M2 NAC internship in CIMAP

Molecular growth induced by ion collisions

We are living in a molecular universe. Large molecules as big as C_{60} fullerene have been detected in the interstellar medium and large and complex molecules have been observed in the atmosphere of satellites such as Titan and Europa. However the formation processes of these large molecules are unclear and laboratory studies (both experimentally and theoretically) are required in order to understand the chemical physics behind such observations.

In CIMAP, we are studying the molecular growth inside of molecular cluster induced by ion collisions. We have observed such processes in polycyclic aromatic hydrocarbons (PAH) clusters, in fullerene clusters and in mixed PAH-C_{60} clusters. However the starting building blocks are already quite large. Thus the formation of thess large molecules is currently under investigation, e.g. the growth of cyclic hydrocarbons, the elemental part of PAHs, from linear hydrocarbons such as acetylene, butane, butadiene.

Ion collision experiments are performed at ARIBE the low-energy ion beam facility in GANIL. Complementary studies using photoionisation and electron collisions are done in Prague in the framework of a French-Czech collaboration. Moreover, a theoretical support is provided by people in CIMAP as well as in Toulouse, Madrid and Stockholm also in the framework of funded collaboration including an international laboratory (DYNAMO with Caen, Madrid, and Stockholm).

The experimental method relies on the know-hows of the CIMAP team on the production of molecular clusters using a gas aggregation source and its expertise on the study of the ion interaction with complex molecular systems using coincidence detection of the products of the interaction analysed by time-of-flight mass spectrometry.

This internship is intended for the experimental studies of the ion induced molecular growth inside of clusters of linear hydrocarbon molecules. The analysis of the experiments performed during the first semester 2019 will be done by the student and she/he will perform additional experiments foreseen during the internship in the second semester 2019. Moreover the student may also work on a newly funded project aiming to couple an electrostatic trap to the existing collision device in order to perform additional analysis on the growth products such as studying its stability on the ms timescale. The newly developed experimental setup will allow to perform for the first time pump-probe experiments where the pump is an ion beam.

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