Etude des Interactions entre Membranes Lipidiques Supportées

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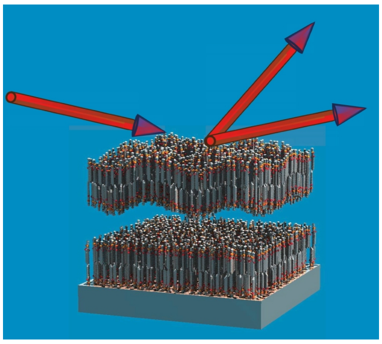
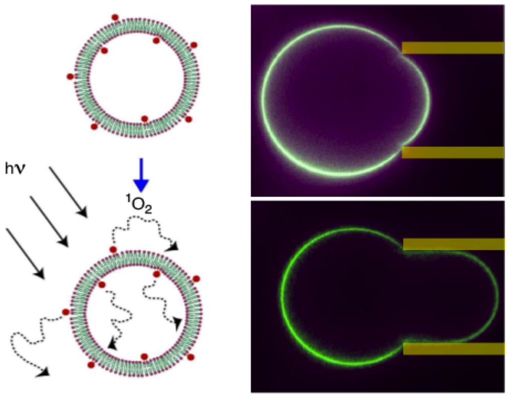
Interactions of lipid membranes are not only crucial for membrane fusion and trafficking, endo- and exocytosis...[1], they are also fascinating from the physical point of view. Membranes indeed exhibit extremely complex interactions with their environment where molecular scale enthalpic (hydration, van der Waals, electrostatic...[1,2]) and fluctuation related entropic contributions are inextricably involved. Determining the interaction potential between bilayers is challenging and first studies were performed on multilamellar stack where static defects can dramatically affect bilayer interactions [3].



In the first part of this presentation, I will present a study of single supported bilayer physical properties. These ~5 nm thick single bilayer are almost defectless, but could not be studied using diffuse scattering until recently [4,5]. By developing an original combination of grazing incidence specular and off-specular scattering using synchrotron radiation, we were able to determine both elastic properties of membranes and their interaction potential. Our measurements demonstrate that floating bilayers are significantly more hydrated than the usually studied multilayers. At equilibrium, the interaction potential can be two orders of magnitude softer than previously reported, which can be explained by the weak electrostatic interaction due to the small fraction (s~0.001 e-/nm2) of ionized lipids in the bilayers.



Photodynamic Therapy (PDT) has been used to treat various solid tumors [6]. The method relies on the administration of a photosensitizer molecule that is suitable to induce the formation of singlet oxygen, a powerful oxidizing agent, able to induce necrosis or apoptosis in cancer cells [7]. In spite of extensive work on chemistry of phospholipids peroxidation, little is known of the deep repercussions that such molecular modifications have on the membrane cohesion and structure. We study the physical transformations induced on giant unilamellar vesicles (GUV) by singlet oxygen species generated at the GUV surface by anchored photosensitive molecules. Lipid peroxidation results for our systems in the production of a significant surface excess that we measure by micropipet aspiration, thus allowing to evaluate the evolution of the different mechanical properties of the membrane under illumination.

[1] R. Lipowsky, “Generic interactions of flexible membranes”, Handbook of Biological Physics, Elsevier,1995.
[2] D. Andelman, “Electrostatic properties of membranes: The Poisson-Boltzmann theory”, Handbook of Biological Physics, Elsevier,1995.
[3] M. Vogel, C. Munster, W. Fenzl and T. Salditt, T., *Physical Review Letters* **84**, 390-393 (2000).
[4] J. Daillant, E. Bellet-Amalric, A. Braslau, T. Charitat, G. Fragneto, F. Graner, S. Mora, F. Rieutord, and B. Stidder, *The Proceding of the National Academy of Sciences USA* **102**, 11639-11644 (2005).
[5] L. Malaquin, T. Charitat and J. Daillant, *Eur. Phys. J. E* **31**, 285-301 (2010).
[6] B. W. Henderson; T. J. Dougherty, J. Photochem. Photobiol. 55, 145 (1992)
[7] D. P. Valenzeno, Photochem. Photobiol. 46, 147 (1987).