallet, C. Gissinger, S. Fauve, N. Mordant, F. Petrelis, M. Bourgoin, P. Odier, J. F. Pinton, N. Plihon, S. Aumaitre, A. Chiffaudel, F. Daviaud, B. Dubrulle, and C. Pirat. Dynamo regimes and transitions in the VKS experiment. *European Physical Journal B*, 77(4):459–468, Oct 2010.

[7] Anne-Florence Bitbol, Nicolas Taberlet, Stephen W. Morris, and Jim N. McElwaine. Scaling and dynamics of washboard roads. *Physical Review E*, 79(6), Jun 2009.

[8] J. Boisson, S. Aumaitre, N. Bonnefoy, M. Bourgoin, F. Daviaud, B. Dubrulle, Ph Odier, J-F Pinton, N. Plihon, and G. Verhille. Symmetry and couplings in stationary Von Karman sodium dynamos. *New Journal of Physics*, 14, Jan 23 2012.

[9] Guilhem Bordes, Frederic Moisy, Thierry Dauxois, and Pierre-Philippe Cortet. Experimental evidence of a triadic resonance of plane inertial waves in a rotating fluid. *Physics of Fluids*, 24(1), Jan 2012.

[10] Guilhem Bordes, Antoine Venaille, Sylvain Joubaud, Philippe Odier, and Thierry Dauxois. Experimental observation of a strong mean flow induced by internal gravity waves. *Physics of Fluids*, 24(8), Aug 2012.

[11] Wouter J. T. Bos, Laurent Chevillard, Julian F. Scott, and Robert Rubinstein. Reynolds number effect on the velocity increment skewness in isotropic turbulence. *Physics of Fluids*, 24(1), Jan 2012.

[12] Freddy Bouchet, Cesare Nardini, and Tomas Tangarife. Kinetic Theory of Jet Dynamics in the Stochastic Barotropic and 2D Navier-Stokes Equations. *Journal of Statistical Physics*, 153(4):572–625, Nov 2013.

[13] Freddy Bouchet and Antoine Venaille. Statistical mechanics of two-dimensional and geophysical flows. *Physics Reports*, 515(5):227–295, Jun 2012.

[14] Baptiste Bourget, Thierry Dauxois, Sylvain Joubaud, and Philippe Odier. Experimental study of parametric subharmonic instability for internal plane waves. *Journal of Fluid Mechanics*, 723:1–20, May 2013.

[15] A. Cahuzac, J. Boudet, P. Borgnat, and E. Lévêque. Smoothing algorithms for mean-flow extraction in large-eddy simulation of complex turbulent flows. *Physics of Fluids*, 22(12), Dec 2010.

[16] A. Cahuzac, J. Boudet, E. Lévêque, and P. Borgnat. Extraction de flot moyen dans des simulations numériques à grande échelle de fluides par filtre de kalman adaptatif. In *23e Colloque sur le Traitement du Signal et des Images. Gretsi-2011*, page id. 191, Sept 2011.

[17] E. Calzavarini, R. Volk, M. Bourgoin, E. Leveque, J. F. Pinton, and F. Toschi. Acceleration statistics of finite-sized particles in turbulent flow: the role of Faxen forces. *Journal of Fluid Mechanics*, 630:179–189, Jul 10 2009.

[18] Enrico Calzavarini, Romain Volk, Emmanuel Leveque, Jean-Francois Pinton, and Federico Toschi. Impact of trailing wake drag on the statistical properties and dynamics of finite-sized particle in turbulence. *Physica D*, 241(3, SI):237–244, Feb 1 2012.

[19] L. Chevillard, B. Castaing, A. Arneodo, E. Lévêque, J.F. Pinton, and S.G. Roux. A phenomenological theory of eulerian and lagrangian velocity fluctuations in turbulent flows. *Comptes Rendus Physique*, 13(9-10):899–928, November 2012.

[20] L. Chevillard, R. Robert, and V. Vargas. A stochastic representation of the local structure of turbulence. *Europhysics Letters*, 89(5), Mar 2010.

[21] Laurent Chevillard, Emmanuel Leveque, Francesco Taddia, Charles Meneveau, Huidan Yu, and Carlos Rosales. Local and nonlocal pressure Hessian effects in real and synthetic fluid turbulence. *Physics of Fluids*, 23(9), Sep 2011.

[22] Laurent Chevillard and Charles Meneveau. Lagrangian time correlations of vorticity alignments in isotropic turbulence: Observations and model predictions. *Physics of Fluids*, 23(10), Oct 2011.

[23] Laurent Chevillard and Charles Meneveau. Orientation dynamics of small, triaxial-ellipsoidal particles in isotropic turbulence. *Journal of Fluid Mechanics*, 737:571–596, Dec 2013.

[24] Laurent Chevillard and Michael Wilczek. Structures and statistics of fluid turbulence Foreword. *Comptes Rendus Physique*, 13(9-10):865, Nov-Dec 2012.

[25] F. Chilla and J. Schumacher. New perspectives in turbulent Rayleigh-Benard convection. *European Physical Journal E*, 35(7), Jul 2012.

[26] S. Denisov, V. Dolgikh, I. Kolesnichenko, R. Khalilov, S. Khripchenko, G. Verhille, N. Pli-

hon, and J. F. Pinton. Flow of liquid metal in a cylindrical crystalizer generating two-directional MHD-stirring. *Magnetohydrodynamics*, 46(1):69–78, Jan-Mar 2010.

[27] Thibaut Divoux, Eric Bertin, Valérie Vidal, and Jean-Christophe Géminard. Intermittent outgassing through a non-Newtonian fluid. *Physical Review E*, 79(5, 2), May 2009.

[28] Thibaut Divoux, Valérie Vidal, Maurizio Ripepe, and Jean-Christophe Géminard. Influence of non-Newtonian rheology on magma degassing. *Geophysical Research Letters*, 38, Jun 24 2011.

[29] Lauris Ducasse and Alain Pumir. Inertial particle collisions in turbulent synthetic flows: Quantifying the sling effect. *Physical Review E*, 80(6, 2), Dec 2009.

[30] E. Falcon, S.G. Roux, and B. Audit. Revealing intermittency in experimental data with steep power spectra. *European Physical Journal*, 90(5):50007, June 2010.

[31] E. Falcon, S.G. Roux, and C. Laroche. On the origin of intermittency in wave turbulence. *European Physical Journal*, 90(3):34005, May 2010.

[32] Gregory Falkovich and Krzysztof Gawedzki. Turbulence on hyperbolic plane: the fate of inverse cascade. *Journal of Statistical Physics*, 156(1):10–54, Jul 2014.

[33] Gregory Falkovich, Haitao Xu, Alain Pumir, Eberhard Bodenschatz, Luca Biferale, Guido Boffetta, Alessandra S. Lanotte, Federico Toschi, and Int Collaboration Turbulence Res. On Lagrangian single-particle statistics. *Physics of Fluids*, 24(5), May 2012.

[34] L. Fiabane, R. Volk, J-F Pinton, R. Monchaux, A. Cartellier, and M. Bourgoin. Do finite-size neutrally buoyant particles cluster? *Physica Scripta*, T155, Jul 2013.

[35] L. Fiabane, R. Zimmermann, R. Volk, J. F. Pinton, and M. Bourgoin. Clustering of finite-size particles in turbulence. *Physical Review E*, 86(3, 2), Sep 21 2012.

[36] E. Freyssingeas, M. J. Dalbe, and J. C. Geminard. Flowers in flour: Avalanches in cohesive granular matter. *Physical Review E*, 83(5, 1), May 27 2011.

[37] B. Gallet, S. Aumaitre, J. Boisson, F. Daviaud, B. Dubrulle, N. Bonnefoy, M. Bourgoin, Ph. Odier, J. F. Pinton, N. Plihon, G. Verhille, S. Fauve, and F. Petrelis. Experimental Observation of Spatially Localized Dynamo Magnetic Fields. *Physical Review Letters*, 108(14), Apr 2 2012.

[38] Krzysztof Gawedzki, David P. Herzog, and Jan Wehr. Ergodic Properties of a Model for Turbulent Dispersion of Inertial Particles. *Communications in Mathematical Physics*, 308(1):49–80, Nov 2011.

[39] M. Gibert, H. Pabiou, J. C. Tisserand, B. Gertjerenken, B. Castaing, and F. Chilla. Heat convection in a vertical channel: Plumes versus turbulent diffusion. *Physics of Fluids*, 21(3), Mar 2009.

[40] Eugenio Hamm and Jean-Christophe Geminard. The weight of a falling chain, revisited. *American Journal of Physics*, 78(8):828–833, Aug 2010.

[41] Sylvain Joubaud, James Munroe, Philippe Odier, and Thierry Dauxois. Experimental parametric subharmonic instability in stratified fluids. *Physics of Fluids*, 24(4), Apr 2012.

[42] Jason Larkin, M. M. Bandi, Alain Pumir, and Walter I. Goldburg. Power-law distributions of particle concentration in free-surface flows. *Physical Review E*, 80(6, 2), Dec 2009.

[43] Yi Li, Laurent Chevillard, Gregory Eyink, and Charles Meneveau. Matrix exponential-based closures for the turbulent subgrid-scale stress tensor. *Physical Review E*, 79(1, 2), Jan 2009.

[44] N. Machicoane, J. Bonaventure, and R. Volk. Melting dynamics of large ice balls in a turbulent swirling flow. *Physics of Fluids*, 25(12), Dec 2013.

[45] Nathanael Machicoane, Robert Zimmermann, Lionel Fiabane, Mickael Bourgoin, Jean-Francois Pinton, and Romain Volk. Large sphere motion in a nonhomogeneous turbulent flow. *New Journal of Physics*, 16(1):013053, 2014.

[46] M. J. Mercier, R. Vasseur, and T. Dauxois. Resurrecting dead-water phenomenon. *Nonlinear Processes in Geophysics*, 18(2):193–208, 2011.

[47] Matthieu J. Mercier, Louis Gostiaux, Karl Helfrich, Joel Sommeria, Samuel Viboud, Henri Didelle, Sasan J. Ghaemsaidi, Thierry Dauxois, and Thomas Peacock. Large-scale, realistic laboratory modeling of M-2 internal tide generation at the Luzon Strait. *Geophysical Research Letters*, 40(21):5704–5709, Nov 16 2013.

[48] Matthieu J. Mercier, Denis Martinand, Manikandan Mathur, Louis Gostiaux, Thomas Peacock, and Thierry Dauxois. New wave generation. *Journal of Fluid Mechanics*, 657:308–334, Aug 25 2010.

[49] Matthieu J. Mercier, Manikandan Mathur, Louis Gostiaux, Theo Gerkema, Jorge M. Magalhaes, Jose C. B. Da Silva, and Thierry Dauxois. Soliton generation by internal tidal beams impinging on a pycnocline: laboratory experiments. *Journal of Fluid Mechanics*, 704:37–60, Aug 10 2012.

[50] P. Mininni, P. Dmitruk, P. Odier, J.-F. Pinton, N. Plihon, G. Verhille, R. Volk, and M. Bourgoin. Long-term memory in experiments and numerical simulations of hydrodynamic and magnetohydrodynamic turbulence. *Phys. Rev. E*, 89:053005, May 2014.

[51] Sophie Miralles, Nicolas Bonnefoy, Mickael Bourgoin, Philippe Odier, Jean-Francois Pinton, Nicolas Plihon, Gautier Verhille, Jean Boisson, Francois Daviaud, and Berengere Dubrulle. Dynamo threshold detection in the von Karman sodium experiment. *Physical Review E*, 88(1), Jul 8 2013.

[52] Sophie Miralles, Johann Herault, Stephan Fauve, Christophe Gissinger, Fran çois Pétrélis, Fran çois Daviaud, Bérengère Dubrulle, Jean Boisson, Mickaël Bourgoin, Gautier Verhille, Philippe Odier, Jean-Fran çois Pinton, and Nicolas Plihon. Dynamo efficiency controlled by hydrodynamic bistability. *Phys. Rev. E*, 89:063023, Jun 2014.

[53] Romain Monchaux, Michael Berhanu, Sebastien Aumaitre, Arnaud Chiffaudel, Francois Daviaud, Berengere Dubrulle, Florent Ravelet, Stephan Fauve, Nicolas Mordant, Francois Petrelis, Mickael Bourgoin, Philippe Odier, Jean-Francois Pinton, Nicolas Plihon, and Romain Volk. The von Karman Sodium experiment: Turbulent dynamical dynamos. *Physics of Fluids*, 21(3), Mar 2009.

[54] G. Montagnac, R. Caracas, E. Bobocioiu, F. Vittoz, and B. Reynard. Anharmonicity of graphite from UV Raman spectroscopy to 2700 K. *Carbon*, 54:68–75, Apr 2013.

[55] Balasubramanya T. Nadiga and Freddy Bouchet. The equivalence of the Lagrangian-averaged Navier-Stokes-alpha model and the rational large eddy simulation model in two dimensions. *Physics of Fluids*,

23(9), Sep 2011.

[56] P. Odier, J. Chen, and R. E. Ecke. Understanding and modeling turbulent fluxes and entrainment in a gravity current. *Physica D*, 241(3, SI):260–268, Feb 1 2012.

[57] P Odier, J. Chen, and R. E. Ecke. Entrainment and mixing in a laboratory model fo oceanic overflow. *J. Fluid Mech.*, 746:498–535, 2014.

[58] P. Odier, J. Chen, M. K. Rivera, and R. E. Ecke. Fluid Mixing in Stratified Gravity Currents: The Prandtl Mixing Length. *Physical Review Letters*, 102(13), Apr 3 2009.

[59] Thomas Peacock, Matthieu J. Mercier, Henri Didelle, Samuel Viboud, and Thierry Dauxois. A laboratory study of low-mode internal tide scattering by finite-amplitude topography. *Physics of Fluids*, 21(12), Dec 2009.

[60] Baptiste Percier, Sebastien Manneville, Jim N. McElwaine, Stephen W. Morris, and Nicolas Taberlet. Lift and drag forces on an inclined plow moving over a granular surface. *Physical Review E*, 84(5, 1), Nov 3 2011.

[61] Baptiste Percier, Sebastien Manneville, and Nicolas Taberlet. Modeling a washboard road: From experimental measurements to linear stability analysis. *Physical Review E*, 87(1), Jan 17 2013.

[62] Christophe Perge, Maria Alejandra Aguirre, Paula Alejandra Gago, Luis A. Pugnaloni, Denis Le Tourneau, and Jean-Christophe Geminard. Evolution of pressure profiles during the discharge of a silo. *Physical Review E*, 85(2, 1), Feb 8 2012.

[63] Nicolas Plihon and Pascal Chabert. Ion acoustic waves and double-layers in electronegative expanding plasmas. *Physics of Plasmas*, 18(8), Aug 2011.

[64] Alain Pumir, Eberhard Bodenschatz, and Haitao Xu. Tetrahedron deformation and alignment of perceived vorticity and strain in a turbulent flow. *Physics of Fluids*, 25(3), Mar 2013.

[65] Alain Pumir and Aurore Naso. Statistical properties of the coarse-grained velocity gradient tensor in turbulence: Monte-Carlo simulations of the tetrad model. *New Journal of Physics*, 12, Dec 16 2010.

[66] Alain Pumir and Aurore Naso. Insight on turbulent flows from Lagrangian tetrads. *Comptes Rendus Physique*, 13(9-10):889–898, NOV-DEC 2012.

[67] Alain Pumir and Michael Wilkinson. Orientation statistics of small particles in turbulence. *New Journal of Physics*, 13, Sep 20 2011.

[68] Alain Pumir and Michael Wilkinson. A Model for the Shapes of Advected Triangles. *Journal of Statistical Physics*, 152(5):934–953, Sep 2013.

[69] X. Riedinger, J.-C. Tisserand, F. Seychelles, B. Castaing, and F. Chilla. Heat transport regimes in an inclined channel. *Physics of Fluids*, 25(1), Jan 2013.

[70] S.G. Roux, P. Koucká Knížová, Z. Mošna, and P. Abry. Ionosphere fluctuations and global indices: A scale dependent wavelet-based cross-correlation analysis. *Journal of Atmospheric and Solar-Terrestrial Physics*, 90–91:186–197, 2012.

[71] E. Rusaouen, X. Riedinger, J. C. Tisserand, F. Seychelles, J. Salort, B. Castaing, and F. Chilla. Laminar and Intermittent flow in a tilted heat pipe. *European Physical Journal E*, 37(1), Jan 29 2014.

[72] J. Salort, O. Liot, E. Rusaouen, F. Seychelles, J-C Tisserand, M. Creyssels, B. Castaing, and F. Chilla. Thermal boundary layer near roughnesses in turbulent Rayleigh-Benard convection: Flow structure and multistability. *Physics of Fluids*, 26(1), Jan 2014.

[73] J. Salort, X. Riedinger, E. Rusaouen, J. C. Tisserand, F. Seychelles, B. Castaing, and F. Chilla. Turbulent velocity profiles in a tilted heat pipe. *Physics of Fluids*, 25(10), Oct 2013.

[74] S. Schael et al. Electroweak measurements in electron positron collisions at W-boson-pair energies at LEP. *Physics Reports*, 532(4):119–244, Nov 30 2013.

[75] Helene Scolan, Eugeny Ermanyuk, and Thierry Dauxois. Nonlinear Fate of Internal Wave Attractors. *Physical Review Letters*, 110(23), Jun 7 2013.

[76] Luca Sorriso-Valvo, Vincenzo Carbone, Michael Bourgoin, Philippe Odier, Nicolas Plihon, and Romain Volk. Statistical analysis of magnetic field reversals in laboratory dynamo and in paleomagnetic measurements. *Internatonal Journal of Modern Physics B*, 23(28-29):5483–5491, Nov 20 2009. Workshop on Modelling Geophysical Systems by Statistical Mechanics Methods, Erice, Italy, Apr 27-May 02, 2008.

[77] J. B. Tary, L. Geli, C. Guennou, P. Henry, N. Sultan, N. Cagatay, and V. Vidal. Microevents produced by gas migration and expulsion at the seabed: a study based on sea bottom recordings from the Sea of Marmara. *Geophysical Journal International*, 190(2):993–1007, Aug 2012.

[78] J. C. Tisserand, M. Creyssels, Y. Gasteuil, H. Pabiou, M. Gibert, B. Castaing, and F. Chilla. Comparison between rough and smooth plates within the same Rayleigh-Benard cell. *Physics of Fluids*, 23(1), Jan 2011.

[79] J-C Tisserand, M. Creyssels, M. Gibert, B. Castaing, and F. Chilla. Convection in a vertical channel. *New Journal of Physics*, 12, Jul 28 2010.

[80] Hatem Touil, Denis Ricot, and Emmanuel Leveque. Direct and large-eddy simulation of turbulent flows on composite multi-resolution grids by the lattice Boltzmann method. *Journal of Computational Physics*, 256:220–233, Jan 1 2014.

[81] Germán Varas, Jean-Christophe Géminard, and Valérie Vidal. Air invasion in a granular layer immersed in a fluid: morphology and dynamics. *Granular Matter*, 15(6):801–810, Dec 2013.

[82] Germán Varas, Valérie Vidal, and Jean-Christophe Géminard. Dynamics of crater formations in immersed granular materials. *Physical Review E*, 79(2, 1), Feb 2009.

[83] Germán Varas, Valérie Vidal, and Jean-Christophe Géminard. Morphology of air invasion in an immersed granular layer. *Physical Review E*, 83(6, 1), Jun 23 2011.

[84] Germán Varas, Valérie Vidal, and Jean-Christophe Géminard. Venting dynamics of an immersed granular layer. *Physical Review E*, 83(1, 1), Jan 28 2011.

[85] A. Venaille. Bottom-trapped currents as statistical equilibrium states above topographic anomalies. *Journal of Fluid Mechanics*, 699:500–510, May 25 2012.

[86] A. Venaille, J. Le Sommer, J. M. Molines, and B. Barnier. Stochastic variability of oceanic flows above topography anomalies. *Geophysical Research Letters*, 38, Aug 27 2011.

[87] A. Venaille, G. K. Vallis, and S. M. Griffies. The catalytic role of the beta effect in barotropization processes. *Journal of Fluid Mechanics*, 709:490–515, Oct 25 2012.

[88] Antoine Venaille and Freddy Bouchet. Statistical Ensemble Inequivalence and Bicritical Points

for Two-Dimensional Flows and Geophysical Flows. *Physical Review Letters*, 102(10), Mar 13 2009.

[89] Antoine Venaille and Freddy Bouchet. Oceanic Rings and Jets as Statistical Equilibrium States. *Journal of Physical Oceanography*, 41(10):1860–1873, Oct 2011.

[90] Antoine Venaille, Geoffrey K. Vallis, and K. Shafer Smith. Baroclinic Turbulence in the Ocean: Analysis with Primitive Equation and Quasigeostrophic Simulations. *Journal of Physical Oceanography*, 41(9):1605–1623, Sep 2011.

[91] Gautier Verhille, Ruslan Khalilov, Nicolas Plihon, Peter Frick, and Jean-Francois Pinton. Transition from hydrodynamic turbulence to magnetohydrodynamic turbulence in von Karman flows. *Journal of Fluid Mechanics*, 693:243–260, Feb 25 2012.

[92] Gautier Verhille, Nicolas Plihon, Mickael Bourgoin, Philippe Odier, and Jean-Francois Pinton. Laboratory Dynamo Experiments. *Space Science Reviews*, 152(1-4):543–564, May 2010.

[93] Gautier Verhille, Nicolas Plihon, Mickal Bourgoin, Philippe Odier, and Jean-Francois Pinton. Induction in a von Karman flow driven by ferromagnetic impellers. *New Journal of Physics*, 12, Mar 9 2010.

[94] Gautier Verhille, Nicolas Plihon, Gregory Fanjat, Romain Volk, Mickael Bourgoin, and Jean-Francois Pinton. Large-scale fluctuations and dynamics of the Bullard-von Karman dynamo. *Geophysical and Astrophysical Fluid Dynamics*, 104(2-3):189–205, 2010.

[95] V. Vidal, M. Ripepe, T. Divoux, D. Legrand, J. C. Geminard, and F. Melo. Dynamics of soap bubble bursting and its implications to volcano acoustics. *Geophysical Research Letters*, 37, Apr 2 2010.

[96] Valérie Vidal, Mie Ichihara, Maurizio Ripepe, and Kei Kurita. Acoustic waveform of continuous bubbling in a non-Newtonian fluid. *Physical Review E*, 80(6, 2), Dec 2009.

[97] Valérie Vidal, François Soubiran, Thibaut Divoux, and Jean-Christophe Géminard. Degassing cascades in a shear-thinning viscoelastic fluid. *Physical Review E*, 84(6, 2), Dec 2 2011.

[98] R. Volk, E. Calzavarini, E. Leveque, and J-F Pinton. Dynamics of inertial particles in a turbulent von Karman flow. *Journal of Fluid Mechanics*, 668:223–235, Feb 10 2011.

[99] M Vosskuhle, A Pumir, E Lévêque, and M Wilkinson. Prevalence of the sling effect for enhancing collision rates in turbulent suspensions. *J. Fluid Mech.*, 749:841–852, 2014.

[100] Michel Vosskuhle, Emmanuel Leveque, Michael Wilkinson, and Alain Pumir. Multiple collisions in turbulent flows. *Physical Review E*, 88(6), Dec 10 2013.

[101] Michael Wilkinson and Alain Pumir. Spherical Ornstein-Uhlenbeck Processes. *Journal of Statistical Physics*, 145(1):113–142, Oct 2011.

[102] H Xu, A Pumir, G Falkovich, E Bodenschatz, M Shats, H Xia, N Francois, and G Boffetta. Flight-crash events in turbulence. *Proceedings of the National Academy of Sciences of the United States of America*, 111:7558–7563, 2014.

[103] Haitao Xu, Alain Pumir, and Eberhard Bodenschatz. The pirouette effect in turbulent flows. *Nature Physics*, 7(9):709–712, Sep 2011.

[104] Robert Zimmermann, Yoann Gasteuil, Mickael Bourgoin, Romain Volk, Alain Pumir, and Jean-Francois Pinton. Rotational Intermittency and Turbulence Induced Lift Experienced by Large Particles in a Turbulent Flow. *Physical Review Letters*, 106(15), Apr 11 2011.

[105] Robert Zimmermann, Haitao Xu, Yoann Gasteuil, Mickael Bourgoin, Romain Volk, Jean-Francois Pinton, and Eberhard Bodenschatz. The Lagrangian exploration module: An apparatus for the study of statistically homogeneous and isotropic turbulence. *Review of Scientific Instruments*, 81(5), May 2010.

T2B. Soft matter : multi-scale mechanics, from measurements to models: *Publications*

[106] Hector Alarcon, Osvanny Ramos, Loic Vanel, Franck Vittoz, Francisco Melo, and Jean-Christophe Geminard. Softening Induced Instability of a Stretched Cohesive Granular Layer. *Physical Review Letters*, 105(20), Nov 10 2010.

[107] Pierre Ballesta, Minne Paul Lettinga, and Sebastien Manneville. Interplay between a hydrodynamic instability and a phase transition: the Faraday instability in dispersions of rodlike colloids. *Soft Matter*, 7(24):11440–11446, 2011.

[108] Julien Beaumont, Nicolas Louvet, Thibaut Divoux, Marc-Antoine Fardin, Hugues Bodiguel, Sandra Lerouge, Sebastien Manneville, and Annie Colin. Turbulent flows in highly elastic wormlike micelles. *Soft Matter*, 9(3):735–749, 2013.

[109] Baptiste Blanc and Jean-Christophe Geminard. Intrinsic creep of a granular column subjected to temperature changes. *Physical Review E*, 88(2), Aug 5 2013.

[110] Baptiste Blanc, Luis A. Pugnaloni, and Jean-Christophe Geminard. Creep motion of a model frictional system. *Physical Review E*, 84(6, 1), Dec 27 2011.

[111] Antoine Bricard, Jean-Baptiste Caussin, Nicolas Desreumaux, Olivier Dauchot, and Denis Bartolo. Emergence of macroscopic directed motion in populations of motile colloids. *Nature*, 503(7474):95–98, 2013.

[112] Tommaso Brotto, Jean-Baptiste Caussin, Eric Lauga, and Denis Bartolo. Hydrodynamics of confined active fluids. *Physical Review Letters*, 110(3), 2013.

[113] Julien Buchoux, Ludovic Bellon, Sophie Marsaudon, and Jean-Pierre Aimé. Carbon nanotubes adhesion and nanomechanical behavior from peeling force spectroscopy. *European Physical Journal B*, 84(1):69–77, Nov 2011.

[114] D. Chateau and J. C. Geminard. Fracture path in an anisotropic material in the light of a friction experiment. *Physical Review E*, 88(3), Sep 16 2013.

[115] Doru Constantin, Patrick Davidson, Eric Freyssingeas, and Anders Madsen. Slow dynamics of a colloidal lamellar phase. *Journal of Chemical Physics*, 133(22), Dec 14 2010.

[116] Pierre-Philippe Cortet, Marie-Julie Dalbe, Claudia Guerra, Caroline Cohen, Matteo Ciccotti, Stephane Santucci, and Loic Vanel. Intermittent stick-slip dynamics during the peeling of an adhesive tape from a roller. *Physical Review E*, 87(2), Feb 19 2013.

[117] Marie-Julie Dalbe, Stephane Santucci, Pierre-

Philippe Cortet, and Loic Vanel. Strong dynamical effects during stick-slip adhesive peeling. *Soft Matter*, 10(1):132–138, 2014.

[118] Jalal Dehmoune, Sebastien Manneville, and Jean-Paul Decruppe. Local Velocity Measurements in the Shear-Thickening Transition of Dilute Micellar Solutions of Surfactants. *Langmuir*, 27(3):1108–1115, Feb 1 2011.

[119] S. Deschanel, L. Vanel, N. Godin, E. Maire, G. Vigier, and S. Ciliberto. Mechanical response and fracture dynamics of polymeric foams. *Journal of Physics D-Applied Physics*, 42(21), 2009.

[120] S. Deschanel, L. Vanel, N. Godin, G. Vigier, and S. Ciliberto. Experimental study of crackling noise: conditions on power law scaling correlated with fracture precursors. *Journal of Statistical Mechanics-Theory and Experiment*, 2009.

[121] Nicolas Desreumaux, Jean-Baptiste Caussin, Raphael Jeanneret, Eric Lauga, and Denis Bartolo. Hydrodynamic fluctuations in confined particle-laden fluids. *Physical Review Letters*, 111(11), 2013.

[122] Clemence Devailly, Justine Laurent, Audrey Steinberger, Ludovic Bellon, and Sergio Ciliberto. Mode coupling in a hanging-fiber AFM used as a rheological probe. *Europhysics Letters*, 106(5):54005, Jun 2014.

[123] Thibaut Divoux, Catherine Barentin, and Sebastien Manneville. From stress-induced fluidization processes to Herschel-Bulkley behaviour in simple yield stress fluids. *Soft Matter*, 7(18):8409–8418, 2011.

[124] Thibaut Divoux, Catherine Barentin, and Sebastien Manneville. Stress overshoot in a simple yield stress fluid: An extensive study combining rheology and velocimetry. *Soft Matter*, 7(19):9335–9349, 2011.

[125] Thibaut Divoux, Vincent Grenard, and Sebastien Manneville. Rheological Hysteresis in Soft Glassy Materials. *Physical Review Letters*, 110(1), Jan 2 2013.

[126] Thibaut Divoux, David Tamarii, Catherine Barentin, and Sebastien Manneville. Transient Shear Banding in a Simple Yield Stress Fluid. *Physical Review Letters*, 104(20), May 21 2010.

[127] Thibaut Divoux, David Tamarii, Catherine Barentin, Stephen Teitel, and Sebastien Manneville. Yielding dynamics of a Herschel-Bulkley fluid: a critical-like fluidization behaviour. *Soft Matter*, 8(15):4151–4164, 2012.

[128] Arthur A. Evans, Saverio E. Spagnolie, Denis Bartolo, and Eric Lauga. Elastocapillary self-folding: buckling, wrinkling, and collapse of floating filaments. *Soft Matter*, 9(5):1711–1720, 2013.

[129] Ralf Everaers. Topological versus rheological entanglement length in primitive-path analysis protocols, tube models, and slip-link models. *Physical Review E*, 86(2, 1), Aug 13 2012.

[130] M. A. Fardin, T. Divoux, M. A. Guedeau-Boudeville, I. Buchet-Maulien, J. Browaeys, G. H. McKinley, S. Manneville, and S. Lerouge. Shear-banding in surfactant wormlike micelles: elastic instabilities and wall slip. *Soft Matter*, 8(8):2535–2553, 2012.

[131] M. A. Fardin, T. J. Ober, V. Grenard, T. Divoux, S. Manneville, G. H. McKinley, and S. Lerouge. Interplay between elastic instabilities and shear-banding: three categories of Taylor-Couette flows and beyond. *Soft Matter*, 8(39):10072–10089, 2012.

[132] Marc-Antoine Fardin, Christophe Perge, Nicolas Taberlet, and Sebastien Manneville. Flow-induced structures versus flow instabilities. *Physical Review E*, 89:011001(R), 2014.

[133] Jean-Christophe Geminard and Eric Bertin. Aging of the frictional properties induced by temperature variations. *Physical Review E*, 82(5, 2), Nov 9 2010.

[134] Jean-Christophe Geminard, Lorene Champougny, Pierre Lidon, and Francisco Melo. Flexural fracturing of a cohesive granular layer. *Physical Review E*, 85(1, 1), Jan 17 2012.

[135] Thomas Gibaud, Catherine Barentin, Nicolas Taberlet, and Sebastien Manneville. Shear-induced fragmentation of laponite suspensions. *Soft Matter*, 5(16):3026–3037, 2009.

[136] Thomas Gibaud, Damien Frelat, and Sebastien Manneville. Heterogeneous yielding dynamics in a colloidal gel. *Soft Matter*, 6(15):3482–3488, 2010.

[137] Thomas Gibaud, Alessio Zaccone, Emanuela Del Gado, Veronique Trappe, and Peter Schurtenberger. Unexpected Decoupling of Stretching and Bending Modes in Protein Gels. *Physical Review Letters*, 110(5), Jan 30 2013.

[138] Vincent Grenard, Thibaut Divoux, Nicolas Taberlet, and Sebastien Manneville. Timescales in creep and yielding of attractive gels. *Soft Matter*, 10:1555–1571, 2014.

[139] Vincent Grenard, Nicolas Taberlet, and Sebastien Manneville. Shear-induced structuration of confined carbon black gels: steady-state features of vorticity-aligned flocs. *Soft Matter*, 7(8):3920–3928, 2011.

[140] M. Grob, J. Schmittbuhl, R. Toussaint, L. Rivera, S. Santucci, and K. J. Maloy. Quake Catalogs from an Optical Monitoring of an Interfacial Crack Propagation. *Pure and Applied Geophysics*, 166(5-7):777–799, Jul 2009.

[141] A. Guarino and S. Ciliberto. Thermally activated fracture of porous media. *European Physical Journal B*, 83(2):215–221, 2011.

[142] Ji-Xuan Hou, Carsten Svaneborg, Ralf Everaers, and Gary S. Grest. Stress Relaxation in Entangled Polymer Melts. *Physical Review Letters*, 105(6), Aug 5 2010.

[143] Raphael Jeanneret and Denis Bartolo. Geometrically-protected reversibility in hydrodynamic loschmidt-echo experiments. *Nature Communication*, page in press, 2014.

[144] C. Nadir Kaplan, Thomas Gibaud, and Robert B. Meyer. Intrinsic curvature determines the crinkled edges of “crenellated disks”. *Soft Matter*, 9(34):8210–8215, 2013.

[145] Z. S. Khan, A. Steinberger, R. Seemann, and S. Herminghaus. Wet granular walkers and climbers. *New Journal of Physics*, 13, May 24 2011.

[146] A. V. Klopper, Carsten Svaneborg, and Ralf Everaers. Microphase separation in cross-linked polymer blends. *European Physical Journal E*, 28(1):89–96, Jan 2009.

[147] Olivier Lengline, Renaud Toussaint, Jean Schmittbuhl, Jean E. Elkhoury, J. P. Ampuero, Ken Tore Tallakstad, Stephane Santucci, and Knut Jorgen Maloy. Average crack-front velocity during subcritical fracture propagation in a heterogeneous medium. *Physical Review E*, 84(3, 2), Sep 9 2011.

[148] Samuel Leroy, Audrey Steinberger, Cecile Cottin-Bizonne, Frederic Restagno, Liliane Leger, and Elisabeth Charlaix. Hydrodynamic Interaction between a Spherical Particle and an Elastic Surface: A Gentle Probe for Soft Thin Films. *Physical Review Let-*

ters, 108(26), Jun 26 2012.

[149] M. Paul Lettinga and Sebastien Manneville. Competition between Shear Banding and Wall Slip in Wormlike Micelles. *Physical Review Letters*, 103(24), Dec 11 2009.

[150] Bertrand Levaché and Denis Bartolo. Revisiting the safman-taylor experiment: imbibition patterns and liquid-entrainment transitions. *Physical Review Letters*, page sub judice, 2014.

[151] Tianjun Li and Ludovic Bellon. Dissipation of micro-cantilevers as a function of air pressure and metallic coating. *Europhysics Letters*, 98(1), Apr 2012.

[152] Tianjun Li, Felipe A. Aguilar Sandoval, Mickael Geitner, Ludovic Bellon, Gianpietro Cagnoli, Jerome Degallaix, Vincent Dolique, Raffaele Flaminio, Daniele Forest, Massimo Granata, Christophe Michel, Nazario Morgado, and Laurent Pinard. Measurements of mechanical thermal noise and energy dissipation in optical dielectric coatings. *Physical Review D*, 89(9), May 8 2014.

[153] Sebastien Michelin, Eric Lauga, and Denis Bartolo. Spontaneous autophoretic motion of isotropic particles. *Physics of Fluids*, 25(6), 2013.

[154] P. Oswald. Experimental study of the growth of cholesteric fingers subjected to an AC electric field and a temperature gradient. *Liquid Crystals*, 36(9):967–975, 2009.

[155] P. Oswald. Lehmann rotation of cholesteric droplets subjected to a temperature gradient: Role of the concentration of chiral molecules. *European Physical Journal E*, 28(4):377–383, Apr 2009.

[156] P. Oswald. Elasto- and electro-capillary instabilities of a nematic-isotropic interface: Experimental results. *European Physical Journal E*, 33(1):69–79, Sep 2010.

[157] P. Oswald. Electro-capillary instability of a nematic-isotropic interface. *Europhysics Letters*, 90(1), Apr 2010.

[158] P. Oswald. About the Leslie explanation of the Lehmann effect in cholesteric liquid crystals. *Europhysics Letters*, 97(3), Feb 2012.

[159] P. Oswald. Measurement with a rotating magnetic field of the surface viscosity of a nematic liquid crystal. *Europhysics Letters*, 100(2), Oct 2012.

[160] P. Oswald. Microscopic vs. macroscopic origin of the Lehmann effect in cholesteric liquid crystals. *European Physical Journal E*, 35(2), Feb 2012.

[161] P. Oswald and Scalliet C. Lehmann rotation of the cholesteric helix in droplets oriented by an electric field. *Physical Review E*, 89(), Mar 2014.

[162] P. Oswald and A. Dequidt. Lehmann effect in chiral liquid crystals and Langmuir monolayers: an experimental survey. *Liquid Crystals*, 36(10-11):1071–1084, 2009.

[163] P. Oswald and A. Dequidt. Comment on "Direct measurements of the thermomechanical Lehmann coefficient in a compensated cholesteric crystal" by Oswald P. and Dequidt A. Reply. *Europhysics Letters*, 89(2), Jan 2010.

[164] P. Oswald and A. Dequidt. Yield torque sliding anchoring in nematic liquid crystals. *Europhysics Letters*, 103(2), Jul 2013.

[165] P. Oswald, L. Jorgensen, and A. Zywocinski. Lehmann rotatory power: a new concept in cholesteric liquid crystals. *Liquid Crystals*, 38(5):601–613, 2011.

[166] P. Oswald, J. Milette, S. Relaix, L. Reven, A. Dequidt, and L. Lejcek. Alloy hardening of a smectic A liquid crystal doped with gold nanoparticles. *Europhysics Letters*, 103(4), Aug 2013.

[167] P. Oswald, G. Poy, F. Vittoz, and V. Popa-Nita. Experimental relationship between surface and bulk rotational viscosities in nematic liquid crystals. *Liquid Crystals*, 40(6):734–744, Jun 1 2013.

[168] P. Oswald and Pirkl S. Lehmann rotation of the cholesteric helix in droplets oriented by an electric field. *Physical Review E*, 89(2), Feb 2014.

[169] Pierdomenico Paolino and Ludovic Bellon. Frequency dependence of viscous and viscoelastic dissipation in coated micro-cantilevers from noise measurement. *Nanotechnology*, 20(40), Oct 7 2009.

[170] Javier C. Pastenes, Jean-Christophe Geminard, and Francisco Melo. Oscillating gas flow induces reptation of granular droplets. *Physical Review E*, 88(1), Jul 3 2013.

[171] Baptiste Percier, Thibaut Divoux, and Nicolas Taberlet. Insights on the local dynamics induced by thermal cycling in granular matter. *Europhysics Letters*, 104(2), Oct 2013.

[172] Christophe Perge, Marc-Antoine Fardin, and Sebastien Manneville. Inertio-elastic instability of non shear-banding wormlike micelles. *Soft Matter*, 10:1450–1454, 2014.

[173] Basile Pottier, Allan Raudsepp, Christian Fretigny, Francois Lequeux, Jean-Francois Palierne, and Laurence Talini. High frequency linear rheology of complex fluids measured from their surface thermal fluctuations. *Journal of Rheology*, 57(2):441–455, Mar 2013.

[174] Andreas S. Poulos, Doru Constantin, Patrick Davidson, Brigitte Pansu, Eric Freyssingeas, Anders Madsen, and Corinne Chaneac. Communications: Short-range dynamics of a nematic liquid-crystalline phase. *Journal of Chemical Physics*, 132(9), Mar 7 2010.

[175] O. Ramos, P. P. Cortet, S. Ciliberto, and L. Vanel. Experimental study of the effect of disorder on subcritical crack growth dynamics. *Physical Review Letters*, 110(16), 2013.

[176] Siti Aminah Setu, Ioannis Zacharoudiou, Gareth J. Davies, Denis Bartolo, Sebastien Moulinet, Ard A. Louis, Julia M. Yeomans, and Dirk G. A. L. Aarts. Viscous fingering at ultralow interfacial tension. *Soft Matter*, 9(44):10599–10605, 2013.

[177] M. Stojanova, S. Santucci, L. Vanel, and O. Ramos. High frequency monitoring reveals aftershocks in subcritical crack growth. *Physical Review Letters*, 112(11):115502, Mar 2014.

[178] Ken Tore Tallakstad, Renaud Toussaint, Stephane Santucci, Jean Schmittbuhl, and Knut Jorgen Maloy. Local dynamics of a randomly pinned crack front during creep and forced propagation: An experimental study. *Physical Review E*, 83(4, 2), Apr 14 2011.

[179] Joe W. Tavacoli, Pierre Bauer, Marc Fermigier, Denis Bartolo, Julien Heuvingh, and Olivia du Roure. The fabrication and directed self-assembly of micron-sized superparamagnetic non-spherical particles. *Soft Matter*, 9(38):9103–9110, 2013.

[180] Shashi Thutupalli, Jean-Baptiste Fleury, Audrey Steinberger, Stephan Herminghaus, and Ralf Seemann. Why can artificial membranes be fabricated so rapidly in microfluidics? *Chemical Communications*, 49(14):1443–1445, 2013.

[181] Kevin Tse-Ve-Koon, Nicolas Tremblay, Doru Con-

stantin, and Eric Freyssingeas. Structure, thermodynamics and dynamics of the isotropic phase of spherical non-ionic surfactant micelles. *Journal of Colloid and Interface Science*, 393:161–173, Mar 1 2013.

[182] Loic Vanel, Sergio Ciliberto, Pierre-Philippe Cortet, and Stephane Santucci. Time-dependent rupture and slow crack growth: elastic and viscoplastic dynamics. *Journal of Physics D-Applied Physics* , 42(21), Nov 7 2009.

[183] Stefan von Kann, Sylvain Joubaud, Gabriel A. Caballero-Robledo, Detlef Lohse, and Devaraj van der Meer. Effect of finite container size on granular jet formation. *Physical Review E*, 81(4, 1), Apr 2010.

[184] Mark J. Zakhary, Thomas Gibaud, C. Nadir Kaplan, Edward Barry, Rudolf Oldenbourg, Robert B. Meyer, and Zvonimir Dogic. Imprintable membranes from incomplete chiral coalescence. *Nature Communications*, 5, Jan 2014.

T3B. Physics of Biological Systems: *Publications*

[185] F Argoul, T Roland, A Fahys, and L Berguiga. Uncovering phase maps from surface plasmon resonance images: towards a sub-wavelength resolution. *Comptes Rendus Physique*, 13:800–814, 2012.

[186] Alain Arneodo, Cédric Vaillant, Benjamin Audit, Françoise Argoul, Yves d'Aubenton-Carafa, and Claude Thermes. Multi-scale coding of genomic information: From DNA sequence to genome structure and function. *Physics Reports*, 498:45–188, 2011.

[187] M. Atakhorrami, G. H. Koenderink, J. F. Palierne, F. C. MacKintosh, and C. F. Schmidt. Scale-Dependent Nonaffine Elasticity of Semiflexible Polymer Networks. *Physical Review Letters*, 112(8), Feb 24 2014.

[188] Benjamin Audit, Lamia Zaghloul, Cédric Vaillant, Guillaume Chevereau, Yves d'Aubenton-Carafa, Claude Thermes, and Alain Arneodo. Open chromatin encoded in DNA sequence is the signature of "master" replication origins in human cells. *Nucleic Acids Research*, 37(18):6064–6075, Oct 2009.

[189] A. Baker, B. Audit, S. C.-H. Yang, J. Bechhoefer, and A. Arneodo. Inferring where and when replication initiates from genome-wide replication timing data. *Physical Review Letters*, 108:268101, 2012.

[190] A. Baker, C. L. Chen, H. Julienne, B. Audit, Y. d'Aubenton Carafa, C. Thermes, and A. Arneodo. Linking the DNA strand asymmetry to the spatio-temporal replication program: II. accounting for neighbor-dependent substitution rates. *European Physical Journal E*, 35(11):123, Nov 2012.

[191] A. Baker, H. Julienne, C. L. Chen, B. Audit, Y. d'Aubenton Carafa, C. Thermes, and A. Arneodo. Linking the DNA strand asymmetry to the spatio-temporal replication program. I. about the role of the replication fork polarity in genome evolution. *European Physical Journal E*, 35(9):92, Sep 2012.

[192] Antoine Baker, Benjamin Audit, Chun-Long Chen, Benoit Moindrot, Antoine Leleu, Guillaume Guilbaud, Aurélien Rappailles, Cédric Vaillant, Arach Goldar, Fabien Mongelard, Yves d'Aubenton Carafa, Olivier Hyrien, Claude Thermes, and Alain Arneodo. Replication fork polarity gradients revealed by megabase-sized U-shaped replication timing domains in human cell lines. *PLoS Computational Biology*, 8(4):e1002443, 2012.

[193] N. B. Becker, A. Rosa, and R. Everaers. The radial distribution function of worm-like chains. *European Physical Journal E*, 32(1):53–69, May 2010.

[194] Nils B. Becker and Ralf Everaers. Comment on "Remeasuring the Double Helix". *Science*, 325(5940), Jul 31 2009.

[195] Nils B. Becker and Ralf Everaers. DNA nanomechanics: How proteins deform the double helix. *Journal of Chemical Physics*, 130(13), Apr 7 2009.

[196] Nils B. Becker and Ralf Everaers. DNA Nanomechanics in the Nucleosome. *Structure*, 17(4):579–589, Apr 15 2009.

[197] Lotfi Berguiga, Elise Boyer-Provera, Cristina Martinez-Torres, Juan Elezgaray, Alain Arneodo, and Françoise Argoul. Guided wave microscopy: mastering the inverse problem. *Optics Letters*, 38(21):4269–4272, Nov 2013.

[198] Lotfi Berguiga, Thibault Roland, Karine Monier, Juan Elezgaray, and Françoise Argoul. Amplitude and phase images of cellular structures with a scanning surface plasmon microscope. *Optics Express*, 19(7):6571–6586, 2011.

[199] R. Bernal, Ch. Tassius, F. Melo, and J. Ch. Geminard. Elastic response and wrinkling onset of curved elastic membranes subjected to indentation test. *European Physical Journal E*, 34(2), Feb 2011.

[200] E. Boyer-Provera, A. Rossi, L. Oriol, C. Dumontet, A. Plesa, L. Berguiga, J. Elezgaray, A. Arneodo, and F. Argoul. Wavelet-based decomposition of high resolution surface plasmon microscopy v(z) curves at visible and near infrared wavelengths. *Optics Express*, 21(6):7456–7477, Mar 2013.

[201] M. Castelnovo, D. Muriaux, and C. Faivre-Moskalenko. Entropic control of particle sizes during viral self-assembly. *New Journal of Physics*, 15, Mar 26 2013.

[202] Martin Castelnovo, Timothée Verdier, and Lionel Foret. Comparing open and closed molecular self-assembly. *Europhysics Letters*, 105, 2014.

[203] Chun-Long Chen, Lauranne Duquenne, Benjamin Audit, Guillaume Guilbaud, Aurélien Rappailles, Antoine Baker, Maxime Huvet, Yves d'Aubenton Carafa, Olivier Hyrien, Alain Arneodo, and Claude Thermes. Replication-associated mutational asymmetry in the human genome. *Molecular Biology and Evolution*, 28(8):2327–2337, Aug 2011.

[204] Chun-Long Chen, Aurélien Rappailles, Lauranne Duquenne, Maxime Huvet, Guillaume Guilbaud, Laurent Farinelli, Benjamin Audit, Yves d'Aubenton-Carafa, Alain Arneodo, Olivier Hyrien, and Claude Thermes. Impact of replication timing on non-CpG and CpG substitution rates in mammalian genomes. *Genome Research*, 20:447–457, Jan 2010.

[205] G. Chevereau, A. Arneodo, and C. Vaillant. Influence of the genomic sequence on the primary structure of chromatin. *Frontiers in Life Science*, 5(1–2):28–68, 2011.

[206] G. Chevereau, L. Palmeira, C. Thermes, A. Ar-

neodo, and C. Vaillant. Thermodynamics of intragenic nucleosome ordering. *Physical Review Letters*, 103(18):188103, Oct 2009.

[207] S. Cuesta-Lopez, D. Angelov, and M. Peyrard. Adding a new dimension to DNA melting curves. *Europhysics Letters*, 87(4), Aug 2009.

[208] Santiago Cuesta-Lopez, Herve Menoni, Dimitar Angelov, and Michel Peyrard. Guanine radical chemistry reveals the effect of thermal fluctuations in gene promoter regions. *Nucleic Acids Research*, 39(12):5276–5283, Jul 2011.

[209] J Elezgaray, L Berguiga, and F Argoul. Optimization of branched resonant nanostructures illuminated by a strongly focused beam. *Applied Physics Letters*, 97:243103, 2010.

[210] Juan Elezgaray, Lotfi Berguiga, and Françoise Argoul. Plasmon-based tomographic microscopy. *Journal of the Optical Society of America A*, 31(1):155, December 2013.

[211] Juan Elezgaray, Thibault Roland, Lotfi Berguiga, and Françoise Argoul. Modeling of the scanning surface plasmon microscope. *Journal of the Optical Society of America A*, 27(3):450–457, 2010.

[212] Ralf Everaers and Angelo Rosa. Multi-scale modeling of diffusion-controlled reactions in polymers: Renormalisation of reactivity parameters. *Journal of Chemical Physics*, 136(1), Jan 7 2012.

[213] Cendrine Faivre-Moskalenko, Julien Bernaud, Audrey Thomas, Kevin Tartour, Yvonne Beck, Maksym Iazykov, John Danial, Morgane Lourdin, Delphine Muriaux, and Martin Castelnovo. RNA Control of HIV-1 Particle Size Polydispersity. *PLOS One*, 9(1), Jan 24 2014.

[214] Flavio H. Fenton, Stefan Luther, Elizabeth M. Cherry, Niels F. Otani, Valentin Krinsky, Alain Pumir, Eberhard Bodenschatz, and Robert F. Gilmour, Jr. Termination of Atrial Fibrillation Using Pulsed Low-Energy Far-Field Stimulation. *Circulation*, 120(6):467–4, Aug 11 2009.

[215] X Gaume, K Monier, F Argoul, F Mongelard, and P Bouvet. *In-vivo* study of the histone chaperon activity of nucleolin by FRAP. *Biochemistry Research International*, 2011:187624, 2011.

[216] Jeremy Grant, Craig Verrill, Vincent Coustham, Alain Arneodo, Francesca Palladino, Karine Monier, and Andre Khalil. Perinuclear distribution of heterochromatin in developing C. elegans embryos. *Chromosome Research*, 18(8):873–885, Dec 2010.

[217] Guillaume Guilbaud, Aurélien Rappailles, Antoine Baker, Chun-Long Chen, Alain Arneodo, Arach Goldar, Yves d'Aubenton-Carafa, Claude Thermes, Benjamin Audit, and Olivier Hyrien. Evidence for sequential and increasing activation of replication origins along replication timing gradients in the human genome. *PLoS Computational Biology*, 7(12):e1002322, Dec 2011.

[218] Johannes-Geert Hagmann, Karol K. Kozlowski, Nikos Theodorakopoulos, and Michel Peyrard. On four-point correlation functions in simple polymer models. *Journal of Statistical Mechanics-Theory and Experiment*, Apr 2009.

[219] Johannes-Geert Hagmann, Naoko Nakagawa, and Michel Peyrard. Critical examination of the inherent-structure-landscape analysis of two-state folding proteins. *Physical Review E*, 80(6, 1), Dec 2009.

