Transfer induced fission in inverse kinematics at VAMOS : Simulations and characterization of the PISTA detector

During the fission process, an heavy nucleus splits into lighter fragments due to the competition between the attractive strong nuclear force and the electrostatic repulsion. This results in a very large distribution of produced nuclei. The nuclear fission process is driven by a complex interplay between the dynamical evolution of a quantum system composed of a large number of nucleons and the intrinsic nuclear structure of the system at extreme deformations as well as heat flows. The balance between these various aspects decide the characteristics of the emerging fragments. Nevertheless, despite almost 80 years of intense research, fission is still far from being fully understood, and the theoretical and experimental knowledge remains incomplete.

Innovative experiments are conducted to widen our knowledge of fission, aiming notably at a complete identification and characterization of the fission fragments and the study of unstable fissioning systems. In particular, pre- and post-neutron evaporation isotopic fission yields are good candidates to investigate the mechanism responsible for the fission fragments production. The experimental access to this production probability (fission yields) requires the measurement of the full distribution of the fission fragments, which is experimentally very challenging.

At GANIL, the inverse kinematics technique is used to produced in-flight fission. Accelerated heavy fissioning system is excited through nuclear reactions, in particular multi-nucleon transfer reactions and the produced fission fragments are emitted at forward angles. The VAMOS large-acceptance magnetic spectrometer is used to identify, in mass and nuclear charge, the full distribution of fragments while a silicon telescope is used to detect the residual recoil emitted in the transfer reaction.

The fission@VAMOS project is undergoing a detection upgrade of the silicon detection system used to tag the fissionning systems produced by transfer reactions. The existing setup will be replaced by a state-of-art device based on highly-segmented silicon detectors (PISTA). The detection setup of VAMOS spectrometer has also been improved with new high-performance gaseous detectors.

The goal of this internship is to perform simulations and detector characterization for the new experimental setup focused on the measurement of isotopic fission yields. The candidate will be involved in the study of these updates performing simulations of the experimental setup in order to study the optimum geometrical design and performing in-place characterization of the new detectors exploring their real response and specifications. The candidate will be also in charge of the analysis of the acquired data. This internship will provide to the student the possibility to work in real experimental conditions and the opportunity to train all the skills needed in the experimental nuclear field, from the computing science to instrumentation.

Requirements

Good knowledge in interaction radiation-matter and detectors is required. Programming skills and prior knowledge of C++ will be very appreciated. The work will be conducted in an international environment and a good level of English is necessary.

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