Thesis abstract T. Nguyen Trung

« Electronic emission in a single collision between a swift heavy ion and a nanoparticle »

The interstellar medium is mainly composed of gas, but also contains dust, which plays an essential role in the surrounding chemistry and physics. These solid grains act as adsorption sites for molecules, facilitating atomic recombination and chemical reactions on their surfaces. In the coldest, densest clouds, the grains are covered by ices that trap the molecules present in the medium. Moreover, the interstellar medium is constantly bombarded by cosmic rays, which play a key role in its dynamics by ionizing the gas, energizing the grains and sputtering the ices. Beyond these chemical interactions, whole grains can become electrically charged, modifying local chemical dynamics. This charge also influences their interaction with the turbulent and violent electromagnetic fields that characterize the interstellar medium, sometimes leading to their acceleration. Understanding the charge of grains is therefore crucial to correctly modeling their behavior and impact on the interstellar medium. In this context, this thesis presents an experimental study aimed at measuring the charge carried by grains analogous to interstellar dust. Polystyrene nanoparticles with a radius of 100 nm were irradiated with various ions (H, H_2, C, Ar) over a range of energies from 0.7 to 9 MeV. The experiment was carried out using the NanoCR device, installed next to the Andromeda accelerator on the MOSAIC platform at IJCLab. The nanoparticles were beam-formed using an aerodynamic lens, while the ions were produced by the 4 MV accelerator to simulate cosmic rays. The experimental set-up offers a unique collision regime between the ions and the insulating nanoparticles. These results are both interesting and valuable for grain modeling, from both astrophysical and materials physics perspectives, given the small number of experiments available in the literature concerning electronic emission from insulating materials. A comparison was made with a simple simulation based on a diffusion model. It revealed a significant effect of charge on electronic emission for insulating materials.