[220] Johannes-Geert Hagmann, Naoko Nakagawa, and Michel Peyrard. Characterization of the low-temperature properties of a simplified protein model. *Physical Review E*, 89(1), Jan 1 2014.

[221] S. Hu, T. Biben, X. Wang, P. Jurdic, and J. C. Geminard. Internal dynamics of actin structures involved in the cell motility and adhesion: Modeling of the podosomes at the molecular level. *Journal of Theoretical Biology*, 270(1):25–30, Feb 7 2011.

[222] Shiqiong Hu, Emmanuelle Planus, Dan Georgess, Christophe Place, Xianghui Wang, Corinne Albiges-Rizo, Pierre Jurdic, and Jean-Christophe Geminard. Podosome rings generate forces that drive saltatory osteoclast migration. *Molecular Biology of the Cell*, 22(17):3120–3126, SEP 1 2011.

[223] Olivier Hyrien, Aurélien Rappailles, Guillaume Guilbaud, Antoine Baker, Chun-Long Chen, Arach Goldar, Nataliya Petryk, Malik Kahli, Emilie Ma, Yves d'Aubenton Carafa, Benjamin Audit, Claude Thermes, and Alain Arneodo. From simple bacterial and archaeal replicons to replication N/U-domains. *Journal of Molecular Biology*, 425(23):4673–4689, Nov 2013.

[224] Meerim Jeembaeva, Bengt Jonsson, Martin Castelnovo, and Alex Evilevitch. DNA Heats Up: Energetics of Genome Ejection from Phage Revealed by Isothermal Titration Calorimetry. *Journal of Molecular Biology*, 395(5):1079–1087, FEB 5 2010.

[225] Daniel Jost. Twist-DNA: computing base-pair and bubble opening probabilities in genomic superhelical DNA. *Bioinformatics*, 29(19):2479–2481, Oct 1 2013.

[226] Daniel Jost. Bifurcation in epigenetics: Implications in development, proliferation, and diseases. *Physical Review E*, 89(1), Jan 23 2014.

[227] Daniel Jost and Ralf Everaers. A Unified Poland-Scheraga Model of Oligo- and Polynucleotide DNA Melting: Salt Effects and Predictive Power. *Biophysical Journal*, 96(3):1056–1067, Feb 4 2009.

[228] Daniel Jost and Ralf Everaers. Genome wide application of DNA melting analysis. *Journal of Physics-Condensed Matter*, 21(3), Jan 21 2009.

[229] Daniel Jost and Ralf Everaers. Prediction of RNA multiloop and pseudoknot conformations from a lattice-based, coarse-grain tertiary structure model. *Journal of Chemical Physics*, 132(9), Mar 7 2010.

[230] Daniel Jost, Asif Zubair, and Ralf Everaers. Bubble statistics and positioning in superhelically stressed DNA. *Physical Review E*, 84(3, 1), Sep 12 2011.

[231] Hanna Julienne, Azedine Zoufir, Benjamin Audit, and Alain Arneodo. Epigenetic regulation of the human genome: coherence between promoter activity and large-scale chromatin environment. *Frontiers in Life Science*, 7(1-2):44–62, 2013.

[232] Hanna Julienne, Azedine Zoufir, Benjamin Audit, and Alain Arneodo. Human genome replication proceeds through four chromatin states. *PLoS Computational Biology*, 9(10):e1003233, Oct 2013.

[233] Claire Lemaitre, Lamia Zaghloul, Marie-France Sagot, Christian Gautier, Alain Arneodo, Eric Tannier, and Benjamin Audit. Analysis of fine-scale mammalian evolutionary breakpoints provides new insight into their relation to genome organisation. *BMC Genomics*, 10:335, 2009.

[234] Laurence Lemelle, Jean-Francois Palierne, Elodie Chatre, and Christophe Place. Counterclockwise Circular Motion of Bacteria Swimming at the Air-Liquid Interface. *Journal of Bacteriology*, 192(23):6307–6308, Dec 2010.

[235] Laurence Lemelle, Jean-Francois Palierne, Elodie Chatre, Cedric Vaillant, and Christophe Place. Curvature reversal of the circular motion of swimming bacteria probes for slip at solid/liquid interfaces. *Soft Matter*, 9(41):9759–9762, 2013.

[236] Paul Lesbats, Yair Botbol, Guillaume Chevereau, Cédric Vaillant, Christina Calmels, Alain Arneodo, Marie-Line Andreola, Marc Lavigne, and Vincent Parissi. Functional coupling between HIV-1 integrase and the SWI/SNF chromatin remodeling complex for efficient in vitro integration into stable nucleosomes. *PLoS Pathogens*, 7(2):e1001280, 2011.

[237] Stefan Luther, Flavio H. Fenton, Bruce G. Kornreich, Amgad Squires, Philip Bittihn, Daniel Hornung, Markus Zabel, James Flanders, Andrea Gladuli, Luis Campoy, Elizabeth M. Cherry, Gisa Luther, Gerd Hasenfuss, Valentin I. Krinsky, Alain Pumir, Robert F. Gilmour, Jr., and Eberhard Bodenschatz. Low-energy control of electrical turbulence in the heart. *Nature*, 475(7355):235–U152, Jul 14 2011.

[238] C Martinez-Torres, L Berguiga, L Streppa, E Boyer-Provera, L Schaeffer, J Elezgaray, A Arneodo, and F Argoul. Diffraction phase microscopy: retrieving phase contours on living cells with a wavelet based space-scale analysis. *Journal of Biomedical Optics*, 19(3):036007, 2014.

[239] Sam Meyer, Nils B. Becker, Sajad Hussain Syed, Damien Goutte-Gattat, Manu Shubhdarshan Shukla, Jeffrey J. Hayes, Dimitar Angelov, Jan Bednar, Stefan Dimitrov, and Ralf Everaers. From crystal and NMR structures, footprints and cryo-electron-micrographs to large and soft structures: nanoscale modeling of the nucleosomal stem. *Nucleic Acids Research*, 39(21):9139–9154, Nov 2011.

[240] Sam Meyer, Daniel Jost, Nikos Theodorakopoulos, Michel Peyrard, Richard Lavery, and Ralf Everaers. Temperature Dependence of the DNA Double Helix at the Nanoscale: Structure, Elasticity, and Fluctuations. *Biophysical Journal*, 105(8):1904–1914, Oct 15 2013.

[241] Pascale Milani, Guillaume Chevereau, Cédric Vaillant, Benjamin Audit, Zofia Haftek-Terreau, Monique Marilley, Philippe Bouvet, Françoise Argoul, and Alain Arneodo. Nucleosome positioning by genomic excluding-energy barriers. *Proceedings of the National Academy of Sciences of the United States of America*, 106(52):22257–22262, Dec 2009.

[242] Pascale Milani, Maryam Gholamirad, Jan Traas, Alain Arneodo, Arezki Boudaoud, Françoise Argoul, and Olivier Hamant. In vivo analysis of local wall stiffness at the shoot apical meristem in Arabidopsis using atomic force microscopy. *The Plant Journal*, 67(6):1116–1123, Sep 2011.

[243] Pascale Milani, Monique Marilley, Albert Sanchez-Sevilla, Jean Imbert, Cédric Vaillant, Françoise Argoul, Jean-Marc Egly, José Rocca-Serra, and Alain Arneodo. Mechanics of the IL2RA gene activation revealed by modeling and atomic force microscopy. *PLOS One*, 6(4):e18811, 2011.

[244] Benoit Moindrot, Benjamin Audit, Petra Klous, Antoine Baker, Claude Thermes, Wouter de Laat, Philippe Bouvet, Fabien Mongelard, and Alain Arneodo. 3D chromatin conformation correlates with replication timing and is conserved in resting cells. *Nucleic Acids Research*, 40(19):9470–9481, Oct 2012.

[245] Fabien Montel, Martin Castelnovo, Herve Menoni, Dimitar Angelov, Stefan Dimitrov, and Cendrine Faivre-Moskalenko. RSC remodeling of oligo-nucleosomes: an atomic force microscopy study. *Nucleic Acids Research*, 39(7):2571–2579, Apr 2011.

[246] Fabien Montel, Herve Menoni, Martin Castelnovo, Jan Bednar, Stefan Dimitrov, Dimitar Angelov, and Cendrine Faivre-Moskalenko. The Dynamics of Individual Nucleosomes Controls the Chromatin Condensation Pathway: Direct Atomic Force Microscopy Visualization of Variant Chromatin. *Biophysical Journal*, 97(2):544–553, Jul 22 2009.

[247] J. Moukhtar, C. Faivre-Moskalenko, P. Milani, B. Audit, C. Vaillant, E. Fontaine, F. Mongelard, G. Lavorel, P. St-Jean, P. Bouvet, F. Argoul, and A. Arneodo. Effect of genomic long-range correlations on DNA persistence length: From theory to single molecules experiments. *Journal of Physical Chemistry B*, 114:5125–5143, 2010.

[248] J. Moukhtar, C. Vaillant, B. Audit, and A. Arneodo. Generalized wormlike chain model for long-range correlated heteropolymers. *Europhysics Letters*, 86:48001, 2009.

[249] J. Moukhtar, C. Vaillant, B. Audit, and A. Arneodo. Revisiting polymer statistical physics to account for the presence of long-range-correlated structural disorder in 2D DNA chains. *European Physical Journal E*, 34(11):119, Nov 2011.

[250] S. Nicolle, L. Noguer, and J. F. Palierne. Shear mechanical properties of the spleen: Experiment and analytical modelling. *Journal of the Mechanical Behavior of Biomedical Materials*, 9:130–136, May 2012.

[251] S. Nicolle, L. Noguer, and J. F. Palierne. Shear mechanical properties of the porcine pancreas: Experiment and analytical modelling. *Journal of the Mechanical Behavior of Biomedical Materials*, 26:90–97, Oct 2013.

[252] S. Nicolle and J. F. Palierne. Dehydration effect on the mechanical behaviour of biological soft tissues: Observations on kidney tissues. *Journal of the Mechanical Behavior of Biomedical Materials*, 3(8):630–635, Nov 2010.

[253] S. Nicolle and J. F. Palierne. On the efficiency of attachment methods of biological soft tissues in shear experiments. *Journal of the Mechanical Behavior of Biomedical Materials*, 14:158–162, Oct 2012.

[254] S. Nicolle, P. Vezin, and J. F. Palierne. A strain-hardening bi-power law for the nonlinear behaviour of biological soft tissues. *Journal of Biomechanics*, 43(5):927–932, Mar 22 2010.

[255] Elmar Nurmemmedov, Martin Castelnovo, Elizabeth Medina, Carlos Enrique Catalano, and Alex Evilevitch. Challenging Packaging Limits and Infectivity of Phage lambda. *Journal of Molecular Biology*, 415(2):263–273, Jan 13 2012.

[256] M. Peyrard, S. Cuesta-Lopez, and D. Angelov. Experimental and theoretical studies of sequence effects on the fluctuation and melting of short DNA molecules. *Journal of Physics-Condensed Matter*, 21(3), Jan 21 2009.

[257] M. Peyrard, S. Cuesta-Lopez, and G. James. Nonlinear Analysis of the Dynamics of DNA Breathing. *Journal of Biological Physics*, 35(1):73–89, Feb 2009.

[258] Franck Picard, Jean-Charles Cadoret, Benjamin Audit, Alain Arneodo, Adriana Alberti, Christophe Battail, Laurent Duret, and Marie-Noelle Prioleau. The spatiotemporal program of DNA replication is

associated with specific combinations of chromatin marks in human cells. *PLoS Genet.*, 10:e1004282, 2014.

[259] Raffaello Potestio, Pep Espanol, Rafael Delgado-Buscalioni, Ralf Everaers, Kurt Kremer, and Davide Donadio. Monte Carlo Adaptive Resolution Simulation of Multicomponent Molecular Liquids. *Physical Review Letters*, 111(6), Aug 8 2013.

[260] Raffaello Potestio, Sebastian Fritsch, Pep Espanol, Rafael Delgado-Buscalioni, Kurt Kremer, Ralf Everaers, and Davide Donadio. Hamiltonian Adaptive Resolution Simulation for Molecular Liquids. *Physical Review Letters*, 110(10), Mar 5 2013.

[261] Anais Poulet, Rémi Buisson, Cendrine Faivre-Moskalenko, Mélanie Koelblen, Simon Amiard, Fabien Montel, Santiago Cuesta-Lopez, Olivier Bornet, Francoise Guerlesquin, Thomas Godet, Julien Moukhtar, Francoise Argoul, Anne-Cécile Déclais, David M J Lilley, Stephen C Y Ip, Stephen C West, Eric Gilson, and Marie-Josèphe Giraud-Panis. TRF2 promotes, remodels and protects telomeric Holliday junctions. *EMBO Journal*, 28(6):641–651, March 2009.

[262] Anaïs Poulet, Sabrina Pisano, Cendrine Faivre-Moskalenko, Bei Pei, Yannick Tauran, Zofia Haftek-Terreau, Frédéric Brunet, Yann-Vaï Le Bihan, Marie-Hélène Ledu, Fabien Montel, Nicolas Hugo, Simon Amiard, Françoise Argoul, Annie Chaboud, Eric Gilson, and Marie-Josèphe Giraud-Panis. The N-terminal domains of TRF1 and TRF2 regulate their ability to condense telomeric DNA. *Nucleic Acids Research*, 40(6):2566–2576, 2012.

[263] Alain Pumir and Boris Shraiman. Epistasis in a Model of Molecular Signal Transduction. *PLOS Computational Biology*, 7(5), May 2011.

[264] Alain Pumir, Sitabhra Sinha, S. Sridhar, Mederic Argentina, Marcel Hoerning, Simonetta Filippi, Christian Cherubini, Stefan Luther, and Valentin Krinsky. Wave-train-induced termination of weakly anchored vortices in excitable media. *Physical Review E*, 81(1, 1), Jan 2010.

[265] Soizic Riche, Melissa Zouak, Françoise Argoul, Alain Arneodo, Jacques Pecreaux, and Marie Delattre. Evolutionary comparisons reveal a positional switch for spindle pole oscillations in caenorhabditis embryos. *The Journal of Cell Biology*, 201(5):653–662, May 2013.

[266] T Roland, L Berguiga, J Elezgaray, and F Argoul. Scanning surface plasmon imaging of nanoparticles. *Physical Review B*, 81(23):235419, 2010.

[267] T. Roland, A. Khalil, A. Tanenbaum, L. Berguiga, P. Delichere, L. Bonneviot, J. Elezgaray, A. Arneodo, and F. Argoul. Revisiting the physical processes of vapodeposited thin gold films on chemically modified glass by atomic force and surface plasmon microscopies. *Surface Science*, 603:3307, 2009.

[268] Angelo Rosa, Nils B. Becker, and Ralf Everaers. Looping Probabilities in Model Interphase Chromosomes. *Biophysical Journal*, 98(11):2410–2419, Jun 2 2010.

[269] Angelo Rosa and Ralf Everaers. Ring Polymers in the Melt State: The Physics of Crumpling. *Physical Review Letters*, 112, 2014.

[270] Rajeev Singh, Jinshan Xu, Nicolas G. Garnier, Alain Pumir, and Sitabhra Sinha. Self-Organized Transition to Coherent Activity in Disordered Media. *Physical Review Letters*, 108(6), Feb 9 2012.

[271] M. Suissa, C. Place, E. Goillot, and E. Freyssingeas. Evolution of the Global Internal Dynamics of a Living Cell Nucleus during Interphase. *Biophysical Journal*, 97(2):453–461, Jul 22 2009.

[272] Sajad Hussain Syed, Damien Goutte-Gattat, Nils Becker, Sam Meyer, Manu Shubhdarshan Shukla, Jeffrey J. Hayes, Ralf Everaers, Dimitar Angelov, Jan Bednar, and Stefan Dimitrov. Single-base resolution mapping of H1-nucleosome interactions and 3D organization of the nucleosome. *Proceedings of the National Academy of Sciences of the United States of America*, 107(21):9620–9625, May 25 2010.

[273] Nikos Theodorakopoulos and Michel Peyrard. Base Pair Openings and Temperature Dependence of DNA Flexibility. *Physical Review Letters*, 108(7), Feb 16 2012.

[274] Andrew A. Travers, Cédric Vaillant, Alain Arneodo, and Georgi Muskhelishvili. DNA structure, nucleosome placement and chromatin remodelling: a perspective. *Biochemical Society Transactions*, 40(2):335–340, Apr 2012.

[275] Cédric Vaillant and Thierry Grange. DNA: a structural "band-pass" filter of genomic sequence. *Physical Review Letters*, 10:68–69, 2013.

[276] Cédric Vaillant, Leonor Palmeira, Guillaume Chevereau, Benjamin Audit, Yves d'Aubenton-Carafa, Claude Thermes, and Alain Arneodo. A novel strategy of transcription regulation by intragenic nucleosome ordering. *Genome Research*, 20(1):59–67, Jan 2010.

[277] Jessica Valle-Orero, Jean-Luc Garden, Jacques Richard, Andrew Wildes, and Michel Peyrard. Glassy Behavior of Denatured DNA Films Studied by Differential Scanning Calorimetry. *Journal of Physical Chemistry B*, 116(14):4394–4402, Apr 12 2012.

[278] Jessica Valle-Orero, Andrew Wildes, Jean-Luc Garden, and Michel Peyrard. Purification of A-Form DNA Fiber Samples by the Removal of B-Form DNA Residues. *Journal of Physical Chemistry B*, 117(6):1849–1856, Feb 14 2013.

[279] T. S. van Erp, S. Cuesta-Lopez, J. G. Hagmann, and M. Peyrard. Comment on "A generalized Langevin formalism of complete DNA melting transition" by Das T. and Chakraborty S. *Europhysics Letters*, 85(6), Mar 2009.

[280] Titus S. van Erp and Michel Peyrard. The dynamics of the DNA denaturation transition. *Europhysics Letters*, 98(4), May 2012.

[281] Andrew Wildes, Nikos Theodorakopoulos, Jessica Valle-Orero, Santiago Cuesta-Lopez, Jean-Luc Garden, and Michel Peyrard. Structural correlations and melting of B-DNA fibers. *Physical Review E*, 83(6, 1), Jun 30 2011.

[282] Andrew Wildes, Nikos Theodorakopoulos, Jessica Valle-Orero, Santiago Cuesta-Lopez, Jean-Luc Garden, and Michel Peyrard. Thermal Denaturation of DNA Studied with Neutron Scattering. *Physical Review Letters*, 106(4), Jan 24 2011.

[283] Jinshan Xu, Changgui Gu, Alain Pumir, Nicolas Garnier, and Zonghua Liu. Entrainment of the suprachiasmatic nucleus network by a light-dark cycle. *Physical Review E*, 86(4, 1), Oct 8 2012.

[284] Jinshan Xu, Rajeev Singh, Nicolas B. Garnier, Sitabhra Sinha, and Alain Pumir. The effect of quenched disorder on dynamical transitions in systems of coupled cells. *New Journal of Physics*, 15, Sep 30 2013.

[285] Lamia Zaghloul, Antoine Baker, Benjamin Audit, and Alain Arneodo. Gene organization inside replication domains in mammalian genomes. *Comptes Rendus Mécanique*, 340:745–757, 2012.

[286] S Zhang, L Berguiga, J Elezgaray, N Hugo, W X Li, T Roland, H Zeng, and F Argoul. Advances in surface plasmon resonance-based high throughput biochips. *Frontiers of Physics in China*, 4:469–480, 2009.

[287] Sanjun Zhang, Nicolas Hugo, Wenxue Li, Thibault Roland, Lotfi Berguiga, Juan Elezgaray, and Françoise Argoul. Impedance spectroscopy of the potential response of MUO and AUT self-assembled monolayers on polycrystalline thin gold films. *Journal of Electroanalytical Chemistry*, 629(1-2):138–146, 2009.

T4B. Mathematical Physics and Fundamental Interactions: *Publications*

[288] Andres Acena, Andres Anabalon, Dumitru Astefanesei, and Robert Mann. Hairy planar black holes in higher dimensions. *Journal of High Energy Physics*, (01), Jan 28 2014.

[289] Andres Anabalon and Dumitru Astefanesei. On attractor mechanism of AdS_4 black holes. *Physics Letters B*, 727(4-5):568–572, Dec 18 2013.

[290] Andres Anabalon, Thomas Ortiz, and Henning Samtleben. Rotating D0-branes and consistent truncations of supergravity. *Physics Letters B*, 727(4-5):516–523, Dec 18 2013.

[291] Remi C. Avohou, Joseph Ben Geloun, and Etera R. Livine. On terminal forms for topological polynomials for ribbon graphs: The N-petal flower. *European Journal of Combinatorics*, 36:348–366, Feb 2014.

[292] Valentina Baccetti, Etera R. Livine, and James P. Ryan. The particle interpretation of N=1 supersymmetric spin foams. *Classical and Quantum Gravity*, 27(22), Nov 21 2010.

[293] Igor Bandos, Henning Samtleben, and Dmitri Sorokin. Duality-symmetric actions for non-Abelian tensor fields. *Physical Review D*, 88(2), Jul 16 2013.

[294] Niklas Beisert, Changrim Ahn, Luis F. Alday, Zoltan Bajnok, James M. Drummond, Lisa Freyhult, Nikolay Gromov, Romuald A. Janik, Vladimir Kazakov, Thomas Klose, Gregory P. Korchemsky, Charlotte Kristjansen, Marc Magro, Tristan Mcloughlin, Joseph A. Minahan, Rafael I. Nepomechie, Adam Rej, Radu Roiban, Sakura Schaefer-Nameki, Christoph Sieg, Matthias Staudacher, Alessandro Torrielli, Arkady A. Tseytlin, Pedro Vieira, Dmytro Volin, and Konstantinos Zoubos. Review of AdS/CFT Integrability: An Overview. *Letters in Mathematical Physics*, 99(1-3):3–32, Jan 2012.

[295] Joseph Ben Geloun and Etera R. Livine. Some classes of renormalizable tensor models. *Journal of Mathematical Physics*, 54(8), Aug 2013.

[296] Quentin Berger and Fabio Lucio Toninelli. On the critical point of the Random Walk Pinning Model in dimension d=3. *Electronic Journal of Probability*, 15:654–683, May 17 2010.

[297] Quentin Berger and Fabio Lucio Toninelli. Hierarchical pinning model in correlated random environment. *Annales de l'Institut Henri Poincaré-Probabilités et Statistiques*, 49(3):781–816, Aug 2013.

[298] E. Bergshoeff, S. Cecotti, H. Samtleben, and E. Sezgin. Superconformal sigma models in three dimensions. *Nuclear Physics B*, 838(3):266–297, Oct 21 2010.

[299] Cedric Bernardin and Fabio Lucio Toninelli. A one-dimensional coagulation-fragmentation process with a dynamical phase transition. *Stochastic Processes and their Applications*, 122(4):1672–1708, Apr 2012.

[300] Valentin Bonzom and Etera R. Livine. Lagrangian approach to the Barrett-Crane spin foam model. *Physical Review D*, 79(6), Mar 2009.

[301] Valentin Bonzom and Etera R. Livine. A new Hamiltonian for the topological BF phase with spinor networks. *Journal of Mathematical Physics*, 53(7), Jul 2012.

[302] Valentin Bonzom and Etera R. Livine. A New Recursion Relation for the 6j-Symbol. *Annales Henri Poincaré*, 13(4):1083–1099, May 2012.

[303] Valentin Bonzom and Etera R. Livine. Generating functions for coherent intertwiners. *Classical and Quantum Gravity*, 30(5), Mar 7 2013.

[304] Valentin Bonzom, Etera R. Livine, and Simone Speziale. Recurrence relations for spin foam vertices. *Classical and Quantum Gravity*, 27(12), Jun 21 2010.

[305] Enrique F. Borja, Jacobo Diaz-Polo, Inaki Garay, and Etera R. Livine. Dynamics for a 2-vertex quantum gravity model. *Classical and Quantum Gravity*, 27(23), Dec 7 2010.

[306] Enrique F. Borja, Laurent Freidel, Inaki Garay, and Etera R. Livine. U(N) tools for loop quantum gravity: the return of the spinor. *Classical and Quantum Gravity*, 28(5), Mar 7 2011.

[307] Freddy Bouchet and Hidetoshi Morita. Large time behavior and asymptotic stability of the 2D Euler and linearized Euler equations. *Physica D*, 239(12):948–966, JUN 15 2010.

[308] E. Buffenoir, Ph. Roche, and V. Terras. Universal vertex-IRF transformation for quantum affine algebras. *Journal of Mathematical Physics*, 53(10), Oct 2012.

[309] David Burke and Robert Wimmer. Quantum energies and tensorial central charges of confined monopoles. *Journal of High Energy Physics*, (10), Oct 2011.

[310] Pietro Caputo, Hubert Lacoin, Fabio Martinelli, Francois Simenhaus, and Fabio Lucio Toninelli. Polymer dynamics in the depinned phase: metastability with logarithmic barriers. *Probability Theory and Related Fields*, 153(3-4):587–641, Aug 2012.

[311] Pietro Caputo, Eyal Lubetzky, Fabio Martinelli, Allan Sly, and Fabio Lucio Toninelli. The shape of the (2+1)D SOS surface above a wall. *Comptes Rendus Mathématique*, 350(13-14):703–706, Jul 2012.

[312] Pietro Caputo, Fabio Martinelli, Francois Simenhaus, and Fabio Lucio Toninelli. "Zero" Temperature Stochastic 3D Ising Model and Dimer Covering Fluctuations: A First Step Towards Interface Mean Curvature Motion. *Communicatons on Pure and Applied Mathematics*, 64(6):778–831, Jun 2011.

[313] Pietro Caputo, Fabio Martinelli, and Fabio Lucio Toninelli. Convergence to Equilibrium of Biased

Plane Partitions. *Random Structures & Algorithms*, 39(1):83–114, Aug 2011.

[314] Pietro Caputo, Fabio Martinelli, and Fabio Lucio Toninelli. Mixing Times of Monotone Surfaces and SOS Interfaces: A Mean Curvature Approach. *Communications in Mathematical Physics*, 311(1):157–189, Apr 2012.

[315] Davide Cassani, Sergio Ferrara, Alessio Marrani, Jose F. Morales, and Henning Samtleben. A special road to AdS vacua. *Journal of High Energy Physics*, (2), Feb 2010.

[316] J. Daniel Christensen, Igor Khavkine, Etera R. Livine, and Simone Speziale. The sub-leading asymptotic behaviour of area correlations in the Barrett-Crane model. *Classical and Quantum Gravity*, 27(3), Feb 7 2010.

[317] J. Daniel Christensen, Etera R. Livine, and Simone Speziale. Numerical evidence of regularized correlations in spin foam gravity. *Physics Letters B*, 670(4-5):403–406, Jan 5 2009.

[318] Eoin O. Colgain and Henning Samtleben. $3D$ gauged supergravity from wrapped M5-branes with AdS/CMT applications. *Journal of High Energy Physics*, (2), Feb 2011.

[319] Christoph Dankert, Richard Cleve, Joseph Emerson, and Etera Livine. Exact and approximate unitary 2-designs and their application to fidelity estimation. *Physical Review A*, 80(1), Jul 2009.

[320] Paul de Fromont, K. Gawedzki, and Clement Tauber. Global gauge anomalies in coset models of conformal field theory. *Communications in Mathematical Physics*, 328(3), Jun 2014.

[321] Nihat Sadik Deger, Henning Samtleben, and Ozgur Sarioglu. On the supersymmetric solutions of $D = 3$ half-maximal supergravities. *Nuclear Physics B*, 840(1-2):29–53, Nov 21 2010.

[322] S Deger, A Kaya, H Samtleben, and E Sezgin. Supersymmetric warped ads in extended topologically massive supergravity. *Nuclear Physics B*, 884:106, 2014.

[323] F. Delduc, M. Magro, and B. Vicedo. A lattice Poisson algebra for the Pohlmeyer reduction of the $AdS_5 \times S^5$ superstring. *Physics Letters B*, 713(3):347–349, Jul 9 2012.

[324] F. Delduc, M. Magro, and B. Vicedo. Alleviating the non-ultralocality of coset sigma-models through a generalized Faddeev-Reshetikhin procedure. *Journal of High Energy Physics*, (8), Aug 2012.

[325] F. Delduc, M. Magro, and B. Vicedo. Alleviating the non-ultralocality of the $AdS_5 \times S^5$ superstring. *Journal of High Energy Physics*, (10), Oct 2012.

[326] F. Delduc, M. Magro, and B. Vicedo. Generalized sine-Gordon models and quantum braided groups. *Journal of High Energy Physics*, (3), Mar 2013.

[327] F. Delduc, M. Magro, and B. Vicedo. On classical q-deformations of integrable sigma-models. *Journal of High Energy Physics*, (11), Nov 26 2013.

[328] F. Delduc, M. Magro, and B. Vicedo. Integrable deformation of the $AdS_5 \times S^5$ superstring action. *Physical Review Letters*, 112(5), Feb 5 2014.

[329] Bernard Derrida, Giambattista Giacomin, Hubert Lacoin, and Fabio Lucio Toninelli. Fractional Moment Bounds and Disorder Relevance for Pinning Models. *Communications in Mathematical Physics*, 287(3):867–887, May 2009.

[330] Maiete Dupuis and Etera R. Livine. Lifting SU(2) spin networks to projected spin networks. *Physical Review D*, 82(6), Sep 30 2010.

[331] Maite Dupuis, Laurent Freidel, Etera R. Livine, and Simone Speziale. Holomorphic Lorentzian simplicity constraints. *Journal of Mathematical Physics*, 53(3), Mar 2012.

[332] Maite Dupuis, Florian Girelli, and Etera R. Livine. Spinors group field theory and Voros star product: First contact. *Physical Review D*, 86(10), Nov 20 2012.

[333] Maite Dupuis and Etera R. Livine. Pushing the asymptotics of the 6j-symbol further. *Physical Review D*, 80(2), Jul 2009.

[334] Maite Dupuis and Etera R. Livine. The 6j-symbol: recursion, correlations and asymptotics. *Classical and Quantum Gravity*, 27(13), Jul 7 2010.

[335] Maite Dupuis and Etera R. Livine. Boundary state stability under spinfoam evolution for the quantum 4-simplex. *Classical and Quantum Gravity*, 28(21), Nov 7 2011.

[336] Maite Dupuis and Etera R. Livine. Holomorphic simplicity constraints for 4D spinfoam models. *Classical and Quantum Gravity*, 28(21), Nov 7 2011.

[337] Maite Dupuis and Etera R. Livine. Revisiting the simplicity constraints and coherent intertwiners. *Classical and Quantum Gravity*, 28(8), Apr 21 2011.

[338] Sergio Ferrara, Alessio Marrani, Jose F. Morales, and Henning Samtleben. Intersecting attractors. *Physical Review D*, 79(6), Mar 2009.

[339] Laurent Freidel, Kirill Krasnov, and Etera R. Livine. Holomorphic Factorization for a Quantum Tetrahedron. *Communications in Mathematical Physics*, 297(1):45–93, Jul 2010.

[340] Laurent Freidel and Etera R. Livine. The fine structure of SU(2) intertwiners from U(N) representations. *Journal of Mathematical Physics*, 51(8), Aug 2010.

[341] Laurent Freidel and Etera R. Livine. U(N) coherent states for loop quantum gravity. *Journal of Mathematical Physics*, 52(5), May 2011.

[342] Krzysztof Gawedzki, Rafal R. Suszek, and Konrad Waldorf. Bundle gerbes for orientifold sigma models. *Advances in Theoretical and Mathematical Physics*, 15(3):621–687, Jun 2011.

[343] Krzysztof Gawedzki, Rafal R. Suszek, and Konrad Waldorf. Global Gauge Anomalies in Two-Dimensional Bosonic Sigma Models. *Communications in Mathematical Physics*, 302(2):513–580, Mar 2011.

[344] Krzysztof Gawedzki, Rafal R. Suszek, and Konrad Waldorf. The gauging of two-dimensional bosonic sigma models on world-sheets with defects. *Reviews in Mathematical Physics*, 25(6), Jul 2013.

[345] Krzysztof Gawedzki and Konrad Waldorf. Polyakov-Wiegmann formula and multiplicative gerbes. *Journal of High Energy Physics*, (9), Sep 2009.

[346] Giambattista Giacomin, Hubert Lacoin, and Fabio Toninelli. Marginal Relevance of Disorder for Pinning Models. *Communicatons on Pure and Applied Mathematics*, 63(2):233–265, Feb 2010.

[347] Giambattista Giacomin, Hubert Lacoin, and Fabio Lucio Toninelli. Hierarchical pinning models, quadratic maps and quenched disorder. *Probability Theory and Related Fields*, 147(1-2):185–216, May 2010.

[348] Giambattista Giacomin, Hubert Lacoin, and Fabio Lucio Toninelli. Disorder relevance at marginality and critical point shift. *Annales de*

l'Institut Henri Poincaré - Probabilités et Statistiques, 47(1):148–175, Feb 2011.

[349] Giambattista Giacomin and Fabio Lucio Toninelli. On the irrelevant disorder regime of pinning models. *Annals of Probability*, 37(5):1841–1875, Sep 2009.

[350] Florian Girelli and Etera R. Livine. A deformed Poincare invariance for group field theories. *Classical and Quantum Gravity*, 27(24), Dec 21 2010.

[351] Florian Girelli and Etera R. Livine. Special relativity as a noncommutative geometry: Lessons for deformed special relativity. *Physical Review D*, 81(8), Apr 15 2010.

[352] Florian Girelli and Etera R. Livine. Scalar field theory in Snyder space-time: alternatives. *Journal of High Energy Physics*, (3), Mar 2011.

[353] Florian Girelli, Etera R. Livine, and Daniele Oriti. Four-dimensional deformed special relativity from group field theories. *Physical Review D*, 81(2), Jan 15 2010.

[354] N. Grosjean, J. M. Maillet, and G. Niccoli. On the form factors of local operators in the lattice sine-Gordon model. *Journal of Statistical Mechanics-Theory and Experiment*, Oct 2012.

[355] N. Grosjean and G. Niccoli. The tau(2)-model and the chiral Potts model revisited: completeness of Bethe equations from Sklyanin's SOV method. *Journal of Statistical Mechanics-Theory and Experiment*, Nov 2012.

[356] M. Gunaydin, H. Samtleben, and E. Sezgin. On the magical supergravities in six dimensions. *Nuclear Physics B*, 848(1):62–89, Jul 1 2011.

[357] Olaf Hohm and Henning Samtleben. Exceptional Form of $D = 11$ Supergravity. *Physical Review Letters*, 111(23), Dec 4 2013.

[358] Olaf Hohm and Henning Samtleben. Gauge theory of Kaluza-Klein and winding modes. *Physical Review D*, 88(8), Oct 4 2013.

[359] Olaf Hohm and Henning Samtleben. U-duality covariant gravity. *Journal of High Energy Physics*, (9), Sep 16 2013.

[360] Olaf Hohm and Henning Samtleben. Exceptional field theory. I. $E_{6(6)}$-covariant form of M-theory and type IIB. *Physical Review D*, 89, Mar 27 2014.

[361] Olaf Hohm and Henning Samtleben. Exceptional field theory. II. $E_{7(7)}$. *Physical Review D*, 89, Mar 27 2014.

[362] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. Algebraic Bethe ansatz approach to the asymptotic behavior of correlation functions. *Journal of Statistical Mechanics-Theory and Experiment*, Apr 2009.

[363] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. On the thermodynamic limit of form factors in the massless XXZ Heisenberg chain. *Journal of Mathematical Physics*, 50(9), Sep 2009. Workshop on Integrable Quantum Systems and Solvable Statistical Mechanics Models, CRM, Montreal, Canada, Jun 30-Jul 05, 2008.

[364] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. Riemann-Hilbert Approach to a Generalised Sine Kernel and Applications. *Communications in Mathematical Physics*, 291(3):691–761, Nov 2009.

[365] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. A form factor approach to the asymptotic behavior of correlation functions in critical models. *Journal of Statistical Mechanics-Theory and Experiment*, Dec 2011.

[366] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. The thermodynamic limit of particle-hole form factors in the massless XXZ Heisenberg chain. *Journal of Statistical Mechanics-Theory and Experiment*, May 2011.

[367] N. Kitanine, K. K. Kozlowski, J. M. Maillet, N. A. Slavnov, and V. Terras. Form factor approach to dynamical correlation functions in critical models. *Journal of Statistical Mechanics-Theory and Experiment*, Sep 2012.

[368] N Kitanine, K K Kozlowski, J M Maillet, and V Terras. Large-distance asymptotic behaviour of multi-point correlation functions in massless quantum models. *Journal of Statistical Mechanics: Theory and Experiment*, 2014(5):P05011, 2014.

[369] N Kitanine, J M Maillet, and G Niccoli. Open spin chains with generic integrable boundaries: Baxter equation and bethe ansatz completeness from separation of variables. *Journal of Statistical Mechanics: Theory and Experiment*, 2014(5):P05015, 2014.

[370] Dmitry Korotkin and Henning Samtleben. Generalization of Okamoto's Equation to Arbitrary 2 x 2 Schlesinger System. *Advances in Mathematical Physics*, 2009.

[371] K. K. Kozlowski, J. M. Maillet, and N. A. Slavnov. Correlation functions for one-dimensional bosons at low temperature. *Journal of Statistical Mechanics-Theory and Experiment*, Mar 2011.

[372] K. K. Kozlowski, J. M. Maillet, and N. A. Slavnov. Long-distance behavior of temperature correlation functions in the one-dimensional Bose gas. *Journal of Statistical Mechanics-Theory and Experiment*, Mar 2011.

[373] K. K. Kozlowski and V. Terras. Long-time and large-distance asymptotic behavior of the current-current correlators in the non-linear Schrodinger model. *Journal of Statistical Mechanics-Theory and Experiment*, Sep 2011.

[374] Arnaud Le Diffon and Henning Samtleben. Supergravities without an action: Gauging the trombone. *Nuclear Physics B*, 811(1-2):1–35, Apr 11 2009.

[375] Arnaud Le Diffon, Henning Samtleben, and Mario Trigiante. $N = 8$ supergravity with local scaling symmetry. *Journal of High Energy Physics*, (4), Apr 2011.

[376] D. Levy-Bencheton and V. Terras. An algebraic Bethe ansatz approach to form factors and correlation functions of the cyclic eight-vertex solid-on-solid model. *Journal of Statistical Mechanics-Theory and Experiment*, Apr 2013.

[377] D. Levy-Bencheton and V. Terras. Spontaneous staggered polarizations of the cyclic solid-on-solid model from the algebraic Bethe Ansatz. *Journal of Statistical Mechanics-Theory and Experiment*, Oct 2013.

[378] D Levy-Bencheton and V Terras. Multi-point local height probabilities of the csos model within the algebraic bethe ansatz framework. *Journal of Statistical Mechanics-Theory and Experiment*, Apr 2014.

[379] Etera Livine and Johannes Tambornino. Spinor representation for loop quantum gravity. *Journal of Mathematical Physics*, 53(1), Jan 2012.

[380] Etera R. Livine. Matrix models as non-commutative field theories on R-3. *Classical and Quantum Gravity*, 26(19), Oct 7 2009.

[381] Etera R. Livine. Notes on qubit phase space and discrete symplectic structures. *Journal of Physics A-Mathematical and Theoretical*, 43(7), Feb 19 2010.

[382] Etera R. Livine. Deformations of polyhedra and polygons by the unitary group. *Journal of Mathematical Physics*, 54(12), Dec 2013.

[383] Etera R. Livine. Deformation operators of spin networks and coarse-graining. *Classical and Quantum Gravity*, 31(7), Apr 7 2014.

[384] Etera R. Livine and Mercedes Martin-Benito. Group theoretical quantization of isotropic loop cosmology. *Physical Review D*, 85(12), Jun 22 2012.

[385] Etera R. Livine and Mercedes Martin-Benito. Classical setting and effective dynamics for spinfoam cosmology. *Classical and Quantum Gravity*, 30(3), Feb 7 2013.

[386] Etera R. Livine, Daniele Oriti, and James P. Ryan. Effective Hamiltonian constraint from group field theory. *Classical and Quantum Gravity*, 28(24), Dec 21 2011.

[387] Etera R. Livine and James P. Ryan. A note on B-observables in Ponzano-Regge 3D quantum gravity. *Classical and Quantum Gravity*, 26(3), Feb 7 2009.

[388] Etera R. Livine, Simone Speziale, and Johannes Tambornino. Twistor networks and covariant twisted geometries. *Physical Review D*, 85(6), Mar 2 2012.

[389] Etera R. Livine and Johannes Tambornino. Holonomy operator and quantization ambiguities on spinor space. *Physical Review D*, 87(10), May 10 2013.

[390] Etera R. Livine and Daniel R. Terno. The entropic boundary law in BF theory. *Nuclear Physics B*, 806(3):715–734, Jan 11 2009.

[391] Etera R. Livine and Daniel R. Terno. Entropy in the classical and quantum polymer black hole models. *Classical and Quantum Gravity*, 29(22), Nov 21 2012.

[392] Eyal Lubetzky, Fabio Martinelli, Allan Sly, and Fabio Lucio Toninelli. Quasi-polynomial mixing of the 2D stochastic Ising model with "plus" boundary up to criticality. *Journal of the European Mathematical Society*, 15(2):339–386, 2013.

[393] Marc Magro. The classical exchange algebra of $AdS_5 \times S^5$ string theory. *Journal of High Energy Physics*, (1), Jan 2009.

[394] Marc Magro. Review of AdS/CFT Integrability, Chapter II.3: Sigma Model, Gauge Fixing. *Letters in Mathematical Physics*, 99(1-3):149–167, Jan 2012.

[395] Fabio Martinelli and Fabio Lucio Toninelli. On the Mixing Time of the 2D Stochastic Ising Model with "Plus" Boundary Conditions at Low Temperature. *Communications in Mathematical Physics*, 296(1):175–213, May 2010.

[396] Thomas Ortiz and Henning Samtleben. $SO(9)$ supergravity in two dimensions. *Journal of High Energy Physics*, (1), Jan 2013.

[397] A. Rebhan, P. van Nieuwenhuizen, and R. Wimmer. Quantum corrections to solitons and BPS saturation. In Daniel Grumiller, Anton Rebhan, and Dimitri Vassilevich, editors, *Fundamental Interactions: A Memorial Volume for Wolfgang Kummer*. World Scientific, Sep 2009.

[398] Diederik Roest and Henning Samtleben. Twin supergravities. *Classical and Quantum Gravity*, 26(15), Aug 7 2009.

[399] Christian Saemann, Robert Wimmer, and Martin Wolf. A twistor description of six-dimensional N = (1,1) super Yang-Mills theory. *Journal of High Energy Physics*, (5), May 2012.

[400] Henning Samtleben. Actions for non-abelian twisted self-duality. *Nuclear Physics B*, 851(2):298–313, Oct 11 2011.

[401] Henning Samtleben. Action principle for non-abelian twisted self-duality. *Fortschritte der Physik-Progress of Physics*, 60(9-10, SI):1093–1097, Sep 2012.

[402] Henning Samtleben, Ergin Sezgin, and Dimitrios Tsimpis. Rigid 6D supersymmetry and localization. *Journal of High Energy Physics*, (3), Mar 2013.

[403] Henning Samtleben, Ergin Sezgin, and Robert Wimmer. (1,0) superconformal models in six dimensions. *Journal of High Energy Physics*, (12), Dec 2011.

[404] Henning Samtleben, Ergin Sezgin, and Robert Wimmer. Six-dimensional superconformal couplings of non-abelian tensor and hypermultiplets. *Journal of High Energy Physics*, (3), Mar 2013.

[405] Henning Samtleben and Dimitrios Tsimpis. Rigid supersymmetric theories in 4d Riemannian space. *Journal of High Energy Physics*, (5), May 2012.

[406] Henning Samtleben and Robert Wimmer. $N = 6$ superspace constraints, SUSY enhancement and monopole operators. *Journal of High Energy Physics*, (10), Oct 2010.

[407] Henning Samtleben and Robert Wimmer. $N = 8$ superspace constraints for three-dimensional gauge theories. *Journal of High Energy Physics*, (2), Feb 2010.

[408] Fabio Lucio Toninelli. Coarse graining, fractional moments and the critical slope of random copolymers. *Electronic Journal of Probability*, 14:531–547, Feb 23 2009.

[409] Fabio Lucio Toninelli. Localization Transition in Disordered Pinning Models. In Biskup, M, editor, *Methods of Contemporary Mathematical Statistical Physics*, volume 1970 of *Lecture Notes in Mathematics*, pages 129–176. Springer, 2009.

[410] Robert Wimmer. An index for confined monopoles. *Communications in Mathematical Physics*, 327:117–149, Apr 2014.

T5B. Condensed Matter: *Publications*

[411] P. Adroguer, C. Grenier, D. Carpentier, J. Cayssol, P. Degiovanni, and E. Orignac. Probing the helical edge states of a topological insulator by Cooper-pair injection. *Physical Review B*, 82(8), Aug 5 2010.

[412] Pierre Adroguer, David Carpentier, Jerome Cayssol, and Edmond Orignac. Diffusion at the surface of topological insulators. *New Journal of Physics*, 14, Oct 17 2012.

[413] A. Alastuey and V. Ballenegger. Exact asymptotic expansions for the thermodynamics of hydrogen gas in the Saha regime. *Journal of Physics A-Mathematical and Theoretical*, 42(21), May 29 2009. International Conference on Strongly Coupled Coulomb Systems, Univ Camerino, Camerino, Italy, Jul 29-Aug 02, 2008.

[414] A. Alastuey and V. Ballenegger. Pressure of a Partially Ionized Hydrogen Gas: Numerical Results from Exact Low Temperature Expansions. *Con-*

tributions to Plasma Physics, 50(1, SI):46–53, Jan 2010. 13th International Conference on Physics of Non-Ideal Plasmas, Chemogolovka, Russia, SEP 13-18, 2009.

[415] A. Alastuey and V. Ballenegger. Atomic Ionization and Molecular Dissociation in a Hydrogen Gas within the Physical Picture. *Contributions to Plasma Physics*, 52(1):95–99, Jan 2012.

[416] A. Alastuey and V. Ballenegger. Thermodynamics of atomic and ionized hydrogen: Analytical results versus equation-of-state tables and Monte Carlo data. *Physical Review E*, 86(5, 2), Dec 6 2012.

[417] A. Alastuey and J. Piasecki. Interacting Bose gas: Mean field and fluctuations revisited. *Physical Review E*, 84(4, 1), Oct 17 2011.

[418] Christopher Bauerle, Pascal Degiovanni, and Laurent Saminadayar. Quantum coherence and magnetic scattering. *International Journal of Nanotechnology*, 7(4-8, SI):403–419, 2010.

[419] J.-S. Bernier, R. Citro, C. Kollath, and E. Orignac. Correlation dynamics during a slow interaction quench in a one-dimensional Bose gas. *Physical Review Letters*, 112(6), Feb 12 2014.

[420] E. Bocquillon, V. Freulon, J M Berroir, P. Degiovanni, B. Placais, A. Cavanna, Y. Jin, and G. Feve. Coherence and Indistinguishability of Single Electrons Emitted by Independent Sources. *Science*, 339(6123):1054–1057, Mar 1 2013.

[421] E. Bocquillon, V. Freulon, J. M. Berroir, P. Degiovanni, B. Placais, A. Cavanna, Y. Jin, and G. Feve. Separation of neutral and charge modes in one-dimensional chiral edge channels. *Nature Communications*, 4, May 2013.

[422] E. Bocquillon, V. Freulon, F.D. Parmentier, J.-M. Berroir, B. Plaçais, C. Wahl, J. Rech, T. Jonckheere, T. Martin, C. Grenier, D. Ferraro, P. Degiovanni, and G. Fève. Electron quantum optics in ballistic chiral conductors. *Annalen des Physik (Berlin)*, 526:1–30, 2014.

[423] E. Bocquillon, F. D. Parmentier, C. Grenier, J. M. Berroir, P. Degiovanni, D. C. Glattli, B. Placais, A. Cavanna, Y. Jin, and G. Feve. Electron Quantum Optics: Partitioning Electrons One by One. *Physical Review Letters*, 108(19), May 8 2012.

[424] Pierre Bouillot, Corinna Kollath, Andreas M. Laeuchli, Mikhail Zvonarev, Benedikt Thielemann, Christian Ruegg, Edmond Orignac, Roberta Citro, Martin Klanjsek, Claude Berthier, Mladen Horvatic, and Thierry Giamarchi. Statics and dynamics of weakly coupled antiferromagnetic spin-1/2 ladders in a magnetic field. *Physical Review B*, 83(5), Feb 9 2011.

[425] L. Bovo, L. D. C. Jaubert, P. C. W. Holdsworth, and S. T. Bramwell. Crystal shape-dependent magnetic susceptibility and Curie law crossover in the spin ices Dy2Ti2O7 and Ho2Ti2O7. *Journal of Physics-Condensed Matter*, 25(38), Sep 25 2013.

[426] M. E. Brooks-Bartlett, S. T. Banks, L. D. C. Jaubert, A. Harman-Clarke, and P. C. W. Holdsworth. Magnetic-moment fragmentation and monopole crystallization. *Phys. Rev. X*, 4:011007, Jan 2014.

[427] T. Capron, G. Forestier, A. Perrat-Mabilon, C. Peaucelle, T. Meunier, C. Bäuerle, L. P. Lévy, D. Carpentier, and L. Saminadayar. Magnetic dephasing in mesoscopic spin glasses. *Physical Review Letters*, 111(187203), 2013.

[428] T. Capron, A. Perrat-Mabilon, C. Peaucelle, T. Meunier, D. Carpentier, L. P. Lévy, C. Bauerle, and L. Saminadayar. Remanence effects in the electrical resistivity of spin glasses. *Europhysics Letters*, 27001, 2011.

[429] D. Carpentier, E. Orignac, G. Paulin, and T. Roscilde. Disorder in low dimensions: localisation effects in spin glass wires and cold atoms. *International Journal of Nanotechnology*, 7(4-8, SI):420–437, 2010.

[430] David Carpentier, Andrei A. Fedorenko, and Edmond Orignac. Effect of disorder on 2D topological merging transition from a Dirac semi-metal to a normal insulator. *Europhysics Letters*, 102(6), Jun 2013.

[431] M. A. Cazalilla, R. Citro, T. Giamarchi, E. Orignac, and M. Rigol. One dimensional bosons: From condensed matter systems to ultracold gases. *Reviews of Modern Physics*, 83(4):1405–1466, Dec 1 2011.

[432] Roberta Citro, Adele Naddeo, and Edmond Orignac. Quantum dynamics of a binary mixture of BECs in a double-well potential: a Holstein-Primakoff approach. *Journal of Physics B-Atomic Molecular and Optical Physics*, 44(11), Jun 14 2011.

[433] O. Crauste, Y. Ohtsubo, P. Ballet, P. Delplace, C. Carpentier, C. Bouvier, T. Meunier, A. Taleb-Ibrahimi, and L. Lévy. Topological surface states of strained mercury-telluride probed by ARPES. arXiv:1307.2008.

[434] M. Dalmonte, K. Dieckmann, T. Roscilde, C. Hartl, A. E. Feiguin, U. Schollwoeck, and F. Heidrich-Meisner. Dimer, trimer, and Fulde-Ferrell-Larkin-Ovchinnikov liquids in mass- and spin-imbalanced trapped binary mixtures in one dimension. *Physical Review A*, 85(6), Jun 8 2012.

[435] P. Degiovanni, Ch. Grenier, and G. Feve. Decoherence and relaxation of single-electron excitations in quantum Hall edge channels. *Physical Review B*, 80(24), Dec 2009.

[436] P. Degiovanni, Ch. Grenier, G. Feve, C. Altimiras, H. le Sueur, and F. Pierre. Plasmon scattering approach to energy exchange and high-frequency noise in nu=2 quantum Hall edge channels. *Physical Review B*, 81(12), Mar 2010.

[437] J. Y. P. Delannoy, A. G. Del Maestro, M. J. P. Gingras, and P. C. W. Holdsworth. Site dilution in the half-filled one-band Hubbard model: Ring exchange, charge fluctuations, and application to La2Cu1-x(Mg/Zn)(x)O-4. *Physical Review B*, 79(22), Jun 2009.

