PhD position in experimental nuclear physics

FIssion Studies at VAMOS in Inverse Kinematics (FISVIK)

During the fission process, a 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 [1].

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 fissionning 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 [2] is used to identify, in mass and nuclear charge, the full distribution of fragments while a silicon telescope is used to characterize the fissionning system by detecting the residual recoil emitted in the transfer reaction [3,4,5,6].

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). This will result in an improved selectivity and precision of the formation condition of the fissionning system (Mass, Atomic charge, and Excitation energy). The detection setup of VAMOS spectrometer has also been improved with new high-performance gaseous detectors. The first experimental campaign using this upgraded setup is expected in 2022.

The proposed thesis project deals with a detailed multi-parameter study of fission using the VAMOS spectrometer and the PISTA charged particle array to study the fission process in the regions of light actinides. The successful candidate will be in charge of the characterisation of the PISTA detectors, and be strongly involved the setup of the VAMOS spectrometer and PISTA array. She/He will be in charge of the analysis and dissemination of experimental data.

[1] K.-H. Schmidt and B. Jurado, Rep. Prog. Phys. 81 (2018) 106301
[2] M. Rejmund et al., Nucl. Instrum. Methods A **646**, 184 (2011).
[3] Y. Kim, A. Lemasson et al., Eur. Phys. J. A **53**, 162 (2017).
[4] M. Caamano et al. Phys. Rev. C 88 (2013) 024605,
[5] D. Ramos et al. Phys. Rev. Lett. 123 (2019) 092503
[6] D. Ramos, M. Caamaño, A. Lemasson, Phys. Rev. Lett. **123**, 092503 (2019)
[7] D. Ramos, M. Caamaño, A. Lemasson, et al. Phys. Rev. C **101**, 034609. (2020)

Expected skills:

The Phd Candidate :

- Is expected to be a strongly motivated person, with good English communication skills and with a basic background in nuclear reactions and physics of fission;
- Experimental profile and skill in the use of scientific software packages for the data analysis (C++/ ROOT) and simulation.
- Is expected to present the results of his work at scientific conferences at both national and international levels, as well as publish them in scientific journals;
- Will join the international researcher team and take an active part in the ongoing experimental program conducted by the group.

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