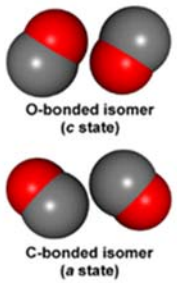
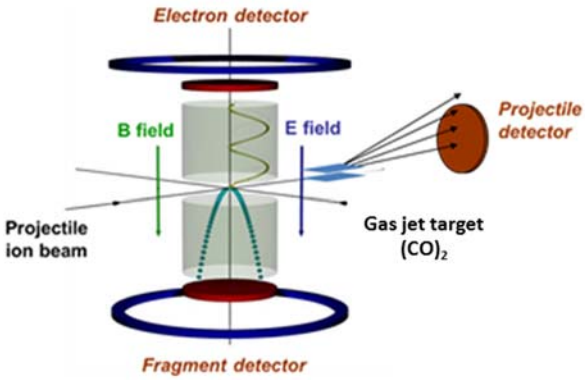
Internship – Master 2 – Erasmus Mundus

Coulomb Explosion Imaging of Molecular Clusters

Molecular clusters such as $(N_2)_n$ or $(CO)_n$ are formed by n≥2 covalent molecules (nitrogen N_2 or carbon monoxyde CO) weakly bounded by the van der Waals force. Despite their simplicity, there are very few experimental data (Infrared spectroscopy) on the 3-dimensional geometry of such clusters : intermolecular distances, relative orientation of the molecules within the cluster... In the last decade, a new experimental technique providing more direct measurements has been developed: by Coulomb exploding the cluster, all momentum vectors of the charged ions can be measured in coincidence, giving access to the initial 3D relative position prior dissociation.

In the experiment developped by the CIMAP laboratory, the Coulomb explosion of the clusters is induced by collisions between a supersonic gas jet and the highly charged ions delivered by the low energy beam line of the GANIL/ARIBE facility. The fragments momenta of each emitted ions are then measured in coincidence using a COLTRIMS setup. One limitation of this technique is the detection efficiency of the microchannel plates (MCPs). The typical efficiency is about 50 % which, for example, leads to a global efficiency of $(0.5)^3$=0.125=12.5% for the coïncident measurement of the three ions emitted from the explosion of a trimer. A new detector with an expected efficiency of about 90% has recently been installed to overcome this limitation.





The main goal of the internship will be to fully characterize the detector performances (efficiency, spacial resolution and linearity,…). The detection efficiency will be both measured using an offline dedicated setup but also deduced from an accurate analysis of the coïncident data from the coulomb explosion of a dedicated molecule or cluster.

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