[438] J-Y. P. Delannoy, M. J. P. Gingras, P. C. W. Holdsworth, and A. M. S. Tremblay. Low-energy theory of the t-t '-t ''-U Hubbard model at half-filling: Interaction strengths in cuprate superconductors and an effective spin-only description of La2CuO4. *Physical Review B*, 79(23), Jun 2009.

[439] P. Delplace, J. Li, and D. Carpentier. Topological weyl semi-metal from a lattice model. *Europhysics Letters*, 97(67004), 2012.

[440] X. Deng, R. Citro, E. Orignac, and A. Minguzzi. Superfluidity and Anderson localisation for a weakly interacting Bose gas in a quasiperiodic potential. *European Physical Journal B*, 68(3):435–443, 2009.

[441] Xiaolong Deng, Roberta Citro, Edmond Orignac, Anna Minguzzi, and Luis Santos. Bosonization and entanglement spectrum for one-dimensional polar bosons on disordered lattices. *New Journal of Physics*, 15, Apr 26 2013.

[442] Xiaolong Deng, Roberta Citro, Edmond Orignac,

Anna Minguzzi, and Luis Santos. Polar bosons in one-dimensional disordered optical lattices. *Physical Review B*, 87(19), May 2 2013.

[443] J. Dubois, T. Jullien, C. Grenier, P. Degiovanni, P. Roulleau, and D. C. Glattli. Integer and fractional charge Lorentzian voltage pulses analyzed in the framework of photon-assisted shot noise. *Physical Review B*, 88(8), Aug 1 2013.

[444] Maria Eckholt and Tommaso Roscilde. Comment on "Feshbach-Einstein Condensates". *Physical Review Letters*, 105(19), Nov 5 2010.

[445] G. M. Falco, A. A. Fedorenko, J. Giacomelli, and M. Modugno. Density of states in an optical speckle potential. *Physical Review A*, 82(5), Nov 8 2010.

[446] A. A. Fedorenko and D. Carpentier. Nonlinear sigma-model study of magnetic dephasing in a mesoscopic spin glass. *Europhysics Letters*, 88(5), 2009.

[447] Andrei A. Fedorenko, David Carpentier, and Edmond Orignac. Two-dimensional Dirac fermions in the presence of long-range correlated disorder. *Physical Review B*, 85(12), Mar 28 2012.

[448] D. Ferraro, A. Feller, A. Ghibaudo, E. Thibierge, E. Bocquillon, G. Feve, Ch Grenier, and P. Degiovanni. Wigner function approach to single electron coherence in quantum Hall edge channels. *Physical Review B*, 88(20), Nov 11 2013.

[449] M. Fruchart and D. Carpentier. An introduction to topological insulators. *Comptes Rendus Physique*, 14:779, 2013.

[450] Michel Fruchart, David Carpentier, and Krzysztof Gawedzki. Parallel transport and band theory in crystals. arXiv:1403.2836.

[451] S. R. Giblin, S. T. Bramwell, P. C. W. Holdsworth, D. Prabhakaran, and I. Terry. Creation and measurement of long-lived magnetic monopole currents in spin ice. *Nature Physics*, 7(3):252–258, Mar 2011.

[452] Ch Grenier, J. Dubois, T. Jullien, P. Roulleau, D. C. Glattli, and P. Degiovanni. Fractionalization of minimal excitations in integer quantum Hall edge channels. *Physical Review B*, 88(8), Aug 1 2013.

[453] Ch Grenier, R. Herve, E. Bocquillon, F. D. Parmentier, B. Placais, J. M. Berroir, G. Feve, and P. Degiovanni. Single-electron quantum tomography in quantum Hall edge channels. *New Journal of Physics*, 13, Sep 6 2011.

[454] Charles Grenier, Remy Herve, Gwendal Feve, and Pascal Degiovanni. Electron quantum optics in quantum Hall edge channels. *Modern Physics Letters B*, 25(12-13, SI):1053–1073, May 30 2011. International Conference on Frustrated Spin Systems, Cold Atoms and Nanomaterials, Hanoi, Vietnam, JUL 14-16, 2010.

[455] Philipp Hauke, Tommaso Roscilde, Valentin Murg, J. Ignacio Cirac, and Roman Schmied. Modified spin-wave theory with ordering vector optimization: frustrated bosons on the spatially anisotropic triangular lattice. *New Journal of Physics*, 12, 2010.

[456] Philipp Hauke, Tommaso Roscilde, Valentin Murg, J. Ignacio Cirac, and Roman Schmied. Modified spin-wave theory with ordering vector optimization: spatially anisotropic triangular lattice and J(1)J(2)J(3) model with Heisenberg interactions. *New Journal of Physics*, 13, Jul 29 2011.

[457] Louis-Paul Henry, Peter C. W. Holdsworth, Frederic Mila, and Tommaso Roscilde. Spin-wave analysis of the transverse-field Ising model on the checkerboard lattice. *Physical Review B*, 85(13), Apr 16 2012.

[458] C. Hernandez, C. Consejo, P. Degiovanni, and C. Chaubet. Admittance of multiterminal quantum hall conductors at kilohertz frequencies. *Journal of Applied Physics*, 115:123710, 2014.

[459] Peter Holdsworth. SPIN ICE Flaws curb the flow. *Nature Physics*, 9(1):8–9, Jan 2013.

[460] Birger Horstmann, Stephan Duerr, and Tommaso Roscilde. Localization of Cold Atoms in State-Dependent Optical Lattices via a Rabi Pulse. *Physical Review Letters*, 105(16), Oct 12 2010.

[461] Stephan Humeniuk and Tommaso Roscilde. Quantum Monte Carlo calculation of entanglement Renyi entropies for generic quantum systems. *Physical Review B*, 86(23), Dec 12 2012.

[462] Thibaut Jacqmin, Bess Fang, Tarik Berrada, Tommaso Roscilde, and Isabelle Bouchoule. Momentum distribution of one-dimensional Bose gases at the quasicondensation crossover: Theoretical and experimental investigation. *Physical Review A*, 86(4), 2012.

[463] L. D. C. Jaubert, J. T. Chalker, P. C. W. Holdsworth, and R. Moessner. Spin Ice under Pressure: Symmetry Enhancement and Infinite Order Multicriticality. *Physical Review Letters*, 105(8), 2010.

[464] L. D. C. Jaubert, M. J. Harris, T. Fennell, R. G. Melko, S. T. Bramwell, and P. C. W. Holdsworth. Topological-Sector Fluctuations and Curie-Law Crossover in Spin Ice. *Physical Review X*, 3(1), Feb 21 2013.

[465] L. D. C. Jaubert and P. C. W. Holdsworth. Signature of magnetic monopole and Dirac string dynamics in spin ice. *Nature Physics*, 5(4):258–261, 2009.

[466] L. D. C. Jaubert and P. C. W. Holdsworth. Magnetic monopole dynamics in spin ice. *Journal of Physics-Condensed Matter*, 23(16, SI), 2011.

[467] Vassilios Kapaklis, Unnar B. Arnalds, Adam Harman-Clarke, Evangelos Th Papaioannou, Masoud Karimipour, Panagiotis Korelis, Andrea Taroni, Peter C. W. Holdsworth, Steven T. Bramwell, and Bjorgvin Hjorvarsson. Melting artificial spin ice. *New Journal of Physics*, 14, Mar 16 2012.

[468] Tassilo Keilmann, Ignacio Cirac, and Tommaso Roscilde. Dynamical Creation of a Supersolid in Asymmetric Mixtures of Bosons. *Physical Review Letters*, 102(25), Jun 26 2009.

[469] Andrew J. Macdonald, Peter C. W. Holdsworth, and Roger G. Melko. Classical topological order in kagome ice. *Journal of Physics-Condensed Matter*, 23(16, SI), Apr 27 2011.

[470] E. Orignac and S. Burdin. Kondo screening by the surface modes of a strong topological insulator. *Physical Review B*, 88(3), Jul 8 2013.

[471] E. Orignac and R. Citro. Response functions in multicomponent Luttinger liquids. *Journal of Statistical Mechanics-Theory and Experiment*, Dec 2012.

[472] E. Orignac, R. Citro, S. De Palo, and M. L. Chiofalo. Light scattering in inhomogeneous Tomonaga-Luttinger liquids. *Physical Review A*, 85(1), Jan 25 2012.

[473] E. Orignac, M. Tsuchiizu, and Y. Suzumura. Competition of superfluidity and density waves in one-dimensional Bose-Fermi mixtures. *Physical Review A*, 81(5), May 2010.

[474] E. Orignac, M. Tsuchiizu, and Y. Suzumura. Spectral functions of two-band spinless fermion and single-band spin-1/2 fermion models. *Physical Re-*

view B, 84(16), Oct 25 2011.

[475] Edoardo Pasca, Tommaso Roscilde, Marco Evangelisti, Enrique Burzuri, Fernando Luis, L. Jos de Jongh, and Stefania Tanase. Realization of the one-dimensional anisotropic XY model in a Tb(III)-W(V) chain compound. *Physical Review B*, 85(18), May 30 2012.

[476] G. Paulin and D. Carpentier. Cross-over between universality classes in a magnetically disordered metallic wire. *New Journal of Physics*, 14(023026), 2012.

[477] P. E. Roche, C. F. Barenghi, and E. Leveque. Quantum turbulence at finite temperature: The two-fluids cascade. *Europhysics Letters*, 87(5), 2009.

[478] T. Roscilde, C. Degli Esposti Boschi, and M. Dalmonte. Pairing, crystallization and string correlations of mass-imbalanced atomic mixtures in one-dimensional optical lattices. *Europhysics Letters*, 97(2), Jan 2012.

[479] T. Roscilde, M. Rodriguez, K. Eckert, O. Romero-Isart, M. Lewenstein, E. Polzik, and A. Sanpera. Quantum polarization spectroscopy of correlations in attractive fermionic gases. *New Journal of Physics*, 11, May 14 2009.

[480] Tommaso Roscilde. Probing correlated phases of bosons in optical lattices via trap squeezing. *New Journal of Physics*, 11, Feb 11 2009.

[481] Tommaso Roscilde. Exploring the grand-canonical phase diagram of interacting bosons in optical lattices by trap squeezing. *Physical Review A*, 82(2), 2010.

[482] Tommaso Roscilde. Thermometry of cold atoms in optical lattices via artificial gauge fields. *Physical Review Letters*, 112:110403, Mar 2014.

[483] Tommaso Roscilde and Massimo Boninsegni. Off-diagonal correlations in a one-dimensional gas of dipolar bosons. *New Journal of Physics*, 12, 2010.

[484] Guillaume Roux, Anna Minguzzi, and Tommaso Roscilde. Dynamic structure factor of one-dimensional lattice bosons in a disordered potential: a spectral fingerprint of the Bose-glass phase. *New Journal of Physics*, 15, May 1 2013.

[485] J. Salort, C. Baudet, B. Castaing, B. Chabaud, F. Daviaud, T. Didelot, P. Diribarne, B. Dubrulle, Y. Gagne, F. Gauthier, A. Girard, B. Hebral, B. Rousset, P. Thibault, and P. E. Roche. Turbulent velocity spectra in superfluid flows. *Physics of Fluids*, 22(12), Dec 2010.

[486] J. Salort, B. Chabaud, E. Leveque, and P. E. Roche. Energy cascade and the four-fifths law in superfluid turbulence. *Europhysics Letters*, 97(3), Feb 2012.

[487] J. Salort, P-E Roche, and E. Leveque. Mesoscale equipartition of kinetic energy in quantum turbulence. *Europhysics Letters*, 94(2), Apr 2011.

[488] O. Shevtsov, P. Carmier, C. Groth, X. Waintal, and D. Carpentier. Tunable thermopower in a graphene-based topological insulator. *Phys. Rev. B*, 85(245441), 2012.

[489] O. Shevtsov, P. Carmier, C. Petitjean, C. Groth, D. Carpentier, and X. Waintal. Graphene based heterojunction between two topological insulators. *Phys. Rev. X*, 2(031004), 2012.

[490] B. Thielemann, Ch. Rueegg, K. Kiefer, H. M. Ronnow, B. Normand, P. Bouillot, C. Kollath, E. Orignac, R. Citro, T. Giamarchi, A. M. Laeuchli, D. Biner, K. W. Kraemer, F. Wolff-Fabris, V. S. Zapf, M. Jaime, J. Stahn, N. B. Christensen, B. Grenier, D. F. McMorrow, and J. Mesot. Field-controlled magnetic order in the quantum spin-ladder system (Hpip)(2)CuBr4. *Physical Review B*, 79(2), Jan 2009.

[491] Kien Trinh, Stephan Haas, Rong Yu, and Tommaso Roscilde. Correlations in quantum spin ladders with site and bond dilution. *Physical Review B*, 85(3), Jan 31 2012.

[492] S. Villerot, B. Castaing, and L. Chevillard. Static Spectroscopy of a Dense Superfluid. *Journal of Low Temperature Physics*, 169(1-2):1–14, Oct 2012.

[493] R. Yu, S. Haas, and T. Roscilde. Revealing novel quantum phases in quantum antiferromagnets on random lattices. *Condensed Matter Physics*, 12(3):519–530, 2009.

[494] R. Yu, S. Haas, and T. Roscilde. Universal phase diagram of disordered bosons from a doped quantum magnet. *Europhysics Letters*, 89(1), Jan 2010.

[495] Rong Yu, Corneliu F. Miclea, Franziska Weickert, Roman Movshovich, Armando Paduan-Filho, Vivien S. Zapf, and Tommaso Roscilde. Quantum critical scaling at a Bose-glass/superfluid transition: Theory and experiment for a model quantum magnet. *Physical Review B*, 86(13), Oct 23 2012.

[496] Rong Yu, Omid Nohadani, Stephan Haas, and Tommaso Roscilde. Magnetic Bose glass phases of coupled antiferromagnetic dimers with site dilution. *Physical Review B*, 82(13), Oct 22 2010.

[497] Rong Yu, Liang Yin, Neil S. Sullivan, J. S. Xia, Chao Huan, Armando Paduan-Filho, Nei F. Oliveira, Jr., Stephan Haas, Alexander Steppke, Corneliu F. Miclea, Franziska Weickert, Roman Movshovich, Eun-Deok Mun, Brian L. Scott, Vivien S. Zapf, and Tommaso Roscilde. Bose glass and Mott glass of quasiparticles in a doped quantum magnet. *Nature*, 489(7416):379–384, 2012.

[498] Andrey Zheludev and Tommaso Roscilde. Dirty-boson physics with magnetic insulators. *Comptes Rendus Physique*, 14(8):740–756, Oct 2013.

[499] M. E. Zhitomirsky, M. V. Gvozdikova, P. C. W. Holdsworth, and R. Moessner. Quantum Order by Disorder and Accidental Soft Mode in Er2Ti2O7. *Physical Review Letters*, 109(7), Aug 16 2012.

T6B. Infophysics, Signal and Systems: *Publications*

Pour ce thème, nous avons retenus les articles publiés dans des revues à comité de lecture ainsi que les articles de congrès avec comité de lecture puisque, pour cette communauté, cette catégorie est souvent prestigieuse et difficile.

[500] P Abry. Wavelet leader multifractal analysis for heart rate variability. In *35th Annual International Conference of the IEEE EMBS*, page xx, 2013.

[501] P. Abry, M. Clausel, S. Jaffard, S.G. Roux, and B. Vedel. Hyperbolic wavelet transform: an efficient tool for multifractal analysis of anisotropic textures. *Revista Matematica Iberoamericana,*, accepted for publication, October 2013.

[502] P. Abry, P. Flandrin, and D. Veitch. Phénomènes d'invariance d'échelle dans l'internet. *Les Dossiers de La Recherche*, (46):52–55, 2011.

[503] P. Abry, H. Helgason, P. Goncalves, E. Pereira, P. Gaucherand, and M. Doret. Multifractal analysis of ECG for intrapartum diagnosis of fetal asphyxia. In *2010 IEEE International Conference on Acoustics, Speech, and Signal Processing*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 566–569. IEEE Signal Proc Soc, 2010. 2010 IEEE International Conference on Acoustics, Speech, and Signal Processing, Dallas, TX, Mar 10-19, 2010.

[504] P. Abry, S. Jaffard, and H. Wendt. Bruegel's drawings under the multi fractal microscope. In *2012 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pages 3909–3912. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2012. IEEE International Conference on Acoustics, Speech and Signal Processing, Kyoto, Japan, Mar 25-30, 2012.

[505] P Abry, S Roux, V Chudacek, P Borgnat, P Goncalves, and M Doret. Hurst exponent and intrapartum fetal heart rate: Impact of decelerations. In *The 26th IEEE International Symposium on Computer-Based Medical Systems (CBMS 2013)*, 2013.

[506] P. Abry, H. Wendt, and S. Jaffard. When Van Gogh meets Mandelbrot: Multifractal classification of painting's texture. *Signal Processing*, 93(3, SI):554–572, Mar 2013.

[507] P. Abry, H. Wendt, S. Jaffard, H. Helgason, P. Goncalves, E. Pereira, Cl Gharib, P. Gaucherand, and M. Doret. Methodology for Multifractal Analysis of Heart Rate Variability: From LF/HF Ratio to Wavelet Leaders. In *2010 Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, IEEE Engineering in Medicine and Biology Society Conference Proceedings, pages 106–109. IEEE Engn Med & Biol Soc (EMBS), 2010. 32nd Annual International Conference of the IEEE Engineering-in-Medicine-and-Biology-Society (EMBC 10), Buenos Aires, Argentina, Aug 30-Sep 04, 2010.

[508] Patrice Abry, Pierre Borgnat, Fabio Ricciato, Antoine Scherrer, and Darryl Veitch. Revisiting an old friend: on the observability of the relation between long range dependence and heavy tail. *Telecommunication Systems*, 43(3-4):147–165, Apr 2010.

[509] Patrice Abry, Pierre Chainais, Laure Coutin, and Vladas Pipiras. Multifractal Random Walks as Fractional Wiener Integrals. *IEEE Transactions on Information Theory*, 55(8):3825–3846, Aug 2009.

[510] Patrice Abry, Jim Coddington, Ingrid Daubechies, Ella Hendriks, Shannon Hughes, Don H. Johnson, and Eric Postma. Special Issue: Image Processing for Digital Art Work Foreword. *Signal Processing*, 93(3, SI):525–526, Mar 2013.

[511] Patrice Abry, Hannes Helgason, and Vladas Pipiras. Wavelet-Based Analysis of non-gaussian long-range dependent processes and estimation of the Hurst parameter. *Lithuanian Mathematical Journal*, 51(3):287–302, Jul 2011.

[512] Patrice Abry, Stephane Jaffard, Stephane Roux, Beatrice Vedel, and Herwig Wendt. Wavelet Decomposition of Measures: Application to Multifractal Analysis of Images. In Byrnes, J, editor, *Unexplored ordnance detection and mitigation*, NATO Science for Peace and Security Series B - Physics and Biophysics, pages 1–20. NATO Adv Study Inst, 2009. Conference of the NATO-Advances-Study-Institute on Unexploded Ordnance Detection and Mitigation, Ciocco, Italy, Jul 20-Aug 02, 2008.

[513] Patrice Abry, Stephane G. Roux, and Stephane Jaffard. Detecting oscillating singularities in multifractal analysis: application to hydrodynamic turbulence. In *2011 IEEE International Conference on Acoustics, Speech, and Signal Processing*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 4328–4331. Inst Elect & Elect Engineers Signal Processing Soc; IEEE, 2011. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Prague Congress Ctr, Prague, Czech Republic, May 22-27, 2011.

[514] Hassan Amoud, Paul Honeine, Cedric Richard, Pierre Borgnat, and Patrick Flandrin. Sur la caracérisation de non-stationnariés par la méthode des substituts. In *Actes du XXIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2009. Dijon.

[515] Hassan Amoud, Paul Honeine, Cedric Richard, Pierre Borgnat, and Patrick Flandrin. Time-frequency learning machines for nonstationarity detection using surrogates. In *IEEE/SP 15th Workshop on Statistical Signal Processing SSP-2009, Vols. 1 and 2*, pages 565–568, Aug. 31-Sep. 03, 2009. Cardiff, Wales.

[516] Elmer Andres Fernandez, E. P. Souza Neto, P. Abry, R. Macchiavelli, M. Balzarini, B. Cuzin, C. Baude, J. Frutoso, and C. Gharib. Assessing erectile neurogenic dysfunction from heart rate variability through a Generalized Linear Mixed Model framework. *Computer Methods and Programs in Biomedicine*, 99(1):49–56, Jul 2010.

[517] F. Angeletti, H. Touchette, E. Bertin, and P. Abry. Large deviations for correlated random variables described by a matrix product ansatz. *Journal of Statistical Mechanics-Theory and Experiment*, 2014(2):P02003, 2014.

[518] Florian Angeletti, Eric Bertin, and Patrice Abry. Critical moment definition and estimation, for finite size observation of log-exponential-power law random variables. *Signal Processing*, 92(12):2848–2865, Dec 2012.

[519] Florian Angeletti, Eric Bertin, and Patrice Abry. Matrix products for the synthesis of stationary time series with a priori prescribed joint distributions. In *2012 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pages 3897–3900. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2012. IEEE International Conference on Acoustics, Speech and Signal Processing, Kyoto, Japan, Mar 25-30, 2012.

[520] Florian Angeletti, Eric Bertin, and Patrice Abry. Renormalization flow for extreme value statistics of random variables raised to a varying power. *Journal of Physics A-Mathematical and Theoretical*, 45(11), Mar 23 2012.

[521] Florian Angeletti, Eric Bertin, and Patrice Abry. On the existence of a glass transition in a random energy model. *Journal of Physics A-Mathematical and Theoretical*, 46(31), Aug 9 2013.

[522] Florian Angeletti, Eric Bertin, and Patrice Abry. Random Vector and Time Series Definition and Synthesis From Matrix Product Representations: From

Statistical Physics to Hidden Markov Models. *IEEE Transactions on Signal Processing*, 61(21):5389–5400, Nov 2013.

[523] Florian Angeletti, Eric Bertin, and Patrice Abry. Statistics of sums of correlated variables described by a matrix product ansatz. *Europhysics Letters*, 104(5), Dec 2013.

[524] Florian Angeletti, Marc Mezard, Eric Bertin, and Patrice Abry. Linearization effect in multifractal analysis: Insights from the Random Energy Model. *Physica D*, 240(16):1245–1253, AUG 1 2011.

[525] Andrea Apolloni, Jean-Baptiste Rouquier, and Pablo Jensen. Collaboration range: Effects of geographical proximity on article impact. *European Physics Journal-Special Topics*, 222(6):1467–1478, Sep 2013.

[526] A. Arneodo, B. Audit, E.-B. Brodie of Brodie, S. Nicolay, M. Touchon, Y. d'Aubenton-Carafa, M. Huvet, and C. Thermes. Fractals and wavelets: what can we learn on transcription and replication from wavelet-based multifractal analysis of DNA sequences? In R. A. Meyers, editor, *Encyclopedia of Complexity and Systems Science*, pages 3893–3924. Springer, New York, 2009.

[527] H. Asai, K. Fukuda, P. Abry, P. Borgnat, and H. Esaki. Network application profiling with traffic causality graphs. *International Journal of Network Management*, 24(4):289–303, 2014.

[528] B. Audit, A. Baker, R. E. Boulos, H. Julienne, A. Arneodo, C. L. Chen, Y. d'Aubenton Carafa, C. Thermes, A. Goldar, G. Guilbaud, A. Rappailles, and O. Hyrien. Relating mammalian replication program to large-scale chromatin folding. In *ACM Conference on Bioinformatics, Computational Biology and Biomedical Informatics*, pages 800–811. ACM BCB, Washington DC, 2013.

[529] Benjamin Audit, Antoine Baker, Chun-Long Chen, Aurélien Rappailles, Guillaume Guilbaud, Hanna Julienne, Arach Goldar, Yves d'Aubenton Carafa, Olivier Hyrien, Claude Thermes, and Alain Arneodo. Multiscale analysis of genome-wide replication timing profiles using a wavelet-based signal-processing algorithm. *Nature Protocols*, 8(1):98–110, Dec 2013.

[530] Benjamin Audit, Lamia Zaghloul, Antoine Baker, Alain Arneodo, Chun-Long Chen, Yves d'Aubenton Carafa, and Claude Thermes. Megabase replication domains along the human genome: relation to chromatin structure and genome organisation. *Subcellular Biochemistry*, 61:57–80, 2012.

[531] Francois Auger, Eric Chassande-Mottin, and Patrick Flandrin. Réallocation de Levenberg-Marquardt. In *Actes du XXIIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2011. Bordeaux.

[532] Francois Auger, Eric Chassande-Mottin, and Patrick Flandrin. On phase-magnitude relationships in the Short-Time Fourier Transform. *IEEE Signal Processing Letters*, 19(5):267–270, May 2012.

[533] Francois Auger, Patrick Flandrin, Yu-Ting Lin, Stephen McLaughlin, Sylvain Meignen, Thomas Oberlin, and Hau-Tieng Wu. Time-frequency reassignment and synchrosqueezing. *IEEE Signal Processing Magazine*, 30(6):32–41, November 2013.

[534] Changryong Baek, Vladas Pipiras, Herwig Wendt, and Patrice Abry. Second order properties of distribution tails and estimation of tail exponents in random difference equations. *Extremes*, 12(4):361–400, Dec 2009.

[535] A. Baker, S. Nicolay, L. Zaghloul, Y. d'Aubenton-Carafa, C. Thermes, B. Audit, and A. Arneodo. Wavelet-based method to disentangle transcription- and replication-associated strand asymmetries in mammalian genomes. *Appl. Comput. Harmon. Anal.*, 28:150–170, 2010.

[536] A. Barrat, C. Cattuto, V. Colizza, F. Gesualdo, L. Isella, E. Pandolfi, J-F Pinton, L. Rava, C. Rizzo, M. Romano, J. Stehle, A. E. Tozzi, and W. Van den Broeck. Empirical temporal networks of face-to-face human interactions. *European Physical Journal-Special Topics*, 222(6):1295–1309, Sep 2013.

[537] Martin W. Bauer and Pablo Jensen. The mobilization of scientists for public engagement. *Public Understanding of Science*, 20(1):3–11, Jan 2011.

[538] Sueleyman Baylcut, Paulo Goncalves, Pierre-Herve Luppi, Patrice Abry, Edmundo Pereira de Souza Neto, and Damien Gervasoni. EMD-based analysis of rat EEG data for sleep state classification. In Encarnacao, P and Veloso, A, editor, *Biosignals 2009: Proceedings of the International Conference on Bio-inspired Systems and Signal Processing*, pages 115–123. Inst Syst & Technologies Informat, Control & Commun; IEEE Engn Med & Biol Soc; IEEE Circuits & Syst Soc; Assoc Advancement Artificial Intelligence; ACM SIGART, 2009. 2nd International Conference on Bio-Inspired Systems and Signal Processing, Oporto, Portugal, JAN 14-17, 2009.

[539] Elyes Ben Hamida, Pierre Borgnat, Hiroshi Esaki, Patrice Abry, and Eric Fleury. Live E! Sensor Network: Correlations in Time and Space. In *Actes du XXIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2009. Dijon.

[540] Elyes Ben Hamida, Hideya Ochiai, Hiroshi Esaki, Pierre Borgnat, Patrice Abry, and Eric Fleury. Measurement Analysis of the Live E! Sensor Network: Spatial-Temporal Correlations and Data Aggregation. In *2009 9TH Annual International Symposium on Applications and the Internet*, pages 263–266, 2009. 9th Annual International Symposium on Applications and the Internet (SAINT 2009), Bellevue, Wa, Jul 20-24, 2009.

[541] Eric Bertin and Geza Györgyi. Renormalization flow in extreme value statistics. *Journal of Statistical Mechanics-Theory and Experiment*, Aug 2010.

[542] Pierre Borgnat, Patrice Abry, and Patrick Flandrin. Studying Lyon's Vélo'v : A statistical cyclic model. In *Proc. of the European Conference on Complex Systems ECCS-09*, September 2009. Warwick (UK).

[543] Pierre Borgnat, Patrice Abry, and Patrick Flandrin. Using surrogates and optimal transport for synthesis of stationary multivariate series with prescribed covariance function and non-Gaussian joint-distribution. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2012*, pages 3729–3732, Mar. 25-30, 2012. Kyoto, Japan.

[544] Pierre Borgnat, Patrice Abry, Patrick Flandrin, Celine Robardet, Jean-Baptiste Rouquier, and Eric Fleury. Shared bicycles in a city: A signal processing and data analysis perspective. *Advances in Complex Systems*, 14(3):415–438, June 2011.

[545] Pierre Borgnat, Patrice Abry, Patrick Flandrin, and Jean-Baptiste Rouquier. Modélisation statistique cyclique des locations de Vélo'v à Lyon. In *Actes du XXIIème Colloque GRETSI sur le Traitement*

du Signal et des Images, September 2009. Dijon.

[546] Pierre Borgnat, Guillaume Dewaele, Kensuke Fukuda, Patrice Abry, and Kenjiro Cho. Seven Years and One Day: Sketching the Evolution of Internet Traffic. In *IEEE INFOCOM 2009 - IEEE Conference on Computer Communications, Vols 1-5*, IEEE INFOCOM, pages 711–719. IEEE, 2009. IEEE INFOCOM Conference 2009, Rio de Janeiro, Brazil, Apr 19-25, 2009.

[547] Pierre Borgnat and Patrick Flandrin. Stationarization via surrogates. *Journal of Statistical Mechanics-Theory and Experiments*, :, January 2009.

[548] Pierre Borgnat, Patrick Flandrin, Andre Ferrari, and Cedric Richard. Transitional surrogates. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2011*, pages 3600–3603, May 22-27 2011. Prague, CZ.

[549] Pierre Borgnat, Patrick Flandrin, Paul Honeine, Cedric Richard, and Jun Xiao. Testing stationarity with surrogates: A time-frequency approach. *IEEE Transactions on Signal Processing*, 58(7):3459–3470, July 2010.

[550] Pierre Borgnat, Eric Fleury, Jean-Loup Guillaume, and Celine Robardet. Characteristics of the Dynamic of Mobile Networks. In Altman, E and Carrera, I and ElAzouzi, R and Hart, E and Hayel, Y, editor, *Bioinspired models of network, information, and computing systems*, volume 39 of *Lecture Notes of the Institute for Computer Sciences Social Informatics and Telecommunications Engineering*, pages 130–139. ICST; Createnet; PerAda; INRIA; Univ Avignon; Bionets, 2010. 4th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems, Avignon, France, Dec 09-11, 2009.

[551] Pierre Borgnat, Eric Fleury, Céline Robardet, and Antoine Scherrer. Spatial analysis of dynamic movements of Vélo'v, Lyon's shared bicycle program. In *Proc. of the European Conference on Complex Systems ECCS-09*, September 2009. Warwick (UK).

[552] Borgnat, P. and Flandrin, P. and Richard, C. and Ferrari, A. and Hamoud, H. and Honeine, P. Time-frequency learning machines for nonstationarity detection using surrogates. In M.J. Way, J.D. Scargle, K. Ali and A.N. Srivastava, editor, *Data Mining and Machine Learning for Astronomical Applications*, chapter 22, pages 487–504. CRC Press, Boca Raton, LA, 2012.

[553] J. Boulanger, N. Pustelnik, and L. Condat. Nonsmooth convex optimization for an efficient reconstruction in structured illumination microscopy. In *2014 IEEE International Symposium on Biomedical Imaging (ISBI)*, 2014. IEEE International Symposium on Biomedical Imaging, Beijing, China, Apr 22- May 2, 2014.

[554] R. E. Boulos, A. Arneodo, P. Jensen, and B. Audit. Graph analysis of chromatin conformation data in relation with the human replication program. In *14ième Journées Ouvertes en Biologie, Informatique et Mathématiques*, page 35. JOBIM, Toulouse, 2013.

[555] R. E. Boulos, A. Arneodo, P. Jensen, and B. Audit. Revealing long-range interconnected hubs in human chromatin interaction data using graph theory. *Physical Review Letters*, 111:118102, 2013.

[556] C. Canonne and N. B. Garnier. A model for collective free improvisation. In C. Agon, E. Amiot, G. Andreatta, M.and Assayag, J. Bresson, and J. Manderau, editors, *Mathematics and Computation in Music*, pages 29–41. Springer, 2011.

[557] C. Canonne and N. B. Garnier. Cognition and segmentation in collective free improvisation: An exploratory study. In E. Cambouropoulos, C. Tsougras, P. Mavromatis, and K. Pastiadis, editors, *International Conference on Music Perception and Cognition ICMPC 2012*, pages 197–204. School of Music Studies, Aristotle University, 2012.

[558] Ciro Cattuto, Wouter Van den Broeck, Alain Barrat, Vittoria Colizza, Jean-Francois Pinton, and Alessandro Vespignani. Dynamics of Person-to-Person Interactions from Distributed RFID Sensor Networks. *PLOS ONE*, 5(7), Jul 15 2010.

[559] Laurent Chevillard, Remi Rhodes, and Vincent Vargas. Gaussian Multiplicative Chaos for Symmetric Isotropic Matrices. *Journal of Statistical Physics*, 150(4):678–703, Feb 2013.

[560] G. Chierchia, N. Pustelnik, J. C. Pesquet, and B. Pesquet-Popescu. A proximal approach for constrained cosparse modelling. In *2012 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pages 3433–3436. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2012. IEEE International Conference on Acoustics, Speech and Signal Processing, Kyoto, Japan, Mar 25-30, 2012.

[561] G. Chierchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu. An epigraphical convex optimization approach for multicomponent image restoration using non-local structure tensor. In *2013 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 1359–1363. Inst Elect & Elect Engineers; Inst Elect & Elect Engineers Signal Proc Soc, 2013. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Vancouver, Canada, May 26-31, 2013.

[562] G. Chierchia, N. Pustelnik, J. C. Pesquet, and B. Pesquet-Popescu. Epigraphic proximal projection for sparse multiclass SVM. In *2014 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2014. IEEE International Conference on Acoustics, Speech and Signal Processing, Florence, Italy, May 4-9, 2014.

[563] G. Chierchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu. Epigraphical splitting for solving constrained convex formulations of inverse problems with proximal tools. *Signal, Image and Video Processing*, to appear, 2014.

[564] V Chudacek, J Anden, S Mallat, P Abry, and M Doret. Scattering transform for intrapartum fetal heart rate characterization and acidosis detection. In *35th Annual International Conference of the IEEE EMBS*, pages 2898–2901, 2013.

[565] V Chudacek, J Anden, S Mallat, P Abry, and M Doret. Scattering transform for intrapartum fetal heart rate variability fractal analysis: a case-control study. *Eng. Med. and Biol., IEEE Transactions on*, xx(xx):xx, 2013.

[566] P. Ciuciu, B. He, and P. Abry. Interplay between functional connectivity and scale-free dynamics in intrinsic fmri networks. *NeuroImage*, (to appear), 2014.

[567] P. Ciuciu, G. Varoquaux, P. Abry, S. Sadaghiani, and A. Kleinschmidt. Scale-free and multifractal dynamic properties of fmri signals during rest and task. *Frontiers in Physiology*, 3(186), 2012.

[568] Philippe Ciuciu, Gael Varoquaux, Patrice Abry, and Moty Almog. Multifractal Analysis of resting state networks in functional MRI. In *2011 8TH IEEE International Symposium on Biomedical Imaging from Nano to Macro*, IEEE International Symposium on Biomedical Imaging, pages 473–478. Inst Elect & Electron Engn; Engn Med & Biol Soc (EMBS); IEEE Signal Proc Soc (SPS), 2011. 8th IEEE International Symposium on Biomedical Imaging (ISBI) - From Nano to Macro, Chicago, IL, Mar 30-Apr 02, 2011.

[569] Marcelo Colominas, Gaston Schlotthauer, Maria-Eugenia Torres, and Patrick Flandrin. Noise-assisted EMD methods in action. *Advances in Adaptive Data Analysis*, 4(4):1250025–1–1250025–1, October 2012.

[570] L. Condat, J. Boulanger, N. Pustelnik, S. Sahnoun, and L. Sengmanivong. A 2-d spectral analysis method to estimate the modulation parameters in structured illumination microscopy. In *2014 IEEE International Symposium on Biomedical Imaging (ISBI)*, 2014. IEEE International Symposium on Biomedical Imaging, Beijing, China, Apr 22- May 2, 2014.

[571] A. Costard, S. Achard, O. Michel, P. Borgnat, and P. Abry. Encadrement du paramètre de pénalisation dans l'estimation bayésienne asymptotique de la structure d'un graphe initialisée par graphical lasso. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images,*, September 2013. Brest, France.

[572] Douglas Baptista de Souza, Jocelyn Chanussot, Anne-Catherine Favre, and Pierre Borgnat. A modified time-frequency method for testing wide-sense stationarity. In *2012 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pages 3409–3412. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2012. IEEE International Conference on Acoustics, Speech and Signal Processing, Kyoto, Japan, Mar 25-30, 2012.

[573] Douglas Baptista de Souza, Jocelyn Chanussot, Anne-Catherine Favre, and Pierre Borgnat. A new nonparametric method for testing stationarity based on trend analysis in the time marginal distribution. In *2014 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2014. IEEE International Conference on Acoustics, Speech and Signal Processing, Florence, Italy, May 4-9, 2014.

[574] Edmundo Pereira de Souza Neto, Elmer Andres Fernandez, Patrice Abry, Beatrice Cuzin, Patrick Loiseau, Christian Baude, Jean Frutoso, Claude Gharib, and Xavier Martin. Application of Cardiac Autonomous Indices in the Study of Neurogenic Erectile Dysfunction. *Urologia Internationalis*, 86(3):290–297, 2011.

[575] Guillaume Dewaele, Yosuke Himura, Pierre Borgnat, Kensuke Fukuda, Patrice Abry, Olivier Michel, Romain Fontugne, Kenjiro Cho, and Hiroshi Esaki. Unsupervised host behavior classification from connection patterns. *International Journal of Network Management*, 20(5, SI):317–337, Sep-Oct 2010.

[576] Muriel Doret, Hannes Helgason, Patrice Abry, Paulo Goncalves, Claude Gharib, and Pascal Gaucherand. Multifractal Analysis of Fetal Heart Rate Variability in Fetuses with and without Severe Acidosis during Labor. *American Journal of Perinatology*, 28(4):259–266, Apr 2011.

[577] E. Pereira de Souza Neto, P. Abry, J. Frutoso, P. Flandrin, C. Gharib. Heart Rate Variability Analyses. In J.J. Lehot et M. Cannesson, editor, *Monitorage des paramètres physiologiques en situation clinique*, pages 42–59. Arnette, Rueil-Malmaison, 2004.

[578] Sebastien Equis, Patrick Flandrin, and Pierre Jacquot. Extraction de phase en interférométrie speckle par encerclement du signal analytique associé. In *Actes du XXIIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2011. Bordeaux.

[579] Sebastien Equis, Patrick Flandrin, and Pierre Jacquot. Phase extraction in speckle interferometry by a circle fitting procedure in the complex plane. *Optics Letters*, 36(23):4617–4619, December 2011.

[580] Patrick Flandrin. An empirical model for electronic submissions to conferences. In *Proc. of the European Conference on Complex Systems ECCS-09*, September 2009. Warwick (UK).

[581] Patrick Flandrin. Un modèle empirique pour la soumission de communications aux conférences. In *Actes du XXIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2009. Dijon.

[582] Patrick Flandrin. An empirical model for electronic submissions to conferences. *Advances in Complex Systems*, 13(3, SI):439–449, June 2010.

[583] Patrick Flandrin. A note on reassigned Gabor spectrograms of Hermite functions. *Journal of Fourier Analysis and Applications*, 19(2):285–295, April 2013.

[584] Patrick Flandrin, Moeness Amin, Stephen McLaughlin, and Bruno Torresani. Time-Frequency Analysis and Applications. *IEEE Signal Processing Magazine*, 30(6), November 2013.

[585] Patrick Flandrin and Pierre Borgnat. Revisiting and testing stationarity. *Journal of Physics: Conference Series*, 139, 2009.

[586] Patrick Flandrin and Pierre Borgnat. Time-frequency energy distributions meet compressed sensing. *IEEE Transactions on Signal Processing*, 58(6):2974–2982, June 2010.

[587] Patrick Flandrin, Eric Chassande-Mottin, and Francois Auger. Uncertainty and spectrogram geometry. In *Proc. of the 20th European Signal Processing Conference EUSIPCO-2012*, pages 794–798, Aug. 27-31 2012. Bucharest, Romania.

[588] Patrick Flandrin, Antonio Napolitano, Haldun M. Ozaktas, and David J. Thomson. Recent Advances in Theory and Methods for Nonstationary Signal Analysis. *EURASIP Journal on Advances in Signal Processing*, 2011.

[589] Patrick Flandrin, Cedric Richard, Pierre-Olivier Amblard, Pierre Borgnat, Paul Honeine, Hassan Amoud, Andre Ferrari, Jun Xiao, Azadeh Moghtaderi, and Pepa Ramirez-Cobo. Relative stationarity and connected approaches. *Traitement du Signal*, 28(6):691–716, 2011.

[590] Romain Fontugne, Pierre Borgnat, Patrice Abry, and Kensuke Fukuda. MAWILab : Combining Diverse Anomaly Detectors for Automated Anomaly Labeling and Performance Benchmarking. In *ACM*

CoNEXT 2010, 2010. Philadelphia (PA), Nov. 30-Dec. 3 2010.

[591] Romain Fontugne, Pierre Borgnat, Patrice Abry, and Kensuke Fukuda. Uncovering Relations between Traffic Classifiers and Anomaly Detectors via Graph Theory. In Ricciato, F and Mellia, M and Biersack, E, editor, *Traffic monitoring and analysis, Proceedings*, volume 6003 of *Lecture Notes in Computer Science*, pages 101–114. COST IC0703, 2010. 2nd International Workshop on Traffic Monitoring and Analysis, Zurich, Switzerland, Apr 07, 2010.

[592] Romain Fontugne, Jorge Ortiz, Nicolas Tremblay, Pierre Borgnat, Patrick Flandrin, Kensuke Fukuda, D. Culler, and Hiroshi Esaki. Strip, Bind, and Search: A Method for Identifying Abnormal Energy Consumption in Buildings. In *IEEE/ACM Information Processing in Sensor Networks, ISPN'13*, 8-11 April, 2013. Philadelphia (PN, USA).

[593] Romain Fontugne, Nicolas Tremblay, Pierre Borgnat, Patrick Flandrin, and Hiroshi Esaki. Mining anomalous electricity consumption using Ensemble Empirical Mode Decomposition. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2013*, pages 5238–5242, May 26-31, 2013. Vancouver, Canada.

[594] E. Gerasimova, B. Audit, S. G. Roux, A. Khalil, F. Argoul, O. Naimark, and A. Arneodo. Multifractal analysis of dynamic infrared imaging of breast cancer. *Europhysics Letters*, 104:68001, 2013.

[595] E. Gerasimova, B. Audit, S.G. Roux, A. Khalil, O. Gileva, F. Argoul, O. Naimark, and A. Arneodo. A wavelet-based method for multifractal analysis of medical signals:application to dynamic infrared thermograms of breast cancer. *Communications in Computer and Information Science (CCIS)*, 438:288–300, 2014.

[596] Evgeniya Gerasimova, Benjamin Audit, Stephane G. Roux, André Khalil, Olga Gileva, Françoise Argoul, Oleg Naimark, and Alain Arneodo. Wavelet-based multifractal analysis of dynamic infrared thermograms to assist in early breast cancer diagnosis. *Front. Physiol.*, 5:176, 2014.

[597] Sergio Gomez, Pablo Jensen, and Alex Arenas. Analysis of community structure in networks of correlated data. *Physical Review E*, 80(1, 2), Jul 2009.

[598] Sebastian Grauwin, Guillaume Beslon, Eric Fleury, Sara Franceschelli, Celine Robardet, Jean-Baptiste Rouquier, and Pablo Jensen. Complex Systems Science: Dreams of Universality, Interdisciplinarity Reality. *Journal of the American Society for Information Science and Technology*, 63(7):1327–1338, Jul 2012.

[599] Sebastian Grauwin and Pablo Jensen. Mapping scientific institutions. *Scientometrics*, 89(3):943–954, Dec 2011.

[600] Ronan Hamon, Pierre Borgnat, Patrick Flandrin, and Céline Robardet. Networks as signals, with an application to bike sharing systems. In *Proc. of IEEE-GlobalSIP*, December 2013. Austin (TX).

[601] Ronan Hamon, Pierre Borgnat, Patrick Flandrin, and Céline Robardet. Tracking of a dynamic graph using a signal theory approach : application to the study of a bike sharing system. In *European Conference of Complex Systems, ECCS 2013*, September 2013. Barcelona (Spain).

[602] Ronan Hamon, Pierre Borgnat, Patrick Flandrin, and Céline Robardet. Nonnegative matrix factorization to find features in temporal networks. In *2014 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, 2014. IEEE International Conference on Acoustics, Speech and Signal Processing, Florence, Italy, May 4-9, 2014.

[603] Ronan Hamon, Pierre Borgnat, Céline Robardet, and Patrick Flandrin. Transformation de graphes dynamiques en signaux non stationnaires. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2013. Brest.

[604] H. Helgason, P. Abry, P. Goncalves, Cl. Gharib, P. Gaucherand, and M. Doret. Adaptive Multiscale Complexity Analysis of Fetal Heart Rate. *IEEE Transactions on Biomedical Engineering*, 58(8), Aug 2011.

[605] Hannes Helgason, Jay Bartroff, and Patrice Abry. Framework for Adaptive Multiscale Analysis of Nonhomogeneous Point Processes. In *2011 Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, IEEE Engineering in Medicine and Biology Society Conference Proceedings, pages 7727–7730. IEEE; Engn Med & Biol Soc (EMBS), 2011. 33rd Annual International Conference of the IEEE Engineering-in-Medicine-and-Biology-Society (EMBS), Boston, Aug 30-Sep 03, 2011.

[606] Hannes Helgason, Vladas Pipiras, and Patrice Abry. Fast and exact synthesis of stationary multivariate Gaussian time series using circulant embedding. *Signal Processing*, 91(5):1123–1133, May 2011.

[607] Hannes Helgason, Vladas Pipiras, and Patrice Abry. Synthesis of multivariate stationary series with prescribed marginal distributions and covariance using circulant matrix embedding. *Signal Processing*, 91(8):1741–1758, Aug 2011.

[608] Hannes Helgason, Vladas Pipiras, and Patrice Abry. Smoothing windows for the synthesis of Gaussian stationary random fields using circulant matrix embedding. *Journal of Computational and Graphical Statistics*, xx(x):xx, 2013.

[609] Yosuke Himura, Kensuke Fukuda, Patrice Abry, Kenjiro Cho, and Hiroshi Esaki. Characterization of Host-Level Application Traffic with Multi-Scale Gamma Model. *IEICE Transactions on Communications*, E93B(11):3048–3057, Nov 2010.

[610] Yosuke Himura, Kensuke Fukuda, Kenjiro Cho, Pierre Borgnat, Patrice Abry, and Hiroshi Esaki. Synoptic Graphlet: Bridging the Gap Between Supervised and Unsupervised Profiling of Host-Level Network Traffic. *IEEE-ACM Transactions on Networking*, 21(4):1284–1297, Aug 2013.

[611] Lorenzo Isella, Juliette Stehle, Alain Barrat, Ciro Cattuto, Jean-Francois Pinton, and Wouter Van den Broeck. What's in a crowd? Analysis of face-to-face behavioral networks. *Journal of Theoretical Biology*, 271(1):166–180, Feb 21 2011.

[612] Stephane Jaffard, Patrice Abry, and Stephane Roux. Function Spaces Vs. Scaling Functions: Tools for Image Classification. In Bergounioux, M, editor, *Mathematical Image Processing*, volume 5 of *Springer Proceedings in Mathematics*, pages 1–39. Res Federat Denis Poisson Orleans; Tours Univ; Region Ctr; Conseil Gen Loiret; Mairie Orleans; Univ Orleans; Federat Denis Poisson & Lab MAPMO Orleans; Commissariat Energie Atom, 2011. 2nd Conference on Mathematics and Image Processing, Univ

Orleans, Orleans, France, Mar 29-Apr 01, 2010.

[613] Pablo Jensen. Analyzing the Localization of Retail Stores with Complex Systems Tools. In Adams, NM and Robardet, C and Siebes, A and Boulicaut, JF, editor, *Advances in intelligent Data Analysis VIII, Proceedings*, volume 5772 of *Lecture Notes in Computer Science*, pages 10–20. Inst Natl Sci Appl Lyon; Rhibe-Alpes Reg Complex System Inst; Reg Rhone-Alpes; Minist Enseignement Super Rech, 2009. 8th International Symposium on Intelligent Data Analysis, Lyon, France, Aug 31-Sep 02, 2009.

[614] Pablo Jensen. A statistical picture of popularization activities and their evolutions in France. *Public Understanding of Science*, 20(1):26–36, Jan 2011.

[615] Pablo Jensen. The benefits of reaching out. *Physics World*, 25(11):17, Nov 2012.

[616] Pablo Jensen and Katsiaryna Lutkouskaya. The many dimensions of laboratories' interdisciplinarity. *Scientometrics*, 98(1):619–631, Jan 2014.

[617] Pablo Jensen and Julien Michel. Measuring spatial dispersion: exact results on the variance of random spatial distributions. *Annals of Regional Science*, 47(1):81–110, Aug 2011.

[618] Pablo Jensen, Jean-Baptiste Rouquier, and Yves Croissant. Testing bibliometric indicators by their prediction of scientists promotions. *Scientometrics*, 78(3):467–479, Mar 2009.

[619] Pablo Jensen, Jean-Baptiste Rouquier, Nicolas Ovtracht, and Celine Robardet. Characterizing the speed and paths of shared bicycle use in Lyon. *Transportation Research Part D- Transport and Environment*, 15(8):522–524, Dec 2010.

[620] P. Kestener, P. A. Conlon, A. Khalil, L. Fennell, R. T. J. McAteer, P. T. Gallagher, and A. Arneodo. Characterizing complexity in solar magnetogram data using a wavelet-based segmentation method. *Astrophysical Journal*, 717(2):995–1005, Jul 10 2010.

[621] Pablo Kreimer, Luciano Levin, and Pablo Jensen. Popularization by Argentine researchers: the activities and motivations of CONICET scientists. *Public Understanding of Science*, 20(1):37–47, Jan 2011.

[622] Hernan Larralde, Juliette Stehle, and Pablo Jensen. Analytical solution of a multi-dimensional Hotelling model with quadratic transportation costs. *Regional Science and Urban Economics*, 39(3):343, May 2009.

[623] Bruno Latour, Pablo Jensen, Tommaso Venturini, Sebastian Grauwin, and Dominique Boullier. 'The whole is always smaller than its parts' - a digital test of Gabriel Tardes' monads. *British Journal of Sociology*, 63(4):590–615, Dec 2012.

[624] Ming Li and Pierre Borgnat. Foreword to the special issue on traffic modeling, its computations and applications. *Telecommunication Systems*, 43(3-4):145–146, Apr 2010.

[625] Patrick Loiseau, Paulo Goncalves, Guillaume Dewaele, Pierre Borgnat, Patrice Abry, and Pascale Vicat-Blanc Primet. Investigating Self-Similarity and Heavy-Tailed Distributions on a Large-Scale Experimental Facility. *IEEE-ACM Transactions on Networking*, 18(4):1261–1274, Aug 2010.

[626] Remi Louf, Pablo Jensen, and Marc Barthelemy. Emergence of hierarchy in cost-driven growth of spatial networks. *Proceedings of the National Academy of Science of the United States of America*, 110(22):8824–8829, May 28 2013.

[627] R. T. James McAteer, Pierre Kestener, Alain Arneodo, and Andre Khalil. Automated detection of coronal loops using a wavelet transform modulus maxima method. *Solar Phys.*, 262(2):387, Apr 2010.

[628] G. Michau, A. Nantes, E. Chung, P. Borgnat, and P. Abry. Retrieving Dynamic Origin-Destination Matrices from Bluetooth Data'. In *Transportation Research Board, 93rd Annual Meeting*, January 2014. Bordeaux.

