ENS DE LYON

Lyon 1

M2 internship fellowship:

Modelling a photo-induced cyclization mechanism

Supervisor: Tangui Le Bahers (tangui.le_bahers@ens-lyon.fr)
Location: Laboratoire de Chimie (Lyon, France)
Duration: 5 months
Subject:

The Laboratory of Chemistry (LCH, UMR 5182) possess a recognized experience in the synthesis of extended binol derivatives, such as molecule **1** on Figure 1. Recently, it has been found that some representatives of this family can experience a cyclization upon light exposure leading to the molecule **2** (Figure 1). This molecule **2** interacts strongly with DNA and is able to generate singlet oxygen, a powerful cytotoxic molecule. In other words, molecule **2** is particularly interesting for photodynamic therapy application. However, in order to expand the availability of molecule **2** or closely related derivatives, we need to understand its synthesis mechanism from molecule **1**. This is the topic of this master project under the supervision of Tangui Le Bahers and in collaboration with Laure Guy and Cyrille Monnereau.

The objective of the M2 project is to determine the mechanism of the photo-induced cyclization of molecule **1** into molecule **2** by quantum chemistry (DFT and TD-DFT). A preliminary investigation proved that the reaction barrier of a direct photo-cyclization is too large (171 kJ.mol^{-1}, Figure 1) at the ground state to be possible, as observed experimentally. The M2 student will have to build the reaction cyclization mechanism at the first singlet excited state S_1 and the first triplet excited state T_1. Based on the mechanism found and discussions with the experimentalists of this project, propositions of molecule **1** functionalization will be performed to improve the synthesis. The computational results will be confronted to experimental observation.

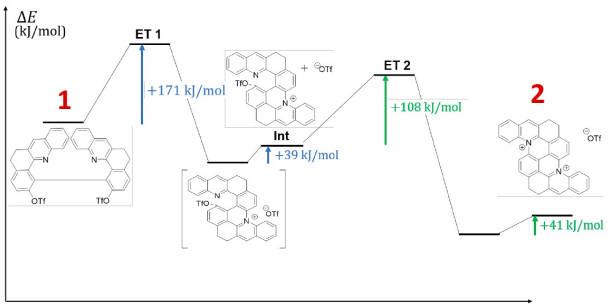

Figure 1. Computed reaction profile for the cyclization of 1 in 2 at the ground state (DFT/PBE0/D3-BJ/6-31+G(d))

Skills:

The candidate must have a good formation in chemical physics and in theoretical chemistry. From a practical point of view, knowledge in quantum chemistry codes will be appreciated.