Université Claude Bernard Lyon 1

MASTER de PHYSIQUE

Proposition de sujet de stage
Année 2017-2018

Parcours Optique, Physique Atomique et Moléculaire

Nom du Laboratoire : Institut Lumière Matière
Groupe : Spectrométries des Biomolécules et Agrégats
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Intitulé du stage :

Stability of Single Viruses upon Photon Irradiation

Résumé du travail demandé :

Viruses appear to constitute the most abundant and robust biological entities on earth. All viruses contain a nucleic acid genome and a protein capsid that covers the genome. The capsid is almost always made up of repeating structural subunits that are arranged in one of two symmetrical structures, a helix or an icosahedron. Self-assembly of a viral capsid is a complex oligomerization process that proceeds along a pathway regulated by ordered interactions between the participating protein subunits, and that involves a series of (usually transient) assembly intermediates. The final, mature capsid is a relatively robust protein complex able to protect the viral genome from physicochemical aggressions; however, it is also a metastable, dynamic structure poised to undergo controlled conformational transitions required to perform its biological activity. Studies aiming at evaluating the fragmentation of viruses are very scarce.

A new electrostatic trap has recently been implemented to achieve fragmentation experiments on single ions. We coupled this trap to a CO2 laser to perform infrared multiphoton dissociation of and determine the unimolecular dissociation energy of activation of macro-polymers and whole DNAs. The trapped ions are then irradiated with CO2 laser and fragmented by vibrational heating following a multiphoton IR activation.

A big part of the intern's job will be to perform and interpret photo-fragmentation induced by infrared laser irradiation on intact viruses (with defined structures : helix or icosahedron). The objective of this project is to establish a link between the photo-fragmentation observed in viruses and their structure and establish laws and mechanisms for energy dissipation in these objects. This project will be performed in collaboration with the group of Jean-Luc Pellequer (IBS, Grenoble) who will explore the stability of viruses under high-energy X-ray irradiation beam by AFM measurements. Also, the student will take part in statistical modeling development models polymers using heating / cooling stages to reproduce the observed dissociation dynamics.

[1] Doussineau T, Mathevon C, Altamura L, Vendrely C, Dugourd P, Forge V, et al. Mass Determination of Entire Amyloid Fibrils by Using Mass Spectrometry. Angewandte Chemie International Edition. 2016,55 (7):2340-4.

[2] Costa, L.; Andriatis, A.; Brennich, M.; Teulon, J.-M.; Chen, S.-w. W.; Pellequer, J.-L.; Round, A., Combined small angle X-ray solution scattering with atomic force microscopy for characterizing radiation damage on biological macromolecules. BMC Structural Biology 2016, 16 (1), 18.

Indication éventuelle d'ouverture vers un sujet de thèse : Oui. **Type de financement envisagé :** Bourse ministère.