[629] Gabriel Michau, Céline Robardet, Luc Merchez, Pablo Jensen, Patrice Abry, Patrick Flandrin, and Pierre Borgnat. Peut-on attraper les utilisateurs de Vélo'v au Lasso ? In *Actes du XXIIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2011. Bordeaux.

[630] Azadeh Moghtaderi, Pierre Borgnat, and Patrick Flandrin. Trend filtering: Empirical Mode Decompositions versus l1 and Hodrick-Prescott. *Advances in Adaptive Data Analysis*, 3(1-2):41–61, April 2011.

[631] Azadeh Moghtaderi, Pierre Borgnat, and Patrick Flandrin. Gap-filling by the Empirical Mode Decomposition. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2012*, pages 3821–3824, Mar. 25-30 2012. Kyoto, Japan.

[632] Azadeh Moghtaderi, Patrick Flandrin, and Pierre Borgnat. Time-varying spectrum estimation of uniformly modulated processes by means of surrogate data and Empirical Mode Decomposition. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2010*, pages 3678–3681, Mar. 14-19 2010. Dallas, TX.

[633] Azadeh Moghtaderi, Patrick Flandrin, and Pierre Borgnat. Trend filtering via Empirical Mode Decompositions. *Computational Statistics & Data Analysis*, 58:114–126, February 2013.

[634] Michele Orini, Raquel Bailon, Luca T. Mainardi, Pablo Laguna, and Patrick Flandrin. Characterization of dynamic interactions between cardiovascular signals by time-frequency coherence. *IEEE Transactions on Biomedical Engineering*, 59(3):663–673, March 2012.

[635] P. Borgnat, C. Robardet, P. Abry, P. Flandrin, J.-B. Rouquier, N. Tremblay. A dynamical network view of Lyon's Vélo'v shared bicycle system. In A. Mukherjee et al., editor, *Dynamics on and of Complex Networks, Vol. 2*, pages 267. Springer, 2013.

[636] P. Flandrin. Des signaux stationnaires en quel sens ? In A. Appriou et O. Macchi, editor, *Le traitement de l'information en interaction avec les mathématiques et la physique*, pages 105–127. CNRS Éditions, Paris, 2010.

[637] P. Flandrin. Écrire un article. In É. Guichard, editor, *Écritures : sur les traces de Jack Goody*. Presses de l'ENSSIB, Villeurbanne, 2012.

[638] P. Honeine, P. Borgnat, C. Richard, P. Flandrin. Nonstationary signal analysis with kernel machines. In E. Soria, J.D. Martin, R. Magdanela, M. Martinez and A.J. Serrano, editor, *Handbook of Research on Machine Learning Applications and Trends: Algorithms, Methods and Techniques.* ICI Global, 2012.

[639] J.-C. Pesquet and N. Pustelnik. A parallel inertial proximal optimization method. *Pacific Journal of Optimization*, 8(2):273–306, Apr 2012.

[640] N. Pustelnik, P. Borgnat, and P. Flandrin. Empirical mode decomposition revisited by multicomponent non smooth convex optimization. *Signal Processing*, 102:x+45, September 2014.

[641] N. Pustelnik, J.-C. Pesquet, and C. Chaux. Relaxing tight frame condition in parallel proximal methods for signal restoration. *IEEE Transactions on Signal Processing*, 60(2):968–973, Feb 2012.

[642] N. Pustelnik, H. Wendt, and P. Abry. Régularité locale pour l'analyse de texture : le mariage des *coefficients dominants* et de la *minimisation proximale*. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images,*, September 2013. Brest, France.

[643] Nelly Pustelnik, Pierre Borgnat, and Patrick Flandrin. A multicomponent proximal algorithm for Empirical Mode Decomposition. In *Proc. of the 20th European Signal Processing Conference EUSIPCO-2012*, pages 1880–1884, Aug. 27-31, 2012. Bucharest, Romania.

[644] Fabio Ricciato, Angelo Coluccia, Alessandro D'Alconzo, Darryl Veitch, Pierre Borgnat, and Patrice Abry. On the role of flows and sessions in Internet traffic modeling: an explorative toy-model. In Ulema, M, editor, *GLOBECOM 2009 - 2009 IEEE Global Telecommunications Conference, Vols 1-8*, IEEE Global Telecommunications Conference (Globecom), pages 2880–2887. IEEE, 2009. IEEE Global Telecommunications Conference (GLOBECOM 09), Honolulu, HI, NOV 30-DEC 04, 2009.

[645] Cedric Richard, Andre Ferrari, Hassan Amoud, Paul Honeine, Patrick Flandrin, and Pierre Borgnat. Statistical hypothesis testing with time-frequency surrogates to check signal stationarity. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP-2010*, pages 3666, Mar. 14-19, 2010. Dallas, TX.

[646] Gabriel Rilling and Patrick Flandrin. Sampling effects on the Empirical Mode Decomposition. *Advances in Adaptive Data Analysis*, 1(1):43–59, January 2009.

[647] J.-B. Rouquier and P. Borgnat. Cartographie des pratiques du vélo'v : le regard de physiciens et d'informaticiens. *Revue Sciences/Lettres*, 2, 2014.

[648] S. Roux, M. Clausel, B. Vedel, S. Jaffard, and P. Abry. Transformée hyperbolique en ondelettes 2d pour la caractérisation d'images autosimilaires anisotropes. In *Actes du XXIIIème Colloque GRETSI sur le Traitement du Signal et des Images,*, September 2011. Bordeaux, France.

[649] S. Roux, B. Vedel, S. Jaffard, and P. Abry. Coefficients dominants de la transformée hyperbolique en ondelettes 2d: Application à l'analyse de textures invariantes d'échelle, multifractales et anisotropes. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2013. Brest, France.

[650] S. G. Roux, V. Venugopal, K. Fienberg, A. Arneodo, and E. Foufoula-Georgiou. Evidence for inherent nonlinearity in temporal rainfall. *Adv. Water Resourc.*, 32(1):41–48, January 2009.

[651] Stephane G. Roux, Patrice Abry, Petra Koucka Knizova, and Zbysek Mosna. Scale-dependent analysis of ionosphere fluctuations. In *2011 IEEE International Conference on Acoustics, Speech, and Signal Processing*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 3836–3839. Inst Elect & Elect Engineers Signal Processing Soc; IEEE, 2011. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Prague Congress Ctr, Prague, Czech Republic, May 22-27, 2011.

[652] Stephane G. Roux, Marianne Clausel, Beatrice Vedel, Stephane Jaffard, and P. Abry. Self-Similar Anisotropic Texture Analysis: The Hyperbolic Wavelet Transform Contribution. *IEEE Transactions on Image Processing*, 22(11):4353, Nov 2013.

[653] Johan Sandberg, Maria Hansson-Sandsten, Tomi Kinnunen, Rahim Saeidi, Patrick Flandrin, and Pierre Borgnat. Multitaper estimation of frequency-warped cepstra with application to speaker verification. *IEEE Signal Processing Letters*, 17(4):343–346, April 2010.

[654] Ginette Saracco, Alain Arneodo, and Gregory Beylkin. Special issue on continuous wavelet transform in memory of Jean Morlet, part I preface. *Appl. Comput. Harmon. Anal.*, 28(2, SI):129–130, Mar 2010.

[655] Ginette Saracco, Alain Arneodo, and Gregory Beylkin. Special issue on continuous wavelet transform in memory of Jean Morlet, part II preface. *Appl. Comput. Harmon. Anal.*, 28(3, SI):249–250, May 2010.

[656] Nicoletta Saulig, Nelly Pustelnik, Pierre Borgnat, Patrick Flandrin, and Victor Sucic. Instantaneous counting of components in nonstationary signals. In *Proc. of the 21st European Signal Processing Conference EUSIPCO-2013*, Sep. 9-13, 2013. Marrakech, Morocco.

[657] A. Scherrer and P. Abry. Synthèse de processus bivariés non gaussiens à mémoires longues. In *Actes du XXIIIème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2009. Dijon, France.

[658] A. Scherrer, P. Abry, S. Jaffard, H. Ji, and Z. Shen. Wavelet leader multifractal analysis for texture classification. In *International Conference on Image processing,*, 2009. Cairo, Egypt.

[659] Gaston Schlotthauer, Maria-Eugenia Torres, Hugo Rufiner, and Patrick Flandrin. EMD of Gaussian white noise: Effects of signal length and Ssifting number on the statistical properties of Intrinsic Mode Functions. *Advances in Adaptive Data Analysis*, 1(4):517–527, October 2009.

[660] J. Schmitt, N. Pustelnik, P. Borgnat, and P. Flandrin. 2D Hilbert-Huang transform. In *2014 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*. Inst Elect & Elect Engineers, Signal Processing Soc; IEEE, May 4-9, 2014. IEEE International Conference on Acoustics, Speech and Signal Processing, Florence, Italy.

[661] Juliette Stehle, Nicolas Voirin, Alain Barrat, Ciro Cattuto, Vittoria Colizza, Lorenzo Isella, Corinne Regis, Jean-Francois Pinton, Nagham Khanafer, Wouter Van den Broeck, and Philippe Vanhems. Simulation of an SEIR infectious disease model on the dynamic contact network of conference attendees. *BMC Medicine*, 9, Jul 19 2011.

[662] Juliette Stehle, Nicolas Voirin, Alain Barrat, Ciro Cattuto, Lorenzo Isella, Jean-Francois Pinton, Marco Quaggiotto, Wouter Van den Broeck, Corinne Regis, Bruno Lina, and Philippe Vanhems. High-Resolution Measurements of Face-to-Face Contact Patterns in a Primary School. *PLOS ONE*, 6(8), Aug 16 2011.

[663] Maria E. Torres, Marcelo A. Colominas, Gaston Schlotthauer, and Patrick Flandrin. A complete Ensemble Empirical Mode Decomposition with adaptive noise. In *Proc. of the IEEE International Conference on Acoustics, Speech and Signal Processing*

ICASSP-2011, pages 4144–4147, May 22-27, 2011. Prague, CZ.

[664] Nicolas Tremblay, Alain Barrat, Cary Forest, Mark Nornberg, Jean-François Pinton, and Pierre Borgnat. Bootstrapping under constraint for the assessment of group behavior in human contact networks. *Physical Review E*, 88(5), Nov. 25 2013.

[665] Nicolas Tremblay and Pierre Borgnat. Community Mining in Large Networks using Graph Wavelet Transform of Random Vectors. In *Proc. of IEEE-GlobalSIP*, December 2013. Austin (TX).

[666] Nicolas Tremblay and Pierre Borgnat. Multiscale community mining in networks using spectral graph wavelets. In *Proc. of the 21st European Signal Processing Conference EUSIPCO-2012*, Sep. 9-13, 2013. Marrakech, Morocco.

[667] Nicolas Tremblay and Pierre Borgnat. Multiscale Detection of Stable Communities Using Wavelets on Networks. In *European Conference of Complex Systems, ECCS 2013*, September 2013. Barcelona (Spain).

[668] Nicolas Tremblay and Pierre Borgnat. Partitionnement multi-échelle d'un graphe en communautés: détection des échelles pertinentes. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images*, September 2013. Brest, France.

[669] Nicolas Tremblay, Pierre Borgnat, Jean-François Pinton, Alain Barrat, Mark Nornberg, and Cary Forest. Constrained graph resampling for group assessment in human social networks. In *European Conference of Complex Systems, ECCS 2012*, September 2012. Bruxelles (Belgique).

[670] Philippe Vanhems, Alain Barrat, Ciro Cattuto, Jean-Francois Pinton, Nagham Khanafer, Corinne Regis, Byeul-a Kim, Brigitte Comte, and Nicolas Voirin. Estimating Potential Infection Transmission Routes in Hospital Wards Using Wearable Proximity Sensors. *PLOS ONE*, 8(9), Sep 11 2013.

[671] M. Vogel, R. Hamon, G. Lozenguez, L. Merchez, P. Abry, J. Barnier, P. Borgnat, P. Flandrin, I. Mallon, and C. Robardet. From bicycle sharing system movements to users: A typology of vélo'v cyclists in lyon based on large-scale behavioural dataset. *Journal of Transport Geography*, to appear, 2014.

[672] H. Wendt, N. Dobigeon, J.-Y. Tourneret, and P. Abry. Estimation bayésienne du paramètre de multifractalité. In *Actes du XXIVème Colloque GRETSI sur le Traitement du Signal et des Images,*, September 2013. Brest, France.

[673] H. Wendt, S. Jaffard, and P. Abry. Multifractal analysis of self-similar processes. In *2012 IEEE Statistical Signal Processing Workshop (SSP)*, pages 69–72. IEEE, 2012. IEEE Statistical Signal Processing Workshop (SSP), Ann Arbor, Aug 05-08, 2012.

[674] H. Wendt, A. Scherrer, P. Abry, and S. Achard. Testing Fractal Connectivity in multivariate long memory processes. In *2009 IEEE International Conference on Acoustics, Speech, and Signal Processing, Vols 1- 8, Proceedings*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 2913–2916. IEEE; IEEE Signal Proc Soc, 2009. IEEE International Conference on Acoustics, Speech and Signal Processing, Taipei, Taiwan, Apr 19-24, 2009.

[675] Herwig Wendt, Patrice Abry, Stephane Jaffard, Hui Ji, and Zuowei Shen. Wavelet leader mutifractal analysis for texture classification. In *2009 16TH IEEE International Conference on Image Processing, VOLS 1-6*, pages 3785–3788. IEEE, 2009. 16th IEEE International Conference on Image Processing, Cairo, Egypt, Nov 07-10, 2009.

[676] Herwig Wendt, Patrice Abry, Stephane G. Roux, Stephane Jaffard, and Beatrice Vedel. Multifractal Analysis for Images: The wavelet Leaders contribution. *Traitement du Signal*, 26(1):47–65, 2009.

[677] Herwig Wendt, Nicolas Dobigeon, Jean-Yves Tourneret, and Patrice Abry. Bayesian estimation for the multifractality parameter. In *2013 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 6556–6560. Inst Elect & Elect Engineers; Inst Elect & Elect Engineers Signal Proc Soc, 2013. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Vancouver, Canada, May 26-31, 2013.

[678] Herwig Wendt, Stephane G. Roux, Stephane Jaffard, and Patrice Abry. Wavelet leaders and bootstrap for multifractal analysis of images. *Signal Processing*, 89(6):1100–1114, Jun 2009.

[679] Hau-Tieng Wu, Patrick Flandrin, and Ingrid Daubechies. One or two frequencies? The synchrosqueezing answers. *Advances in Adaptive Data Analysis*, 3(1-2):29–39, April 2011.

[680] Nicolas Zilber, Philippe Ciuciu, Patrice Abry, and Virginie van Wassenhove. Modulation of scale-free properties of brain activity in MEG. In *2012 9TH IEEE International Symposium on Biomedical Imaging (ISBI)*, pages 1531–1534. IEEE; IEEE Engn Med & Biol Soc (EMBS); IEEE Signal Proc Soc, 2012. 9th IEEE International Symposium on Biomedical Imaging (ISBI) - From Nano to Macro, Barcelona, Spain, May 02-05, 2012.

[681] Nicolas Zilber, Philippe Ciuciu, Patrice Abry, and Virginie van Wassenhove. Learning-induced modulation of scale-free properties of brain activity measured with MEG. In *2013 IEEE 10th International Symposium on Biomedical Imaging (ISBI)*, IEEE International Symposium on Biomedical Imaging, pages 998–1001. IEEE; IEEE Signal Processing Soc; Engn Med Biol Soc, 2013. IEEE 10th International Symposium on Biomedical Imaging - From Nano to Macro (ISBI), San Francisco, CA, Apr 07-11, 2013.

T7B. Statistical Physics: *Publications*

[682] Angel Alastuey and Jaroslaw Piasecki. Approach to a stationary state in an external field. *Journal of Statistical Physics*, 139(6):991–1012, Jun 2010.

[683] Erik Aurell, Krzysztof Gawedzki, Carlos Mejia-Monasterio, Roya Mohayaee, and Paolo Muratore-Ginanneschi. Refined Second Law of Thermodynamics for Fast Random Processes. *Journal of Statistical Physics*, 147(3):487–505, May 2012.

[684] R. Bachelard, T. Dauxois, G. De Ninno, S. Ruffo, and F. Staniscia. Vlasov equation for long-range interactions on a lattice. *Physical Review E*, 83(6, 1), Jun 21 2011.

[685] R. Bachelard, F. Staniscia, T. Dauxois, G. De Ninno, and S. Ruffo. Stability of in-

homogeneous states in mean-field models with an external potential. *Journal of Statistical Mechanics-Theory and Experiment*, Mar 2011.

[686] Eric Bertin. Entropic aging and extreme value statistics. *Journal of Physics A-Mathematical and Theoretical*, 43(34), Aug 27 2010.

[687] Eric Bertin. How far can stochastic and deterministic views be reconciled? *Progress in Biophysics & Molecular Biology*, 110(1, SI):11–16, Sep 2012.

[688] Eric Bertin. On-off intermittency over an extended range of control parameter. *Physical Review E*, 85(4, 1), Apr 18 2012.

[689] Eric Bertin. Ageing in the trap model as a relaxation further away from equilibrium. *Journal of Physics A-Mathematical and Theoretical*, 46(9), Mar 8 2013.

[690] Eric Bertin, Hugues Chate, Francesco Ginelli, Guillaume Gregoire, Sebastien Leonard, and Anton Peshkov. Comment on "towards a quantitative kinetic theory of polar active matter" by t. ihle. *European Physical Journal Special Topics*, 223:1419, 2014.

[691] Eric Bertin, Hugues Chate, Francesco Ginelli, Shradha Mishra, Anton Peshkov, and Sriram Ramaswamy. Mesoscopic theory for fluctuating active nematics. *New Journal of Physics*, 15, Aug 28 2013.

[692] Eric Bertin and Olivier Dauchot. Far-from-Equilibrium State in a Weakly Dissipative Model. *Physical Review Letters*, 102(16), Apr 24 2009.

[693] Eric Bertin, Michel Droz, and Guillaume Gregoire. Hydrodynamic equations for self-propelled particles: microscopic derivation and stability analysis. *Journal of Physics A-Mathematical and Theoretical*, 42(44), Nov 6 2009.

[694] Eric Bertin, David Halley, Yves Henry, Nabil Najjari, Hicham Majjad, Martin Bowen, Victor DaCosta, Jacek Arabski, and Bernard Doudin. Random barrier double-well model for resistive switching in tunnel barriers. *Journal of Applied Physics*, 109(8), Apr 15 2011.

[695] Eric Bertin and Peter C. W. Holdsworth. Dissipation-induced non-Gaussian energy fluctuations. *Europhysics Letters*, 102(5), Jun 2013.

[696] A. Berut, A. Petrosyan, and S. Ciliberto. Detailed jarzynski equality applied to a logically irreversible procedure. *Europhysics Letters*, 103(6), 2013.

[697] Antoine Berut, Artak Arakelyan, Artyom Petrosyan, Sergio Ciliberto, Raoul Dillenschneider, and Eric Lutz. Experimental verification of landauer's principle linking information and thermodynamics. *Nature*, 483(7388):187–U1500, 2012.

[698] Freddy Bouchet and Marianne Corvellec. Invariant measures of the 2D Euler and Vlasov equations. *Journal of Statistical Mechanics-Theory and Experiment*, Aug 2010.

[699] Freddy Bouchet, Shamik Gupta, and David Mukamel. Thermodynamics and dynamics of systems with long-range interactions. *Physica A-Statistical Mechanics and its Applications*, 389(20, SI):4389–4405, Oct 15 2010. 12th International Summer School on Fundamental Problems in Statistical Physics, European Ctr Foresta, Leuven, Belgium, Aug 31-Sep 11, 2009.

[700] Freddy Bouchet, Jason Laurie, and Oleg Zaboronski. Langevin dynamics, large deviations and instantons for the quasi-geostrophic model and two-dimensional euler equations. *arXiv preprint arXiv:1403.0216*, 2014.

[701] Freddy Bouchet and Eric Simonnet. Random Changes of Flow Topology in Two-Dimensional and Geophysical Turbulence. *Physical Review Letters*, 102(9), Mar 6 2009.

[702] Freddy Bouchet and Hugo Touchette. Non-classical large deviations for a noisy system with non-isolated attractors. *Journal of Statistical Mechanics-Theory and Experiment*, May 2012.

[703] O. M. Braun and M. Peyrard. Master equation approach to friction at the mesoscale. *Physical Review E*, 82(3, 2), Sep 28 2010.

[704] O. M. Braun and M. Peyrard. Dependence of kinetic friction on velocity: Master equation approach. *Physical Review E*, 83(4, 2), Apr 28 2011.

[705] O. M. Braun and M. Peyrard. Crack in the frictional interface as a solitary wave. *Physical Review E*, 85(2, 2), Feb 21 2012.

[706] O. M. Braun and Michel Peyrard. Role of aging in a minimal model of earthquakes. *Physical Review E*, 87(3), Mar 15 2013.

[707] O. M. Braun, Michel Peyrard, D. V. Stryzheus, and Erio Tosatti. Collective Effects at Frictional Interfaces. *Tribology Letters*, 48(1, SI):11–25, Oct 2012.

[708] Alessandro Campa, Thierry Dauxois, and Stefano Ruffo. Statistical mechanics and dynamics of solvable models with long-range interactions. *Physics Reports*, 480(3-6):57–159, Sep 2009.

[709] A. Caussarieu, A. Petrosyan, and S. Ciliberto. Accurate determination of the freedericksz transition threshold using a method based upon precise fluctuation measurements. *Applied Physics Letters*, 103(14), 2013.

[710] A. Caussarieu, A. Petrosyan, and S. Ciliberto. Dynamics of a liquid crystal close to the freedericksz transition. *Europhysics Letters*, 104(2), 2013.

[711] Jean-Baptiste Caussin and Denis Bartolo. Tailoring the interactions between self-propelled bodies. *European Physical Journal E*, 37:13, 2014.

[712] Jean-Baptiste Caussin, Alexandre Solon, Anton Peshkov, Hugues Chaté, Thierry Dauxois, Julien Tailleur, Vincenzo Vitelli, and Denis Bartolo. Emergent spatial structures in flocking models: A dynamical system insight. *Physical Review Letters*, 112:148102, 2014.

[713] Raphael Chetrite and Krzysztof Gawedzki. Eulerian and Lagrangian Pictures of Non-equilibrium Diffusions. *Journal of Statistical Physics*, 137(5-6):890–916, Dec 2009.

[714] S. Ciliberto, R. Gomez-Solano, and A. Petrosyan. Fluctuations, linear response, and currents in out-of-equilibrium systems. *Annual Review of Condensed Matter Physics, Vol 4*, 4:235–261, 2013. Langer, JS.

[715] S. Ciliberto, A. Imparato, A. Naert, and M. Tanase. Heat flux and entropy produced by thermal fluctuations. *Physical Review Letters*, 110(18), 2013.

[716] S. Ciliberto, A. Imparato, A. Naert, and M. Tanase. Statistical properties of the energy exchanged between two heat baths coupled by thermal fluctuations. *Journal of Statistical Mechanics-Theory and Experiment*, 2013.

[717] S. Ciliberto, S. Joubaud, and A. Petrosyan. Fluctuations in out-of-equilibrium systems: from theory to experiment. *Journal of Statistical Mechanics-Theory and Experiment*, Dec 2010.

[718] Olivier Dauchot and Eric Bertin. Subcritical transition to turbulence: What we can learn from the physics of glasses. *Physical Review E*, 86(3, 2), Sep 19 2012.

[719] Olivier Dauchot and Eric Bertin. The glass transition in a nutshell: a source of inspiration to describe the subcritical transition to turbulence. *European Physical Journal E*, 37:31, 2014.

[720] Thierry Dauxois, Pierre de Buyl, Leonardo Lori, and Stefano Ruffo. Models with short- and long-range interactions: the phase diagram and the reentrant phase. *Journal of Statistical Mechanics-Theory and Experiment*, Jun 2010.

[721] Thierry Dauxois, Francesca Di Patti, Duccio Fanelli, and Alan J. McKane. Enhanced stochastic oscillations in autocatalytic reactions. *Physical Review E*, 79(3), Mar 2009.

[722] Pietro de Anna, Francesca di Patti, Duccio Fanelli, Alan J. McKane, and Thierry Dauxois. Spatial model of autocatalytic reactions. *Physical Review E*, 81(5, 2), May 2010.

[723] Manlio De Domenico, Mariangela Settimo, Simone Riggi, and Eric Bertin. Reinterpreting the development of extensive air showers initiated by nuclei and photons. *Journal of Cosmology and Astroparticle Physics*, (7), Jul 2013.

[724] Andrei A. Fedorenko, Pierre Le Doussal, and Kay J. Wiese. Non-Gaussian effects and multifractality in the Bragg glass. *Europhysics Letters*, 105(1), Jan 2014.

[725] Andrei A. Fedorenko, Pierre Le Doussal, and Kay Joerg Wiese. Functional renormalization-group approach to decaying turbulence. *Journal of Statistical Mechanics-Theory and Experiment*, Apr 2013.

[726] J. R. Gomez-Solano, L. Bellon, A. Petrosyan, and S. Ciliberto. Steady-state fluctuation relations for systems driven by an external random force. *Europhysics Letters*, 89(6), 2010.

[727] J. R. Gomez-Solano, A. Petrosyan, and S. Ciliberto. Heat fluctuations in a nonequilibrium bath. *Physical Review Letters*, 106(20), 2011.

[728] J. R. Gomez-Solano, A. Petrosyan, and S. Ciliberto. Fluctuations, linear response and heat flux of an aging system. *Europhysics Letters*, 98(1), 2012.

[729] J. R. Gomez-Solano, A. Petrosyan, S. Ciliberto, R. Chetrite, and K. Gawedzki. Experimental verification of a modified fluctuation-dissipation relation for a micron-sized particle in a nonequilibrium steady state. *Physical Review Letters*, 103(4), 2009.

[730] Juan Ruben Gomez-Solano, Artyom Petrosyan, and Sergio Ciliberto. Finite sampling effects on generalized fluctuation-dissipation relations for steady states. *Statphys-Kolkata Vii*, 297, 2011. Bhattacharjee, JK Chakrabarti, BK Inoue, JI Sen, P International Conference on Statphys Kolkata VII Nov 26-30, 2010 Kolkata, India Saha Inst Nucl Phys, Ctr Appl Math and Computat Sci (CAMCS); Satyendra Nath Bose Natl Ctr Basic Sci.

[731] Juan Ruben Gomez-Solano, Artyom Petrosyan, Sergio Ciliberto, and Christian Maes. Fluctuations and response in a non-equilibrium micron-sized system. *Journal of Statistical Mechanics-Theory and Experiment*, 2011.

[732] Sebastian Grauwin, Eric Bertin, Remi Lemoy, and Pablo Jensen. Competition between collective and individual dynamics. *Proceedings of the National Academy of Science of the United States of America*, 106(49):20622–20626, Dec 8 2009.

[733] Sebastian Grauwin, Florence Goffette-Nagot, and Pablo Jensen. Dynamic models of residential segregation: An analytical solution. *Journal of Public Economics*, 96(1-2):124–141, Feb 2012.

[734] Sebastian Grauwin, Dominic Hunt, Eric Bertin, and Pablo Jensen. Efective free energy for individual dynamics. *Advances in Complex Systems*, 14(4):529–536, Aug 2011.

[735] Sebastian Grauwin and Pablo Jensen. Opinion group formation and dynamics: Structures that last from nonlasting entities. *Physical Review E*, 85(6, 2), Jun 11 2012.

[736] Shamik Gupta, Thierry Dauxois, and Stefano Ruffo. A stochastic model of long-range interacting particles. *Journal of Statistical Mechanics-Theory and Experiment*, Nov 2013.

[737] Christian Borghesi Jean-Philippe Bouchaud and Pablo Jensen. On the emergence of an 'intention field' for socially cohesive agents. *J. Stat. Mech.*, ():P03010, 2014.

[738] Pierre Jop, Juan Ruben Gomez-Solano, Artyom Petrosyan, and Sergio Ciliberto. Experimental study of out-of-equilibrium fluctuations in a colloidal suspension of laponite using optical traps. *Journal of Statistical Mechanics-Theory and Experiment*, 2009.

[739] S. Joubaud, G. Huillard, A. Petrosyan, and S. Ciliberto. Work fluctuations in a nematic liquid crystal. *Journal of Statistical Mechanics-Theory and Experiment*, Jan 2009.

[740] S. Joubaud, B. Percier, A. Petrosyan, and S. Ciliberto. Aging and Effective Temperatures Near a Critical Point. *Physical Review Letters*, 102(13), Apr 3 2009.

[741] Sylvain Joubaud, Detlef Lohse, and Devaraj van der Meer. Fluctuation Theorems for an Asymmetric Rotor in a Granular Gas. *Physical Review Letters*, 108(21), May 24 2012.

[742] V. Kaiser, S. T. Bramwell, P. C. W. Holdsworth, and R. Moessner. Onsager's Wien effect on a lattice. *Nature Materials*, 12(11):1032–1036, Nov 2013.

[743] Gaultier Lambert, Guillaume Chevereau, and Eric Bertin. A symmetry-breaking phase transition in a dynamical decision model. *Journal of Statistical Mechanics-Theory and Experiment*, Jun 2011.

[744] Lasse Laurson, Xavier Illa, Stephane Santucci, Ken Tore Tallakstad, Knut Jorgen Maloy, and Mikko J. Alava. Evolution of the average avalanche shape with the universality class. *Nature Communications*, 4, Dec 2013.

[745] Lasse Laurson, Stephane Santucci, and Stefano Zapperi. Avalanches and clusters in planar crack front propagation. *Physical Review E*, 81(4, 2), Apr 2010.

[746] R. L.Bellon, A. Gomez-Solano, A. Petrosyan, and Ciliberto S. Measuring out of equilibrium fluctuations. *Book Chapter in "Nonequilibrium Statistical Physics of Small Systems: Fluctuation relations and beyond", Edited by R.Klages, W.Just, C.Jarzynski (Eds.), published by Wiley-VCH*, (2013).

[747] Remi Lemoy and Eric Bertin. Dynamical fluctuations in a simple housing market model. *Journal of Statistical Mechanics-Theory and Experiment*, Dec 2012.

[748] Remi Lemoy, Eric Bertin, and Pablo Jensen. Socio-economic utility and chemical potential. *Europhysics Letters*, 93(3), Feb 2011.

[749] Jensen P. Lemoy R., Raux C. An agent-based model of residential patterns and social structure in urban area. *Cybergeo*, 512():, 2011.

[750] Kirsten Martens and Eric Bertin. The influence of flux balance on the generalized chemical potential in mass transport models. *Journal of Statistical*

Mechanics-Theory and Experiment, Sep 2011.

[751] Kirsten Martens, Eric Bertin, and Michel Droz. Dependence of the Fluctuation-Dissipation Temperature on the Choice of Observable. *Physical Review Letters*, 103(26), Dec 31 2009.

[752] Kirsten Martens, Eric Bertin, and Michel Droz. Entropy-based characterizations of the observable dependence of the fluctuation-dissipation temperature. *Physical Review E*, 81(6, 1), Jun 2 2010.

[753] George Miloshevich, Thierry Dauxois, Ramaz Khomeriki, and Stefano Ruffo. Dipolar needles in the microcanonical ensemble: Evidence of spontaneous magnetization and ergodicity breaking. *Europhysics Letters*, 104(1), Oct 2013.

[754] Anne Mounier and Antoine Naert. The Hatano-Sasa equality: Transitions between steady states in a granular gas. *Europhysics Letters*, 100(3), Nov 2012.

[755] A. Naert. Experimental study of work exchange with a granular gas: The viewpoint of the Fluctuation Theorem. *Europhysics Letters*, 97(2), Jan 2012.

[756] Cesare Nardini, Shamik Gupta, Stefano Ruffo, Thierry Dauxois, and Freddy Bouchet. Kinetic theory for non-equilibrium stationary states in long-range interacting systems. *Journal of Statistical Mechanics-Theory and Experiment*, Jan 2012.

[757] Cesare Nardini, Shamik Gupta, Stefano Ruffo, Thierry Dauxois, and Freddy Bouchet. Kinetic theory of nonequilibrium stochastic long-range systems: phase transition and bistability. *Journal of Statistical Mechanics-Theory and Experiment*, Dec 2012.

[758] Alain Olivetti, Julien Barre, Bruno Marcos, Freddy Bouchet, and Robin Kaiser. Breathing Mode for Systems of Interacting Particles. *Physical Review Letters*, 103(22), Nov 27 2009.

[759] Alain Olivetti, Julien Barre, Bruno Marcos, Freddy Bouchet, and Robin Kaiser. Breathing dynamics for systems of interacting particles in the microcanonical and canonical descriptions. *Transport and Statistical Physics*, 39(5-7, SI):524–551, 2010.

[760] Anton Peshkov, Igor S. Aranson, Eric Bertin, Hugues Chate, and Francesco Ginelli. Nonlinear Field Equations for Aligning Self-Propelled Rods. *Physical Review Letters*, 109(26), Dec 27 2012.

[761] Anton Peshkov, Eric Bertin, Francesco Ginelli, and Hugues Chate. Boltzmann-ginzburg-landau approach for continuous descriptions of generic vicsek-like models. *European Physical Journal Special Topics*, 223:1315, 2014.

[762] Anton Peshkov, Sandrine Ngo, Eric Bertin, Hugues Chate, and Francesco Ginelli. Continuous Theory of Active Matter Systems with Metric-Free Interactions. *Physical Review Letters*, 109(9), Aug 28 2012.

[763] Ramon Planet, Stephane Santucci, and Jordi Ortin. Avalanches and Non-Gaussian Fluctuations of the Global Velocity of Imbibition Fronts. *Physical Review Letters*, 102(9), Mar 6 2009.

[764] Ramon Planet, Stephane Santucci, and Jordi Ortin. Comment on “Avalanches and Non-Gaussian Fluctuations of the Global Velocity of Imbibition Fronts” Reply. *Physical Review Letters*, 105(2), Jul 9 2010.

[765] Ramon Planet, Stephane Santucci, and Jordi Ortin. Roughness and intermittent dynamics of imbibition fronts due to capillary and permeability disorder. *Journal of Contaminant Hydrology*, 120-21(SI):157–169, Mar 1 2011.

[766] Max Potters, Timothee Vaillant, and Freddy Bouchet. Sampling microcanonical measures of the 2D Euler equations through Creutz’s algorithm: a phase transition from disorder to order when energy is increased. *Journal of Statistical Mechanics-Theory and Experiment*, Feb 2013.

[767] S. Santucci, M. Grob, R. Toussaint, J. Schmittbuhl, A. Hansen, and K. J. Maloy. Fracture roughness scaling: A case study on planar cracks. *Europhysics Letters*, 92(4), Nov 2010.

[768] S. Santucci, R. Planet, K. Jorgen Maloy, and J. Ortin. Avalanches of imbibition fronts: Towards critical pinning. *Europhysics Letters*, 94(4), May 2011.

[769] Ken Tore Tallakstad, Renaud Toussaint, Stephane Santucci, and Knut Jorgen Maloy. Non-Gaussian Nature of Fracture and the Survival of Fat-Tail Exponents. *Physical Review Letters*, 110(14), Apr 2 2013.

[770] Simon Thalabard, Bérengère Dubrulle, and Freddy Bouchet. Statistical mechanics of the 3d axisymmetric euler equations in a taylor–couette geometry. *Journal of Statistical Mechanics: Theory and Experiment*, 2014(1):P01005, 2014.

[771] Antoine Venaille and Freddy Bouchet. Solvable Phase Diagrams and Ensemble Inequivalence for Two-Dimensional and Geophysical Turbulent Flows. *Journal of Statistical Physics*, 143(2):346–380, Apr 2011.

[772] M. E. Zhitomirsky, P. C. W. Holdsworth, and R. Moessner. Nature of finite-temperature transition in anisotropic pyrochlore $er_2ti_2o_7$. *Physical Review B*, 89:140403, Apr 2014.

T8B. Instrumentation and Imaging: *Publications*

[773] L Berguiga, F Argoul, and A Fahys. Microscope de plasmon de surface à haute résolution comportant un interféromètre heterodyne fibré. CNRS-ENS Lyon patent 09 50878, 2009.

[774] L Berguiga, E Provera, J Elezgaray, and F Argoul. Sensing Nanometer Depth of Focused Optical Fields with Scanning Surface Plasmon Microscopy. *Plasmonics*, 8:715–722, 2013.

[775] Y. Berthoumieu, C. Dossal, N. Pustelnik, P. Ricoux, and F. Turcu. An evaluation of the sparsity degree for sparse recovery with deterministic measurement matrices. *J. Math. Imaging. Vis.*, 48(2, SI):266–278, Feb 2014.

[776] Thomas Gallot, Christophe Perge, Vincent Grenard, Marc-Antoine Fardin, Nicolas Taberlet, and Sebastien Manneville. Ultrafast ultrasonic imaging coupled to rheometry: Principle and illustration. *Review of Scientific Instruments*, 84(4), Apr 2013.

[777] Justine Laurent, Audrey Steinberger, and Ludovic Bellon. Functionalized AFM probes for force spectroscopy: eigenmode shapes and stiffness calibration through thermal noise measurements. *Nanotechnology*, 24(22), Jun 7 2013.

[778] Kevin Mader, Rajmund Mokso, Christophe Raufaste, Benjamin Dollet, Stephane Santucci, Jerome

Lambert, and Marco Stampanoni. Quantitative 3d characterization of cellular materials: Segmentation and morphology of foam. *Colloids and Surfaces A-Physicochemical and Engineering Aspects*, 415:230–238, DEC 5 2012.

[779] Sophie Miralles, Gautier Verhille, Nicolas Plihon, and Jean-Francois Pinton. The magnetic-distortion probe: Velocimetry in conducting fluids. *Review of Scientific Instruments*, 82(9), Sep 2011.

[780] Vitaly Noskov, Rodion Stepanov, Sergey Denisov, Peter Frick, Gautier Verhille, Nicolas Plihon, and Jean-Francois Pinton. Dynamics of a turbulent spin-down flow inside a torus. *Physics of Fluids*, 21(4), Apr 2009.

[781] Pierdomenico Paolino, Felipe A. Aguilar Sandoval, and Ludovic Bellon. Quadrature phase interferometer for high resolution force spectroscopy. *Review of Scientific Instruments*, 84(9), Sep 2013.

[782] Pierdomenico Paolino, Bruno Tiribilli, and Ludovic Bellon. Direct measurement of spatial modes of a microcantilever from thermal noise. *Journal of Applied Physics*, 106(9), Nov 1 2009.

[783] Nelly Pustelnik, Herwig Wendt, and Patrice Abry. Local regularity for texture segmentation: Combining wavelet leaders and proximal minimization. In *2013 IEEE Int. Conf. Acoust., Speech Signal Process (ICASSP)*, International Conference on Acoustics Speech and Signal Processing ICASSP, pages 5348–5352. Inst Elect & Elect Engineers; Inst Elect & Elect Engineers Signal Proc Soc, May 26-31 2013. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Vancouver, Canada.

[784] Kian Rahbarnia, Benjamin P. Brown, Mike M. Clark, Elliot J. Kaplan, Mark D. Nornberg, Alex M. Rasmus, Nicholas Zane Taylor, Cary B. Forest, Frank Jenko, Angelo Limone, Jean-Francois Pinton, Nicolas Plihon, and Gautier Verhille. Direct observation of the turbulent emf and transport of magnetic field in a liquid sodium experiment. *Astrophysical Journal*, 759(2), Nov 10 2012.

[785] Julien Salort, Hervé Pabiou, Francesca Chillá, and Christophe Ménézo. Cross Ventilation Measurements in Buildings : small and full scales experimental models. *Proceedings of 15th International Heat Transfer Conference, Kyoto Japan* , 2014, to appear.

[786] A. Tantot, S. Santucci, O. Ramos, S. Deschanel, M. A. Verdier, E. Mony, Y. Wei, S. Ciliberto, L. Vanel, and P. C. F. Di Stefano. Sound and Light from Fractures in Scintillators. *Physical Review Letters*, 111(15), Oct 10 2013.

[787] R. Zimmermann, L. Fiabane, Y. Gasteuil, R. Volk, and J-F Pinton. Measuring Lagrangian accelerations using an instrumented particle. *Physica Scripta*, T155, Jul 2013.

[788] Robert Zimmermann, Lionel Fiabane, Yoann Gasteuil, Romain Volk, and Jean-Francois Pinton. Characterizing flows with an instrumented particle measuring Lagrangian accelerations. *New Journal of Physics*, 15, Jan 25 2013.

[789] Robert Zimmermann, Yoann Gasteuil, Mickael Bourgoin, Romain Volk, Alain Pumir, Jean-Francois Pinton, and Int Collaboration Turbulence. Tracking the dynamics of translation and absolute orientation of a sphere in a turbulent flow. *Review of Scientific Instruments*, 82(3), Mar 2011.

agence d'évaluation de la recherche et de l'enseignement supérieur

A. Présentation synthétique

Présentation synthétique de l'entité

Unité de recherche

Vague A : campagne d'évaluation 2014-2015

Intitulé de l'unité : Laboratoire de Physique (LPENSL)

Nom du directeur de l'unité: Thierry Dauxois

Effectifs de l'entité.

21 enseignants-chercheurs ; 41 chercheurs ; 15 techniciens, ingénieurs et autres personnels ; 78 post-docs et doctorants.

Personnels ayant quitté l'entité pendant le contrat en cours (et nombre de mois cumulés passés dans l'entité au cours de cette période).

6 statutaires (542 mois) ; 47 doctorants (1746 mois) ; 44 post-docs (733 mois).

Nombre de recrutements réalisés au cours de la période considérée et origine des personnels

11 recrutements : F. BOUCHNEB (PME, comptable), F. BOUCHET (INLN, CR1), A. FEDORENKO (LPT-ENS, Post-doc), S. JOUBAUD (Twente, Post-doc), A. STEINBERGER (Göttingen, Post-doc), N. PUSTELNIK (IMS-Bordeaux, Post-doc), D. BARTOLO (PMMH-ESPCI, MCF), T. GIBAUD (Brandeis, Post-doc), A. VENAILLE (Princeton, Post-doc), C. CRAUSTE-THIBIERGE (LLB Saclay, Post-doc), G. NICOLLI (Stony Brook, Post-doc).

Réalisations et produits de la recherche au cours de la période écoulée (1er janvier 2009 - 30 juin 2014) :

1) Mesure de l'énergie minimale nécessaire pour inscrire un bit informatique. Aux cotés du Boson de Higgs, ce résultat a été classé par Physics World dans les 10 avancées scientifiques majeures de 2012.

2) Développement du formalisme de l'optique quantique électronique, en collaboration avec plusieurs groupes expérimentaux.

3) Renouvellement de l'Identification de communautés dans un réseau par une approche multi-échelle sur graphes.

4) Le développement dispositif d'imagerie ultrasonore ultrarapide a permis une analyse résolue en temps et en espace de la compétition entre instabilité hydrodynamique et instabilité.

5) Construction d'une q-déformation intégrable de la théorie des cordes sur AdS_5xS^5.

Bilan quantitatif des publications de l'entité. 789 publications.

Indiquer les **5 publications majeures** de l'entité

1) A. Bricard, J.-B. Caussin, N. Desreumaux, O. Dauchot, D. Bartolo, *Emergence of macroscopic directed motion in populations of motile colloids*, Nature 95, 503 (2013).
2) F. Bouchet, A. Venaille, *Statistical mechanics of two-dimensional and geophysical flows*, Physics Reports 515, 227-295 (2012).

3) M. A. Cazalilla, R. Citro, T. Giamarchi, E. Orignac, M. Rigol, *One dimensional bosons: From condensed matter systems to ultracold gases*, Reviews of Modern Physics 83, 1405-1466 (2011).
4) V. Vidal, M. Ripepe, T. Divoux, D. Legrand, J.-C. Geminard, F. Melo (2010), *Dynamics of soap bubble bursting and its implications to volcano acoustics*, Geophysical Research Letters, 37, L07302 (2010).
5) A. Arneodo, C. Vaillant, B. Audit, F. Argoul, Y. d'Aubenton-Carafa, C. Thermes. *Multi-scale coding of genomic information: From DNA sequence to genome structure and function*, Physics Reports 498, 45 (2011).

Indiquer **au maximum 5 documents majeurs** (autres que les publications) produits par l'entité

1) LaBS, un logiciel de simulation de dynamique des fluides.

2) Lokéo, un logiciel pour une implantation optimale de nouveaux commerces.

3) Deux monographies en physique statistique.

4) Un vélocimètre pour un fluide électriquement conducteur (Brevet FR1054250).

5) Un violon qui joue tout seul (Brevet FR1260891).

Indiquer **au maximum 5 faits illustrant le rayonnement ou l'attractivité académiques** de l'entité

1) Élection de P. Flandrin à l'Académie des Sciences (2011), Cristal CNRS de M. Moulin (2013) et Prix Gay-Lussac Humbolt de A. Pumir (2013)}.

2) 5 enseignants chercheurs (Bartolo, Holdsworth, Manneville, Roscilde, Samtleben) nommés à l'IUF sur la période.

3) 3 ERC et 46 ANR. Viennent s'ajouter à cela de très nombreux accords internationaux bilatéraux.

4) Organisation de 61 conférences dont ETC14, European Turbulence Conference avec plus de 650 participants.

5) Doublement en 5 ans du nombre de doctorants et de celui des postdoctorants au sein du laboratoire.

Indiquer **5 faits illustrant les interactions de l'entité avec son environnement socio-économique ou culturel**

1) Étude et modélisation du système de velopartage lyonnais, Vélo'V, en étroite collaboration avec le Grand Lyon et Cyclocity (JCDecaux), les opérateurs, respectivement, publics et privés du système.

2) Liens très étroits avec les Hospices Civils de Lyon, à travers deux projets phares.

3) Participation au documentaire diffusé par France 3 à l'occasion de l'anniversaire de la disparition de H. Poincaré.

4) Le FUI Patvax a permis le développement de microcapteurs innovants pour un meilleur suivi en temps réel de la fabrication de vaccins et produits biothérapeutiques en partenariat avec Merial, Sanofi Pasteur et Smartinst.

5) Développement avec L'Oréal de nouvelles techniques de formulation de microcapsules.

Indiquer **les principales contributions de l'entité à des actions de formation**

1) Le Master Sciences de la Matière, une des formations phares du PRES de Lyon.

2) Le Master 2 Modélisation des Systèmes Complexes, l'exemple le plus abouti de parcours interdisciplinaire.

3) Le Master Erasmus Mundus Atosim, issu d'une collaboration entre Lyon, Rome et Amsterdam et le réseau CECAM.

4) Implication forte des chercheurs CNRS aux côtés de leurs collègues enseignants-chercheurs dans l'enseignement.

5) L'école d'été de traitement du signal et des images de Peyresq, créée à l'initiative de P. Flandrin.

Le **directeur d'unité** peut indiquer **3 points précis** sur lesquels il souhaite obtenir l'expertise du comité.

1) Le laboratoire a un grand potentiel de formation et est très attractif. Avec des locaux saturés et un laboratoire de taille déjà imposante, comment éviter le risque de perdre souplesse, réactivité et dynamique collective ?

2) Comment assurer que les équipes dont l'activité principale relève d'un institut autre que l'INP puissent néanmoins bénéficier de recrutement par l'INSII ou l'INSIS ?

3) Nous souhaitons recruter un(e) spécialiste pour épauler les chercheurs dans l'utilisation et le partage de ces outils. Quel niveau de qualification (T, AI, IE) et compétences initiales viser ?

agence d'évaluation de la recherche et de l'enseignement supérieur

Executive summary of the unit

Research unit

Group A: 2014-2015 evaluation campaign

Unit name: Laboratoire de Physique (LPENSL)

Name of the unit director: Thierry Dauxois

Unit workforce

21 professors; 41 researchers; 15 technicians, engineers and other staff; 78 post-doctoral and doctoral students.

Staff who have left the unit during the current contract (and number of total months spent in the unit during this period).

6 established staff (542 months); 47 doctoral students (1746 months); 44 post-doctoral students (733 months).

Number of recruitments carried out during the period in question and where the staff come from

11 recruitments: F. BOUCHNEB (PME, comptable), F. BOUCHET (INLN, CR1), A. FEDORENKO (LPT-ENS, Post-doc), S. JOUBAUD (Twente, Post-doc), A. STEINBERGER (Göttingen, Post-doc), N. PUSTELNIK (IMS-Bordeaux, Post-doc), D. BARTOLO (PMMH-ESPCI, MCF), T. GIBAUD (Brandeis, Post-doc), A. VENAILLE (Princeton, Post-doc), C. CRAUSTE-THIBIERGE (LLB Saclay, Post-doc), G. NICOLLI (Stony Brook, Post-doc).

Research products and achievements over the previous period (1 January 2009 – 30 June 2014):

1) Measurement of the minimal energy to erase an individual bit of data. Together with the Higgs Boson, this result has been chosen by Physics World as one of the top ten breakthroughs for 2012.

2) Development of the formalism for electronic quantum optics, in collaboration with several experimental groups.

3) Renewing of community identification in a network thanks to a multiscale approach on graphs.

4) Development of ultrasonic imaging to analyse, spatially and temporally, the competition between hydrodynamic and elastic instabilities.

5) Construction of an integrable q-deformation of the AdS_5xS^5 string theory.

Quantitative overview of the unit's publications. 789 publications.

Please state the unit's **5 major publications**

1) A. Bricard, J.-B. Caussin, N. Desreumaux, O. Dauchot, D. Bartolo, *Emergence of macroscopic directed motion in populations of motile colloids*, Nature 95, 503 (2013).
2) F. Bouchet, A. Venaille, *Statistical mechanics of two-dimensional and geophysical flows,* Physics Reports 515, 227-295 (2012).
3) M. A. Cazalilla, R. Citro, T. Giamarchi, E. Orignac, M. Rigol, *One dimensional bosons: From condensed matter systems to ultracold gases,* Reviews of Modern Physics 83, 1405-1466 (2011).
4) V. Vidal, M. Ripepe, T. Divoux, D. Legrand, J.-C. Geminard, F. Melo (2010), *Dynamics of soap bubble bursting and its implications to volcano acoustics,* Geophysical Research Letters, 37, L07302 (2010).
5) A. Arneodo, C. Vaillant, B. Audit, F. Argoul, Y. d'Aubenton-Carafa, C. Thermes. *Multi-scale coding of genomic information: From DNA sequence to genome structure and function,* Physics Reports 498, 45 (2011).

Please state **5 major documents at the most** (other than publications) that the unit has produced

1) LaBS, a simulation software for fluid dynamics.

2) Lokéo, a software for an optimized implantation of new shops.

3) Two monographs in statistical physics.

4) A velocimeter for a electrically conducting fluid (Patent FR1054250).

5) A violin that plays by itself (Patent FR1260891).

Please state **no more than 5 facts illustrating the academic appeal or reputation** of the unit

1) Election of P. Flandrin to the Académie des Sciences (2011), Cristal CNRS for M. Moulin (2013) and Gay-Lussac Humbolt prize for A. Pumir (2013).

2) 5 university professors (Bartolo, Holdsworth, Manneville, Roscilde, Samtleben) appointed to IUF over the period.

3) 3 ERC, 46 ANR and many international bilateral agreements.

4) Organization of 61 conferences including ETC14, European Turbulence Conference with more than 650 participants

5) Doubling in 5 years of the number of PhD students and of the number of post-docs in the laboratory.

Please state **no more than 5 facts illustrating the unit's interactions with its socioeconomic or cultural environment**

1) Study and modelization of the Lyon bike sharing system, Vélo'V, in close collaboration with the Grand Lyon and Cyclocity (JCDecaux), the operators, respectively, public and private.

2) Close links with the Hospices Civils de Lyon, through two flagship projects.

3) Participation in the documentary broadcast by France 3 on the occasion of the anniversary of H. Poincaré's death.

