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Primary processes: from ion-solid to ion-ion collisions

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Fast Highly Charged Ions (HCIs) going through matter induce material modifications and, in turn, their stopping power, charge state and excited states are affected by the material encountered. Here, we report on experimental studies, performed at GANIL, on the production and transport of HCIs excited states in thin solid targets in the so-called high velocity domain. Solids of various thicknesses to investigate the transport effects have been used but also atomic targets to control the primary process that populates the projectile excited states. With the development of quantum transport theories to treat, on the same footing, all the competing processes, we have reached an unprecedented precision in the description of the ion transport in matter in this perturbative regime.
On the other hand, in the non-perturbative regime, where the ion stopping power is maximum, the probabilities related to all the primary electronic processes are of the same order of magnitude. This leads to "interference effects" and makes the determination of experimental cross sections of single elementary collision processes extremely difficult. To overcome this issue, we propose a project, named FISIC*, that will allow studying ion-ion collisions under well controlled conditions. Our goal is to reach experimentally the true three-body system and then add additional electrons, one by one, to explore the quantum dynamics of N-body systems. Those experiments are now possible with the avenue of the new large scale facilities such as GANIL/SPIRAL2 and FAIR/CRYRING.

- FISIC for Fast Ion-Slow Ion Collisions

Primary author: Prof. LAMOUR, Emily (Institut des NanoSciences de Paris - UPMC)

Co-authors: LÉVY, Anne (Institut des NanoSciences de Paris - UPMC); PRIGENT, Christophe (Institut des NanoSciences de Paris - UPMC); VERNHET, Dominique (Institut des NanoSciences de Paris - UPMC); Mr ROZET, Jean-Pierre (INSP - UPMC); Dr TRASSINELLI, Martino (Insitut des NanoSciences de Paris); MACÉ, Stéphane (Institut des NanoSciences de Paris - UPMC); STEYDLI, Sébastien (Institut des NanoSciences de Paris - UPMC)

Presenter: Prof. LAMOUR, Emily (Institut des NanoSciences de Paris - UPMC)

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