PhD 2022-2025

Biomolecular structures and radiation damages : experimental developments for gas phase characterization

Location : Team BMS (Biomolecules and Spectroscopy).
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Group

The Biomolecules and Spectroscopy team is internationally known for its structural studies of biomolecules. Our goals are on the one hand to understand the link between structure and function of biomolecules, and on the other hand to characterize the induced fit recognition mechanisms. We work in a strong European and national collaborative network, for experimentations (Free Electron Lasers FELIX in Nijmegen (Netherlands) and CLIO in Orsay (France), ion mobility spectrometry in Lyon (France), radiation damages in Caen (France)) as well as for theory (*ab initio* molecular dynamic calculations at university of L'Aquila (Italy)).

Scientific background

The biological functions of biomolecules (proteins, DNA, RNA) are intimately linked to their secondary or tertiary structure. The knowing of biomolecules excited states and the way they de-excite is also of fundamental interest to understand the reactions in which they are engaged and the way they protect its selves from natural light or ionizing radiations (radiotherapy, hadron therapy). We investigate these topics using the powerful tools of the gas phase, combining mass spectrometry and infra-red spectroscopy, and leading DFT calculations.

Current research project

The gas phase desorption of large biomolecules has been made possible by the advent in the last decades of soft sources, such as electrospray ionization or matrix assisted laser desorption sources. Even if these sources have the capability to preserve low interactions in the gas phase, the desorption process might generate structural changes of the biomolecules and relevance for biological understanding is not always assessed. In this context, we have started the development of a very new laser induced liquid bead ion desorption (LILBID) source: liquid micro droplets, containing the biomolecules of interest, are laser ablated directly under vacuum. This innovative source, which is unique in France, should allow to benefit from the gas phase advantages (stoichiometry control, ions manipulation and trapping) while preserving the biomolecules native structure. The candidate will optimize the working of this source and its coupling with a mass spectrometer, in order to get good resolution mass spectra of large proteins or DNA strands. This first step requires motivation for experimental development and good skills in optics, mechanics and electronics. The second step of this PhD thesis will consist in the coupling of the LILBID source either with a cold trap for IR spectroscopy structural studies, either with an irradiation platform for the characterization of radiation damages on DNA inside the droplets. These coupling will require from the candidate a good level in chemical-physics together with the ability to work with laser and ion beams.