4) FUI PATVAX has enabled the development of innovative microsensors for better real-time monitoring of the manufacture of vaccines and biotherapeutics in partnership with Merial, Sanofi Pasteur and Smartinst

5) Development in collaboration with L'Oréal of new techniques for microcapsule synthesis.

Please state **the unit's main contributions to training actions**

1) The Master Sciences de la Matière, one of the flagships of the PRES de Lyon.

2) Master 2 Modélisation des Systèmes Complexes, the most successful example of interdisciplinary courses.

3) Master Erasmus Mundus Atosim, a collaboration between Lyon, Rome and Amsterdam and CECAM network.

4) Strong involvement of CNRS researchers alongside their colleagues enseignant-chercheurs in teaching.

5) The Peyresq summer school on signal processing and images, created at the initiative of P. Flandrin.

Here, the **unit director/team manager** may briefly indicate **3 specific points** on which s/he would like to get the committee's expert opinion.

1) The laboratory has a great potential for training and is very attractive. With saturated space and an already large size laboratory, how to mitigate the risk of losing flexibility, responsiveness and group dynamics?

2) How to ensure that teams whose main activities lie outside the domain of research of the INP can still benefit from CNRS recruitment?

3) We want to recruit a specialist in acquisition and analysis of images to help researchers in the use and sharing of these tools. What level (T, AI, IE) and initial skills should be targeted?

B. Équipements, plateformes

- MEB: Microscope Électronique à Balayage
- PERPET: Table tournante
- Banc de diffusion de lumière
- Plusieurs Microscopes à Force Atomique (AFM)
- Four à refusion pour composants montés en surface.
- Générateur d'ondes Agilent RF 6 GHz
- Table de sérigraphie
- Plusieurs caméras (rapides, infrarouge,...)
- Cage de Faraday
- Cluster de calcul du laboratoire (Phycalc)
- Soufflerie
- Salle Blanche
- Atelier de Mécanique de l'ENS de Lyon
- CBP: Centre Blaise Pascal (http://www.cbp.ens-lyon.fr/)
- IXXI: Institut des Systèmes Complexes (http://www.ixxi.fr/)
- PSMN: Pôle Scientifique de Modélisation Numérique (http://www.ens-lyon.fr/PSMN/)
- PLATIM: Plateau Technique Imagerie/Microscopie (http://www.ifr128.prd.fr/PLATIM/)
- ESRF: Le Synchrotron européen (http://www.esrf.eu/)
- IDRIS: Institut du Développement et des Ressources en Informatique Scientifique (http://www.idris.fr/)
- ILL: Institut Laue-Langevin (http://www.ill.eu/)
- Swiss Light Source (http://www.psi.ch/sls/)

C. Organigramme fonctionnel

1. *Organigramme*

2014
DIRECTION
Thierry DAUXOIS

SERVICES COMMUNS

Gestion et secrétariat
Responsable :
CLERVAUX Nadine (CNRS, AI)
BOUCHNEB Fatiha (CNRS, TCN)
DUMAZEL Laure (ENS, Adt)
MAUDUIT Laurence (CNRS, TCS)

Service informatique
Responsable :
LOUIS-LUCAS Bertrand (CNRS, IE)
BARROUX Hervé (ENS, TCS)

Atelier mécanique
Responsable :
MOULIN Marc (CNRS, IE)
ARNOULD Frédéric (ENS, TCN)
LE TOURNEAU Denis (ENS, ASI)
VITTOZ Franck (CNRS, TCE)

Atelier électronique
Responsable :
METZ Pascal (CNRS, IE)
ROPARS Franck (CNRS, IE)
TANASE Marius (CNRS, TCN)

Équipe 1
Matière & Complexité

Responsable :
GEMINARD Jean-Christophe, DR

Effectif : 43

10 CHERCHEURS :
BERGERON Vance, DR
CASTELNOVO Martin, CR
GIBAUD Thomas, CR
OSWALD Patrick, DR
PALIERNE Jean-François, CR
PLACE Christophe, CR
SANTUCCI Stéphane, CR
VAILLANT Cédric, CR
VIDAL Valérie, CR

10 ENSEIGNANTS/CHERCHEURS :
BARTOLO Denis, PR
EVERAERS Ralf, PR
FREYSSINGEAS Eric, MC
GAYVALLET Hervé, MC
MANNEVILLE Sébastien, PR
MOSKALENKO Cendrine, MC
PAULIN Sébastien, PRAG
PEYRARD Michel, PR Emérite
RIGORD Patrick, PRAG
TABERLET Nicolas, MC

13 DOCTORANTS :
BRICARD Antoine
BERNAUD Julien
CAUSSIN Jean Baptiste
CHASTAING Jean-Yonnel
CLOTET FONS Xavier
DALBE Marie-Julie
DESREUMAUX Nicolas
HADDAD Noëlle
LIDON Pierre
MOKHTARI Zakia
PERGE Christophe
SANCHEZ Claudia
VERDIER Timothée

10 POST-DOCTORANTS :
CECCIA Simona
CHIKKADI Vijayakumar
FARDIN Marc-Antoine
JEANNERET Raphaël
JOST Daniel
LASTAKOWSKI Henri
LEOCMACH Mathieu
MODLINSKA Anna
TAPIA Franco
WEIJS Joost

Équipe 2
PHYNOLIN-Physique Statistique, Hydrodynamique et non Linéarités

Responsable :
BELLON Ludovic, CR

Effectif : 50

15 CHERCHEURS :
ARGOUL Françoise, DR
ARNEODO Alain, DR Emérite
BOUCHET Freddy, DR
CILIBERTO Sergio, DR
CRAUSTE Caroline, CR
DAUXOIS Thierry, DR
ERMANYUK Evgeny, CDD DR
GARNIER Nicolas, CR
PETROSYAN Artyom, IR
PINTON Jean-François, DR
PLIHON Nicolas, CR
PUMIR Alain, DR
STEINBERGER Audrey, CR
VENAILLE Antoine, CR

5 ENSEIGNANTS/CHERCHEURS:
CHILLA Francesca, MC
JOUBAUD Sylvain, MC
NAERT Antoine, MC
ODIER Philippe, MC
VOLK Romain, MC

17 DOCTORANTS :
BERUT Antoine
BERTOLACCINI Jonathan
BOURGET Baptiste
BROUZET Christophe
DEVAILLY Clémence
GEITNER Mickaël
GUICHARDAZ Robin
HORNE Ernesto
JULIEN Jean-Daniel
LAPERROUSAZ Bastien
LE CUNUDER Anne
LIOT Olivier
MACHICOANE Nathanaël
MARTINEZ Cristina
RUSAOUEN Eléonore
STREPPA Laura
TANGARIFE Tomas

12 POST-DOCTORANTS :
BOUSSELIN Guillaume
DIGIUNI Simona
DRILLON Guénola
GERASIMOVA Evgeniya
HOMAN Tess
LOPEZ CABALLERO Miguel
MARTINEZ Ignacio
PEREZ APARICIO Roberto
SALORT Julien
SCOLAN Hélène
THEURKAUFF Isaac
WOUTERS Jeroen

1 CDD ITA :
PROVERA/BOYER Elise, IR

Équipe 3
SISYPHE - Signaux, Systèmes et Physique

Responsable :
ABRY Patrice, DR

Effectif : 20

7 CHERCHEURS :
AUDIT Benjamin, CR
BORGNAT Pierre, CR
CHEVILLARD Laurent, CR
FLANDRIN Patrick, DR
JENSEN Pablo, DR
PUSTELNIK Nelly, CR

2 ENSEIGNANTS/CHERCHEURS:
CASTAING Bernard, PR
ROUX Stéphane, MC

6 DOCTORANTS :
BOULOS Rasha
COSTARD Aude
FRECON Jordan
HAMON Ronan
MICHAU Gabriel
TREMBLAY Nicolas

5 POST-DOCTORANTS :
HAMONIER Julien
LOZENGUEZ Guillaume
PEREIRA Rodrigo
SCHMITT Jérémy
SPILKA Jiri

Équipe 4
Physique Théorique

Responsable :
MAILLET Jean-Michel, DR

Effectif : 30

10 CHERCHEURS :
ALASTUEY Angel, DR
CARPENTIER David, CR
DEGIOVANNI Pascal, DR
DELDUC François, DR
FEDORENKO Andrey, CR
GAWEDZKI Krzysztof, DR
LIVINE Etera, CR
NICCOLI Giuliano, CR
ORIGNAC Edmond, CR

4 ENSEIGNANTS/CHERCHEURS:
HOLDSWORTH Peter, PR
MAGRO Marc, MC
ROSCILDE Tommaso, MC
SAMTLEBEN Henning, PR

11 DOCTORANTS :
CHAMPION Maxime
CHARLES Christophe
FAULKNER Michaël
FRUCHART Michel
KAISER Vojtech
LOPES CARDOZO David
MALPETTI Danièle
ORTIZ Thomas
TAUBER Clément
THIBIERGE Etienne
WENDLAND David

5 POST-DOCTORANTS :
DE FORGES DE PARNY Laurent
DELPLACE Pierre
HENRY Louis-Paul
LE DIFFON Arnaud
NARDINI Cesare

2. *Composition du conseil de laboratoire (au 30 Juin 2014)*

- Patrice Abry (nommé, responsable de l'équipe 3)
- Angel Alastuey (nommé)
- Ludovic Bellon (nommé, responsable de l'équipe 2)
- Pierre Borgnat (élu)
- Jean-Yonnel Chastaing (élu, représentant des doctorants)
- Thierry Dauxois (directeur d'unité, membre de droit)
- Ralf Everaers (nommé)
- Jean-Christophe Geminard (nommé, responsable de l'équipe 1)
- Marc Magro (élu)
- Jean-Michel Maillet (nommé, responsable de l'équipe 4)
- Marc Moulin (élu)
- Nicolas Taberlet (élu)
- Isaac Theurkauf (élu, représentant des post-doctorants)
- Valérie Vidal (élue)

Invités:
- Nadine Clervaux (responsable administrative)
- Peter Holdsworth (directeur du département de physique)
- Pascal Metz (correspondant formation)
- Franck Vittoz (assistant prévention)

3. *Principales responsabilités collectives*

- Responsable communication: M. Castelnovo et N. Plihon.
- Correspondant valorisation: N. Plihon.
- Responsable sites web: N. Garnier pour la partie laboratoire en collaboration avec E. Bertin (pour le laboratoire 2009-13), S. Santucci (Eq. 1), N. Plihon (Eq. 2), P. Borgnat (Eq. 3), A. Fedorenko (Eq. 4).
- Responsables séminaires:
  - Colloquium: L. Chevillard (2008-2010), A. Steinberger (2010-2012), A. Venaille (2012-).
  - Physique Expérimentale: S. Santucci (2009-2013), V. Vidal (2013-).
  - Physique Théorique: P. Degiovanni (2009-2013), M. Magro (2013), F. Delduc (2014-).
  - Groupe de travail en matière condensée: T. Roscilde (2009-2012), A. Fedorenko (2012-).
  - Séminaire de Théorie des doctorants: C. Tauber (2012-).
- Assistants Prévention: F. Vittoz et M. Tanase (depuis 2013).
- Représentant du laboratoire au CHSCT: S. Joubaud (2011-)
- Correspondant Formation (COFO): P. Metz.
- Responsable du petit atelier; A. Petrosyan (2009-2012), N. Taberlet (2012-).
- Correspondant bibliothèque: H. Gayvallet (2009-2013), V. Vidal (2009-2013), N. Pustelnik (2013-).
- Référente ED Phast auprès des étudiants: C. Moskalenko (2012-).
- Correspondant Direction du Patrimoine et des Moyens Généraux (DPMG): S. Joubaud (2013-).
- Responsable "Fête de la science": R. Volk (2009-2011), A. Steinberger (2012-).
- Responsable Microscope Electronique à Balayage (MEB): L. Bellon (2013-).
- Responsable de la table tournante (PERPET): P. Odier (2012-).
- Responsable de la salle blanche: D. Bartolo (2013-).
- Représentant du laboratoire au bureau de la FRAMA: L. Bellon (2009-2012), N. Taberlet (2012-).
- Représentant du laboratoire au copil du Labex iMust: A. Pumir (2011-2013), S. Maneville (2013-).

Avenant règlement intérieur
Laboratoire de Physique de l'ENS-Lyon
UMR5672 –CNRS

INTRODUCTION

Le présent règlement est destiné à organiser la vie et les conditions d'exécution du contrat de travail au sein du laboratoire de physique de l'ENS-Lyon. Il fixe les règles de fonctionnement interne et précise les règles relatives à l'hygiène et à la sécurité.

Ce règlement ayant pour objectif d'organiser la vie au sein du laboratoire afin d'en assurer son bon fonctionnement, s'impose, à compter de sa date d'entrée en vigueur, à tous les personnels employés au sein du laboratoire quelque soit leur statut, ainsi qu'aux personnes effectuant un stage dans les locaux. C
Ce règlement intérieur s'applique sous réserve du respect des règles posées par le CNRS, par le règlement intérieur de l'ENS et par les lois et règlements en vigueur.
Ces règles sont disponibles :

- pour celles relatives au CNRS :
  www.cnrs.fr, > Intranet > Bibliothèque numérique > Ressources humaine
  ou http://www.dgdr.cnrs.fr/bpc/pratique/default.htm > Ressources humaines
- pour celles relatives à l'ENS :
  www.ens-lyon.eu > Intranet > Informations Institutionnels > Règlement intérieur et Guide des procédures

Il sera remis à chaque agent, doctorant et stagiaire un exemplaire du présent règlement, qui sera par ailleurs disponible au secrétariat du laboratoire afin que chacun puisse en prendre connaissance.

I- DISPOSITIONS GENERALES

1 – Dispositions relatives au comportement général

Le comportement des personnes travaillant au sein du laboratoire de physique doit être conforme au présent règlement notamment en ce qui concerne les règles relatives à l'hygiène et à la sécurité.
D'une manière générale, le comportement des personnels doit être conforme aux règles communément admises en matière de respect d'autrui, de civilité et de bonnes mœurs, ainsi qu'aux lois et règlements en vigueur.

Rappel :
Sont des délits punissables dans les conditions prévues par le code pénal :
- le fait de harceler autrui par des agissements répétés ayant pour objet ou pour effet une dégradation des conditions de travail susceptibles de porter atteinte à ses droits et à sa dignité, d'altérer sa santé physique ou mentale ou de compromettre son avenir professionnel,
- le fait de harceler autrui dans le but d'obtenir des faveurs de nature sexuelle.
Le fait de harcèlement peut donner lieu à une sanction disciplinaire indépendante de la mise en œuvre de poursuites pénales.

2- Dispositions relatives à l'organisation administrative

2.1. Conseil d'Unité – Assemblée Générale

Le Conseil de laboratoire est présidé par le directeur de l'Unité. Il a un rôle consultatif et émet un avis sur toutes les questions relatives à la politique scientifique, la gestion des ressources, l'organisation et le fonctionnement de l'Unité. Sa composition et ses modalités de fonctionnement sont prévues en application de la décision CNRS du 28/10/1992.

Composition du conseil de laboratoire :

- 1 membre de droit : Le Directeur de l'Unité
- 7 membres élus :
  *** Collège Chercheurs et Enseignants-Chercheurs : 6**
  - Sous-collège Chercheurs et Enseignants-Chercheurs : 4
  - Sous-collège Doctorants : 1
  - Sous-collège Post-Doctorants : 1
  *** Collège ITA : 1**
- 6 membres nommés

La durée du mandat des membres du conseil de laboratoire est fixée à 4 ans.

L'Assemblée générale comprend tous les personnels de l'Unité. Elle est réunie au moins une fois par an.

2.2. Catégories de personnel

Du fait de son statut d'unité mixte, différentes catégories de personnels sont accueillies au laboratoire :
- les personnels de l'ENS,
- les personnels du CNRS,
- les doctorants et post-doctorants,
- les étudiants, stagiaires ou collaborateurs extérieurs.

3- Dispositions relatives à la vidéo-surveillance sur le site

L'établissement est placé sous vidéo-surveillance conformément aux dispositions de l'article 10 de la loi modifiée 95-73 du 21 janvier 1995 d'orientation et de programme, relative à la sécurité.

Toute personne intéressée peut s'adresser au responsable d'un système de vidéo-surveillance afin d'obtenir un accès aux enregistrements qui la concernent ou d'en vérifier la destruction dans le délai prévu de 8 jours (un refus d'accès peut toutefois être opposé pour un motif tenant à la sûreté de l'État, à la défense, à la sécurité publique, au déroulement de procédures ou au droit des tiers).

4- Dispositions relatives à l'usage des parkings

Toute personne utilisant les parkings offerts par l'établissement doit se déclarer auprès du service de sécurité de l'École et fournir le numéro d'immatriculation du véhicule afin de se voir délivrer un macaron. A défaut, l'ENS se réserve le droit de recourir aux forces de police et de fourrière pour l'enlèvement des véhicules non identifiés.

Toute personne utilisant les parkings à des fins privatives et notamment en dehors de son temps de présence dans l'établissement est redevable d'une indemnité compensatrice dont le montant est fixé par le conseil d'administration de l'ENS.

5- Dispositions relatives aux tenues vestimentaires et au port de signes extérieurs d'appartenance à une religion ou philosophie

Les tenues vestimentaires, au sein des laboratoires, doivent être conformes aux règles d'hygiène et de sécurité et adaptées aux travaux pratiques réalisés.
Ne peuvent donc être admis les vêtements et les accessoires flottants ou facilement inflammables, ou susceptibles d'entraver le port d'équipement de protection individuelle. De même, les pieds nus ne sauraient être tolérés dans les locaux.
Il est rappelé au personnel que dans les laboratoires, la tenue de rigueur est la suivante : blouse en coton, chaussures fermées, jambes protégées, cheveux longs attachés, lunettes et gants adaptés aux risques encourus lors de la réalisation des travaux.

Par ailleurs, en vertu du principe de laïcité et de neutralité des services publics, le port de signes extérieurs ostensibles d'appartenance à une religion ou philosophie des agents publics qu'ils soient titulaires ou stagiaires est prohibé.

6 - Dispositions relatives à la participation des salariés aux conditions de travail

6.1. Droit d'alerte

Tout agent signale immédiatement au directeur de l'Unité toute situation de travail dont il a un motif raisonnable de penser qu'elle présente un danger grave et imminent pour sa vie ou sa santé ainsi que toute défectuosité qu'il constate dans les systèmes de protection.

6.2. Droit de retrait :

Dans le cas où un agent estime qu'il est menacé par un danger grave et imminent, il peut se retirer de son poste de travail après avoir alerté l'autorité dont il dépend.

II- DISPOSITIONS RELATIVES A L'ORGANISATION DU TRAVAIL

1- Gestion des arrivées et des départs

Tout nouvel arrivant est tenu de remplir les fiches administratives afférentes à son statut, prendre connaissance du règlement intérieur et le signer, ainsi que des chartes relatives à l'hygiène et à la sécurité et informatique annexées. Tout nouveau doctorant doit également signer la convention de thèse et reste soumis au règlement intérieur de l'ENS.
Un Guide des nouveaux arrivants est disponible sur le site : http://www.ens-lyon.fr/PHYSIQUE/

A son départ, tout personnel à l'obligation de restituer tout le matériel qui lui a été confié durant son séjour au laboratoire (clefs, badges d'accès au bâtiment, publications, livres, matériels scientifiques, etc.).

2 - Horaires de travail

La durée annuelle de travail effectif est de 1607 h.
Les modalités de mise en œuvre dans l'Unité prennent en compte les dispositions figurant dans le décret du 25/08/00 ainsi que celles énoncées d'une part dans l'arrêté du 31/08/01 et d'autre part dans le cadrage national du CNRS.

2.1. Durée hebdomadaire

La durée hebdomadaire du travail effectif pour chaque agent de l'Unité travaillant à plein temps, est, sur cinq jours, de 38 heures 30 pour les agents CNRS et de 37 heures ou 37 heures 55 pour les agents ENS.

Les personnels autorisés à accomplir un service à temps partiel d'une durée inférieure ou égale à 80% peuvent travailler selon un cycle hebdomadaire inférieur à 5 jours.

Le temps de travail correspond à un temps de travail « effectif ». Il ne prend pas en compte la pause méridienne obligatoire qui ne peut être ni inférieure à 45 minutes ni supérieure à 2 heures.

2.2. Horaires journaliers, ouverture du laboratoire, accès aux locaux, travail isolé

La plage horaire de travail de référence commence à 7h30 et se termine à 19h.

Après accord du directeur d'Unité et sous condition des nécessités de service, certains personnels peuvent pratiquer un horaire décalé par rapport à la plage horaire de référence. L'accès aux locaux en dehors de ces plages peut être expressément et nommément autorisé par le directeur de laboratoire.

Les personnels dont les travaux jugés dangereux nécessitent d'être exécutés en dehors des horaires normaux de travail et/ou sur des lieux ou locaux éloignés, doivent impérativement être accompagnés. Cette obligation est levée s'il existe un service de garde à qui les personnels doivent impérativement signaler leur présence, ce qui est le cas à l'ENS. Les agent doivent donc informer l'accueil (numéro de poste 9 ou 81 51) de leur présence dans les locaux de l'ENS.
Dans tous les cas, ces personnels doivent respecter les consignes d'hygiène et de sécurité affichés dans les locaux mis à leur disposition.

3 - Congés annuels

Les jours de congés sont accordés, après avis du responsable hiérarchique, sous réserve des nécessités de service.
Le suivi des congés (annuels et RTT) est réalisé dans l'Unité sous la responsabilité du directeur par l'application informatique « Hamac » pour le personnel de l'ENS et par un document papier disponible au secrétariat pour le personnel CNRS.
Afin de pouvoir adapter l'organisation du travail, chacun doit effectuer ses demandes de congés auprès de la direction du laboratoire avec un délai de prévenance proportionnel du double au nombre de jours demandés (par exemple, pour un congé de 4 jours, la demande devra être faite au moins 8 jours avant la prise de congés).
Dans une logique destinée à assurer la continuité et dans un esprit de conscience professionnelle, une autre personne du service ou d'un autre service est désignée comme interlocuteur de substitution.

Le nombre de congés annuel se décompte en jours ouvrés (c'est-à-dire du lundi au vendredi). Ils sont indiqués dans le tableau ci-dessous, en fonction de l'appartenance des personnels de l'Unité au CNRS ou à l'ENS.

	Jours ouvrés de congés annuels	Jours de RTT	Jours de fraction *	Durée hebdomadaire
CNRS	32	12	2	38h30
ENS	46(1) ou 55(2)	Aucun	2	37h(1) ou 37h55(2)

* Tous les personnels peuvent bénéficier de deux jours de fractionnement des congés annuels : 1 jour si l'agent prend 5,6 ou 7 jours en dehors de la période du 1er mai au 31 octobre et de 2 jours si ce nombre est au moins égal à 8 jours. Ces jours de congés supplémentaires devront également être pris en dehors de la période allant du 1er mai au 31 octobre.

La prise de congés et jours RTT ne peut excéder 31 jours consécutifs sauf si les congés sont pris dans le cadre du Compte Épargne Temps et à l'exception des personnels originaires des DOM-TOM qui bénéficient sous certaines conditions du « congé bonifié » (la durée des congés est calculée du premier au dernier jour sans déduction des samedis, dimanches et jours fériés).

Lorsqu'un agent est dans l'impossibilité de prendre tous ses congés annuels ou RTT avant le 31 décembre de l'année civile pour les agents CNRS ou le 31 août pour les agents ENS, les jours non utilisées sont portées sur le crédit de l'année civile ou universitaire suivante. Pour les agents CNRS, ce reliquat est sans limite mais doit être demandé avant le 28 février de l'année civile suivante. En revanche, pour les agents ENS, le nombre de jours reportés automatiquement est limité à 22 devant être impérativement consommés avant le 31 décembre de l'année universitaire suivante.
L'agent dispose également de la faculté de les capitaliser sur un Compte Épargne Temps.
Un récapitulatif de l'ensemble de vos congés figure en annexe.

4 - Compte Épargne Temps

Le compte épargne temps (CET) permet au salarié d'accumuler des droits à congés rémunérés ou de bénéficier d'une rémunération, immédiate ou différée, en contrepartie des périodes de congés ou de repos non prises sans que le nombre de jours de congés pris dans l'année ne puisse être inférieur à 20 jours.
Il a été institué dans la Fonction Publique de l'État par le décret n°2002-634 du 29 avril 2002, modifié par le décret n°2009-1065 du 28 août 2009.
Les modalités d'application de ces décrets ont été précisé :

- pour le CNRS, par un arrêté du 20 janvier 2004 modifié par l'arrêté du 17 avril 2009,

- pour l'ENS, par une circulaire n°2004-145 du 10 septembre 2004 et un arrêté 28 juillet 2004.

4.1. Conditions et modalités d'ouverture d'un Compte Épargne Temps

L'accès au compte épargne-temps est ouvert aux agents titulaires et non titulaires exerçant leur fonction au sein du CNRS ou de l'ENS de manière continue depuis au moins 1 an.
Les agents CNRS peuvent, à tout moment, effectuer une demande d'ouverture du CET en remplissant un formulaire auprès du secrétariat qui sera transmis au(à la) délégué(e) régional(e).
S'agissant des agents ENS, la demande (dont les formulaires sont disponibles sur l'intranet de l'ENS ou au secrétariat) doit être transmise par l'agent au service des ressources humaines de l'ENS.

Ils seront informés dans un délai raisonnable par écrit de l'acceptation ou du refus d'ouverture du compte**.**

4.2. Alimentation du Compte Épargne Temps

Le CET peut être alimenté par les jours de congés payés annuels (à l'exception des 4 premières semaines) et les jours de repos et de congés accordés au titre de l'organisation du travail (RTT).

Une demande d'alimentation du compte doit être effectuée par l'agent (qui devra remplir un formulaire accompagnée d'un décompte annuel des congés) une fois par an, entre le 1er novembre pour les agents CNRS) ou 1er septembre (pour les agents ENS) et le 31 décembre au plus tard.

- Pour les agents CNRS, la demande doit être faite auprès du secrétariat qui se chargera de la transmettre à la direction des ressources humaines de la délégation Rhône-Auvergne (DR07).
- Pour les agents ENS, la demande (dont les formulaires sont disponibles sur l'intranet de l'ENS ou au secrétariat) doit être transmise par l'agent au service des ressources humaines de l'ENS.

En cas de non respect des délais, les jours de congés non pris au titre de l'année civile concernée ne pourront être admis au crédit du CET.

L'abondement du CET est soumis à une double limitation.
D'une part, le CET ne pourra être abondé que dans la limite de 10 jours par an pour les agents CNRS et 22 jours par an pour les agents ENS dès lors que 20 jours de congés seront inscrits à son crédit.
D'autre part, le nombre de jours de congés inscris ne peut dépasser un plafond global maximum de 60 jours.

4.3. Utilisation du Compte Épargne Temps

4.3.1. <u>Condition d'utilisation du Compte Épargne Temps</u>

L'agent doit présenter une demande d'utilisation (formulaire disponible au secrétariat et sur l'intranet de l'ENS pour les agents ENS) des congés acquis au titre du CET signée par le responsable d'unité ou de service en respectant un délai de prévenance suffisant pour permettre le traitement normal de la demande. La demande doit être déposée au secrétariat qui se chargera de la transmettre à la direction des ressources humaines de la délégation Rhône-Auvergne pour les agents CNRS. Pour les agents ENS, cette demande signée par le DU doit être directement envoyée au service des ressources humaines de l'ENS.
L'agent ENS doit avoir épuisé ses congés annuels avant de pouvoir utiliser son compte épargne temps.
Pour les agents CNRS, rien ne tel n'est prescrit.

4.3.2. Modalités d'utilisation du Compte Épargne Temps

Les 20 premiers jours épargnés doivent obligatoirement être utilisés sous forme de congés.
Pour les jours excédentaires, l'agent doit, avant le 31 janvier de l'année suivant celle au cours de laquelle le compte a été alimenté, exprimer son choix entre les trois possibilités suivantes qu'il peut cumuler dans les proportions qu'il souhaite :

- maintient de ces jours sur son CET en vue d'une utilisation sous forme de congés (congés non rémunérés, formation, etc)
- indemnisation de tout ou partie de ces jours d'un maximum de 4 jours par an jusqu'à l'épuisement du solde (125€ brut par jour pour la catégorie A, 80€ brut pour la catégorie B et 65€ pour la catégorie C) *[que pour les jours excédents le minimum légal de 30 jours ouvrables],*
- prise en compte de tout ou partie de ces jours au sein du régime de retraite additionnelle de la fonction publique (RAFP) *[uniquement pour les fonctionnaires]*. Plus d'informations sont disponibles sur ce point sur le site :
  http://www.rafp.fr/spip.php?page=article&id_article=466&lang=fr

A défaut de l'expression d'un choix dans les délais, ces jours excédentaires seront automatiquement placés au RAFP pour les fonctionnaires ou indemnisés pour les agents non titulaire.

4.4. Liquidation du Compte Épargne Temps

En cas de transfert de droits à un autre employeur ou de rupture du contrat de travail, le salarié peut demander la conversion monétaire de l'intégralité des droits qu'il a acquis sur son CET.
Le salarié pourra également conserver ses droits sur son CET en cas de changement d'employeur si ce dernier est un organisme public ayant mis en place le CET dans les conditions fixées par lui.

5 – Absences

Toute absence doit être signalée au secrétariat de direction par une inscription dans le cahier d'absence (ce dispositif ayant pour but exclusif d'éviter de rechercher les personnes absentes au sein du laboratoire).

De plus, toute indisponibilité consécutive à la maladie doit, sauf cas de force majeure, être dûment être justifiée et signalée au responsable de l'Unité dans les 24 heures. Dans les 48 heures qui suivent l'arrêt de travail, l'agent doit produire un certificat médical indiquant la durée prévisible de l'indisponibilité.

Tout accident corporel survenant dans le cadre de l'activité professionnelle devra être immédiatement déclaré auprès de l'Unité.

6- Missions

Tout agent se déplaçant pour l'exercice de ses fonctions, doit être en possession d'un ordre de mission établi préalablement au déroulement de la mission. Ce document est obligatoire du point de vue administratif et juridique ; il assure la couverture de l'agent au regard de la réglementation sur les accidents de service.
L'agent conduit à se rendre directement de son domicile sur un lieu de travail occasionnel sans passer par sa résidence administrative habituelle, est couvert en cas d'accident du travail sous réserve de remplir les deux conditions suivantes :

- être en possession d'une copie d'un ordre de mission

- avoir une copie de l'autorisation du Directeur de laboratoire d'utilisation d'un véhicule administratif ou de son véhicule personnel

Les modalités de règlement des missions sont décrites dans le Guide des nouveaux arrivants.

7 - Diffusion des résultats scientifiques

7.1. Confidentialité

Chacun est tenu de respecter la confidentialité des travaux qui lui sont confiés ainsi que ceux de ses collègues. En particulier, en cas de présentation à l'extérieur, l'autorisation du directeur d'Unité ou du responsable scientifique est obligatoire.

7.2. Publications

Les publications des membres de l'Unité doivent faire apparaître l'appartenance à l'Unité et le rattachement aux tutelles sous la forme :

Prénom Nom
Université de Lyon, France ;
CNRS, UMR 5672, 46 allée d'Italie, Lyon, F-69364, France ;
ENS de Lyon, France

Un exemplaire de toutes les publications (articles, revues, thèses…) dont tout ou partie du travail a été effectuée à l'Unité doit être remis dès parution au secrétariat et mise à jour sur les sites HAL (http://hal.archives-ouvertes.fr/) et PRUNEL (http://prunel.ccsd.cnrs.fr/).

8 - Formation

Le plan de formation de l'Unité est soumis pour avis au conseil d'Unité.
Le correspondant formation de l'Unité informe et conseille les personnels pour leurs besoins et demandes de formation. Il participe, auprès du directeur d'Unité, à l'élaboration du plan de formation de l'Unité.

9 - Utilisation des moyens informatiques

L'utilisation des moyens informatiques est soumise à des règles explicitées dans la charte informatique en annexe. Cette charte est avant tout un code de bonne conduite. Elle a pour objet de préciser la responsabilité des utilisateurs, en accord avec la législation, et doit être signée par tout nouvel arrivant.
Par ailleurs, les agents administrant eux-mêmes leur ordinateur signent un document dans lequel ils s'engagent personnellement à respecter les dispositions édictées dans ce document (en annexe).

III - DISPOSITIONS RELATIVES A L'HYGIENE ET A LA SECURITE

Les dispositions relatives à l'hygiène et à la sécurité se trouvent dans la charte relative à l'hygiène et à la sécurité annexée au présent règlement. Cette charte a pour objet d'assurer la sécurité du personnel sur le site du laboratoire et doit être signée par tout nouvel arrivant.

IV - SANCTIONS DISCIPLINAIRES

Peut faire l'objet d'une procédure disciplinaire tout personnel du laboratoire auteur ou complice :
- d'un fait de nature à porter atteinte à l'ordre public ou au bon fonctionnement du laboratoire,
- d'un manquement au règlement intérieur.

En fonction de la gravité des faits, les sanctions disciplinaires applicables sont les suivantes :

- avertissement
- blâme
- mise à pied disciplinaire
- licenciement

La mise en œuvre de la procédure disciplinaire et le prononcé, au terme de celle-ci, d'une sanction, sont indépendants de la mise en œuvre, à raison des mêmes faits, d'une action pénale.

La procédure disciplinaire se déroule dans le respect des droits de la défense de l'agent.

Rappel des droits de la défense du salarié :
Toute sanction sera motivée et notifiée par écrit au salarié.
Aucun fait fautif ne peut être invoqué au-delà d'un délai de deux mois à compter du jour où l'employeur en a eu connaissance, à moins que des poursuites pénales n'aient été exercées dans ce même délai. Aucune sanction antérieure de plus de trois ans à l'engagement des poursuites disciplinaires ne peut être invoquée à l'appui d'une nouvelle sanction.
Toute sanction disciplinaire est précédée d'une convocation du salarié ; cette convocation doit mentionner son objet. Le salarié peut se faire assister d'un autre salarié de l'entreprise lors de cet entretien. La sanction ne peut intervenir moins d'un jour franc, ni plus d'un mois après le jour fixé pour l'entretien.

V – ENTREE EN VIGUEUR

Le règlement intérieur entre en vigueur dans le laboratoire de physique le 01er janvier 2010 après avoir été soumis à l'avis du Conseil du laboratoire et homologué par le CNRS et l'ENS.

Toute modification, adjonction ou retrait au présent règlement sera soumis à la même procédure.

E. Indices de rayonnement et d'attractivité académiques

1. *Prix, distinctions et promotions*

a. Prix

Abry Patrice. IEEE Fellow. 2011.
Bartolo Denis. Membre Junior de l'Institut Universitaire de France. 2012.
Castelnovo Martin. Prix Jeune Equipe de Recherche, Fondation Del Duca (Institut de France). 2009.
Flandrin Patrick. EURASIP Fellow. 2009.
Flandrin Patrick. Médaille d'Argent du CNRS. 2010.
Flandrin Patrick. Membre de l'Académie des Sciences. 2011.
Flandrin Patrick. Distinguished Lecturer of the IEEE Signal Processing Society. 2011-2012.
Holdsworth Peter. Membre senior, Institut Universitaire de France 2010.
Joubaud Sylvain. Chaire d'excellence. 2009.
Manneville Sébastien. Membre junior de l'Institut Universitaire de France. 2010.
Pumir Alain. Humboldt Forschunspreis. 2013.
Roscilde Tommaso. Membre junior, Institut Universitaire de France. 2013.
Samtleben Henning. Membre junior, Institut Universitaire de France. 2010.

b. Professeurs associés dans des universités étrangères

Abry Patrice. Professeur invité du National Institute of Informatics (NII), Tokyo, Japon.
Argoul Françoise. Professeur associé, East China Normal University, Shanghai, China.
Arneodo Alain. Membre de l'Institute for Molecular Biophysics, Bar Harbor, Maine, USA
Flandrin Patrick. Advisory Professor, East China Normal University, Shanghai, China.
Livine Etera. Research Fellow du Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada.
Pumir Alain. Adjunct Professor, Institute of Mathematical Sciences, Chennai, India.

c. Promotions

Abry Patrice. Promotion DR1 (section 7), Octobre 2010.
Alastuey Angel. Promotion DR1 (section 2), Octobre 2010.
Arneodo Alain. Directeur de Recherche émérite depuis Décembre 2013.
Barroux Hervé. Promotion TCS (BAP E), Septembre 2012.
Bartolo Denis. Promotion PR2 (section 28), Septembre 2012.
Bertin Eric. Promotion CR1 (section 2), Octobre 2010.
Bouchet Freddy. Promotion DR2 (section 2), Octobre 2013.
Chevillard Laurent. Promotion CR1 (section 5), Octobre 2011.
Chillà Francesca. Promotion MCHC, Septembre 2010.
Ciliberto Sergio. Promotion DRCE1 (section 2), Octobre 2010.
Clervaux Nadine. Promotion AI (BAP J), Janvier 2013.
Dauxois Thierry. Promotion DR1 (section 2), Octobre 2012.
Degiovanni Pascal. Promotion DR2 (section 2), Octobre 2011.
Everaers Ralf. Promotion PRCE (section 28), Septembre 2012.
Flandrin Patrick. Promotion DRCE1 (section 7), Octobre 2012.
Freyssingeas Eric. Promotion MCHC, Septembre 2012.
Géminard Jean-Christophe. Promotion DR2 (section 5), Octobre 2010.
Holdsworth Peter. Promotion PRCE1 (section 29), Septembre 2010.
Leveque Emmanuel. Promotion DR2 (section 10), Octobre 2013.
Livine Etera. Promotion CR1 (section 2), Septembre 2009.
Manneville Sébastien. Promotion PR1 (section 28), Septembre 2011.
Mauduit Laurence. Promotion TCS (BAP J), Janvier 2014.
Odier Philippe. Promotion MCHC (section 28), Septembre 2010.
Peyrard Michel Professeur émérite depuis Janvier 2010.
Pinton Jean-François. Promotion DRCE1 (2012).
Plihon Nicolas. Promotion CR1 (section 2), Octobre 2013.
Samtleben Henning. Promotion PR1 (section 29), Septembre 2013.
Santucci Stéphane. Promotion CR1 (section 11), Octobre 2012.
Toninelli Fabio. Promotion DR2 (section 41), Octobre 2012.
Vidal Valérie. Promotion CR1 (section 5), Octobre 2009.

2. *Responsabilités éditoriales*

Abry Patrice
- *IEEE Transactions on Signal Processing*, Membre du Comité Éditorial 2009.
- *IEEE Signal Processing Societyand Method committee*, 2004-2010 & 2014-.

Alastuey Angel
- *Journal of Statistical Mechanics*, Membre du Comité Éditorial.

Arneodo Alain
- *The European Physical Journal B*, Membre du Comité Éditorial.
- *International Journal of Fractals*, Membre du Comité Éditorial.
- *International Journal of Bifurcation and Chaos*, Membre du Comité Éditorial.
- *Signal Processing*, Membre du Comité Éditorial.
- *Journal of Difference Equations & Applications*, Membre du Comité Éditorial.
- *Applied and Comp. Harmonic Analysis : Wavelets, Signal Processing and Applications, Signal, Image and Video Processing*, Membre du Comité Éditorial.

Audit Benjamin
- *BMC Bioinformatics*, Membre du Comité Éditorial.

Borgnat Pierre
- *Traitement du Signal*, Membre du Comité Éditorial.
- *Telecommunication Systems*, éditeur invité pour un numéro.

Bouchet Freddy
- *Journal of Statistical Mechanics*, Membre du Comité Éditorial.

Castaing Bernard
- *Europhysics Letters*, Membre du Comité Éditorial.

Chevillard Laurent
- *Comptes Rendus Académie des Sciences*, Editeur du numéro sur la turbulence.

Ciliberto Sergio
- *Journal of Statistical Mechanics*, Membre du Comité Éditorial.

Dauxois Thierry
- *Journal of Statistical Mechanics*, Éditeur de "Long-range interactions" (2010).

Flandrin Patrick
- *IEEE Transactions on Signal Proc.*, Membre du Comité Éditorial (2009-2011).
- *Applied and Computational Harmonic Analysis*, Membre du Comité Éditorial.
- *Journal of Fourier Analysis and Applications*, Membre du Comité Éditorial.
- *Advances in Adaptive Data Analysis*, Membre du Comité Éditorial.
- *EURASIP Journal of Applied Signal Processing*, Éditeur du numéro "Recent Advances in Theory and Methods of Nonstationary Signal Processing" (2011).
- *IEEE Signal Processing Magazine*, Éditeur du numéro "Time-Frequency Analysis and Applications" (2013).
- *IEEE Signal Processing Magazine*, Membre du Comité Éditorial.

Gawędzki Krzysztof
- *Annales Henri Poincaré*, Éditeur-en-Chef.
- *Journal of Statistical Physics*, Membre du Comité Éditorial.

Géminard Jean-Christophe
- *Papers in Physics*, Membre du Comité Éditorial.
- *Frontiers*, Membre du Comité Éditorial.

Holdsworth Peter
- *Journal of Physics, Condensed Matter*, Membre du Comité Éditorial.
- *Scientific Reports*, Membre du Comité Éditorial.

Leveque Emmanuel
- *Journal of Turbulence*, Associate Editor.

Livine Etera
- *Sigma*, Éditeur du numéro "Loop Quant. Grav. and Cosmo" (2011-13).

Maillet Jean-Michel
- *Annales Henri Poincaré*, Membre du Comité Éditorial.

Orignac Edmond
- *European Physical Journal: Special Topics*, Éditeur du numéro *Novel quantum phases and mesoscopic physics in quantum gases*, 217 (2013).

Peyrard Michel
- *Nonlinearity*, Membre du Comité Éditorial.
- *Journal of Biological Physics*, Membre du Comité Éditorial.

Pinton Jean-François
- *European Journal of Physics E*, Membre du Comité Éditorial.
- *New Journal of Physics*, Membre du Comité Éditorial.
- *Lecture Notes in Physics*, Membre du Comité Éditorial.

Pumir Alain
- *Physical Review E*, Membre du Comité Éditorial.
- *Journal of Physica A*, Membre du Comité Éditorial.
- *Journal of NonLinear Science*, Membre du Comité Éditorial.

Roscilde Tommaso
- *European Physical Journal: Special Topics*, Éditeur du numéro *Novel quantum phases and mesoscopic physics in quantum gases*, 217 (2013).

Toninelli Fabio
- *Communications in Mathematical Physics*, Membre du Comité Éditorial.
- *International Journal of Mathematics*, Membre du Comité Éditorial.

3. *Appui à la recherche*

a. Participation à l'administration de structures de recherche

Structure de Recherche	Responsabilité	NOM Prénom	Début	Fin
INP CNRS	Directeur d'Institut	PINTON Jean-François	2012	En cours
ENS de Lyon	VP Recherche	CILIBERTO Sergio	2012	En cours
ENS de Lyon	VP Recherche	PINTON Jean-François	2011	2012
CCSD	Directeur	ALASTUEY Angel	2008	2009
LJC	Directrice	ARGOUL Françoise	2011	2011
Lab. de Physique	Directeur	DAUXOIS Thierry	2012	En cours
Centre Blaise Pascal	Directeur	EVERAERS Ralf	2008	En cours
CECAM-RA	Directeur	EVERAERS Ralf	2009	En cours
IXXI	Directeur	JENSEN Pablo	2009	2014
Lab. de Physique	Directeur	PINTON Jean-François	2006	2011
Centre de Phys. des Houches	Directeur	PINTON Jean-François	2008	2012
INSII CNRS	Chargé de mission	ABRY Patrice	2012	2012
INP CNRS	Chargé de mission	JENSEN Pablo	2011	2014
ENS de Lyon	Resp. PSMN	LEVEQUE Emmanuel	2007	2010
GDR Phénix	Directeur	DAUXOIS Thierry	2006	2009
GDR Phénix	Directeur	GEMINARD JC	2010	En cours
GDRI Franco-Russe	Directeur	MAILLET Jean Michel	2004	2012
GDR Atomes Froids	Directeur adjoint	ROSCILDE Tommaso	2013	En cours
Fédération AM Ampère	Directeur adjoint	PUMIR Alain	2011	En cours
ED PHAST	Directeur	DELDUC François	2007	2009
ED PHAST	Directeur adjoint	SAMTLEBEN Henning	2010	En cours

b. Participation à des comités scientifiques

Niveau	Comité	Structure	Respons-abilité	NOM Prénom	Dates
Local	CS	ENS Lyon	Membre	BELLON Ludovic	2006-2009
Local	CS	ENS Lyon	Membre	GARNIER Nicolas	2009-
Local	Bureau	FRAMA	Membre	BELLON Ludovic	2010-2012
Local	Copil	IXXI	Président	BERTIN Eric	2009-2011
Local	CD	IXXI	Membre	BERTIN Eric	2012-2013
Local	Bureau	FLMSN	Membre	EVERAERS Ralf	2009-
Local	Bourse de Thèse	ENS de Lyon	Responsable	FREYSSINGEAS Eric	2012-
Local	Copil	LABEX IMUST	Membre	MANNEVILLE Sébastien	2014-
Local	Copil	ENSL-Rhodia	Membre	MANNEVILLE Sébastien	2012-
Local	Copil	LABEX IMUST	Membre	PUMIR Alain	2012-2014
Local	Copil	Semovi	Membre	VAILLANT Cédric	2007-
Local	Copil	IXXI	Membre	GARNIER Nicolas	2013-
National	AERES	LPTMS	Président	ALASTUEY Angel	2013
National	ANR	CSD 7	Membre	ARGOUL Françoise	2013
National	PES	Section 28	Membre	ARGOUL Françoise	2013
National	CD	EISBM	Membre	ARGOUL Françoise	2010-
National	CAP CNRS	CR	Membre	BORGNAT Pierre	2009-2012
National	AERES	LPS (Paris)	Membre	CASTAING Bernard	2009
National	AERES	SPEC (Saclay)	Président	CASTAING Bernard	2009
National	AERES	LadHyX	Président	CASTAING Bernard	2013
National	CS	IHEST	Membre	CASTAING Bernard	2011-
National	AERES	INLN (Nice)	Membre	DAUXOIS Thierry	2011
National	AERES	LPS (Paris)	Membre	DAUXOIS Thierry	2012
National	AERES	LPTMC (Paris)	Membre	DAUXOIS Thierry	2013
National	AERES	LPT (Orsay)	Président	DAUXOIS Thierry	2013
National	Les Houches	CA	Membre	DAUXOIS Thierry	2010-
National	CoNRS	Section 02	Membre	DAUXOIS Thierry	2008-2010
National	CoNRS	Section 02	Président	DAUXOIS Thierry	2010-2012
National	CS	Féd. D. Poisson	Membre	DELDUC François	2012-2014
National	GDR	CALCUL	Membre CS	EVERAERS Ralf	2009
National	GDR	ADN	Membre CS	ARNEODO Alain	2013-
National	GDR	ISIS	Membre CS	BORGNAT Pierre	2009-
National	GDR	Turbulence	Membre CS	CHEVILLARD Laurent	2011-
National	GDR	IQFA	Membre CS	DEGIOVANNI Pascal	2013-

National		RNL	Membre CS	CHEVILLARD Laurent	2013-
National	INRIA	Rennes	Membre	FLANDRIN Patrick	2009
National	ASTI	Paris	Membre	FLANDRIN Patrick	2009
National	INRIA	Paris	Membre	FLANDRIN Patrick	2014
National	CoNRS	Section 11	Membre	FREYSSINGEAS Eric	2012-
National	ProSFeR	ENS/ECNU	Coordinateur	GARNIER Nicolas	2009-
National	AERES	LPTHE	Membre	GAWEDZKI Krzysztof	2012
National	AERES	LPT (Orsay)	Membre	GAWEDZKI Krzysztof	2013
National	AERES	LPTMS	Membre	ALASTUEY Angel	2013
National	CoNRS	Section 05	Membre	GEMINARD Jean-Christophe	2012-
National	CoNRS	Section 02	Président	MAILLET Jean-Michel	2012-
National	IHP	CA	Membre	MAILLET Jean Michel	2012
National	AERES	LPTENS	Membre	SAMTLEBEN Henning	2012
National	CNU	Section 29	Membre	SAMTLEBEN Henning	2012-
National	AERES	LPTMS (Orsay)	Membre	HOLDSWORTH Peter	2013
National	CNU	Section 29	Membre	HOLDSWORTH Peter	2011-2014
National	Comité des sages	CEA	Membre	CASTAING Bernard	2012-
International	Com. Eval.	FET-Proactive	Evaluateur	BERTIN Eric	2012
International	Jury ERC	Starting Grant	Membre	CILIBERTO Sergio	2009-2011
International	Jury ERC	Consol. Grant	Président	CILIBERTO Sergio	2013
International	PRACE	Priorit. Panel	Membre	EVERAERS Ralf	2012
International	UNLocX	Wolkersdorf (A)	Membre	FLANDRIN Patrick	2013
International	SPTM	IEEE SPS	Membre	ABRY Patrice	2003-2010
International	SPTM	IEEE SPS	Membre	ABRY Patrice	2014-
International	CS	ETH-Pauli Inst.	Membre	GAWEDZKI Krzysztof	2012
International	Abilitazione	Italie	Membre	PEYRARD Michel	2012-2014
International	Selection	Max-Planck	Membre	PUMIR Alain	2014

c. Participation à des jurys

NOM Prénom	Jury de thèse	Jury d'HDR	Comité de sélection
ABRY Patrice	11	3	
ALASTUEY Angel	2	1	5
ARGOUL Françoise	3		
ARNEODO Alain	9	4	3
AUDIT Benjamin	3	1	1
BARTOLO Denis	2		2
BELLON Ludovic	2		1
BERTIN Eric	4		4
BORGNAT Pierre	10		3
BOUCHET Freddy	3		
CARPENTIER David	6	1	1
CASTAING Bernard	5	1	3
CASTELNOVO Martin	2	1	
CHILLA Francesca	3		2
CILIBERTO Sergio	5	1	
DAUXOIS Thierry	19	7	6
DEGIOVANNI Pascal	6	1	2
DELDUC François	4	1	
EVERAERS Ralf	3	3	4
FLANDRIN Patrick	6	13	2
FREYSSINGEAS Eric	3		3
GARNIER Nicolas	2		
GAWEDZKI Krzysztof	4	2	3
GEMINARD Jean-Christophe	16	5	1
GIBAUD Thomas	1		
HOLDSWORTH Peter	6	5	5
JENSEN Pablo	4		2
JOUBAUD Sylvain	1		2
LEVEQUE Emmanuel	6	1	2
LIVINE Etera	10		
MAGRO Marc			1
MAILLET Jean Michel	6	4	3
MANNEVILLE Sébastien	9	4	3

MOSKALENKO Cendrine	6		4
OSWALD Patrick	1	1	1
PALIERNE Jean-François	2		
PETROSYAN Artyom	3		
PEYRARD Michel	2		
PLACE Christophe	1		
PLIHON Nicolas	2		
PUMIR Alain	7	3	
PUSTELNIK Nelly			3
ROSCILDE Tommaso	3		1
ROUX Stephane	1		
SAMTLEBEN Henning	13		2
SANTUCCI Stéphane	2		1
TABERLET Nicolas	2		1
TERRAS Véronique	1		
TONINELLI Fabio	2		
VAILLANT Cédric	1		
VIDAL Valérie	2		
VOLK Romain	4		

4. Participation aux activités des Groupements de Recherche (GDR)

GDR ADN (Argoul, Arneodo, Audit, Everaers, Vaillant)
GDR Analyse Multifractale (Abry, Arneodo, Roux)
GDR Atomes Froids (Orignac, Roscilde)
GDR Bio Mol (Arneodo)
GDR Cell Tiss (Castelnovo, Moskalenko)
GDR Dynamo (Odier, Plihon)
GDR DYCOEC (Bouchet)
GDR IQFA (Degiovanni)
GDR ISIS (Abry, Argoul, Borgnat, Flandrin, Pustelnik, Roux)
GDR LIAIN (Bellon, Crauste, Steinberger)
GDR M&Em (Vidal)
GDR MEPHY (Bartolo, Bertin, Géminard, Santucci, Steinberger, Taberlet, Vidal)
GDR MesoImage (Carpentier, Orignac)
GDR MFV (Argoul)
GDR MIA (Pustelnik)
GDR MICO (Carpentier, Orignac)
GDR MOA (Pustelnik)
GDR MOUSSE (Manneville, Santucci)
GDR ONDES (Argoul)
GDR PHENIX (Abry, Audit, Bartolo, Bertin, Borgnat, Bouchet, Castaing, Castelnovo, Chevillard, Dauxois, Flandrin, Géminard, Gibaud, Naert, Petrosyan, Pumir, Taberlet, Vidal)
GDR PQM (Carpentier, Degiovanni)
GDR TransNat (Taberlet, Vidal)
GDR Turbulence (Arneodo, Castaing, Chevillard, Flandrin, Leveque, Plihon, Pumir, Venaille, Volk)
GDRE "Comparative Genomics Rhônes-Alpes ARC" (Arneodo)

5. Conférences organisées

Abry Patrice.
Complexity in Physics/Physique de la complexité, Lyon (France), Juin 2009
Multifractal Analysis: From Theory to Applications and Back, Banff (Canada), Février 2014
Alain Arneodo;
Oncology : on the Frontiers of Molecular Genetics, Biophysics and Medecine, Perm (Russie), Juin 2012
Audit Benjamin.
International Conference on Complexity in Physics, Lyon (France), Juin 2009.
Journées Interface Physique-Biologie du GdR Phenix, Lyon (France), Novembre 2009.
Bartolo Denis.
Flowing Soft Matter: Bridging the gap between stat. phys. and fluid mech. Udine (Italie), Juillet 2014
Bellon Ludovic.
Forum des microscopies à sonde locale, Lyon (France), Mars 2011
Out-of-equilibrium physics and its applications, Lyon (France), Juin 2013
Bertin Eric.
Physique statistique des particules actives, Lyon (France), Mai 2012
Borgnat Pierre.
Graphical models for the charact. of information flow in complex networks, Grenoble (France), Juil. 2013
Journées SIERRA : Signal et Images En Région Rhône Alpes, (France), 4 journées par an depuis 2012
Bouchet Freddy.
Computation of transition trajectories and rare events in non-equilibrium systems, Lyon (France), Juin 2012
Carpentier David.
Topological Insulators and Quantum Spin Hall effect, Lyon (France), Decembre 2009
Carpentier David, Bertin Eric, Orignac Edmond, Holdsworth Peter.
Glasses : Recent experimental results and perspectives, Lyon (France), Avril 2011
Chillà Francesca, Bernard Castaing.
High Rayleigh Number Convection, Les Houches (France), Janvier 2010
Ciliberto Sergio, Abry Patrice, Audit Benjamin, Manneville Sébastien, Roux Stéphane
International Conference on Complexity in Physics, Lyon (France), Juin 2009
Dauxois Thierry.
Topographical Internal Waves, Cargèse (France), Novembre 2010
Geophysical and Astrophysical Internal Waves, Les Houches (France), Février 2011
Long-Range Interacting Systems, Lyon (France), Octobre 2011
International School on Nonlinear Dynamics in Complex Systems, Yaoundé (Cameroun), Novembre 2011
Equilibrium and out-of-equilibrium properties of systems with long-range int., Lyon (France), Août 2012
Statistical mechanics of self-gravitating particles, Fondation les Treilles (France), Octobre 2012
Out-of-equilibrium Physics, Lyon (France), Juin 2013
Nonlinear Effects In Internal Waves Conference, Université de Cornell (USA), Juin 2014
Degiovanni Pascal.
Réunion plénière du GDR de Physique Quantique Mésoscopique, Aussois (France), Décembre 2009
Everaers Ralf.
Physics of DNA assembly and applications, Les Houches (France), Mai 2009
Coarse-Grain Mechanics of DNA: Bases to Chromosomes, Lyon (France), Juin 2010
First school in computational physics - soft matter, Les Houches (France), Juin 2011
Coarse-Grain Mechanics of DNA: Part II From Electrons to Oligomers, Lausanne (Switzerland), Sept. 2011
Genome Mechanics at the Nuclear Scale, Lorentz-center, Leiden (Netherlands), December 2012
3rd school in computational physics - DNA, from molecules to evolution, Les Houches (France), Mai 2013
Journée CECAM-FR en l'honneur de Jean-Pierre Hansen, Paris (France), December 2013
Flandrin Patrick.
4ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juillet 2009
5ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juillet 2010
6ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juillet 2011
7ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juin 2012
8ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juin 2013
9ème École d'Été en Traitement du Signal et des Images, Peyresq (France), Juin 2014
Holdsworth Peter.
Geometrically Frustrated Magnets: From Spin Ice to Kagomé Planes, Paris (France), Mai 2005
Jensen Pablo.
Réseaux sociaux : des structures à la politique, Lyon (France), Novembre 2011
Penser les transformations, Lyon (France), Novembre 2012

La politique des données personnelles : big data ou contrôle individuel ?, Lyon (France), Décembre 2013
Le tout et les parties, Sciences Po, Paris (France), Mai 2013
La gouvernance et la révolution numérique, Lyon (France), Avril 2014

Joubaud Sylvain.
Out-of-Equilibrium Physics, Lyon (France), Juin 2013

Leveque Emmanuel.
Superfluid Turbulence from the perspective of numerics, Lyon (France), Décembre 2012

Livine Etera.
Spinfoam & Cosmology, Lyon (France), Novembre 2013

Maillet Jean-Michel.
ICMP 2012 - session "integrable systems and operator algebra, Aalborg (Denmark), Août 2012

Manneville Sébastien.
Ultrasonic Doppler Methods for Fluid Mechanics and Fluid Engineering, Göteborg (Suède), Avril 2010

Moskalenko Cendrine.
Forum des Microscopies à Sondes Locales, Ecully (France), Mars 2011

Orignac Edmond.
Physique Mésoscopique avec des gaz quantiques, Lyon (France), Juin 2012

Pinton Jean-François, Pumir Alain, Chevillard Laurent, Volk Romain.
European Turbulence Conference 14, Lyon (France), Septembre 2013

Plihon Nicolas.
Dynamics and turbulent transport in plasmas and conducting fluids, Les Houches (France), Mars 2011
Dimensionnality of turbulence, Coventry (U.K.), Mai 2014

Roscilde Tommaso.
4th School on Comp. Physics: from Quant. Gases to Strongly Corr. Syst., Les Houches (France), Juin 2014
BEC 2014: Quantum Gases and Quantum Coherence, Levico (Italy), Mai 2014
Lyon BEC 2012: Theory of Quantum Gases and Quantum Coherence, Lyon (France), Juin 2012

Samtleben Henning.
Workshop on Gauge Theories, Supersymmetry, and Mathematical Physics, Lyon (France), Avril 2010
Journées de Physique Mathématique: Loop quantum gravity, Lyon (France), Septembre 2011
Journées de Physique Mathématique: AdS/CFT, Supersym. and Integrability, Lyon (France), Sept. 2012
Journées de Physique Mathématique: Topological Insulators, Lyon (France), Septembre 2013
Recent Developments in Supergravity Theories, Istanbul (Turkey), Juin 2014

Santucci Stéphane.
Materials' Deformation: Fluctuations, Scaling, Predictibility, Les Houches (France), Janvier 2012
Materials' Deformation: Fluctuations, Scaling, Predictibility. 2nd Ed., Les Houches (France), Février 2013
Out-of-Equilibrium Physics, ENS-Lyon, Lyon (France), Juin 2013
Avalanches and Intermittency, Courmayeur (Italy), Janvier 2014
Crack Patterns, ENS-Lyon, Lyon (France), Avril 2014

Taberlet Nicolas.
Workshop on numerical modelling of grain/fluid flows Lyon (France), Novembre 2013

Toninelli Fabio.
Session Spin Glasses, IMS Annual Meeting, Gothenburg (Suède), Août 2010
Session Disordered Systems, World Congress in Probability, Istanbul (Turkey), Juillet 2012

Venaille Antoine, Bouchet Freddy.
Geoturb, CBP/ENS de Lyon (France), Octobre 2013

Vidal Valérie.
Deformation, Flow and Rupture of Soft Matter, Lyon (France), Juillet 2010
Soft Matter Physics and Solid Earth Sciences: Unifying Concepts, Tokyo (Japon), Juin 2012

6. Conférences invitées

Abry Patrice.
Conference in Analysis and its Applications, Bangalore (India), Mai 2009
Traffic Monitoring and Analysis, 4th Workshop (Keynote Speaker) Barcelona (Espagne), Octobre 2009
Asian Internet Engineering Conference 2009 (AINTEC2009), Bangkok (Thailande), Novembre 2009
International Vilnius Conference on Probability and Mathematical Statistics Vilnius (Lituanie), Juin 2010
Int. Conf. Acoust. Speech Signal Processing Tutorial conference Prague (Rèp. tchèque), Avril 2011
XIV Reunión de Trabajo en Procesamiento de la Información y Control, Entre-Rios (Argentina), Oct. 2011
Mathematics: Muse, Maker, and Measure of the Arts Banff (Canada), Décembre 2011
Long-Range Dependence, Self-Similarity and Heavy Tails , North Carolina (USA), Avril 2012
Alastuey Angel.
Path Integrals 2010, Washington (USA), Juillet 2010
Equilibrium and out-of-equilibrium prop. of systems with long-range int., Lyon, Aout 2012
International Conference on Recent Progress in Many-Body-Theories, Rostock (Allemagne), Septembre 2013
Dynamics and Kinetic theory of self-gravitating systems, Paris (France), Novembre 2013
Argoul Françoise.
Ecole thématique interdisciplinaire microscopie fonctionnelle en biologie, Seignosse (France), Septembre 2009
Oncology : on the Frontiers of Molecular Genetics, Biophysics and Medicine, Perm (Russia), Juin 2012
Molecular Nano- and Biophotonics Conference 2012, Giens (France), Juin 2012
Arneodo Alain.
Workshop on "Self-Organization and Dynamics of Active Matter, IHP, Paris (France), Janvier 2009
Ecole Thématique Interdisciplinaire d'Echanges et de Formation en Biologie, Berder (France), Mars 2009
"Vers une Architecture Fonctionnelle du Chromosome Eucaryote", UPMC, Paris (France), Avril 2009
Cycle Carnot de Conférences Pluridisciplinaires, ICB, Dijon (France), Mai 2009
Conférence on "Dynamics in Systems Biology", Aberdeen (Royaume-Uni), Septembre 2009
"Integrative Post-Genomics : A multidisciplinary approach to living systems", Lyon (France), Nov. 2009
Conférence "Ondelettes et Sciences du Vivant", Gembloux (Belgique), Décembre 2009
Colloque "Theoretical Physics of Biological Systems", IHP, Paris (France), Décembre 2009
6th Course on "Epigenetics", Institut Curie, Paris (France), Mars 2010
Conference on "Wavelets and Fractals", Esneux (Belgique), Avril 2010
CECAM Workshop on "Coarse-grain mechanics of DNA bases to chromosome", Lyon (France), Juin 2010
International Conference on "Growth and Form", Agay (France), Juin 2010
Célébration du Prix Gauss et de son lauréat Y. Meyer, Cachan (France), Novembre 2010
Alignement, Phylogénie, Génomique Comparative et Bioinformatique, Lyon (France), Février 2011
American Physical Society Meeting, Dallas (USA), Mars 2011
Colloquium of the Institute of Molecular Biophysics, Montreal (Canada), Juin 2011
Colloque "Biologie & Santé", Lyon (France), Juillet 2011
XXXI Dynamics Days Europe 2011, Oldenburg (Allemagne), Septembre 2011
INSERM Workshop "High-throuput Approaches in Epigenomics", Bordeaux (France), Octobre 2011
Colloquium du Département de Mathématiques de l'Université de Maine, Orono (USA), Novembre 2011
Soft Matter Theory Days, Bordeaux (France), Décembre 2011
Naturel et artificiel : le vivant et ses représentations, Berder (France), Avril 2012
Nucleosome positioning, chromatin structure and evolution, Haifa (Israel), Mai 2012
Theoretical and Computational Chemistry and Biophysics, Jerusalem (Israel), Mai 2012
Oncology : on the Frontiers of Molecular Genetics, Biophysics and Medecine, Perm (Russie), Juin 2012
Conference in honor of P. Clavin 70th birthday : Out-of-equilibrium dynamics, Marseille (France), Juin 2012
ICOST Training School : Players of the Epigenetic Symphony, Poitiers (France), Juillet 2012
Workshop FNRS " Wavelet and Applications", Bruxelles (Belgique), Septembre 2012
Chromatin Days on Epigenetic marks : from code to mechanisms, UPMC, Paris (France), Novembre 2012
Journée du club " Chromatine, Transcription et Epigénétique", Lyon (France), Novembre 2012
Rencontre du Non-Linéaire, Paris (France), Mars 2013
Maths Department Monthly Colloquium, Université du Maine, Orono (USA), Octobre 2013
Colloquium of the Institute for Pure and Applied Mathematics Dept, Aberdeen (Ecosse), Novembre 2013
Multifractal Analysis : From Theory to Applications and Back, Banff (Canada), Fevrier 2014
Colloquium of the Bionanoscience Department, TU Delft, Delft (Holland), Mars 2014
Second International Conference on " Physics and Biological Systems" , Gif/Yvette (France), Juin 2014
Audit Benjamin.
European Conference on Complex Systems - Genomic Complexity, Bruxelles (Belgique), Septembre 2009
An Interdisciplinary Approach to Understand Human Genome Organization, Bangalore (Inde), Fév. 2009
Bartolo Denis.
ICTAM, Beijin (Chine), Aout 2012

ICAM FAPERJ School: The dynamics and assembly of soft structures, Rio de janeiro (Bresil), Avril 2014

Bellon Ludovic.

Journées Surfaces et Interfaces, Poitiers (France), Janvier 2011

Bertin Eric.

Connecting Theory and Experiments on Active Matter, Dresde (Allemagne), Juin 2013
Chance at the Heart of the Cell, Lyon (France), Novembre 2011
Collective Dynamics and Pattern Formation in Active Matter Systems, Dresde (Allemagne), Septembre 2011
Conférence Izykson "Extremes and Records", Saclay (France) Juin 2011

Borgnat Pierre,

The Bicycle Sharing System (BSS) case study, Marne-la-Vallée (France), Décembre 2012
Workshop Dynamics On and Of Complex Networks – V, ECCS 2011, Vienne (Autriche), Septembre 2011
International Workshop TERA-NET, ICALP 2010, Bordeaux (France), Juillet 2010

Bouchet Freddy.

International Seminar on "Many-body systems far from equilibrium", Dresden (Germany), Février 2009
American Geophysical Union meeting, Nonlinear geophysics session, San Francisco (USA), December 2010
Workshop NPDE (Non-Linear Partial Differential Equation), Edinburgh (Scotland), Janvier 2011
Workshop Statistical mechanics and climate, Paris (France), Juin 2011
Minisymposium Dynamical systems techniques for fluids, Loughborough (UK), Août 2001
Modern developments to Onsager's theory on statistical vortices, Kyoto (Japan), Août 2011
GDR DYCOEC: Rencontre "plasma and geophysical flows, Marseille (France), October 2011
European Geophysical Union General Assembly, "Young rising stars", Wien (Austria), Avril 2012.
American Geophysical Union Fall Meeting, San Francisco (USA), December 2012
Non-equilibrium Stat. Mech. and the Theory of Extreme Events in Earth Science, Reading (UK), Jan. 2013
MIRAW day, Warwick university (UK), Février 2013
IUTAM Symp. on Vortex Dynamics: Formation, Structure and Function, Fukuoka (Japan), Mars 2013
Statistical Physics and Low Dimensional Systems, Pont-a-Mousson (France), Mai 2013
Modéliser et simuler la complexité: approches stochastiques et déterministes, Marseille (France), Août 2013
Models from Statistical Mechanics in Applied Sciences, Warwick university (UK), Septembre 2013
Paramétrisation et Turbulence Géophysique, ARP MathsinTerre, Paris (France), Septembre 2013
Entropy in mathematics and in physics, Strasbourg (France), Septembre 2013
Climate and statistical mechanics, Newton Institute, Cambridge (UK), October 2013
Dynamics and Kinetic theory of self-gravitating systems, GRAVASCO, Paris (France), November 2013
Stochastic Modelling of Multiscale Systems, Eindhoven (Netherland), December 2013
Stochastic Partial Differential Equations and Applications - IX, Levico Terme, Trento (Italy), Janvier 2014

Carpentier David.

Electronic noise and relaxation in nanostructures, Grenoble (France), Avril 2010
Isolants topologiques : Introduction et perspectives, ESPCI, Paris (France), Avril 2012
Journées de la Matière Condensée, Montpellier (France), Août 2012
Waves in complex media, Grenoble (France), Décembre 2013

Castaing Bernard.

Breaking Barriers, Bangalore (India), Janvier 2010
High Rayleigh Number Convection, Les Houches (France), Janvier 2010
Universalité et Fractales, Hommage à Benoît Mandelbrot, Palaiseau (France), Mars 2011
New chalenges in Turbulence research, Les Houches (France), Mars 2012
Small scale turbulence, Rouen (France), Juillet 2013

Castelnovo Martin.

Physical Virology, Trieste (Italie), Septembre 2012
Cell Physics Days, Strasbourg (France), Novembre 2011

Chevillard Laurent.

Conference Particles in turbulence, Bangalore (India), Novembre 2013
Symposium on Understanding Common Aspects of Extreme Events in Fluids, Dublin (Irelande), Juillet 2012
New challenges in turbulence research II, Les Houches (France), Mars 2012
New challenges in turbulence research, Les Houches (France), Mars 2010

Chillà Francesca.

ItI20, Bertinoro (Italie), Septembre 2010
Dynamics Days Europe, Oldenburg (Allemagne), Septembre 2011
International Conference on Rayleigh Bénard Convection, Hong Kong (Chine),
Rencontres du non Linŕaire, Paris (France), Mars 2014

Ciliberto Sergio.

Many-Body Systems far from Equilibrium, Dresden (Germany), Février 2009
From nonequilibrium statistical mechanics to mechanical manipulation, Florence (Italy), Février 2009
Frontiers and Directions in Condensed Matter Physics, Bangalore (India), Mai 2009

Understanding and exploiting complexity at the nanoscale, Bruxelles (Belgium), Janvier 2010
Fluctuations in Materials Properties: Phys., Geoscience and Environment, Courmayeur (Italy), Janvier 2010
Fluctuations, information flow, experimental measurements, Paris (France), Janvier 2010
Physics of Amorphous Solids: Mechanical Properties and Plasticity, Les Houches (France), Mars 2010
Liquids Out of Equilibrium, Sidney, Sidney (australia), Juillet 2010
STATPHYS 24, Cairns (Australia), Juillet 2010
Non-equilibrium Statistical Physics of Complex Systems, Seoul (Korea), Juillet 2010
Workshop Optimization in stochastic nano-systems, Bremen (Germany), October 2010
Open questions on glasses and glassforming systems, Paris (France), October 2010
STATPHYS-Kolkata VII, Kolkata (India), November 2010
Fluctuations and Casimir Force, Tenerife (Spain), November 2010
Nonlinear Dynamics and Fluid Instabilities in the 21st Century, Philadelphia (USA), Mai 2011
Nonequilibrium processes: the last 40 years and the future, Obergurgl (Austria), Septembre 2011
NonEqSM2011, Nordita, Stockholm (Sweden), Septembre 2011
Material deformation: scaling, fluctuations, predictability, Les Houches (France), Janvier 2012
Workshop on Fluctuation Theorem, Paris (France), Janvier 2012
3rd RRI school on Statistical Physics, Bangalore (India), Mars 2012
107th statistical mechanics conference, Rutgers (USA), Mai 2012
Workshop on non-equilibrium fluctuation-response, Isola del Giglio (Italy), Juin 2012
Transition trajectories and rare events in non-equilibrium systems applications, Lyon (France), Juin 2012
Green Radio workshop, Paris (France), Juin 2012
Non equilibrium processes and fluctuation-dissipation theorems, Capri (Italy), Septembre 2012
Engineering the Casimir effect: theoretical and experimental perspectives, Canary Islands (Spain), Nov. 2012
GDR Liquides aux Interfaces, Lyon (France), November 2012
Materials Deformation: Fluctuations, Scaling, Predictability, Les Houches (France), Février 2013
Stochastic Thermodynamics, Stockolm (Sweden), Mars 2013
International Conference on Nanoenergy, Perugia (Italy), Juillet 2013
SPIE Conference, " Section on optical trapping", San Diego (USA), Août 2013
Small systems far from equilibrium: Order, correlations, and fluctuations, Dresden (Germany), Oct. 2013
From dynamics to statistical physics and back, Dresden (Germany), October 2013
Solvay Workshop on "Thermodynamics of Small Systems", Bruxelles (Belgium), December 2013
Summer School on Active Matter, Gwangju (Korea), Juin 2014

Crauste Thibierge Caroline.
QENS2014: Neutron for Science, Autrans (France), Mai 2014

Dauxois Thierry.
Many-body systems far from equilibrium, Dresde (Allemagne), Février 2009
Waves and Instabilities in Geophysical and Astrophysical Flows, Porquerolles (France), Mai 2009
12th Marcel Grossman Meeting, UNESCO Paris (France), Juillet 2009
XI Latin American Workshop on Nonlinear Phenomena, Buzios (Brésil), Octobre 2009
Hamiltonian Approaches of ITER Physics, Marseille (France), Novembre 2009
Long-range Interacting Systems in Classical and Quantum Physics, Stellenbosch (Af. du Sud), Nov. 2009
Coordinated Mathematical Modeling of Internal Waves, Banff (Canada), Avril 2010
Wave Turbulence, Fondation les Treilles (France), Juillet 2010
Colloque MathOcéan, Le Bourget du Lac (France), Janvier 2011
International School on Non-linear Dynamics in Complex Systems, Yaoundé (Cameroun), Novembre 2011
Workshop in honor of Jérome Léon, Montpellier (France), Novembre 2011
Tsunami Energy Dissipation Workshop, Sendai (Japon), Septembre 2012
Statistical mechanics of self-gravitating particles, Fondation les Treilles (France), Octobre 2012
Entretien Jacques Cartier: Adventures in Mathematical Physics, Lyon (France), Novembre 2012
Statistical Mechanics and Nonlinear Physics, Lille (France), Novembre 2013

Degiovanni Pascal.
Quantum Thermoelectrics: Dynamics, Fluctuations and Non-linearities, Aachen (Allemagne), Nov. 2013
Charge and heat transport in nano-systems, Orsay (France), Octobre 2011
Conference on frustrated spin systems, cold atoms and nanomaterials, Hanoi (Vietnam), Juillet 2010
Electronic Noise and relaxation in nanostructures, Grenoble (France), Avril 2010

Delduc François.
Supersymmetries & Quantum Symmetries - SQS'2011, Dubna (Russia), Juillet 2011
France-Italy-Russia @Dubna Round Table 5, Dubna (Russia), December 2012
Supersymmetry in Integrable Systems - SIS'13, Hannover (Germany), December 2013

Everaers Ralf.
Mainz Materials Simulation Days, Mainz (Germany), Mai 2009
Coarse-Graining Biological Systems, Lausanne (Switzerland), Septembre 2009

Physics goes DNA: from base-pairs to chromatin, Leiden (Netherlands), Septembre 2009
EMBO Conference Series on Nuclear Structure and Dynamics, Isle de la Sorgue (France), October 2009
Multiple Length and Time Scales in Complex Fluids, Santa Fe (USA), October 2009
APS March Meeting, Portland (USA), Mars 2010
KITP program on Biological Frontiers of Polymer and Soft Matter Physics, Santa Barbara (USA), Mai 2011
KITP workshop on Soft Matter Physics Approaches to Biology, Santa Barbara (USA), Mai 2011
Dynacop Summer School on Understanding polymer dynamics,Capri (Italy), Juillet 2011
CECAM workshop on Polymer Dynamics : Entanglements and Architectures, Capri (Italy), Juillet 2011
Molecular Simulations in Biosystems and Material Science, Konstanz (Germany), October 2011
APS March Meeting, Boston (USA), Mars 2012
DPG March Meeting, Berlin (Germany), Mars 2012
Phys. princ. of multiscale modeling and simulation of soft cond. matter, Santa Barbara (USA), Avril 2012
DPG March Meeting, Dresden (Germany), Mars 2014

Fedorenko Andrei.
Correlations, Fluctuations and Disorder, Grenoble (France), Décembre 2010

Flandrin Patrick.
Int. Conf. on Sparse Representation of Multiscale Data and Images, NTU(Singapore), Décembre 2009
IEEE Int. Conf. on Engineering in Medicine and Biology EMBS-13, Buenos Aires (Argentine), Août 2010
Workshop on Theory and Applications of Wavelets , Philadelphia (USA), Avril 2011
Digital Audio Effects DAFx-11, IRCAM, Paris (France), Septembre 2011
*Traitement et Analyse de l'Information, Modèles et Applications*Hammamet (Tunisie), Octobre 2011
RPIC Conference, Oro Verde (Argentine), Novembre 2011
CIRMMT Distinguished Lecturer, Montréal (Canada), Mai 2012
IPAM Workshop on Adaptive Data Analysis and Sparsity ADA-13, UCLA, Los Angeles (USA), Mai 2012
Workshop on Time-Frequency Analysis and Applications, Budva (Monténégro), Juin 2012
ESI Workshop on Advances in Time-Frequency Analysis, ESI, Vienne (Austria), Décembre 2012
CIMPA Conf. on New Trends in Harmonic Analysis, Mar del Plata (Argentine), Août 2013
Workshop on Theoretical Foundations of Network Analysis, UCL, Londres (UK), Novembre 2013
Colloque "Écrire les sciences aujourd'hui", ENS, Paris (France), Novembre 2013
IEEE Int. Conf. on Industrial Applications of Signal Processing ICIASP-13, Karad (Inde), Novembre 2013
BIRS Workshop on Multifractal Analysis, Banff (Canada), Février 2014
Int. Conf. on Biomedical Systems and Technologies BIOSTEC-14, ESEO, Angers (France), Mars 2014

Géminard Jean-Christophe.
Southern Workshop on Granular Materials, Viña del Mar (Chili), Mai 2009
GISEC33, Bordeaux (France), Novembre 2011
Materials deformation : Fluctuations, scaling, predictability, Les Houches (France), Janvier 2012
Soft Matter Physics and Solid Earth Sciences : Unifying Concepts, Tokyo (Japon), Juin 2012
MarsCOMeeting'12, La Havane (Cuba), Mars 2012
A journey into morphogenesis, Lyon (France), November 2012

Gibaud Thomas.
European Conference on Liquid Crystals 2013, Rhodos (Greece), October 2013

Holdsworth Peter.
Advanced working group on monopoles in spin ice, Royal Holloway (UK), October 2010
Emergence of New States of Matter in Magnetic Systems and Beyond, Trieste (Italy), Juillet 2010
Journee en honour de Jacques Villain, Grenoble (France), November 2010
New trends in the theory of strongly correlated electron systems, Grenoble (France), Avril 2010
Novel Quantum Systems, Kyoto (Japan), November 2011
Geometrically Frustrated Magnets: From Spin Ice to Kagom Planes, Natal (Brazil), December 2011
Emergent Magnetic Monopoles in Frustrated Magnetic Systems, Chicherley (UK), October 2011
Moscow International Symposium on Magnetism, Moscow (Russia), Août 2011
Statistical physics and low dimensional systems, Nancy (France), Août 2011
Engineering Casimir Forces, Tenerife (Spain), November 2012
Localized excitations in flat-band models, Gottingen (Germany), Avril 2012
Low Dimensional Quantum Magnetism, Bad Honnef (Germany), Avril 2012
Phases topologiques et transitions de phases non-conventionnelles, Grenoble (France), October 2013
Ordering and dynamics in Magnetic Nanostructures, Uppsala (Sweden), Septembre 2013
Symposium in honour of Sergio Ciliberto: Out of Equilibrium Physics, Lyon (France), Juin 2013
Highly Frustrated Magnetism 2014, Cambridge (UK), Juillet 2014
Topological Matter out of Equilibrium, Dresden (Germany), Mars 2014
International Workshop on Frustration and Topology, Tainan (Taiwan), Février 2014
Theoretical and Experimental Magnetism Meeting (TEMM), Abingdon (UK), Juillet 2014

Leveque Emmanuel.
Multiscale Fluid Dynamics with the Lattice Boltzmann Method, Leiden (Pays-Bas), Mars 2011
New Challenges in Turbulence Research II, Les Houches (France), Mars 2012
Non-locality in Turbulence, Vienne (Autriche), Décembre 2013
Livine Etera.
Loops '13, Waterloo (Canada), Juillet 2013
Quantum, Fields, Gravity & Information, Nottingham (UK), Avril 2013
Quantum Gravity in Paris, Orsay (France), Mars 2013
International Workshop Relativistic Quantum Information, Madrid (Espagne), Septembre 2011
Magro Marc.
Integrability in Gauge and String Theory 2012, Zurich (Swiss), Août 2012
Maillet Jean-Michel.
UK meeting on Integrable Models, Conformal Field Theory and Related Topics , Oxford (UK), Avril 2009
Infinite dimensional Lie algebras: geometry and topology, Lyon (France), Novembre 2009
*Workshop on Correlation Functions for Integrable Models*Stony Brook (USA), Janvier 2010
Rencontres Claude Itzykson, New Trends In Quantum Integrability, IPhT, Saclay (France), Juin 2010
Conférence RAQIS'10 , LAPTH, Annecy (France), Juin 2010
Correlation Functions of Quantum Integrable Models, IMB, Dijon (France), Septembre 2011
Workshop Strong correlations and disorder in ultra cold quantum gases, Lyon (France), Décembre 2011
*Introductory Workshop, Lattice Models and Combinatorics, programme*MSRI, Berkeley (USA), Janvier 2012
Journées de Physique Théorique, Grenoble (France), Mai 2012
Journées de Physique Mathématique, Lyon (France), Septembre 2012
GATIS kickoff meeting, Hambourg (Allemagne), Février 2013
MSP, Kyoto (Japon), Juillet 2013
Correlation Functions of Quantum Integrable Models, Dijon (France), Septembre 2013
Manneville Sébastien.
34ème Rencontre de Physique Statistique, Paris (France), Janvier 2014
16ème Rencontre du Non-Linéaire, Paris (France), Mars 2013
*Microstructure, setting and aging of cement*Monte Verità (Suisse), Août 2012
15èmes Journées de Formulation de la Société Chimique de France, Bordeaux (France), Mai 2012
Materials deformation: fluctuations, scaling, predictability, Les Houches (France), Janvier 2012
Moskalenko Cendrine.
Form and functions if protein nanoshells, Leiden (Pays-Bas), Février 2014
Players of the epigenetics symphony, Poitiers (France), Juillet 2012
Odier Philippe.
Congrès Français de Mécanique, Bordeaux (France), Août 2013
Small scale turbulence and related gradient statistics, Turin (Italie), Octobre 2009
Oswald Patrick.
10th European Conference on Liquid Crystals, Colmar (France), Avril 2009
International workshop on dynamic cross-effect in softly condensed matter, Tokyo (Japon), Novembre 2009
Tourbillons, Spirales et Labyrinthes, Paris (France), Mai 2010
15ème Colloque Francophone des Cristaux Liquides, Rennes (France), Septembre 2011
16ème colloque sur les Systèmes Anisotropes Auto-organisés, Strasbourg (France), Septembre 2013
Peyrard Michel
From nonequilibrium statistical mechanics to mechanical manipulations, Florence (Italy), Février 2009
Mathematical Challenges in Molecular Dynamics, Bath (UK), Juillet 2009
RIES-Hokudai International Symposium, Sapporo (Japan), Mars 2010
Non Perturbative Techniques in Field Theory, Durham (UK), Juillet 2010
From Field Theory to Quantum Information and Quantum Devices, Perugia (Italy), Janvier 2011
Grand Biological Challenges for Mathematicians, Durham (UK), Juillet 2012
Problems of Theoretical Physics (100th anniversary of Alexander Davydov), Kiev (Ukraine), October 2012
Physical concepts of Nucleic-Acid Structure and Behavior, Yerevan (Armenie), Mai 2013
Pinton Jean-François.
Complexity, Münster (Germany), Fevrier (2009)
Solving the Riddle of Turbulence, Göttingen (Germany), Mai (2009)
From Core to Crust, Trieste (Italy), Juillet (2009)
Particles in Turbulence, Zurich (Switzerland), Août (2009)
Natural dynamos, Kosice (Slovaquie), Septembre (2009)
Turbulence, Beijing (Chine), Septembre (2009)
Euromech Conference, Torino (Italy), Octobre (2009)
Unsual Turbulence, Les Houches (France), Fevrier (2010)
Turbulence & Clouds, Porquerolles (France), Septembre (2010)

Turbulence, Eilet (Israel), Novembre (2010)
APS april meeting, Los Angeles (USA), Mai (2011)
Dynamo, NCAR, Boulder (USA), Septembre (2011)
MHD days, Dresden (Germany), Mars (2013)

Pumir Alain .
Workshop "Turbulence: what, why and how ?", Göttingen (Allemagne), Mai 2009
"Turbulence" , Beijing (China), Septembre 2009
Workshop "Lagrangian aspects in turbulence" , CIRM, Marseille (France), Octobre 2009
COST Meeting " , Nice (France), Novembre 2009
COST Meeting " , Rome (Italie), Décembre 2009
Workshop "Turbulence in fluids and plasmas" , Dresden (Allemagne), Mai 2010
Workshop, "Synthetic models of turbulence" , Ecully (Lyon), Juin 2010
Workshop "COST meeting" , Umweltforschungstation, Scheefernerhaus, Zugspitze (Allemagne), Juin 2010
Dynamics Days South America, Sao Joao dos Campos (Brésil), Juillet 2010
"Turbulence" workshop, Eilat (Israel), Novembre 2010
COST meeting "Particles in Turbulence", Potsdam (Allemagne), Mars 2011
IMA workshop "society relevant computing", Minneapolis (USA), Avril 2011
Cardiac Rhythm Conference, San Francisco (USA), Mai 2011
Conference Mathematical Biology , Bangalore (Inde), Juillet 2011
13th European Turbulence Conference, Varsovie (Pologne), Septembre 2011
European Aerosol conference, Manchester (UK), Septembre 2011
Workshop in honour of Uriel Frisch, Stockholm (Suède), Octobre 2011
Conference on turbulence, Pekin (Chine), Avril 2012
Atelier en l'honeur de Paul Clavin , Marseille (France), Juin 2012
Dynamics Days Europe, Gottenborg (Sweden), Septembre 2012
Atelier franco-indien, Nice, (France), Decembre 2012
Rencontres du Non Linéaire, Paris (France), Mars 2013
SIAM Symposium on Dynamical Systems, Salt-Lake City, (USA), Mai 2013
Dynamics Days Europe , Madrid (Espagne), Juin 2013
COST meeting on Particles in Turbulence, Eindhoven (Hollande), Juillet 2013
Workshop in honour of Rudolf Friedrich, Dresden (Allemagne), Septembre 2013
Workshop on turbulence and glassy systems, Eilat (Israel), November 2013
Strukturbildung in Chemie und Biophysik, Hahnenklee (Germany), Février 2014

Nelly Pustelnik.
Mathematics and Image Analysis (MIA'12), Paris (France), Janvier 2012

Roscilde Tommaso.
Quantum Disordered Systems: What's Next?, Toulouse (France), Juin 2014
Statistical Physics and Low-Dimensional Systems, Pont-à-Mousson (France), Mai 2014
Workshop: DISQUANT, Institut Henri Poincaré, Paris (France), Juillet 2012
Workshop: Mott Physics Beyond Heisenberg, Lausanne (Switzerland), Juin 2012
Swiss Physical Society Meeting, ETH Zürich (Switzerland), Juin 2012
Nice BEC 2010 - Theory of Quantum Gases and Quantum Coherence, Nice (France), Juin 2010
LasPhys09 Conference - Workshop on Cold Atoms, Barcelone (Espagne), Juillet 2009
Emergent Quantum Phenomena from the Nano to the Macro World, Cargèse (France), Juillet 2009
Joint European Japanese Conference : Frustration in Condensed Matter, Lyon (France), Mai 2009

Salort Julien.
Exploratory workshop on reconnection events in classical and quantum fluids, Glasgow (UK), Juin 2014

Samtleben Henning.
New Perspectives in String Theory, Florence (Italy), Mai 2009
4th international Sakharov conference, Moscow (Russia), Mai 2009
XVI International Congress on Mathematical Physics, ICMP 2009, Prague (Czech Republic), Août 2009
XXXIXème Institut d'été: AdS, CFT and related problems, Paris (France), Août 2009
Solvay Workshop: Symmetries and Dualities in Gravitational Theories, Brussels (Belgium), Mai 2010
Higher Structures in Mathematics and Physics, Vienna (Austria), Septembre 2010
Strings, Branes and Supergravity, Istanbul (Turkey), Août 2011
XLIème Institut d'été: Strings, Particles and the Universe, Paris (France), Août 2011
XVIIth European Workshop on String Theory 2011, Padova (Italy), Septembre 2011
Workshop on Fields and Strings: Theory – Cosmology – Phenomenology, Corfu (Greece), Septembre 2011
International Ginzburg Conference, Moscow (Russia), Juin 2012
International Symposium Ahrenshoop on the Theory of Elementary Particles, Berlin (Germany), Août 2012
Symmetries Unification and the search for Quantum Gravity, Golm (Germany), Septembre 2012
Gauged supergravities and the physics of extra dimensions, Groningen (Netherlands), October 2012

Supersymmetry, Geometry, and Holography, IHP Paris (France), Juin 2013
18th Claude Itzykson conference: Frontiers of String Theory, Saclay, Paris (France), Juillet 2013
Supersymmetry in Physics and Mathematics, IPMU Tokyo (Japan), Mars 2014

Santucci Stéphane.
Symposium : Caractérisation de surface de l'échelle du nano au macro, Lyon (France), Avril 2013
Soft Matter Physics & Solid Earth Science : Unifying Concepts, ERI, Tokyo (Japan), Juin 2012
Soft Matter & Complex Flows, Lofoten (Norway), Mai 2012
Complex Matter Physics, Mars COMeeting, Havana (Cuba), Mars 2012
Journée Mousses BlueStar Silicones, St Fons (France), November 2012
Fluctuations in Materials Properties 2nd Ed., Courmayeur, (Italy), Janvier 2011
Deformation, Flow & Rupture of Soft Matter, Franco-Japanese Meeting, Lyon (France), Juillet 2010
APS March Meeting, Portland (USA), Mars 2010
Workshop Fluctuations in Materials Properties, Courmayeur (Italy), Janvier 2010
12th International Conference on Fracture, Ottawa (Canada), Juillet 2009
Workshop 'Avalanche Dynamics", Barcelona (Spain), Mars 2009

Taberlet Nicolas.
International Workshop on Bifurcation and Degradation in Geomaterials, Porquerolles (France), Mai 2011

Terras Véronique.
XVI International Congress on Mathematical Physics, Prague (République Tchèque), Août 2009
Satellite Conf. of the Intern. Congress of Mathematicians on Quant. Systems, Chennai (Inde), Août 2010
Workshop on Functional Analysis, New Delhi (Inde), Décembre 2010
Correlation Functions of Quantum integrable Models, Dijon (France), Septembre 2011
Correlation Functions of Quantum integrable Models, Dijon (France), Septembre 2013

Toninelli Fabio
Random Networks & Environments, Istanbul (Turkey) Juillet 2012
Conference in honor of Giovanni Gallavotti's 70th birthday, Rome (Italy), Juillet 2012
Computation and phase transitions, Georgia Tech (USA), Juin 2012
Random Polymers, Singapour, Mai 2012
Dissipative evolutions and convergence to equilibrium, Toulouse (France), Septembre 2011
Phase boundaries and random polymers, Bath (UK), Septembre 2011
ESI Summer school in Mathematical Physics, Vienna (Austria), Août 2011
Rencontres de Probabilités 2011, Rouen (France), Mai 2011
Seminaire Hypatie, Marseille (France), Decembre 2010
Large scale stochastic dynamics, Oberwolfach (Germany), November 2010
Statistical Mechanics meeting, celebrating Joel Lebowitz's 80th birthday, Paris (France), Mai 2010
Workshop on Probabilistic Techniques in Statistical Mechanics, Berlin (Germany), October 2010
IMS Annual Meeting, Gothenburg (Sweden), Août 2010
Phase transitions, Oberwolfach (Germany), Juin 2010
International Congress on Mathematical Physics, Prague (Czech Republic), Août 2009
Disordered Systems and Spin Glasses, Montreal (Canada), Juin 2009
Random Walks in Random Environments, Vancouver (Canada), Juin 2009

Vaillant Cédric.
International Conference on Complexity in Physics, Lyon (France), Juin 2009
Coarse-Grain Mechanics of DNA : Bases to Chromosomes, Lyon (France), Juin 2010
Les interaction acides nucléiques-protéines, Figeac (France), Septembre 2011

Venaille Antoine.
Fundamental Problems of turbulence, Marseille (France), Septembre 2011
European Geophysical Union 2012, Vienne (Autriche), Avril 2012
Geostrophic turbulence and active tracer transport in two dimensions, PCTS, Princeton (US), Mars 2013
EUROMECH Colloquium 561: Dimensionality of Turbulence, Coventry (UK), Mai 2014
Fundamentals of climate, atmosphere and ocean dynamics, Hamburg (UK), Mai 2014

Vidal Valérie.
Volcano Acoustics: From Installation to Analysis, Sakurajima (Japon), Juillet 2013
iDysCo Annual Meeting, Villard de Lans (France), Janvier 2012

Volk Romain.
Ecole d'été ANISO, Cargèse (France), Juillet 2012
Ecole d'hiver "New Challenges in Turbulence Research", Les Houches (France), Février 2010
Congrès Francais de Mécanique (CFM11), Besancon (France), Août 2011
Euromech Colloquium 512, Turin (Italy), October 2009

Africa

ITP, University of Stellenbosh (Afrique du Sud). (E. Bertin)

Asia

National Institute of Informatics, Tokyo (Japon). (P. Abry, P. Borgnat)
University of Tokyo, Tokyo (Japon). (P. Abry, P. Borgnat, V. Vidal)
East China Normal University (Shanghai) (Chine). (F. Argoul, N. Garnie, A. Pumir, J.-C. Géminard)
Tata Institute of Fundamental Research (Inde). (E. Bertin)
Kyoto University, Kyoto (Japan). (F. Bouchet)
Weizmann Institute, Rehovot (Israel). (F. Bouchet, A. Pumir)
Zhejiang Technical University, Hangzhou (China). (N. Garnier)
Nagoya University, Nagoya (Japon). (E. Orignac)
Department of Mathematical Sciences, Ibaraki University, Mito (Japan). (M. Peyrard)
Institute of Mathematical Sciences, Chennai (Inde). (A. Pumir)
National University of Singapore (Singapore). (T. Roscilde)
Korea Institute for Advanced Study, Seoul (South Korea). (H. Samtleben)
IFREE, Japan Agency for Marine-Earth Science and Technology, Yokosuka (Japon). (V. Vidal)
Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science (India). (S. Roux)

Australia

CUBIN, Dept. of E&E Engineering, University of Melbourne, Victoria (Australia). (P. Borgnat)
Smart Transport Research Centre, Queensland University of Technology, Brisbane (Australia). (P. Borgnat)

Europe

Institute of Atmospheric Physics AS CR, Prague (Czech Republic). (P. Abry, S. Roux)
Forschungszentrum Telekommunikation, Vienna (Austria). (P. Abry, P. Borgnat)
SIP Laboratory, KTH, Stockholm (Sweden). (P. Abry)
Institute for Theoretical Physics, University of Warsaw (Pologne). (A. Alastuey)
Inst. of Cont. Media Mech., Perm (Russie). (F. Argoul, Arneodo, B. Audit, J.F. Pinton, N. Plihon, Roux)
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DAMTP, University of Cambridge (UK). (D. Bartolo)
CRN, ISC, Consiglio Nazionale delle Ricerche, Istituto dei Sistemi Complessi (Italie). (L. Bellon)
ISI, Torino (Italy). (J-F. Pinton, P. Borgnat, P. Jensen, S. Santucci)
University of Rome Tor Vergata, Roma (Italy). (J.-F. Pinton)
Ruhr University, Bochum (Germany). (J.-F. Pinton)
ICSMB, University of Aberdeen (UK). (E. Bertin)
DMP, Eötvös University (Hongrie). (E. Bertin)
DPT, Université de Genève (Suisse). (E. Bertin)
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Queen Mary University, London (UK). (F. Bouchet)
Warwick University, Coventry (UK). (F. Bouchet)
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Department of Physics and Astronomy, University of Aarhus, Aarhus (Denmark). (S. Ciliberto, R. Everaers)
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Dipartimento di Fisica e Astronomia and CSDC, Université de Florence (Italie). (T. Dauxois)
Istituto Superiore di Sanità, Université de Rome (Italie). (T. Dauxois)
Dipartimento di Fisica “Galileo Galilei, Université de Padoue (Italie). (T. Dauxois)
Dipartimento di Fisica, Université de Trieste (Italie). (T. Dauxois)
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School of Applied Sciences, Université de Nova Gorica (Slovenie). (T. Dauxois)

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MPI for Polymer Research, Mainz (Germany). (R. Everaers)
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Lund University, Lund (Sweden). (P. Flandrin, T. Gibaud)
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LCN, University College London (UK). (P. Holdsworth)
Department of Chemistry, University College London (UK). (P. Holdsworth)
Theoretical Physics, University of Oxford, (UK). (P. Holdsworth)
Department of Physics, University of Uppsala, Uppsala (Sweden). (P. Holdsworth)
ISIS, Didcot (UK), (P. Holdsworth)
Physics of Fluids, University of Twente (Pays-Bas). (S. Joubaud)
University of Newcastle (UK). (E. Leveque)
School of Physics, Astronomy and Mathematics, University of Hertfordshire (UK). (M. Magro)
DAMTP, University of Cambridge (Royaume-Uni). (S. Manneville)
IFF, Institut Weiche Materie, Forschungszentrum Jülich (Allemagne). (S. Manneville)
Section de Physique, Université de Genève, Suisse. (E. Orignac)
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Dip. Fisica Teorica, Université de Trieste (Italie). (E. Orignac)
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Institute of Physics, Czech Academy of Sciences (Czeck Republic). (P. Oswald)
Faculty of Physics, University of Bucharest (Romania). (P. Oswald)
Institute of Physical Chemistry, Polish Academy of Sciences (Poland). (P. Oswald)
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Theoretical and Physical Chemistry Institute, Athens (Greece). (M. Peyrard)
MPI for Dyn. and Self-Organ., Göttingen (Allemagne). (J.F. Pinton, A. Pumir, A. Steinberger, R. Volk)
Open University, Milton Keynes (Grande Bretagne). (A. Pumir)
Departement de Physique, Univerité de Turin (Italie). (A. Pumir)
MPI für Chemische Physik fester Stoffe, Dresde (Allemagne). (T. Roscilde)
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Ludwig-Maximilians-Universität, München (Allemagne). (T. Roscilde)
Universidad de Zaragoza (Espagne) (T. Roscilde)
Kammerlingh-Onnes Laboratory, University of Leiden (Pays Bas). (T. Roscilde)
Ecole Polytechnique Fédórale de Lausanne (Suisse). (T. Roscilde)
Università di Bologna (Italie). (T. Roscilde)
MPI für Quantenoptik, Garching (Allemagne). (T. Roscilde)
ICFO, Castelldefels (Espagne). (T. Roscilde)
Universitat Autonoma Barcelona (Espagne). (T. Roscilde)
CERN, Geneva (Switzerland). (H. Samtleben)
INFN - LNF, Frascati (Italy). (H. Samtleben)
INFN, Roma Tor Vergata, Roma (Italy). (H. Samtleben)
Dipartimento di Fisica Galileo Galilei, University of Padova (Italy). (H. Samtleben)
Politecnico di Torino (Italy). (H. Samtleben)
Centre for Theoretical Physics, University of Groningen (Netherlands). (H. Samtleben)
IKERBASQUE, Basque Foundation for Science, Bilbao (Spain). (H. Samtleben)
Arnold Sommerfeld Center for Theoretical Physics, Munich (Germany). (H. Samtleben)
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Department of Physics, Middle East Technical University, Ankara (Turkey). (H. Samtleben)
COMP, Aalto University, (Finland). (S. Santucci)
Fysisk Institutt, Oslo University, (Norway). (S. Santucci)

Swiss Light Source, Paul Scherrer Institut, Villigen, (Switzerland). (S. Santucci)
IENI-CNR, Milano, (Italy). (S. Santucci)
Experimental Physics, Saarland University (Allemagne). (A. Steinberger)
DAMTP, University of Cambridge (UK). (N. Taberlet)
Steklov Mathematical Institute, Moscou (Russie). (J.-M. Maillet, V. Terras)
DESY, Hamburg (Allemagne). (V. Terras)
Dipartimento di Matematica, Università Roma Tre (F. Toninelli)
Dpt. Scienze della Terra, Università degli Studi di Firenze (Italie). (V. Vidal)
CGE, Universidade de Évora (Portugal). (V. Vidal)
Mining Faculty, Istanbul Technical University (ITU) (Turquie). (V. Vidal)
Burgers Centre for Fluid Dynamics, University of Twente (Netherlands). (R. Volk)
CNR IAC (Italy). (R. Volk)
Burgers Centre for Fluid Dynamics, Eindhoven University of Technology (Netherlands). (R. Volk)
Tilburg University, Tilburg (Netherlands). (S. Roux)
Delft University of Technology, Delft (Netherlands). (S. Roux)

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Institute of Molecular Biophysics, The Jackson Laboratory, Bar Harbor, Maine, (USA). (A. Arneodo)
Faculté de Pharmacie, Université de Montréal, Montréal (Canada). (A. Arneodo)
St. Anthony Fall Laboratory, Université du Minnesota, Minneapolis (USA). (A. Arneodo)
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Department of Mech. and Aerospace Engineering, University of California San Diego. (USA). (D. Bartolo)
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U. Wisconsin, Madison (USA). (J.-F. Pinton)
Argonne National Laboratory (USA). (E. Bertin)
University of California, Berkeley (USA). (P. Borgnat)
CNLS, Los Alamos National Laboratory (USA). (F. Bouchet)
Physics Department, University of Wisconsin, Madison (USA). (P. Borgnat)
DP, Carnegie Mellon University, Pittsburgh (USA). (M. Castelnovo)
Johns Hopkins University, Baltimore (USA). (L. Chevillard)
Department of Mechanical Engineering, Massachusetts Institute of Technology (USA). (T. Dauxois)
Department of Physics, Université d'Austin (USA). (T. Dauxois)
Woods Hole Oceanographic Institution (USA). (T. Dauxois)
SANDIA National Laboratory, Albuquerque (USA). (R. Everaers)
University of Rochester (USA). (R. Everaers)
Department of Statistics, University of California, Berkeley (USA). (P. Flandrin)
Department of Mathematics, Duke University, Durham (USA). (P. Flandrin)
Department of Physics, Brandeis University (USA). (T. Gibaud)
SEAS, Harvard University (USA). (T. Gibaud)
Department of Phyisics, University of Waterloo (Canada). (P. Holdsworth)
Perimiter Institute, University of Waterloo (Canada). (P. Holdsworth, E. Livine)
Departement de Physique, Université de Sherbrook (Canada). (P. Holdsworth)
Johns Hopkins University (USA). (E. Leveque)
Department of Mechanical Engineering, Massachusetts Institute of Technology (USA). (S. Manneville)
Department of Physics, University of Toronto (Canada). (S. Manneville)
Department of Physics and Astronomy, University of Rochester (USA). (S. Manneville)
Center for Self-Assembled Chemical Structures, McGill University (Canada). (P. Oswald)
CPLA, University of Wisconsin (USA). (N. Plihon, J.-F. Pinton)
Kavli Institute for Theoretical Physics, Santa Barbara (USA). (A. Pumir)
Department of Physics, University of Pittsburgh (USA). (A. Pumir)
Cornell University, Ithaca (USA). (A. Pumir)
University of Florida, Gainesville (USA). (T. Roscilde)
NHMFL, Los Alamos National Laboratory (USA). (T. Roscilde)
University of Southern California (USA). (T. Roscilde)
Rice University (USA). (T. Roscilde)
Miller Institute for Basic Research in Science, Berkeley (USA). (H. Samtleben)

Stanford Institute for Theoretical Physics, Stanford (USA). (H. Samtleben)
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Institute for Fundamental Physics, Texas A&M University, College Station (USA). (H. Samtleben)
Center for Fundamental Theory, Inst. for Grav. and the Cosmos, Penn. State Univ. (USA). (H. Samtleben)
Department of Mathematics and Statistics, Concordia University, Quebec (Canada). (H. Samtleben)
Institute for Theoretical Physics, Stony Brook (USA). (J.-M. Maillet, H. Samtleben)
Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge (USA). (H. Samtleben)
Department of Physics, Queen's University, Kingston (Canada). (S. Santucci)
IUPUI, Department of Mathematical Sciences, Indianapolis (USA). (V. Terras)
Theory Group, Microsoft Research, Seattle (USA). (F. Toninelli)
GFDL, NOAA, Princeton University (USA). (A. Venaille)
Museum of Modern Art (USA). (S. Roux)
Cornell University (USA). (S. Roux)
University of Wisconsin (USA).(S. Roux)
Worcester Polytechnic Institute (USA). (S. Roux)
Worcester Art Museum (USA). (S. Roux)
University of Santa Clara (USA). (S. Roux)
Indiana University (USA). (S. Roux)
Wilhelm Imaging Research (USA). (S. Roux)
University of Maine (USA). (S. Roux)
University of Minnesota (USA). (S. Roux)

South America

NLPLAB, Universidad de Santiago de Chile (Chili). (J.-C. Géminard)
GMP, Universidad de Buenos Aires (Argentine). (J.-C. Géminard)
IFLYSIB, Universidad Nacional de la Plata (Argentine). (J.-C. Géminard)
Dpto. Bio-Ingenieria, Univ. Oro Verde (Argentine) (P. Flandrin)
Dpto Geofísica, Universidad de Chile (Chile). (J.-C. Géminard)
Universidad de Quilmes, Buenos Aires (Argentine) (P. Jensen)
Universidad Nacional Autónoma de Mexico (P. Jensen)
Universidade de Sao Paulo (Brésil). (T. Roscilde)
Departamento de Ciencias, Universidad Adolfo Ibanez, Vina del Mar (Chile). (H. Samtleben)
Lab. Física No Lineal, Universidad de Santiago de Chile (Chili). (V. Vidal)
Dpt. Geofísica, Universidad de Chile, Santiago (Chili). (V. Vidal)
Instituto de Geofísica, Universidad Autónoma de México (Mexique). (V. Vidal)

8. *Accords internationaux bilatéraux*

ANR International (Chili). (J.-C. Géminard)
Coopera - CMIRA 2009 (Chine) (F. Argoul)
COST-TMA : Traffic Monitoring and Analysis (Action IC0703) 2007-2012. (P. Borgnat)
COST Programme "Particles in Turbulence" (2010-2013). (A. Pumir)
COST, Action MP1210, The String Theory Universe. (H. Samtleben)
CNRS/ASCR (Rèp. tchèque). (P. Abry, S. Roux)
CNRS/CONACYT (Mexique). (F. Argoul)
CNRS/CONICET (Argentina). (P. Abry, P. Flandrin)
CNRS/CONICET (Argentina). (J.-C. Géminard)
CNRS/CONICYT (Chili). (J.-C. Géminard, V. Vidal)
CNRS/GDRI avec Académie des Sciences de Russie en Physique Mathématique. (J.-M. Maillet, V. Terras)
CNRS/GNSF (Georgie) (T. Dauxois)
CNRS/JSPS (Japon). (P. Abry, P. Borgnat)
CNRS/JSPS (Japon) (V. Vidal)
CNRS/LIA (Argentine) (N. Taberlet, J.-C. Géminard)
CNRS/PICS (MIT, USA). (T. Dauxois)
CNRS/PICS (Perm, Russie). (J.-F. Pinton, N. Plihon)
CNRS/PICS (Kiev, Ukraine) (M. Peyrard)
CNRS/RAS Coopération Franco-Russe (F. Argoul)
ECOS-Sud (Chili) (J.-C. Géminard)
EUHIT: collaboration entre centres de recherche européens sur la turbulence). (A. Pumir)
Indo-French Center for Applied Mathematics. (A. Pumir)
MIT France Seed Fund, (USA) (T. Dauxois, P. Odier)
PHC XU GUANGQI, Coopération Franco-Chinoise. (L. Bellon)
CFCAM-RA, CECAM node (R. Everaers)

9. *Séjours prolongés de chercheurs étrangers au laboratoire*

Adam Claudia (CGE, Université d'Évora, Portugal) Février 2012 pour 1 mois. Tectonique des plaques.
Alava Mikko (Aalto University, Finland) Avril 2014. Avalanche Dynamics and Crack Patterns.
Aliseda Alberto (Washington State University, USA) Janvier-Février 2014. Particle Laden Flows.
Anabalon Andres (Université Adolfo Ibanez, Chili) Automne 2013. Solutions exactes avec champs scalaires.
Blavatska Viktoria (ICMP, Lvov Ukraine) 1 mois en 2014. Systèmes de spins avec désordre corrélé.
Boninsegni Massimo (University of Alberta, Edmonton), Avril 2009 pour 3 mois. Bosons dipolaires.
Didier Gustavo (Tulane university, New Orleans, USA) 6 mois en 2011 et 2014. Processus stochastiques.
Ermanyuk Evgeny (Novosibirsk, Russie) 2 mois en 2012, 1 en 2013 et 3 en 2014. Ondes Internes.
Gingras Michel, University of Waterloo, 2 mois en 2012, correlated electrons.
Hamm Eugenio (USACH, Chili) Juillet 2009 pour 1 mois. Dynamiques de chaînes.
Ichihara Mie (ERI, Université de Tokyo) Décembre 2011 pour 1 mois. Acoustique de l'éclatement de bulles.
Ivanov Evgeny (BLTP JINR, Russie) Octobre 2011 pour 1 mois. Mécanique quantique supersymétrique.
Jordi Ortin (University of Barcelona, Spain), Decembre 2011. Fluid Imbibition in Disordered Media.
Måløy Knut Jørgen (University of Oslo, Norway), Mai 2013. Interfacial Failure - Flow in Porous media.
Mathiesen Joachim (NBI, Copenhagen, Danemark), Septembre 2011. Crack Patterns in granular media.
Meneveau Charles (Johns Hopkins University, Baltimore, USA) Mars 2013 pour 2 mois. Turbulence.
Milla Frédéric (Université de Lausanne, Suisse) Novembre 2012 pour 1 mois. Systèmes magnétiques frustrés.
Nicolai Hermann (AEI Potsdam, Allemagne) Novembre 2013. Prix Gay Lussac 2012. Supergavité.
Peacock Thomas (MIT, USA) 2 mois en 2013. Ondes Internes
Pirkl Slavomir (Université de Pardubice, République Tchèque) 1 mois et demi en 2014. Cristaux liquides.
Popa Nita Vlad (Université de Bucarest) Avril 2012 pour 3 mois. Cristaux Liquides.
Rast Mark (University of Colorado, USA) Juin 2012 pour 1 mois. Transport en turbulence.
Ruffo Stefano (Université de Florence, Italie) 2 ans en 2011 et 2012. Physique statistique.
Samoletov Alex (Natl. Acad. Sci. Ukraine, Donetsk, Ukraine), 2013 pour 2 mois. Mouvement Brownien.
Sitabhra Sinha (Institute for Mathematical Sciences, Chennai), 2012 pour 1 mois. Systèmes dynamiques.
Sobral Yuri (Universidad Brasilia, Brésil) 2 mois en 2013. Simulations numériques de lits fluidisés.
Vaz da Costa Bismarck (Belo Horizonte) un mois et demi en 2013. Simulation de bosons corrélés sur réseau.
Wehr Jan (Université d'Arizona, Tucson, EU) Février 2014 pour 1 mois. Dynamique stochastiques.
Wilkinson Michael (Open University, UK), October 2010 pour 1 mois. Turbulence.
Wimmer Robert (Yang Inst.for Theo. Physics, Stony Brook, USA) 3 mois en 2012. Théories superconformes.
Zaboronski Oleg (Warwick university, UK), 2012 during 3 months. Bistability in turbulent flows.
Żywociński Andrzej (Académie des Sciences, Pologne) Septembre 2010 pour 3 mois. Cristaux Liquides

10. *Séjours prolongés de chercheurs du laboratoire dans un laboratoire étranger*

Bertin Eric (MPIPKS, Dresden, Germany) 4 mois entre 2011 et 2013.
Bouchet Freddy (Center for Non-Linear Studies, Los Alamos, USA) 12 mois en 2009-2010.
Bouchet Freddy (Mathematics department, Warwick university, UK) 8 semaines en 2013.
Everaers Ralf (KITP, Santa Barbara, CA, USA) 1 mois en 2011 et 5 semaines en 2012.
Fabio Toninelli (Università Roma Tre), 12 mois en 2010.
Fedorenko Andrei (University of Cologne, Allemagne) 3 mois en 2009 et 2 mois en 2010.
Gibaud Thomas (Brandeis University, USA) 2 mois en 2013.
Holdsworth Peter (MPIPKS, Dresden, Germany) 3 months in 2010.
Livine Etera (Perimeter Institute, Canada) 3 mois en 2011, 3 mois en 2012, 1 mois en 2013.
Magro Marc (Albert-Einstein-Institute, Germany) 12 mois en 2009, 8 mois en 2010.
Niccoli Giuliano (Institut International de Physique, Natal, Brésil) Mars-Mai 2014.
Odier Philippe (Los Alamos National Laboratory, USA) 1 mois et demi en 2009 et en 2013.
Pumir Alain (Institute for Mathematical Sciences, Chennai, Inde) Février 2010.
Pumir Alain (KITP, Santa Barbara, USA) Mai 2011 et Avril 2014.
Pumir Alain (National Center for Atmospheric Research, Boulder, USA) Mai 2012 et 2013.
Pumir Alain (MPI for Dynamics and Self-Organisation, Göttingen, Allemagne) 5 mois 2014.
Santucci Stéphane (Oslo University, Norway) Août, 2012.
Santucci Stéphane (Aalto University, Finland) Juillet 2012.
Santucci Stéphane (Earthquake Research Institute, Tokyo, Japan) Juin 2012.
Santucci Stéphane (CAS, Norwegian Academy of Science and Letters, Oslo, Norway) Avril-Mai 2012.
Santucci Stéphane (Aalto University, Finland) Septembre 2010.
Santucci Stéphane (University of Barcelona, Spain) Mars 2009.

11. *Post-doctorants venus de l'étranger*

Apolloni Andrea (Virginia Tech, USA).
Arakelyan Artak (Université de Erevan, Arménie).
Becker Nils (MPIPKS, Dresden, Allemagne).
Borja-Fernandez Enrique (University of Erlangen-Nurnberg, Allemagne).
Calzavarini Enrico (Université de Twente, Hollande).
Chudacek Vaclav (Czech Technical University in Prague, République Tchèque).
Digiuni Simona (Université de Cologne, Allemagne).
Ferraro Dario (Université de Gènes, Italie).
Homan Tess (University of Twente, Enschede, Pays Bas)
Laurie Jason (Université de Warwick, UK).
Leocmach Mathieu (Université de Tokyo, Japon).
Lopez-Caballero Miguel (Université de Navare, Espagne).
Martinez Ignacio (Université de Barcelone, Espagne).
Mathur Manikandan (MIT, Cambridge USA).
Modlinska Ania (Université de Poznan, Pologne).
Moghtaderi Azadeh (Queens University, Kingston, Canada).
Munroe James (Université d'Alberta, Edmonton, Canada).
Nardini Cesare (Florence university, Italie).
Pereira Rodrigo (Universidade Federal do Rio de Janeiro, Brésil).
Pérez Aparicio Roberto (l'Université du Pays Basque, Espagne).
Planet Ramon (UiB, Barcelona, Espagne).
Spilka Jiri (Czech Technical University in Prague, République Tchèque).
Tapia Franco (USACH, Santiago de Chile, Chili).
Tambornino Johannes (Albert-Einstein-Institut, Potsdam, Allemagne).
Vijayakumar Chikkadi (Weizmann Institute, Rehovot, Israel)
Weijs Joost (University of Twente, Enschede, Pays Bas).
Wimmer Robert (C.N. Yang Institute for Theoretical Physics, Stony Brook, USA).

12. *Doctorants venus de l'étranger*

a. *Thèses à plein temps au laboratoire*

Gomez-Solano Juan Ruben (Université de Mexico, Mexique).
Horne Ernesto (Université de Buenos Aires, Argentine).
Streppa Laura (Università di Urbino, Italie).
Varas Germán (Université du Chile, Chili).
Wendland David (Université de Karlsruhe, Allemagne).
Horne Ernesto (Université de Buenos Aires, Argentine).

b. *Thèses en cotutelle avec un laboratoire étranger*

Aguilar Felipe (USACH, Santiago, Chili).
Clotet Xavier (UiB, Barcelona, Espagne).
Harman-Clarke Adam (UCL Chemistry, London, Angleterre).
Faulkner Michael (UCL Physics, London, Angleterre).
Hu Shiqiong (ECNU, Shanghai, Chine).
Li Tianjun (ECNU, Shanghai, Chine).
Michau Gabriel (Queensland University of Technology, Brisbane, Australie).
Morini Matteo (Turin, Italie).
Nardini Cesare (Université de Florence, Italie).
Sánchez Claudia (USACH, Santiago, Chili).
Vojtech Kaiser, (MIMPKS, Max Planck, Dresden, Allemagne)
Xu Jinshan (ECNU, Shanghai, Chine).

c. *Doctorants ayant séjourné plusieurs mois au laboratoire*

De Oliveira Bruna (University of Southern California, USA).
Eckholt-Perotti Maria (Technische Universität München, Allemagne).
Hauke Philipp (ICFO, Castelldefels, Espagne).
Humeniuk Stephan (ICFO, Castelldefels, Espagne).

Knox David (Université du Colorado, USA).
Zhakary Mark (Brandeis University, USA).

13. Habilitation à Diriger des Recherches

NOM	**Titre**	**Date**
B. Audit	Multi-scale analysis of the mammalian replication program	2013
L. Bellon	Exploring nano-mechanics through thermal fluctuations	2010
E. Bertin	Caractérisation statistique des états hors d'equilibre	2011
P. Borgnat	Signaux, réseaux et graphes	2014
F. Bouchet	Mécanique statistique pour la turbulence bidimensionnelle et géophysique et autres systèmes avec intéractions à longue portée	2011
D. Carpentier	Transport électronique cohérent, verres de spins et isolants topologiques	2012
M. Castelnovo	Modélisation d'objets biologiques: de la chromatine aux virus	2012
F. Chillà	Étudier la turbulence réelle : des tourbillons à la convection thermique	2010
E. Livine	The spinfoam framework for quantum gravity	2010
C. Moskalenko	Molécules uniques et processus biologiques : étude de quelques systèmes hors d'équilibre	2009
E. Orignac	Magnétisme quantique, bosons et interaction en basse dimensionalité	2013
T. Roscilde	Corrélations fortes et désordre dans des systèmes bosoniques	2011
S. Roux	Ondelettes et multifractales	2013
N. Taberlet	Instabilité *washboard road* : la physique de la tôle ondulée	2012
V. Terras	Quantum integrable systems: algebraic structures and correlation functions	2011
F. Toninelli	Polymères en milieu aléatoire : localisation, phénomènes critiques et critère de Harris	2010
C. Vaillant	Chapelet nucléosomal et organisation du génome	2011
V. Vidal	Dynamique et acoustique de bulles dans les milieux complexes	2011
R. Volk	Transport de particules en écoulement turbulent	2013

F. Interaction avec l'environnement social, économique et culturel

1. *Acteurs sociaux et culturels*

Radio, Télévision, Film

– RCF Isère, *Echos d'entreprises* Interview de P. Degiovanni (2010) sur le métier de chercheur avec deux physiciens (L. Saminadayar, R. Withney).

– *L'harmonie et le chaos* (2012), film documentaire de 52' auquel a participé T. Dauxois avec cinq mathématiciens (N. Bergeron, E. Ghys, T. Tokieda, A. Verjovsky, C. Villani). Tourné à l'occasion du centenaire de la mort de Henri Poincaré, il a été diffusé sur France 3 et dans plusieurs festivals scientifiques.

– France 2, *Journal de 20h*, Interview de D. Bartolo (2013) à l'occasion de la publication du premier dispositif permettant de reproduire en laboratoire l'auto-organisation d'un ensemble de plusieurs millions de particules micrométriques autopropulsées.

Articles rédigés dans un journal de vulgarisation scientifique

Physics World *The benefits of reaching out*, éditorial, 25 (11) 17, par P. Jensen (2012)
La Recherche, *Phénomènes d'invariance d'échelle dans l'Internet*, par P. Abry, P. Flandrin, D. Veitch (2011)
La Recherche, *Internet : un modèle pour réguler le trafic* par P. Abry, P. Flandrin et D. Veitch (2011)
La Recherche, *Dette et croissance : trois erreurs bien choisies*, par P. Jensen (2014)
La Recherche, *Chroniques "Déchiffrage"*, P. Jensen (2009-2014)
BUP, *Science et Danse, les mouvements collectifs*, J.F. Le Maréchal, E. Bertin et M. Hallet-Eghayan (2009)
Reflets de la Physique, *Propriétés hydrodynamiques au voisinage d'une surface* par É. Charlaix, C. Cottin-Bizonne, J. Crassous, S. Leroy, F. Restagno et A. Steinberger (2011)
Images de la Physique 2010, *Comment coule la matière molle ?* par S. Manneville et A. Colin (2010)

Le Monde Diplomatique *L'histoire des sciences n'est pas un long fleuve tranquille*, P. Jensen (2010)
Le Monde Diplomatique *Simulation numérique des conflits sociaux*, P. Jensen (2013)
Espaces-temps, revue SHS de l'EPFL *Grandeurs et misères de la sociophysique*, éditorial, P. Jensen (2014)

Articles parus dans un périodique sur les activités scientifiques d'un membre du laboratoire

Le Monde (2010), *Le washboard*, N. Taberlet
Le Monde (2013), *L'intelligence des mouvements collectifs*, D. Bartolo
Le Monde (2013), *Les mystères des tsunamis sous-marins*, T. Dauxois
Le Tout Lyon en Rhône Alpes (2011), *L'esthétisme de la physique*, P. Flandrin
Lyon Capitale (2011), *Les stars de l'Académie*, P. Flandrin
Les Nouvelles, Tahiti (2012), *Etera Livine - Portrait d'un chercheur*, Etera Livine

The Guardian (2013) *Physicists come together to explore mechanics of collective motion*, D. Bartolo
Spiegel (2013) *Tanz der Millionen Kugelchen*, D. Bartolo
Frankfurter Allgemeine (2013) *Der Tanz der Mikrokugeln*, D. Bartolo
NRC Handelsblad (2013) *Even wachten, en als vanzelf stromen de bolletjes eensgezind*, D. Bartolo

DocSciences (2014), *L'appel du signal*, P. Flandrin
Pour la Science (2012) *Le génie de l'utérus*, N. Garnier
Science et Avenir (2012) *L'origine des contractions élucidée*, N. Garnier et A. Pumir
Physics (2013) *"Son et Lumière"*, S. Santucci

Nature (2013), *On a roll*, D. Bartolo
Nature Physics 5, 250-251 doi:10.1038/nphys1244 (P. Holdsworth)
Nature Physics 7, 192-194 doi:10.1038/nphys1935 (P. Holdsworth)
Nature Physics 9, 606-607 doi:10.1038/nphys2774 (P. Holdsworth)
Physics World (2013), *Emitting indistinguishable electrons*, P. Degiovanni
Physics Today (2010), *A complex fluid exhibits unexpected heterogeneous flow*, S. Manneville

Communiqués Nationaux et Actualités de l'INP CNRS

Une nouvelle technique pour restaurer le rythme cardiaque, A. Pumir (2011)
http://www.cnrs.fr/presse/communique/2227.htm
Première mesure de l'énergie minimum nécessaire pour inscrire un bit informatique, S. Ciliberto (2012)
http://www2.cnrs.fr/presse/communique/2513.htm
Du condensat de Bose au verre de Bose, T. Roscilde (2012)
http://www.cnrs.fr/inp/spip.php?article1261

Comment évaluer la rigidité d'un objet sans le toucher, A. Steinberger (2012)
http://www2.cnrs.fr/presse/communique/2677.htm

Des colloïdes autopropulsés pour comprendre l'émergence de mouvements collectifs, D. Bartolo (2013)
http://www.cnrs.fr/inp/spip.php?article2231

Quand les fractures éblouissent les détecteurs de particules, S. Ciliberto (2013), http://www.cnrs.fr/inp/spip.php?article2249

Une première : générer à la demande des électrons indiscernables, P. Degiovanni (2013)
http://www.cnrs.fr/inp/spip.php?article1451

Quand les fractures éblouissent les détecteurs de particules ?, S. Santucci (2013)
http://www.cnrs.fr/inp/spip.php?article2249

Comment les ondulations apparaissent à la surface d'une route de terre ?, S. Manneville et N. Taberlet (2013)
http://www.cnrs.fr/inp/spip.php?article1567

Comment se forment les tsunamis sous-marins en mer de Chine ?, T. Dauxois (2014)
http://www.cnrs.fr/inp/spip.php?article2489

Comment faire pour que deux gouttes en contact ne fusionnent pas ?, T. Gibaud (2014)
http://www.cnrs.fr/inp/spip.php?article2549

Participation à des manifestations culturelles de vulgarisation

Conférence "Changements de climat : changements de société", Lyon (2012), F. Bouchet
Intervention dans "La nuit des chercheurs", Lyon (2012) F. Bouchet
Festival international du film scientifique Pariscience, Paris (2013), T. Dauxois
Festival du film scientifique, Oullins (2013), T. Dauxois
Conférence à la Médiathèque de Vaise, Lyon (2009), P. Flandrin
Ruptures : les matériaux roulent des mécaniques. Palais de la Découverte, Paris (2013), J.-C. Géminard
Conférence "Entre mécanique quantique et relativité générale", Papeete (2013), E. Livine

Conférence dans des établissements scolaires

Highschool: Grammar school of Stratfort-upon-Avon, Grande-Bretagne (2013), F. Bouchet
Kurokami Primary School, Sakurajima, Japon (2013), V. Vidal

Institut Français de l'Éducation, Lyon, Valérie Vidal (2013), T. Dauxois (2012), N. Plihon (2012)

Lycée la Martinière, Lyon (2013), F. Bouchet
Lycée Le Parc, Lyon (2009 & 2013), T. Dauxois
Lycée La Martinière, Lyon (2014), T. Dauxois
Lycée Ampère, Lyon (2014), P. Degiovanni
Lycée de la Cité Scolaire Internationale, Lyon (2013), P. Odier

Collège Gabriel Rosset, Lyon (2009) P. Abry, (2009) T. Dauxois, (2009 à 2014) A. Naert
Collège de la Cité Scolaire Internationale, Lyon V. Vidal 2013), F. Bouchet (2014)
Collège Henri Barbusse, Vaulx en Velin (2010), P. Degiovanni
Collège Schoelcher, Lyon (2014), S. Joubaud
Collège Henri Barbusse, Vaulx-en-Velin, (2010), A. Naert
Collège la Rochette, Chambéry (2009), R. Volk
Collège le Revard, Chambéry, R. Volk
École Primaire Les Veloutier, Thurins, Rhône (2009 à 2014), P. Odier

2. *Acteurs économiques*

Contrats de collaboration engagés avec une entreprise

FUI LABS avec Renault et Airbus Industrie, E. Leveque
FUI PATVAX avec Sanofi-Pasteur et Mérial, R. Volk
AXA, F. Bouchet
Total, D. Bartolo
Rhodia-Solvay, S. Ciliberto et S. Manneville
AID Observatoire, P. Jensen
BioMérieux, S. Manneville
Boiron, C. Place
L'Oréal, V. Bergeron et S. Santucci
IFPEN. R. Volk

Brevets en cours

Un violon qui joue tout seul : (FR12 60891), A. Naert
Dispositif de microstructuration de surface: (FR 0407426) C. Place
Vélocimètre pour un fluide électriquement conducteur (FR1054250), N. Plihon
Stable Bubble encapsulation via silicic acid complexation (OA 13160), V. Bergeron, S. Santucci
Stable Bubble Via Particle Adsorption (OA 13162), V. Bergeron, S. Santucci
Stable Emulsion Via Particle Adsorption (OA 13161), V. Bergeron, S. Santucci
Emulsion stabilisation via silicic acid complexation (OA 13163), V. Bergeron, S. Santucci
Microscope à plasmon de surface à haute résolution (FR09 50878), F. Argoul
Surface plasmon enhanced nonlinear microscopy (EP 2101168 A1), F. Argoul

G. Contrats

Type de Projet	Contact Local	Acronym	Sujet	Partenaires	Dates
ERC Advanced	S. Ciliberto	OutEFLUCOP	Out of equilibrium fluctuations in confined phase transitions		2011-2016
ERC Consolidator	F. Bouchet	TRANSITION	Large deviations, rare events, and applications in climate and the solar system		2014-2019
ERC Starting	S. Manneville	USOFT	Ultrasound techniques for soft jammed materials		2010-2015
ANR Blanc	P. Abry	FETUSES	Intrapartum Fetal Heart Rate Variability	LIP, ENS Lyon, Hospices Civils de Lyon	2012-2014
ANR Blanc	P. Abry	AMATIS	Multifractal Analysis	Creteil, Paris Est	2012-2015
ANR Blanc	F. Argoul	MECHASTEM	Physique de la morphogenèse des plantes	Univ. Diderot	2011-2014
ANR Blanc	A. Arneodo	HUGOREP	Origines de réplication chez les métazoaires : caractérisation et nouvelles approches à l'échelle du génome	CGM, IBENS, IBCP	2005-2009
ANR Blanc	A. Arneodo	REFOPOL	Programme spatio-temporel de réplication du génome humain	IBENS,CEA,CGM-CNRS	2011-2013
ANR Blanc	D. Bartolo	Mitra	Microfluidic traffic flows		2013-2017
ANR Blanc	V. Bergeron	WHIFF	Biocollecteur individuel électrocyclonique de haute efficacité	Paul Boyé Technologies, Bertin Technologies	2010-2013
ANR Blanc	E. Bertin	DYCOACT	Collective Dynamics of Self-Propelled Particles	Gulliver, SPEC, MSC	2009-2011
ANR Blanc	D. Carpentier	MesoGlass	Spin Glass Probe via electronic Coherent Transport	Grenoble	2006-2010
ANR Blanc	D. Carpentier	IsoTop	Transport in Topological Insulator	Bordeaux	2010-2014
ANR Blanc	D. Carpentier	SemiTopo	Topological properties of HgTe	Grenoble, LETI	2012-2016
ANR Blanc	B. Castaing	SHREK	Turbulence Normale et Superfluide		2009-2013
ANR Blanc	F. Chillà	GIMIC	Transport et mélange écoulements gravitaires confinés	FAST, IMFT	2007-2010
ANR Blanc	T. Dauxois	PIWO	Physics of Internal Waves for Oceanography	LEGI	2009-2012
ANR Blanc	P. Degiovanni	1shot	Optique quantique électronique	LPA, CPT Marseille	2010-2014
ANR Blanc	R. Everaers	FSCS	Fluctuations in Structured Coulomb Fluids	IRI-CNRS Lille, PCT-ESPCI, IPhT-CEA	2012-2015
ANR Blanc	P. Flandrin	StaRAC	Stationnarité relative	GIPSA-lab LCD-UTT	2008-2010
ANR Blanc	P. Flandrin	ASTRES	Data-driven analyses	LJK, IREENAV	2014-2016
ANR Blanc	E. Livine	LQG09	Quantum Gravity Renormalisation	CPT, LPT Orsay, LPTA	2009-2013
ANR Blanc	J.-M. Maillet	DIADEMS	Developing an Integrable Approach to Dynamical and Elliptic ModelS	IMB, Dijon	2010-2014
ANR Blanc	K. Gawędzki	STOSYMAP	Systèmes stochastiques en math. et phys.	Cergy, Cachan-Bretagne	2012-2015

ANR Blanc	P. Odier	ONLITUR	Ondes Non-LInéaires et TURbulence en écoulement tournants et stratifiés	FAST	2011-2014
ANR Blanc	J.F. Pinton	DESPET	Particles in turbulence	OCA, LEGI, LMFA	2011-2013
ANR Blanc	J.F. Pinton	VKS	Effet dynamo	SPEC, LPS Paris	2009-2011
ANR Blanc	A. Pumir	TEC2	Turbulence and phase changes	LMFA, Nice, LEGI	2013-2016
ANR Blanc	S. Santucci	StickSlip	Stick-slip rupture instability in polymers	ILM, FAST, ESPCI	2012-2015
ANR Blanc	A. Steinberger	NANOFLUIDYN	Nanoscale fluid dynamics	CEMES, CBMN, IMFT	2014-2018
ANR JC	L. Bellon	HiResAFM	High resolution adhesion force measurements		2012-2015
ANR JC	L. Chevillard	CHAMU	Matrices aléatoires	Ceremade	2009-2013
ANR JC	N. Plihon	DYNAMO	Dynamique d'un plasma turbulent et induction	LMFA, LPP	2013-2017
ANR JC	T. Roscilde	ArtiQ	Artificial Quantum Spin Systems from Atomics Physics		2013-2017
ANR JC	A. Venaille	STRATIMIX	Mixing in stratified fluids	LMFA	2014-2017
ANR Emergence	F. Argoul	BIOPLASM-OSCOPE	Microscopie plasmonique à haute résolution		2011-2013
ANR PCV	A. Arneodo	DNAnucl	DNA sequence effects on the structure and dynamics of nucleosome	CGM	2006-2010
ANR Soc Innov	P. Borgnat	Vel'Innov	Etude du VLS et de Vélo'v	LET, CMW, LIRIS, Grand Lyon, Cyclocity JC Decaux	2013-2015
ANR SYSCOM	F. Bouchet	STATOCEAN	Out of equilibrium statistical mechanics of geophysical flows	LEGI, LPO	2009-2012
ANR Chaire d'excellence	R. Everaers	Comp Phys Soft Bio Mat	Computational Physics of Soft and Biological Matter		2006-2010
ANR Chaire d'excellence	S. Ruffo	LORIS	Long-Range Interacting Systems		2011-2013
ANR Chaire d'excellence	H. Samtleben	DUAL SUGRA STRING	Dualities in String Theory		2007-2011
ANR International	J.-C. Géminard	MICMAC-GRAINS	Dynamique des milieux granulaires	USACH (Chile), SUPMECA	2009-2013
ANR PDOC	T. Gibaud	HARB	Hierarchical self-Assembly of Rod-like Bio-colloids		2012-2014
ANR PIRIBIO	C. Place	CONE	cell Chemotaxis	Institut Pasteur	2009-2012
ANRS	A. Arneodo	LEDG-VIH-1	Rôle de la chromatine et de la transcription dans l'intégration du VIH-1		2011-2013
ANRS	C. Moskalenko	HIV-AD	HIV-A assembly and disassembly	CPBS	2013-2015
IUF Senior	P. Holdsworth	IUF	Statistical Physics		2010-2015
IUF Junior	D. Bartolo	IUF	Collective Phenomena		2012-2017
IUF Junior	S. Manneville	IUF	Rheology		2010-2015
IUF Junior	T. Roscilde	IUF	Quantum Simulation		2013-2018
IUF Junior	H. Samtleben	IUF	Supergravity		2010-2015
Marie-Curie	E. Ermanyuk		Interactions ondes-tourbillons		2014-2016
Contrat recherche CEA	N. Plihon	PEMDYN	Pompe électromagnétique fort débit	CEA, ENS	2011-2013
ECO INDUSTRIES	V. Bergeron	ALBEDO	AnaLyse Biologique de l'Environnement et Dispersion des AérOsols	Magnisense, Bertin Technologies, Paris-LHVP	2011-2014

FUI	E. Leveque	LABS	Lattice Boltzmann Solver	Renault, Airbus, CS-SI, UPMC	2010-2013
FUI	R. Volk	PATVAX	Instrumentation for vaccine processes	Sanofi Merial	2010-2013
PALSE	F. Argoul	RHEOPLASM-OSCOPE	a combined optical and microfluidic device for acute leukemia diagnosis	Hopitaux Lyon Sud	2013-2015
PALSE	T. Roscilde	FUA	Frustrated Ultracold Atoms		2013-2016
PALSE	N. Taberlet	NoGelPo	Rheology of Poly(inoic liquids) electrolytes	Chimie-ENS de Lyon	2013-2015
PALSE	R. Volk	MORIN	Optical methods for industry and research	LHC Saint-Etienne LMFA, IFPEN, CRAL	2014-2015
Europe	F. Chillà	EuHIT	Velocity and temperature measurement technologies	Institut NEEL	2011-2015
Europe	P Jensen	DYNANETS	Modèles épidémio	Amsterdam	2008 - 2011
Europe	A. Pumir	EuHIT	Infrastructures en turbulence en Europe	$\sim$ 20 groupes en Europe	2013-2016
Europe	R. Volk	EuHIT	Experimental methods, velocimetry	more than 30	2014-2015
Europe	R. Volk	Eswirp	Experiments in giant wind tunnels	more than 10	2014
PICS CNRS	T. Dauxois		Internal Waves	MIT	2012-2014
PICS CNRS	F. Delduc	DIGEST	Integrable systems	Univ. of Hertfordshire (UK)	2014-2016
PICS CNRS	M. Peyrard	Meso-Friction	Friction at the mesoscale	Inst. Phys. Kiev	2010-2012
PCV RISK CNRS	F. Argoul	SPR-CARS	Imagerie SPR spectroscopique pour le vivant		2009
CNRS-ASCR	P. Abry		Scaling in Ionosphere	Inst. of Atmos. Physics (Czeck republic)	2009-2010
CNRS-PIR-Interface Phys. Bio.	M. Castelnovo		Retrovirus à l'échelle du virus unique		2009-2010
PEPS INSIS	P. Borgnat	ARDyC	Analyse de réseaux dynamiques de contacts	CPT Marseille	2011
PEPS-PTI	M. Castelnovo		Mod. des étapes d'une infection virale		2013-2014
PEPS-PTI	L. Chevillard		Physique Théorique		2009
PEPS-PTI	T. Dauxois		Long Range Systems		2011
PEPS-PTI	N. Garnier		Information Theory in Neurosciences	Lyon 1	2013
PEPS-PTI	P. Jensen	MODYS	Modèles sociaux	MédiaLab Paris	2011-2012
PEPS-PTI	T. Roscilde		Corrélations fortes et désordre dans les gaz quantiques ultrafroids		2011
PEPS-PTI	C. Vaillant	REpigen	Modélisation du Repliement de l'Epigénome : structure et dynamique.	IGH, LPTMC	2013-2014
PEPS-BMI	N. Pustelnik	PROMIS	Algorithmes proximaux pour la microscopie	GISPA-Lab	2012-2013
PEPS BMI	B. Audit		Multi-scale analysis of mechano-sensitive gene regulation dynamics in plant stem cells par illumination structurée	RDP, Institut Curie	2012-2013
Mi-lourd CNRS	P. Odier	PERPET	Plate-forme Tournante		2012-2013
Fond recherche ENS	P. Odier	PERPET	Plate-forme Tournante		2012-2013

MI CNRS	P Jensen	CartIndis	Cartes interdisciplinarité labos		2011-2013
PLAN CANCER INSERM	F. Argoul	MECANSTEM	Impact of physicals constraints on cancer stem cell resistance	CRCL Lyon	2012-2015
FONDECYT	L. Bellon		Modified AFM tips interacting with supported lipid bilayers	USACH (Chili)	2013-2016
Prix Fondation Del Duca	M. Castelnovo		Retrovirus à l'échelle du virus unique		2009-2014
FINOVI	C. Place	IPAL	Imaging bacteria landing		2012-2014
MRCT	C. Place	SUPERES	fluorescence en super-résolution		2011-2012
Region COOPERA CMIRA	F. Argoul		Physical approaches of acupuncture	FUDAN Shanghai	2009
Région CIBLE	F. Argoul	SPRM	Microscopie plasmonique à haute résolution	ECNU Shanghai	2011
Région CIBLE	F. Chillà	CIBLE	Echanges thermiques Turbulents		2011-2014
Région CIBLE	T. Dauxois		Interactions ondes-tourbillons		2010-2011
Région CIBLE	P Jensen	ModPar	modélisation participative	Lyon2	2013-2014
Région CIBLE	S. Manneville		Rhéo-vélocimétrie ultrasonore		2010
Région CIBLE	N. Plihon	DYPTIC	Dynamo, Plasma, Turbulence		2012-2014
Emergence Rhône Alpes	A. Arneodo F. Argoul	ADN CHROMATINE	Le rôle de la séquence d'ADN sur la structure et la dynamique de la chromatine		2005-2010
LABEX Lio	L. Bellon		fm transducer for optical coatings characterization	LMA	2013
LABEX IMUST	F. Chillà	Denvib	Experimental Study Natural Ventilation in Buildings	CETHIL	2012-2014
LABEX IMUST	N. Plihon	DYPFORC	Dynamique d'un plasma forcé	LMFA	2012-2014
LABEX IMUST	V. Vidal	GLIFSO	Gas-Liquid Flows in Porous Media	LGPC, CPE Lyon	2014-2017
LABEX IMUST	R. Volk	MAXIMIX	Mixing of colloids	ILM, LMFA	2013
IXXI	P. Jensen	MoDys	Modélisation sociale	MédiaLab Paris	2009-2010
IXXI	P. Jensen	SchellingFeed	Modèle multiniveaux	UMPA ENSL	2012-2013
IXXI	C. Vaillant		Modèles théoriques de l'Hétérochromatine:entre répression de la transcription et transcription pour la répression.	IAB	2014
JoRISS	N. Garnier		Synchronization in Biologocial systems	ECNU	2013
Projet Jeunes Chercheurs	N. Pustelnik	GALILEO	Segmentation de signaux et images par	GIPSA-Lab	2013-2014
Fédération de Physique	A. Steinberger		Transitions de phase sous confinement		2010
Fédération de Physique	A. Naert		Physique statistique hors-équilibre dans les gaz granulaires		2013

H. Formation par la recherche

1. *Thèses soutenues pendant la période*

NOM Prénom	Encadrant	Début-Soutenance	Origine	Financement ENS/ED/ANR ERC/Région/...	Devenir
ADROGUER P.	P. Degiovanni, D. Carpentier	01/10/09 23/02/13	ENS de Lyon	ENS	Post-doc Univ. Wurzburg
AGUILAR F.	L. Bellon	01/03/10 25/09/13	USACH (Chili)	Bourse Chili + contrat ERC	Post-doc USACH (Chili)
ANGELETTI F.	E. Bertin, P. Abry	01/09/09 06/12/12	ENS de Lyon	ED	Post-doc à Stellenbosch (A. du Sud)
BAKER A.	A. Arneodo	01/10/08 08/12/11	ENS de Lyon	ED	Post-doc, Simon Fraser University (Canada)
BERGER Q.	F. Toninelli	01/10/09 15/06/12	ENS de Paris	ENS	Post-doc à University of South California (USA)
BLANC B.	J.-C. Géminard	01/09/10 16/10/13	ENS de Paris	ENS	Post-doct. ILM (Lyon)
BONZOM V.	E. Livine	01/09/07 23/09/10	ENS de Lyon	ENS	MCF Paris-Nord (LIPN)
BORDES G.	T. Dauxois, J.B. Flor (LEGI)	01/09/09 16/07/12	ENS de Lyon	ENS	PRAG en IUT
BOURGET B.	T. Dauxois, P. Odier	01/09/11 01/07/14	ENS de Lyon	ENS	Enseignant en CPGE
BRICARD C.	D. Bartolo	01/10/11 01/07/14	ENS de Cachan	ENS	Préparation à l'agrégation
CAHUZAC A.	E. Leveque, M. Jacob (LMFA)	01/11/08 19/07/12	EC Lyon	Projet industriel	Industrie
CAUSSARIEU A.	S. Ciliberto	01/09/09 12/12/12	ENS Lyon	ENS	AP
CHEVEREAU G.	A. Arnéodo, C. Vaillant	01/10/07 01/11/10	ENS de Lyon	ENS	PRAG (Strasbourg)
CLOTET X.	S. Santucci, J. Ortin	01/10/11 11/07/14	Univ. Barcelona	Univ. Barcelona	Post-doc (Clark Univ.)
CORVELLEC M.	F. Bouchet	01/09/08 10/01/12	ENS de Lyon	ENS	Post-doc au Canada
DIVOUX T.	J.-C. Géminard	01/09/06 23/06/09	ENS Cachan	Allocation couplée	CR2 (Bordeaux)
DUPUIS M.	E. Livine	01/09/07 16/12/10	ENS de Lyon	ENS	Banting Fellowhsip (Canada)
GASTEUIL Y.	J.-F. Pinton	01/09/06 10/11/09	ENS de Lyon	ED	Ingénieur SmartInst
GOMEZ-SOLANO R.	S. Ciliberto, A. Petrosyan	01/10/09 08/11/11	ENS de Lyon	ENS	Post-doc à Stuttgart
GRAUWIN S.	P. Jensen	01/09/08 01/07/11	ENS de Lyon	ENS	Post-doc MIT
GRENARD V.	N. Taberlet , S. Manneville	01/09/09 02/07/12	ENS de Lyon	ENS	Enseignant CPGE
GRENIER C.	P. Degiovanni	01/10/08 30/06/11	ENS de Lyon	ENS	Post-doc ETHZ
GROSJEAN N.	J. M. Maillet	01/10/09 30/09/13	ENS de Lyon	ENS	ATER Cergy
HAGMANN J.-G.	M. Peyrard	01/09/06 14/09/09	University Karlsruhe	ED	Conservateur Deutsches Museum
HARMAN-CLARKE A.	P. Holdsworth, S. Bramwell (UCL)	01/10/08 01/11/12	UCL Chemistry	EPSRC (UK)	Consultant
HENRY L.-P.	T. Roscilde	01/09/10 29/11/13	ENS de Lyon	ENS	Post-doc
HOU J.	R. Everaers	01/09/08 24/07/12	ENS de Lyon	ESTN Eurosim + ENS	Prof U Nanjing
HU S.	J.-C. Géminard	01/09/07 29/10/10	ECNU (Shanghai)	ENS ECNU Région	Post-doc MBI (Singapour)

JAUBERT L.	P. Holdsworth	01/10/06 01/11/09	ENS de Lyon	ENS	Post-doc OIST Japan
JEANNERET R.	D. Bartolo	01/10/10 15/01/14	ENS de Lyon	ENS	Post-doc Oxford
JOST D.	R. Everaers	01/09/07 23/06/10	ENS de Lyon	ENS	CR2 CNRS
JULIENNE H.	A. Arneodo, B. Audit	01/10/10 11/12/13	INSA-Lyon	ED	Entreprise
LE DIFFON A.	H. Samtleben	01/10/07 31/07/10	ENS de Lyon	ED	PRAG
LEMOY R. S	P. Jensen, C. Raux	01/09/08 10/10/11	M1 ENS	Bourse Ministère	Post-doc Finlande
LEVACHE B.	D. Bartolo	01/02/11 01/03/14	ESPCI	Cifre TOTAL	Ingénieur TOTAL
LEVY- BENCHETON D.	V. Terras	01/09/10 22/10/13	ENS de Lyon	ENS	ATER à Dijon
LI T.	L. Bellon	01/09/10 10/10/13	ECNU (Shanghai)	Bourse Chine + complément labo et région	Professeur associé Chine
MACHICOANE N.	R. Volk, J.-F. Pinton	01/09/11 18/07/14	ENS de Lyon	Contrat PATVAX	Post-doc au FAST
MALLICK N.	S. Roux, L. Vanel	01/10/06 29/01/10	ENS de Lyon	ENS	Prague, Galatasaray French University (Turkey)
MERCIER M.	T. Dauxois	01/09/07 29/06/10	ENS de Lyon	ENS	Post-doc au MIT
METHANI A.	V. Bergeron	01/09/07 29/06/10	ENS de Lyon	ENS	Post-doc au MIT
MEYER S.	R. Everaers	01/09/09 28/09/12	ENS de Lyon	ENS	Post-doc Lyon
MIRALLES S.	J.-F. Pinton, N. Plihon	01/10/10 11/10/13	ENS de Lyon	ENS	Post-doc ETH Zurich
NARDINI C.	T. Dauxois, L. Casetti (Florence)	01/10/13 22/02/13	Université de Florence	Italie	Post-doc à l'ENS de Lyon
ORTIZ T.	H. Samtleben	01/10/11 07/07/14	ENS de Lyon	ENS	Enseignant en CPGE
PAULIN G.	D. Carpentier	01/09/07 31/08/10	ENS de Lyon	ENS	Post-doc à Cologne puis Enseignement
PERCIER B.	N. Taberlet , S. Manneville	01/09/10 28/06/13	ENS de Lyon	ENS	Enseignant en CPGE
PERGE C.	N. Taberlet , S. Manneville	01/10/11 03/07/14	ENS de Lyon	ERC	Enseignant
ROLAND T	F. Argoul	01/09/06 02/11/09	ENS de Lyon	ENS	Post-doc Cornell U.
TALLAKSTAD K.T.	S. Santucci, K. J. Måløy	01/10/07 01/10/10	Oslo	Oslo	Lloyd's Register Consulting
TISSERAND J-C.	F. Chillà, B. Castaing	01/09/07 16/12/10	ENS de Lyon	ED FAST	Enseignant CPGE
VALLE-ORERO J.	M. Peyrard	01/10/09 31/08/13	University College London	ED Lyon / ILL	Post-doc New York
VARAS G.	V. Vidal	07/01/08 17/11/11	Univ. de Chile, Santiago	CONICYT	Assistant Prof., Valparaíso, Chili
VERHILLE G.	J.-F. Pinton, N. Plihon	01/09/07 14/09/10	ENS de Lyon	CNRS	CR2 CNRS IRPHE
VILLEROT S.	B. Castaing, L. Chevillard	01/10/10 27/11/13	Université Orsay	ED	IR temporaire LOA Lille I
VOSSKUHLE M	A. Pumir, E. Lévèque	01/09/10 13/12/13	Université de Münster (D)	ED	Industrie
XU J.	A. Pumir, N. Garnier	01/10/09 31/12/12	ECNU	CSC / Region	Prof. Ass. en Chine
ZAGHLOUL L.	B. Audit	01/10/06 30/11/09	INSA-Lyon	CNRS	
ZIMMERMANN R.	R. Volk, J.-F. Pinton	01/09/09 20/07/12	Dresde University	MENSR	Industrie

2. *Thèses en cours*

NOM Prénom	Encadrant	Début	Origine	Financement ENS/ED/ANR ERC/Région/...
BERNAUD J.	C. Moskalenko, M. Castelnovo	01/09/12	ENS de Lyon	ENS
BERTOLACCINI J.	E. Leveque, P-E Roche	01/11/12	ENS de Lyon	Région
BERUT A.	S.Ciliberto, A.Petrosyan	01/09/12	ENS de Lyon	ENS
BOULOS R.	B. Audit	01/10/12	Université Saint-Joseph, Liban	ED
BROUZET C.	T. Dauxois, S. Joubaud	01/10/13	ENS de Lyon	ENS
CAUSSIN J.-B.	D. Bartolo	01/10/12	ENS de Lyon	ENS
CHAMPION M.	A. Alastuey	01/09/12	ENS de Lyon	ENS
CHASTAING J.-Y.	J.-C. Géminard, A. Naert	01/09/13	ENS de Lyon	ENS
CHIERCHIA G.	N. Pustelnik B. Pesquet-Popescu	01/10/11	Università di Napoli	Fondation Telecom et Institut Carnot
COSTARD A.	P. Abry, P. Borgnat, O. Michel, S. Achard	01/10/11	INPG	ARC Région
DALBE M.-J.	S. Santucci, L. Vanel	01/10/11	ENS de Lyon	ENS
DEVAILLY C.	S. Ciliberto, A. Steinberger	01/09/11	ENS de Lyon	ENS
FAULKNER M.	P. Holdsworth, S. Bramwell	01/11/11	U. Cambridge	CNRS / EPSRC
FRECON J.	P. Abry, N. Pustelnik	01/09/13	Univ. Lyon I	ED
FRUCHART M.	D. Carpentier, K.Gawędzki	01/10/13	ENS de Lyon	ENS
GEITNER M.	L. Bellon	01/11/12	U. Montpellier 2	ANR
GUICHARDAZ R.	A. Pumir	01/09/13	ENS Lyon	ED
HADDAD N.	D. Jost, C. Vaillant	01/10/13	ENS de Lyon	ED
HAMON R.	P. Flandrin, P. Borgnat	01/10/13	INSA Toulouse	Région
HORNE E.	P. Odier, S. Joubaud	01/10/12	ENS de Lyon	ANR
JULIEN J.D.	A. Pumir, A. Boudaoud	01/09/12	ENS Lyon	ED
KAISER V.	P. Holdsworth, R. Moessner	01/10/11	University of Prague	PHAST
LAPERROUSAZ B.	F. Argoul, V. Maguer-Satta	01/09/11	ENS de Lyon	ENS
LASLIER B.	F. Toninelli	01/10/11	ENS de Paris	ENS
LE CUNUDER A.	S. Ciliberto	01/10/13	Univ. Paris 7	ERC
LEONARDUZZI R.	P. Abry	01/10/10	Entre-Rios, Argentina	Entre-Rios, Argentina
LIDON P.	N. Taberlet, S. Manneville	01/09/13	ENS de Lyon	ENS
LIOT O.	F. Chillà, M. Bourgoin	01/09/12	ENS de Lyon	ENS
LOPES CARDOZO D..	P. Holdsworth	01/10/12	ENS de Lyon	ERC
MALPETTI D.	T. Roscilde	01/09/13	Université de Pavie	PALSE
MARTINEZ C.	F. Argoul	01/02/12	ENS de Lyon	ENS
MICHAU G.	P. Abry, P. Borgnat	01/03/13	ENS de Lyon	QUT - Australia
MOKHTARI Z.	E. Freyssingeas	01/10/11	Lyon 1	Laboratoire de Physique
RUSAOUEN E.	F. Chillà, B. Castaing	01/10/11	EC de Lyon	Région
SÁNCHEZ C.	V. Vidal	15/03/11	USACH (Chili)	CONICYT

STREPPA L.	F. Argoul, L. Schaeffer	01/03/13	ENS de Lyon	AFM
TANGARIFE T.	F. Bouchet	01/09/12	ENS de Lyon	ENS
TAUBER C.	K. Gawędzki	01/10/12	ENS de Lyon	ENS
THIBIERGE E.	P. Degiovanni	01/10/12	ENS de Lyon	ENS
TREMBLAY N.	P. Borgnat	01/09/11	ENS de Lyon	ENS
VERDIER T.	M. Castelnovo	01/10/12	ENS de Lyon	X
WENDLAND D.	A. Alastuey	01/10/12	Univ. of Karlsruhe	ED /Région Franche Comté

3. Post-doctorants

NOM Prénom	Encadrant	Début-Départ	Origine	Financement AP ENS/ANR ERC/Région/...	Devenir
APOLLONI A.	P. Jensen	2010-2011	Virginia Tech	DYNANETS	Post-doc UK
ARAKELYAN A.	A.Petrosyan	17/04/11 17/04/12	Université de Erevan, Arménie	ERC	Université de Erevan
BECKER N.	R. Everaers	01/01/09 31/08/09	MPIPKS Dresden (Germany)	ANR	Post-doc AMOLF (Amsterdam)
BORJA-FERNANDEZ E.	E. Livine	01/10/12 31/08/13	Erlangen (Allemagne)	CNRS	Universidad de Sevilla
BOUSSELIN G.	N. Plihon, J.-F. Pinton	01/11/13	U. Lorraine	CNRS	Encore au laboratoire
CALZAVARINI E.	R. Volk	01/09/09 31/08/11	Twente	ANR	MCF Lille
CASCALES E.	F. Argoul	01/02/13 30/04/13	Bordeaux	INSERM	
CECCIA S.	S. Manneville	01/10/13	Italie	Solvay	Ingénieur chez Michelin
CHAREYRON D.	R. Volk	01/10/08 31/08/10	LMFA	AP	Enseignement
CHEVEREAU G.	E. Bertin	01/09/10 31/08/11	ENS Lyon	AP ENS	Post-doc à Vienne (Autriche)
CHIKKADI V.	D. Bartolo	01/04/14 01/04/15	Weizmann Institut (Israel)	ANR	Encore au laboratoire
CHUDACEK V.	P. Abry	01/01/12 31/12/12	Univ. Prague	ANR	Post-Doc à Prague (Tchéquie)
CRAUSTE C.	S. Ciliberto	01/07/11 30/11/13	Orsay (France)	ERC	CR2 CNRS (Lyon)
DELPLACE P.	D. Carpentier	01/04/14	Genève	ANR	Encore au laboratoire
DESSEIGNE J.	S. Ciliberto	01/10/12 30/11/13	ILM (Lyon)	ERC	Amáco
DEWAELE G.	P. Abry, P. Borgnat	01/09/06 31/08/09	Univ. Grenoble	AP	Prof. Classe Préparatoire
DIGIUNI S.	F. Argoul	01/11/12 30/08/14	Italie	ANR	Encore au laboratoire
DIVOUX T.	S. Manneville	01/09/09 31/12/12	ENS de Lyon	ENS et ERC	CR2 CNRS (Bordeaux)
DRILLON G.	F. Argoul	01/10/13 30/09/15	France	INSERM	Encore au laboratoire
FAHYS A.	F. Argoul	15/01/09 31/12/09	Université de Besançon	Lyon Science Transfert	Post-doc à Lyon
FARDIN M.-A.	S. Manneville	01/10/12 30/09/14	Université Paris 7	ERC	CR2 CNRS (Paris)
FERRARO D.	P. Degiovanni	01/10/12 30/09/13	Université de Gènes (Italie)	ANR	Post-doc au CPT (Marseille)
FIABANE L.	R. Volk	01/02/11 31/08/13	ENSTA	FUI	IR IRSTEA (Rennes)
GALLOT T.	S. Manneville	01/01/11 31/08/11	Université Joseph Fourier	ERC	Assistant professor (Montevideo, Uruguay)

GUERRA C.	V. Bergeron	03/01/11 31/12/11	SPEC	Bluestar	Effinov
GUPTA S.	S. Ruffo	01/02/11 30/09/12	Weizmann (Israel)	ANR	Post-doc au LPTMS (Orsay)
HAMONIER J.	P. Abry	01/10/12	Univ. Lille	ANR	Encore au laboratoire
HELGASON H.	P. Abry	01/01/09 30/06/10	UCLA	Inst. France	Privé
HOMAN T.	S. Joubaud	01/04/14 31/03/15	Univ. Twente (Pays-Bas)	ENS	Encore au laboratoire
IAZYKOV M.	C. Moskalenko	01/09/11 31/12/12	Ecole Centrale Lyon	Fondation Del Duca	Post-doc à l'INSA (Lyon)
JACQUIN H.	P. Holdsworth	01/10/12 31/12/13	Paris VII	ERC OUTEFLUCOP	Post-doc au LPS ENS (Paris)
JEANNERET R.	D. Bartolo	01/01/14 01/06/15	ESPCI (Paris)	ANR	Encore au laboratoire
KLIRONOMOS F.	D. Carpentier/E. Orignac	01/09/07 01/09/09	UC Riverside (É.-U.)	Post-doc CNRS	Post-doc Univ. Cologne (Allemagne)
LASTAKOWSKI H.	V. Vidal	01/09/13	ILM (Lyon)	ATER, ENS de Lyon	Encore au laboratoire
LAURENT J.	S. Ciliberto	01/03/11 30/09/13	Grenoble (France)	ERC	Post-doc INSA (Lyon)
LAURIE J.	F. Bouchet	01/10/10 30/09/12	Warwick Uni. (UK)	ANR	Post-doc au Weizmann Institute (Israel)
LEMOY R.	E. Bertin	01/09/11 31/08/12	ENS Lyon	AP ENS	Post-doc à Helsinki (Finlande)
LEOCMACH M.	S. Manneville, N. Taberlet	01/09/12 01/09/14	Tokyo University	ERC puis PALSE	Encore au laboratoire
LOPEZ-CABALLERO M.	R. Volk	01/10/13	Navare University	Europe	Encore au laboratoire
LOZENGUEZ G.	P. Borgnat	01/11/13	Univ. Caen	ANR	Maitre Assistant aux Mines de Douai
MALIK S.	V. Bergeron	01/01/12 31/12/13	Univ. Le Havre	ANR	Post-doc au LMFA
MARSELLA L.	R. Everaers	01/01/09 31/03/09	CECAM	ANR	Post-doc U Sardinia
MARTINEZ I.	S. Ciliberto	01/06/14	Lyon (France)	ERC	Univ. Barcelona
MATHUR M.	F. Bouchet	01/10/11 30/09/12	MIT (USA)	ANR	Ass. Prof. India
MAUGER C.	R. Volk	01/09/12 31/08/13	LMFA	Labex	MCF INSA
MEYER S.	R. Everaers	01/11/12 30/04/13	ENS de Lyon	ANR	Post-doc INSA Lyon
MILANI P.	F. Argoul	01/07/09 31/12/09	Université de Marseille	ANR	Post-doc au RDP
MODLINKA A.	T. Gibaud	01/10/13 01/10/14	Poznan University	ANR PDOC	Encore au laboratoire
MOGHTADERI A.	P. Flandrin, P. Borgnat	01/05/09 31/08/10	Queens Univ. (Canada)	ANR	Ingénieure chez eBay
MUNROE J.	T. Dauxois et P. Odier	01/01/12 30/08/12	Edmonton (Canada)	ANR	Assistant Prof (Canada)
NARDINI C.	F. Bouchet, K. Gawędzki	01/06/13	Florence (Italie)	ANR	Encore au laboratoire
NASO A.	A. Pumir	01/09/08 30/09/10	SPEC	ANR	CR2 CNRS (Lyon)
NESPOULOUS M.	T. Gibaud	01/09/12 01/09/13	CRPP (Bordeaux, Fr)	ANR PDOC	MCF au MADIREL (Marseille)
PALERMO F.	N. Plihon	01/06/13	CEA Cadarache	Labex IMUST	Encore au laboratoire
PALMEIRA L.	A. Arnéodo, C. Vaillant	01/10/07 30/06/09	UCBL (Lyon)	ANR	Post-doc (Liège)
PASKAUSKAS R.	S. Ruffo	01/11/12 19/07/13	Stellenbosch (Afrique du Sud)	ANR	Post-doc (Lucca)

PEREIRA R.	L. Chevillard	01/03/14 01/03/16	Rio do Janeiro (Brésil)	Bourse Brésilienne	Encore au laboratoire
PEREZ-APARICIO R.	S. Ciliberto	01/10/13	Univ of Basque Country (Espagne)	Rhodia-Solvay	Encore au laboratoire
PETITJEAN C.	D. Carpentier/E. Orignac	01/12/11 31/12/13	CEA (Grenoble)	ANR	Post-doc Univ. Liège (Belgique)
PLANET R.	V. Bergeron, S. Santucci	01/01/09 01/01/11	Barcelona	L'Oréal	Post-doc à l'ILM (Lyon)
POPELIER L.	N. Plihon	01/12/12 16/01/13	LPP	CNRS	Enseignement
RAMOS O.	S. Santucci	01/01/09 01/09/09	Oslo (Norvège)	ANR	MCF à l'ILM (Lyon)
RIEDINGER X.	F. Chillà	01/09/09 01/09/11	IRPHE	ANR+ATER	Post-doc Exter
SALORT J.	F. Chillà	01/11/11 01/09/14	Inst. Néel	AGPR	Encore au laboratoire
SCHMITT J.	N. Pustelnik, P. Borgnat, P. Flandrin	01/10/12 30/09/15	CEA	AP ENS	Encore au laboratoire
SCOLAN H.	T. Dauxois, P. Odier	01/09/11 13/02/14	Grenoble (France)	AP ENS	Post-doc à Oxford (UK)
SEYCHELLES F.	F. Chillà	15/12/10 01/09/13	FAST	CNRS +ATER	Post-doc au CORIA
SPILKA J.	ABRY P.	01/01/13	Univ. Prague	ANR	Encore au laboratoire
TAMBORNINO J.	E. Livine	01/09/10 31/08/12	Berlin (Allemagne)	ANR	
TAPIA F.	J.-C. Géminard	01/01/14	USACH (Chili)	Conicyt	Encore au laboratoire
THEURKAUFF I.	S. Ciliberto	01/12/13	Lyon (France)	ERC	Encore au laboratoire
TOUIL H.	E. Leveque	01/01/10 30/06/13	industrie	FUI	industrie
WEIJS J.	D. Bartolo	01/04/14 01/04/15	Univ. Twente (Pays-Bas)	ENS	Encore au laboratoire
WIMMER R.	H. Samtleben	01/11/08 31/12/11	Vienne (Austria)	ANR	Editor Phys.Rev.D

4. Stagiaires

NOM Prénom	**Année**	**Durée** (en mois)	**Niveau d'étude** (L3, M1, M2)	**Établissement d'origine**
ADROGUER P.	2009	4	M2	ENS de Lyon
AGUIRRE D.	2010	5	M2	Univ. Monterrey (Mexico)
ANGELETTI F.	2009	5	M2	ENS de Lyon
ASSANIOUSSI M.	2012	3	M2	Université d'Aix-Marseille
BECK Y.	2010	6	M1	ENS de Lyon
BEDESSEM B.	2011	2	M1	ENS de Lyon
BEGUE F.	2012	4	M2	ENS de Lyon
BENKASSAOUI S.	2013	5	M1	POLYTECH Lyon
BERGER Q.	2009	2	M2	ENS Paris
BERNAUD J.	2010	3	M1	ENS de Lyon
BERNAUD J.	2012	2	M2	ENS de Lyon
BERTHELOT C.	2010	3	L3	Université Paris-Sud XI
BERTRAND V.	2013	4	M2	ENS de Lyon
BERUT A.	2011	4	M2	ENS de Lyon
BLANC B.	2010	5	M2	ENS Paris
BONNAVENTURE J.	2012	3	M1	ENS de Lyon
BORDES G.	2011	4	M2	ENS de Lyon
BOURGET B.	2011	4	M2	ENS de Lyon
BRES A.	2013	1	L3	ENS
BROUZET C.	2011	2	L3	ENS de Lyon
CABART C.	2013	3	M1	ENS de Lyon
CALVET T.	2013	4	M2	Université d'Aix-Marseille
CAO N.	2013	4	M1	INSA de Lyon

CHAMPION M.	2011	4	M2	ENS de Lyon
CHAMPOUGNY L.	2012	4	M2	ENS de Lyon
CHAN-LANG S.	2011	4	M2	ENS de Lyon
CHARLES C.	2011	2	L3	ENS de Lyon
CHARLES C.	2013	4	M2	ENS de Lyon
CHASTAING J.-Y.	2010	2	L3	ENS de Lyon
CHATEAU D.	2012	3	M1	ENS de Lyon
CHIPON R.	2012	4	M2	Université Paris 11
COUTANT A.	2009	4	M2	ENS de Lyon
DALBE M.-J.	2009	2	L3	ENS de Lyon
DALBE M.-J.	2011	4	M2	ENS de Lyon
DANIAL J.	2011	2	M1	Université Lyon 1
DE ZOTTI V.	2013	3	M1	ENS de Lyon
DEBIERRE V.	2011	3	M1	ENS de Lyon
DECOYERE M.	2012	3	IUT	IUT Villeurbanne
DEFROMONT P.	2009	2	M1	ENS de Lyon
DELMONT O.	2013	3	M1	ECAM Lyon
DESANGLES V.	2014	3	M1	ENS de Lyon
DEVAILLY C.	2011	4	M2	ENS de Lyon
DI MARE A.	2009	5	M2	Universita di Pisa
EL FADI N.	2009	3	M1	ENSEIRB (Bordeaux)
FELLER A.	2012	2	L3	ENS de Lyon
FELLER A.	2014	3	M2	ENS de Lyon
FERRAND J.	2014	2	M2	ENS de Lyon
FEVRIER C.	2009	2	L3	UCBL
FIS A.	2014	6	M2	Université de Montpellier
FRECON J.	2013	4	M2	ENS de Lyon
FRELAT D.	2010	5	M2	ENS de Lyon
FREROT I.	2013	10	M2	ENS Paris
FRUCHART M.	2013	4	M2	ENS de Lyon
GARDETTE L.	2013	2	L3	ENS de Lyon
GHIBAUDO A.	2012	3	M1	ENS de Lyon
GHODBADPOUR E.	2014	5	M2	ENS de Lyon
GIAUSSERAND L.	2014	3	M1	ENS de Lyon
GIROUD N.	2011	8	L3	UCBL
GOMEZ-SOLANO R.	2009	3	M2	ENS de Lyon
GRENARD V.	2009	3	M2	ENS de Lyon
GROSJEAN N.	2009	4	M2	ENS de Lyon
GUICHARDAZ R.	2013	4	M2	ENS de Lyon
HADDAD N.	2012	3	M1	ENS de Lyon
HADDAD N.	2013	4	M2	ENS de Lyon
HAMON R.	2012	4	M2	INPT (Toulouse)
HAUTIER L.	2012	2	M1	UCBL
HENRY L.-P.	2010	4	M2	ENS de Lyon
HERFRAY. Y.	2013	3	M1	ENS de Lyon
HIMURA Y.	2009	1	M1	Univ. Tokyo
HUCK P.	2013	3	M1	ENS de Lyon
HUMENIUK S.	2010	3	M1	Université de Munich
HUMENIUK S.	2011	11	M2	Université de Munich
ICETA N.	2009	2	L3	ENS de Lyon
IKHENACHE N.	2014	4	M2	Université Lyon 1
JAMI S.	2014	5	M2	U. Bordeaux
JORGENSEN L.	2010	3	M1	ENS de Lyon
JOUFFREY V.	2013	3	M1	ENS de Lyon
JULIEN J.D.	2011	3	M1	ENS de Lyon
KATO M.	2012	1	M1	Univ. Keio (Tokyo)
KHOKHLOVA V.	2013	3	M1	ENS de Lyon
KUMAR A.	2013	2	L3	IIT (India)
FRECON J.	2013	5	M2	Univ. Lyon I
L'HERMINIER S.	2013	4	M2	ENS de Lyon
LAMBERT G.	2010	2	M1	Ecole Centrale de Lyon
LAURIN I.	2011	1	L3	ENS Cachan
LAVAU S.	2011	4	M1	ENS de Lyon
LAVIGNE Q.	2013	1	L3	Telecom St. Etienne
LE BOULC'H Q.	2009	3	M1	ENS de Lyon

LECOMTE C.-É.	2012	2	L3	ENS de Lyon
LEHERICY T.	2013	2	L3	ENS de Paris
LE GOFF T.	2011	3	M1	ENS de Lyon
LELEU A.	2010	4	L3	IUT Perpignan
LELEU A.	2012	5	M2	Université de Bordeaux I
LEVY-BENCHETON D.	2010	4	M2	ENS de Lyon
LHERMINIER S.	2013	4	M1	ENS de Lyon
LICARI A.	2012	4	M2	ENS de Lyon
LIOT O.	2011	3	M1	ENS de Lyon
LOPEZ J.	2010	3	M1	Université de Provence
LORI L.	2009	6	Laurea	Université de Florence
LOUVET T.	2014	4	M2	ENS de Lyon
MAO B.	2013	6	M2	UTC (Compiègne)
MATEOS M.	2013	3	M1	ENS de Lyon
MENAUT R.	2013	2	L3	ENS de Lyon
MERIC J.	2012	2	L2	IUT (La Rochelle)
MICARD D.	2011	2	L3	ENS de Lyon
MICHAU G.	2010	3	M1	ENS de Lyon
MIRALLES S.	2009	3	M1	ENS de Lyon
MORIN A.	2014	6	M1	Ecole Centrale de Lyon
MOTODATE T.	2010	1	M1	Univ. Tokyo
MOUNIER A.	2011	3	M1	ENS de Lyon
ORTIZ T.	2010	4	M2	ENS de Lyon
PERCIER B.	2009	3	M2	ENS de Lyon
PERGE C.	2011	5	M2	ENS de Lyon
PICCINI A.	2012	2	L3	UCBL
PILLET G.	2013	3	M1	ENS de Lyon
POLLET-VILLARD M.	2009	2	L3	ENS de Lyon
PORYLES R.	2014	4	M2	ENS de Lyon
POTTERS M.	2011	12	M2	Utrecht university
POY G.	2012	2	L3	ENS de Lyon
RABAUD N.	2013	3	M1	ENS de Lyon
RAYNAUD G.	2009	4	M2	ENS de Lyon
RENAUD A.	2013	9	M1	ENS Cachan
RENEUVE J.	2013	2	L3	ENS de Lyon
RIVERA SILVA V.	2012	4	M2	UNAM (Mexico)
ROBERT P.	2011	4	M1	ENS de Lyon
ROSSI A.	2012	4	M1	Univ Lyon I
ROUSSEL B.	2013	3	M1	ENS de Lyon
SAHLI R.	2012	3	M1	ENS de Lyon
SAVOIE C.	2014	4	M2	ENS de Lyon
SBAILO L.	2014	5	M2	ENS de Lyon
SCALLIET C.	2013	2	L3	ENS de Lyon
SCHEMMER M.	2014	4	M1	ENS de Lyon
STOJANOVA M.	2011	4	M1	Univ. Lyon 1
TANGARIFE T.	2012	4	M2	ENS de Lyon
TARTOUR K.	2011	6	M2	ENS de Lyon
TAUB R.	2014	2	L3	ENS de Lyon
TAUBER C.	2011	3	M2	ENS de Lyon
TEFFANY J.	2010	3	M1	ENS de Lyon
THIBIERGE E.	2011	4	M2	ENS de Lyon
VERDIER T.	2012	2	M2	Polytechnique
WANG C.	2013	3	M2	ECNU (Shanghai)
WENDLAND D.	2012	6	M2	Univ. Karlsruhe
YACOUB M.	2010	6	M3	CPE Lyon
ZUBAIR A.	2010	4	M2	ENS de Lyon

5. *Participation des chercheurs CNRS à l'enseignement à l'ENS.*

Abry Patrice, 25h/an de Sept 2008 à Juin 2014.
Alastuey Angel, 40h/an de Sept 2008 à Juin 2014.
Bellon Ludovic, 54h/an de Sept 2008 à Juin 2014.
Borgnat Pierre, 42h/an de Sept 2008 à Juin 2014.
Bouchet Freddy, 39h/an de Sept 2012 à Juin 2014.
Carpentier David, 64h/an de Sept 2008 à Juin 2014.
Castelnovo Martin, 40h/an de Sept 2008 à Juin 2014.
Chevillard Laurent, 30h/an de Sept 2008 à Juin 2014.
Ciliberto Sergio, 40h/an de Sept.2008 à Juin 2014.
Dauxois Thierry, 44h/an de Sept 2008 à Juin 2014.
Degiovanni Pascal, 34h/an de Sept 2012 à Juin 2014.
Delduc François, 60h/an de Sept 2008 à Juin 2014.
Flandrin Patrick, 40h/an de Sept 2008 à Juin 2014.
Garnier Nicolas, 48h/an de Sept 2008 à Juin 2014.
Gawęzki Krzysztof, 20h/an de Sept 2008 à Juin 2014.
Géminard Jean-Christophe, 64h/an de Sept 2008 à Juin 2014.
Gibaud Thomas, 40h/an de Sept 2012 à Juin 2014.
Jensen Pablo, 40h/an de Sept 2008 à Juin 2014.
Livine Etera, 10h/an de Sept 2009 à Juin 2014.
Maillet Jean Michel, 30h/an de Sept 2009 à Juin 2014.
Orignac Edmond, 10h de Sept 2009 à Juin 2014.
Oswald Patrick, 120h/an de Sept 2008 à Juin 2014.
Petrosyan Artyom, 96h/an de Sept 2008 à Juin 2014.
Plihon Nicolas, 60h/an de Sept 2008 à Juin 2014.
Pumir Alain, 30h/an de Sept 2008 à Juin 2014.
Pustelnik Nelly, 18h/an de Sept 2012 à Juin 2014.
Steinberger Audrey, 34h/an de Sept 2012 à Juin 2014.
Terras Véronique, 20h/an de Sept 2009 à Juin 2011.
Venaille Antoine, 30h de Sept 2013 à Juin 2014.
Vidal Valérie, 30h/an de Sept 2008 à Juin 2014.

6. *Participation des (enseignants)-chercheurs à des masters extérieurs à l'ENS.*

Master 2 IPB, Françoise Argoul, Alain Arneodo, Benjamin Audit, Cédric Vaillant (2009-2014)
Master 2 à l'ECNU (Shanghai, Chine), Thomas Gibaud (2014)
Master 2 SIB (Lyon 1), Pablo Jensen (2014)
Master 2 IPB, Christophe Place (2009-2011)
Master 2 Recherche "Maths en action" Nelly Pustelnik (2013-2014)
Master 2 PSA, Grenoble, Henning Samtleben (2010-2014)
Cours-conférence, École Nationale Supérieure des Mines de Saint Etienne, Sébastien Manneville (2013)
Functional Genomics Program, Université de Maine, Orono (USA), Alain Arneodo (2005-2014).
Filière BioInformatique et Modélisation, INSA, Lyon, Alain Arneodo (2007-2014)

7. *Cours dispensés dans des écoles internationales*

Mar del Plata, Patrice Abry (août 2013)
Warsaw School of Statistical Physics, Kazimierz, Angel Alastuey (Juin 2009)
East China Normal University Shanghai, Françoise Argoul
University of Perm, Françoise Argoul (Novembre 2013)
School, Trieste, Alain Arneodo (Juin 2014)
School, Institut Curie, Paris, Alain Arneodo (Mars 2014)
School, Perm, Alain Arneodo (Novembre 2013)
Les Houches School in Computational Physics, Alain Arneodo (Mai 2013)
School, Institut Curie, Paris, Alain Arneodo (Avril 2013)
Ecole interdisciplinaire d'échanges et de formation en biologie, Benjamin Audit (Avril 2010 et 2013)
East China Normal University, Shanghai, Ludovic Bellon (2009)
USACH, Santiago, Ludovic Bellon (2009)
Université de Leipzig, Eric Bertin (Mai 2013)

Centre de Physique des Houches, Pierre Borgnat (Septembre 2010)
Summer school Université de Cergy-Pontoise, Freddy Bouchet, (Juin 2010)
Spring School, Lyon, Institut Camille Jordan, Freddy Bouchet (Mars 2012)
5th Warsaw School of Statistical Physics, Kazimierz Dolny, Poland, Freddy Bouchet (Juin 2014)
Lecture in Leuven university, Belgium, Freddy Bouchet (Février 2014)
Cargèse, David Carpentier (Septembre 2012)
Peyresq, Rencontres du non linéaire, Bernard Castaing (Juin 2010)
Centre de Physique des Houches, Laurent Chevillard (Mars 2010 et 2012)
Centre de Physique des Houches, Francesca Chillà, (Mars 2012)
Ecole d'été du Nonlinéaire, Peyresq, Thierry Dauxois (Août 2009).
ICTP conference, Yaoundé, Thierry Dauxois (Novembre 2011)
Rencontres de Peyresq, Thierry Dauxois (Juin 2012)
Ecole du GDR de PQM à Cargèse, Pascal Degiovanni (Septembre 2012)
Ecole du GDR IQFA à Nice, Pascal Degiovanni (Mars 2011)
Centre de Physique des Houches, Ralf Everaers (Juin 2011)
Dynacop Summer School in Capri (Italy), Ralf Everaers (Juillet 2011)
Molsim School, Amsterdam, Ralf Everaers (Janvier 2014)
École d'Été à Trieste, Krzysztof Gawędzki, (Août 2010)
Université de Helsinki, Krzysztof Gawędzki, (novembre 2012)
East China Normal University Shanghai, J.-C. Géminard (2010)
Santiago du Chili, Chili, J.-C. Géminard (2011)
Centre de Physique des Houches, Thomas Gibaud (Mars 2013)
School on the Fundamentals of Neutron Scattering, Natal, Peter Holdsworth (2013)
Ecole des Houches, Frontiers of Condensed Matter, Peter Holdsworth (2011)
European School on Magnetism, Targoviste, Peter Holdsworth (Août 2011)
East China Normal University, Shanghai, Emmanuel Leveque (Octobre 2011)
Heriot-Watt University, Edinburgh, Emmanuel Leveque (Septembre 2011)
Beijing Normal University, Livine Etera (Août 2012)
Centre de Physique des Houches, Nicolas Plihon (Mars 2013)
Ecole de Cargèse, Alain Pumir (Juillet 2012)
Ecole d'été de Peyresq, Nelly Pustelnik (Juin 2013)
Tutoriel IEEE ICASSP 2013, Nelly Pustelnik (Juin 2014)
LACES 2011, GGI, Florence, Italy, Henning Samtleben (Décembre 2011)
18th APCTP Winter School, Pohang, South Korea, Henning Samtleben (Janvier 2014)
NUMAGS, Nice, Nicolas Taberlet (Octobre 2011)
Indian Statistical Institute, New Delhi, Véronique Terras (Décembre 2010)
ESI Summer school in Mathematical Physics, Vienna, Fabio Toninelli (Août 2011)
Rencontres de Probabilités 2011, Rouen, Fabio Toninelli (Mai 2011)
Centre de Physique des Houches, Cédric Vaillant (Juin 2013)

I. Document unique d'évaluation des risques (DUER)

évaluation des risques professionnels — **Document unique**

Code du travail Articles L.4121-3 et R.4121-1

Année 2014

Tutelles	CNRS - ENS - UCBL
Etablissement(s) d'hébergement	E.N.S LYON
Unité de recherche ou de service	UMR5672 - Laboratoire de Physique
Principales activités	Recherche
Directeur	DAUXOIS Thierry

Effectifs

Enseignants et/ou chercheurs	62	**ITA ou IATOS**	14	**CDD**	1
Etudiants	0	**Autres**	78	**TOTAL**	155

Sites géographiques et locaux

Nombre de sites	1	**Surface des locaux**	0 m2

Description succincte de la méthode mise en oeuvre Personnes associées à l'évaluation

Les personnes associées pour la réalisation du document unique sont:
-Le directeur.
-Les assistants de prévention.
-Les référents par secteur.

Organisation de la sécurité au sein de l'unité

AP (Assistant de Prévention)	**Nomination**	oui
	Formation initiale	oui
	Formation continue	oui

Présence d'un registre santé et sécurité	oui
Existence d'un règlement intérieur	oui
Mesure pour le travail isolé et/ou horaires décalés	oui
Existence d'une instance consultative (CSHSCT, autre) au sein de l'unité	non
Si non, saisie du conseil de laboratoire, service, unité, département	oui
Rédaction de plans de prévention	oui

Organisation des secours

Nombre de Sauveteurs Secouristes du Travail	2
Nombre de chargés d'évacuation	3
Nombre d'équipiers de première intervention	0
Présence d'armoires de premiers secours	oui
Affichage de consignes générales de sécurité	oui
Affichage de consignes spécifiques sur la conduite à tenir en cas d'accident	oui
Organisation d'exercices d'évacuation	oui
Nombre de personnes formées à la manipulation des extincteurs	0

Information personnel et formations suivies au cours des 12 derniers mois

Affichage de consignes de sécurité aux postes de travail présentant des risques particuliers	oui
Formation à la sécurité des nouveaux entrants au sein de l'unité	oui
Si oui, dispensée par : - l'Assistant de Prévention	non
- l'encadrant	oui

Nature des autres formations en hygiène et sécurité suivies par le personnel	Nombre de personnes
Risque laser	5
Risque chimique	7

Suivi Médical des personnels

Suivi médical adapté aux risques professionnels	
- pour les titulaires	oui
- pour les non titulaires	oui

Accidents du travail et maladies professionnelles au cours des 12 derniers mois

Nombre d'accidents du travail	1
Nombre d'accidents analysés	1
Nombre de maladies professionnelles	0

Nature des accidents et des maladies professionnelles

Laser dans l'œil.

Gestion des déchets

Mise en place d'une gestion des déchets	oui
Stockage des déchets dans un local réservé	oui
Elimination selon une filière agréée	oui

Inventaire des risques

Sigle unité Laboratoire de Physique **Directeur** DAUXOIS Thierry **Année** 2014

Unité de recherche ou de service UMR5672

Date de présentation au CSHSCT ou au conseil d'unité, de laboratoire, département, service 06/01/2014

Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R1/2014	ENS LR1 / Rez de Chaussée / LR1 0 79 - Salle expérimentation / Partout	Laboratoire de Physique	Manutention mécanique	3	Manutention de charges avec élingues et/ou travail à proximité	Vérification périodique	
R2/2014	ENS LR1 / Rez de Chaussée / LR1 0 79 - Salle expérimentation / Partout	Laboratoire de Physique	Incendie	4	Présence de matériaux ou produits combustibles (stockage de cartons)	Moyen de secours adaptés (extincteurs) Organisation du stockage (quantités limitées) Réalisation d'exercices d'évacuation et de lutte contre l'incendie	
R3/2014	ENS LR1 / Rez de Chaussée / LR1 0 63 - Salle expérimentation / Partout	Laboratoire de Physique	Risque chimique	4	Armoire de stockage des produits chimiques	-Équipement de protection individuelle. Système de captage à la source (sorbonne).Système de stockage adapté (Armoire à produits chimiques). -Intégration de la sécurité dans les protocoles expérimentaux -Formation sur les risques liés aux produits manipulés	

Document de travail

Document de travail

Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R4/2014	ENS LR1 / 1er étage / LR1 1 63 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	2	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l'œil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consigne. -Aptitude médicale préalable, formation sur les risques liés au laser.	
R5/2014	ENS LR1 / Sous-sol / LR1 -1 35 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	2	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l'œil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consignes. -Aptitude médicale préalable, formation sur les risques liés au laser.	
R6/2014	ENS LR1 / Sous-sol / LR1 -1 59 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	2	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l'œil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consignes. -Aptitude médicale préalable, formation sur les risques liés au laser.	
R7/2014	ENS LR1 / Sous-sol / LR1 -1 51 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	2	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l'œil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consignes. -Aptitude médicale préalable, formation sur les risques liés au laser.	

Document de travail

Document de travail

Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R8/2014	ENS LR1 / Sous-sol / LR1 -1 59 - Salle expérimentation / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	4	Toutes les situations aux cours desquelles il existe une possibilité: -D'inhalation (anoxie ou asphyxie) ou de contact cutané ou oculaire suite à la libération d'un produit. -De déclenchement d'un incendie. -De projection d'un objet sous pression. -De lésions dues à la manutention.	-Chainage des bouteilles. -Équipements de protection individuelle adaptés et en bon état.	
R10/2014	ENS LR1 / Sous-sol / LR1 -1 31 - Salle expérimentation / Partout	Laboratoire de Physique	Risque chimique	4	Toutes les situations au cours desquelles il y a une possibilité d'inhalation, d'indigestion, de contact cutané ou oculaire de puis la réception du produit jusqu¿à son élimination. Toutes les situations aux cours desquelles les produits sont susceptibles de déclencher ou de propager un incendie.	-Équipement de protection individuelle adapté et en bon état. -Intégration de la sécurité dans les protocoles expérimentaux. -Formation sur les risques liés aux produits manipulés.	
R11/2014	ENS LR1 / Sous-sol / LR1 -1 23 - Salle expérimentation / Partout	Laboratoire de Physique	Equipements sous pression (hors bouteille de gaz) ou sous vide	2	Toutes les situations au cours desquelles il existe une possibilité de libération du contenu sous pression, notamment lors de l'ouverture, du fonctionnement, de la charge de l'appareil, de projection d'objet sous pression.		-Vérification périodique.
R12/2014	ENS LR1 / 1er étage / LR1 1 33 - Atelier d'électronique / Partout	Laboratoire de Physique	Risque électrique	4	Possibilité d'électrocution ou d'électrisation.	-Équipement de protection individuelle. -Contrôle et maintenance du matériel. -Formation.	

Document de travail

Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R13/2014	ENS LR1 / 1er étage / LR1 1 27 - Atelier de mécanique / Partout	Laboratoire de Physique	Equipements de travail et matériel de laboratoire	4	Utilisation de machines coupantes mécanisées. Présence d¿élément en mouvement.	-Équipement de protection individuelle. -Contrôle et maintenance du matériel. -Affichage des consignes et des règles d'utilisation. -Formation.	
R14/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Equipements de travail et matériel de laboratoire	3	Utilisation de machines coupantes mécanisées. Présence d¿éléments en mouvements.	-Équipement de protection individuelle. -Utilisation d'équipement de travail et de matériels adaptés, conformes et maintenus en bon état. -Formation	
R15/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Machines coupantes mécanisées en fonctionnement.	-Equipement de protection individuelle (casque anti bruit). -Limitation du nombre de travailleurs.	
R16/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Manutention manuelle	4	Mouvements (torsions, déplacements, soulèvements).	-Équipements de protection individuelle. -Aides mécaniques adaptées. -Organiser et planifier les manutentions. -Formations des personnels aux gestes et postures.	
R17/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Travail sur écran	4	Contraintes ergonomiques (écrans, clavier, siège etc...).	-Ergonomie du poste adaptée à l'utilisateur. -Pauses régulières. -Formation et information des personnels.	

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Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R18/2014	ENS LR1 / 1er étage / LR1 1 57 - Salle de chimie / Partout	Laboratoire de Physique	Risque chimique	3	Toutes les situations au cours desquelles il y a une possibilité d'inhalation, d'indigestion, de contact cutané ou oculaire depuis la réception du produit jusqu¿à son élimination. Toutes les situations au cours desquelles les produits sont susceptibles de déclencher ou de propager un incendie.	-Équipement de protection individuelle. -Système de captage à la source (sorbonne). -Système de stockage adapté (armoire à produits chimiques). -Intégration de la sécurité dans les protocoles expérimentaux. -Formation sur les risques liés aux produits manipulés.	
R19/2014	ENS LR1 / 1er étage / LR1 1 27 - Atelier de mécanique / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	3	Machines coupantes mécanisées en fonctionnement.	-Limitation du nombre de travailleurs.	-Equipement de protection individuelle (casque anti bruit).
R20/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	3	Toutes les situations au cours desquelles il existe une possibilité, d'inhalation (anoxie ou asphyxie) ou de contact cutané ou oculaire suite à une libération d'un produit. De déclenchement d'un incendie. De projection d'un objet sous pression. De lésions dues à la manutention.	-Chaînage des bouteilles. -Equipement de protection individuelle adaptés et en bon état..	
R21/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Incendie	4	Toutes les situations de travail au cours desquelles peuvent se trouver simultanément présents un matériau ou produit combustible, une source de chaleur et un comburant.	-Moyens de secours adaptés (extincteurs). -Affichage des diverses consignes de sécurités et des plans d'évacuation. -Réalisation d'exercices d'évacuation et de lutte contre l'incendie.	

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Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R22/2014	ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Exposition à des pollutions chimiques, biologique ou radioactive, ou lorsqu'un agent travaille en milieu clos ou confiné.	-Système d'aspiration des fumées performant. -Limitation du nombre de travailleurs et de la durée d'exposition.	
R23/2014	ENS LR1 / Rez de Chaussée / LR1 0 26 - Atelier de menuiserie / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Machines coupantes mécanisées en fonctionnement.	-Equipement de protection individuelle (casque anti-bruit). -Limitation du nombre de travailleurs.	
R24/2014	ENS LR1 / 1er étage / LR1 1 57 - Salle de chimie / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	4	Risque d'inhalation (anoxie ou asphyxie).	-Détecteurs appropriés. -Formation et information sur les risques liés à la manipulation des gaz.	
R25/2014	ENS LR1 / Rez de Chaussée / LR1 0 26 - Atelier de menuiserie / Partout	Laboratoire de Physique	Equipements de travail et matériel de laboratoire	3	Utilisation de machines coupantes mécanisées. Présence d'éléments en mouvements.	-Equipement de protection individuelle. -Utilisation d'équipement de travail et de matériels adaptés, conformes et maintenus en bon état. -Formation.	
R26/2014	ENS LR1 / Sous-sol / LR1 -1 51 - Salle expérimentation / Partout ENS LR1 / Sous-sol / LR1 -1 59 - Salle expérimentation / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	3	Risque d'inhalation (anoxie ou asphyxie).	-Détecteurs appropriés. -Formation et information sur les risques liés à la manipulation des gaz.	
R27/2014	ENS LR1 / Sous-sol / LR1 -1 35 - Salle expérimentation / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Milieu clos ou confiné.	-Limitation du nombre de travailleurs et de la durée d'exposition.	V.M.C pas très efficace.
R29/2014	ENS LR1 / Rez de Chaussée / LR1 0 26 - Atelier de menuiserie / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Exposition à des poussières.	-Aspiration centralisée. -Limitation du nombre de travailleurs et de la durée d'exposition.	
R30/2014	ENS LR1 / Rez de Chaussée / LR1 0 26 - Atelier de menuiserie / Partout	Laboratoire de Physique	Incendie	4	Risque d'inhalation (anoxie ou asphyxie).	-Moyens de secours adaptés (extincteurs). -Affichage des diverses consignes de sécurité et des plans d'évacuation. -Réalisation d'exercices d'évacuation et de lutte contre l'incendie.	

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Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R31/2014	ENS LR1 / Sous-sol / LR1 -1 14 - Salle expérimentation / Partout ENS LR1 / Sous-sol / LR1 -1 15 - Salle expérimentation / Partout ENS LR1 / Sous-sol / LR1 -1 18 - Salle expérimentation / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	4	Risque d'inhalation (anoxie ou asphyxie).	-Détecteurs appropriés. -Formation et information sur les risques liés à la manipulation des gaz.	
R32/2014	ENS LR1 / Partout / Partout / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Expérimentation en cours de fonctionnement.	-Casque anti-bruit. -Limitation du nombre de travailleurs.	
R33/2014	ENS LR1 / Sous-sol / Partout / Partout	Laboratoire de Physique	Ambiances / Conditions de travail	4	Risque ventilation.	-Ventilation mécanique contrôlée.	-V.M.C insuffisante.
R34/2014	ENS LR1 / Partout / Partout / Partout	Laboratoire de Physique	Chutes de personne	3	Chutes.	-Prises adaptées.	
R35/2014	ENS LR1 / Sous-sol / LR1 -1 31 - Salle expérimentation / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	3	Risque d'inhalation (anoxie ou asphyxie).	-Détecteurs appropriées. -Formation et information sur les risques liés à la manipulation des gaz.	
R36/2014	ENS LR1 / Rez de Chaussée / LR1 0 79 - Salle expérimentation / Partout ENS LR1 / Rez de Chaussée / LR1 0 21 - Atelier de mécanique / Partout ENS LR1 / Sous-sol / Couloir sous sol LR1 / Partout	Laboratoire de Physique	Manutention mécanique	2	Écrasement des personnes, défaillance des moyens de manutention.	-Matériel conforme et adapté aux charges.	-Vérifications périodiques obligatoires.
R37/2014	ENS LR1 / Rez de Chaussée / Salle expérimentation / Partout	Laboratoire de Physique	Risque électrique	3	Toutes les situations au cours desquelles il existe des possibilités d¿électrocution ou d'électrisation liées à des appareils, des installations, des machines ou des outils.	-Dispositif de coupure d'urgence. -Contrôle et maintenance des installation.	-Habilitation du personnel.
R38/2014	ENS LR2 / Rez de Chaussée / LR2-0-08 - Salle expérimentation / Partout ENS LR2 / Rez de Chaussée / LR2-0-18 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	3	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l¿œil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consignes.	-Habilitation du personnel. -Aptitude médicale préalable, formation sur les risques liés au laser.

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Réf.	Lieux / Postes	Service	Facteur de risques	P	Modalités d'exposition	Moyens de prévention en place	Carences / Dysfonctions
R39/2014	ENS LR4 / Rez de Chaussée / LR4-0-23 - Salle expérimentation / Partout	Laboratoire de Physique	Laser	3	Toutes les situations au cours desquelles il existe une possibilité d'exposition de l'oeil ou de la peau au faisceau, directement ou par réflexion spéculaire.	-Capotage des faisceaux, écrans de protection. -Signal lumineux à l'entrée de la pièce. -Consignes.	-Visite médicale obligatoire. -Formation liées au risque laser.
R40/2014	ENS LR4 / Rez de Chaussée / LR4-0-03 - Salle expérimentation / Partout	Laboratoire de Physique	Risque chimique	3	Utilisation de produits cancérogènes, mutagènes ou toxiques pour la reproduction (CMR) en faible quantité.	-Intégration de la sécurité dans les protocoles expérimentaux. -Formation sur les risques liés aux produits manipulés.	-Equipement de protection individuelle. -Système de captage à la source (sorbonne). -Système de stockage adapté (armoire à produits chimiques).
R41/2014	ENS LR4 / Rez de Chaussée / LR4-0-03 - Salle expérimentation / Partout	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	2	Chute d'objets.	-Responsable.	-Point d'attache inexistant.

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Programme d'actions de prévention

Sigle Unité Laboratoire de Physique | **Directeur** DAUXOIS Thierry | **Année** 2014

Unité de recherche ou de service UMR5672

Date de présentation au CSHSCT ou au conseil d'unité, de laboratoire, département, service 06/01/2014

Réf.	Service	Facteur de risques	P	Action de prévention	Type	Coût	Fin prévue	Responsable	Statut
R3/2014	Laboratoire de Physique	Risque chimique	4	Changer le filtre régulièrement	Technique	450	10/12/2014	Franck VITTOZ	En cours
R4/2014	Laboratoire de Physique	Laser	2	-Fiche de poste sur les dangers des lasers.	Organisationnel	0	19/12/2014	Franck VITTOZ	En cours
R4/2014	Laboratoire de Physique	Laser	2	-Installer des supports lunettes.	Equipement	0	19/12/2014	Franck VITTOZ	En cours
R5/2014	Laboratoire de Physique	Laser	2	-Installer des supports lunettes.	Equipement	0	19/12/2014	Franck VITTOZ	En cours
R5/2014	Laboratoire de Physique	Laser	2	-Fiche de poste sur les dangers des lasers.	Organisationnel	0	19/12/2014	Franck VITTOZ	En cours
R6/2014	Laboratoire de Physique	Laser	2	-Installer des supports lunettes.	Equipement	0	19/12/2014	Franck VITTOZ	En cours
R6/2014	Laboratoire de Physique	Laser	2	-Fiche de poste sur les dangers des lasers.	Organisationnel	0	19/12/2014	Franck VITTOZ	En cours
R7/2014	Laboratoire de Physique	Laser	2	-Installer des supports lunettes.	Equipement	0	19/12/2014	Franck VITTOZ	En cours
R7/2014	Laboratoire de Physique	Laser	2	-Fiche de poste sur les dangers des lasers.	Organisationnel	0	19/12/2014	Franck VITTOZ	En cours
R11/2014	Laboratoire de Physique	Equipements sous pression (hors bouteille de gaz) ou sous vide	2	-Mettre en place une vérification périodique.	Vérification	0	19/12/2014	Franck VITTOZ	En cours
R18/2014	Laboratoire de Physique	Risque chimique	3	-Changer le filtre tous les ans.	Equipement	400	19/12/2014	Franck VITTOZ	En cours
R19/2014	Laboratoire de Physique	Ambiances / Conditions de travail	3	-Casque anti bruit	Equipement	0	19/12/2014	Franck VITTOZ	En cours

Réf.	Service	Facteur de risques	P	Action de prévention	Type	Coût	Fin prévue	Responsable	Statut
R27/2014	Laboratoire de Physique	Ambiances / Conditions de travail	4	-Améliorer la V.M.C.	Technique	0	19/12/2014	Franck VITTOZ	En cours
R33/2014	Laboratoire de Physique	Ambiances / Conditions de travail	4	-Améliorer V.M.C.	Technique	0	19/12/2014	D.P.M.G	En cours
R34/2014	Laboratoire de Physique	Chutes de personne	3	-Installation de passage de câble.	Equipement	0	19/12/2014	Franck VITTOZ	En cours
R36/2014	Laboratoire de Physique	Manutention mécanique	2	-Mise en place d'un contrat de vérifications périodiques.	Vérification	600	19/12/2014	Bureau Véritas	En cours
R37/2014	Laboratoire de Physique	Risque électrique	3	-Habilitation du personnel.	Formation	0	19/12/2014	Organisme d'habilitation	En cours
R38/2014	Laboratoire de Physique	Laser	3	-Visite médicale obligatoire.	Suivi médical	0	19/12/2014	Service médical	En cours
R38/2014	Laboratoire de Physique	Laser	3	-Formation risque laser.	Formation	0	19/12/2014	Organisme d'habilitation	En cours
R39/2014	Laboratoire de Physique	Laser	3	-Visite médicale.	Suivi médical	0	19/12/2014	Service médical	En cours
R39/2014	Laboratoire de Physique	Laser	3	-Habilitation liée au risque laser.	Formation	0	19/12/2014	Organisme d'habilitation	En cours
R40/2014	Laboratoire de Physique	Risque chimique	3	-Remplacer le stockage actuel par une armoire de stockage des produits chimiques.	Equipement	0	19/12/2014	Marius TANASE	En cours
R40/2014	Laboratoire de Physique	Risque chimique	3	-Stocker les produits CMR dans un réfrigérateur dédié au LR4.	Equipement	0	19/12/2014	Marius TANASE	En cours
R41/2014	Laboratoire de Physique	Liquides cryogéniques et bouteilles de gaz	2	-Attacher la bouteille au mur avec une chaine.	Equipement	0	19/12/2014	Marius TANASE	En cours

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J. Liste des personnels

NOM	Prénom	Signature
ABRY	Patrice	
ALASTUEY	Angel	
AUDIT	Benjamin	
BARTOLO	Denis	
BELLON	Ludovic	
BERGERON	Vance	
BORGNAT	Pierre	
BOUCHET	Freddy	
CARPENTIER	David	
CASTELNOVO	Martin	
CHEVILLARD	Laurent	
CHILLA	Francesca	
CILIBERTO	Sergio	
CRAUSTE THIBIERGE	Caroline	
DAUXOIS	Thierry	
DEGIOVANNI	Pascal	
DELDUC	François	
EVERAERS	Ralf	
FEDORENKO	Andrey	

NOM	Prénom	Signature
FLANDRIN	Patrick	
FREYSSINGEAS	Eric	
GARNIER	Nicolas	
GAWEDZKI	Krzysztof	
GAYVALLET	Hervé	
GEMINARD	Jean-Christophe	
GIBAUD	Thomas	
HOLDSWORTH	Peter	
JENSEN	Pablo	
JOUBAUD	Sylvain	
LIVINE	Etera	
MAGRO	Marc	
MAILLET	Jean-Michel	
MANNEVILLE	Sébastien	
MOSKALENKO	Cendrine	
NAERT	Antoine	
NICCOLI	Giuliano	
ODIER	Philippe	
ORIGNAC	Edmond	
OSWALD	Patrick	
PALIERNE	Jean-François	
PAULIN	Sébastien	

NOM	Prénom	Signature
PEYRARD	Michel	
PINTON	Jean-François	
PLACE	Christophe	
PLIHON	Nicolas	
PUMIR	Alain	
PUSTELNIK	Nelly	
RIGORD	Patrick	
ROSCILDE	Tommaso	
ROUX	Stéphane	
SAMTLEBEN	Henning	
SANTUCCI	Stéphane	
STEINBERGER	Audrey	
TABERLET	Nicolas	
VAILLANT	Cédric	
VENAILLE	Antoine	
VIDAL	Valérie	
VOLK	Romain	

K. Glossaire

- AERES : Agence d'Evaluation de la Recherche et de l'Enseignement Supérieur
- AMUE : Agence de mutualisation des universités et établissements d'enseignement supérieur et de recherche
- ANR : Agence Nationale de la Recherche (French National Science Foundation)
- AP : Assistant Prévention
- BQR : Bonus Qualité Recherche
- CEA : Commissariat à l'Energie Atomique
- CBP : Centre Blaise Pascal
- CETHIL : Centre d'Energétique et de Thermique de Lyon
- CNRS : Centre National de la Recherche Scientifique
- CNU : Conseil National des Universités (national evaluation panel for university professors)
- CoNRS : Comité National de la Recherche Scientifique (CNRS evaluation panel)
- CPGE : Classe Préparatoire aux Grandes Écoles (preparatory school to Grandes Écoles)
- CR : Chargé de Recherches (junior CNRS researcher)
- CRAL : Centre de Recherche en Astrophysique de Lyon
- DR : Directeur de Recherches (senior CNRS researcher)
- ENS : Ecole Normale Supérieure (Graduate school)
- ED : Ecole Doctorale (Graduate school)
- ERC : European Research Council (competitive funding systeprovided by the European Union)
- ESRF : Synchrotron européen (European Synchrotron)
- EvRP : Logiciel d'Évaluation des Risques Santé Sécurité
- FRAMA: Fédération de Recherche André Marie Ampère (local network of physics laboratories)
- FUI: Fonds Unique Interministériel
- GDR : Groupement De Recherche (national network of laboratories, funded by CNRS for several years)
- GRETSI : Groupement de Recherche en Traitement du Signal et des Images
- HCERES : Haut Comité d'Evaluation de la Recherche et de l'Enseignement Supérieur
- HDR : Habilitation à Diriger les Recherches
- IDRIS : Institut du développement et des ressources en informatique scientifique (french computer center)
- IGFL : Institut Génomique Fonctionnelle de Lyon
- ILL : Institut Laue Langevin
- ILM : Institut Lumière Matière
- INP : INstitut de Physique (CNRS department)
- INSII : INstitut des Sciences de l'Information et de leurs Interactions (CNRS department)
- INSIS : INstitut des Sciences de l'Ingénierie et des Systèmes (CNRS department)
- IPNL : Institut de Physique Nucléaire de Lyon
- ITA : Ingénieurs, Techniciens et Administratifs (CNRS denomination for technical and administrative staff)
- IUF : Institut Universitaire de France (service supporting university professors to promote their research)
- IXXI : Institut des Systèmes Complexes
- Labex : Laboratoire d'Excellence (local network of laboratories, funded for a ten-year period)
- LBMC : Laboratoire de Biologie Moléculaire et Cellulaire
- LGL : Laboratoire de Géologie de Lyon
- LGPC : Laboratoire de Génie des Procédés Catalytiques
- LIA : Laboratoire International Associé (joint international laboratory)
- LIP : Laboratoire d'Informatique du Parallélisme
- LJC : Laboratoire Joliot Curie
- LMA: Laboratoire des Matériaux Avancés
- LMFA : Laboratoire de Mécanique des Fluides et d'Acoustique
- MCF : Maître de Conférence (junior university professor)
- PALSE : Plan d'Avenir Lyon Saint Etienne (local network of institutions funded for a ten-year period)
- PEPS : Projets Exploratoires Premier Soutien (CNRS support for one-year project to initiate new activities)
- PES : Prime d'Excellence Scientifique
- PHAST : Ecole Doctorale de Physique et ASTrophysique de Lyon (Lyon's graduate school)
- PICS : Projet International de Coopération Scientifique (international scientific collaboration)
- PR : Professeur (senior university professor)
- PRAG : Professeur agrégé (teaching staff at university)
- PSMN : Pôle Scientifique de Modélisation Numérique (Lyon's computer center)
- RDP : Laboratoire de Reproduction et Développement des Plantes
- RICL : Revue Internationale à Comité de Lecture
- SCTD : Service Central de Traitement de la Dépense (CNRS administrative and financial reform)
- UMPA : Unité de Mathématiques Pures et Appliquées
- UMR : Unité Mixte de Recherche (joint research unit founded by CNRS and other partners)