9th Workshop on Nuclear Level Density and Gamma Strength

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Development of innovative methods for a fission trigger

The FRØZEN project aims to get a better understanding of the angular momentum generation and the energy partition between fragments in the fission process. The reconstruction of the very first moments after the scission point is essential. Correlated neutron and gamma detection as well as measuring kinematic properties of fission fragments is necessary. Such a task could be achieved thanks to the last generation of hybrid γ -spectrometer named ν -Ball2. To describe the entire fission fragments de-excitation process, we investigate the correlations between the individual fission fragments pairs and fission observables by coupling ν -Ball2 and a double Frisch-Grid Ionisation Chamber (dFGIC).

Experimentally, the dFGIC signals were sampled and stored to disk as "traces", allowing the reconstruction of relevant information on fission fragments' kinematics and identifying fission events (fission tag for ν -Ball2 setup). Some promising regression neural network models have been tested to obtain precise fission tag time, the deposited energy, and the electron drift time from the dFGIC traces. The use of these innovative methods is deeply motivated by the computationally expensive and time-consuming characteristics of more traditional trace analysis approaches.

In this experiment, a spontaneous 252Cf fission source was used. However, for other fissioning systems that require the use of a primary beam, fission could become a minor nuclear reaction compared to other processes. Thus, tagging becomes a challenge in itself. To address this challenge, there is the intent to develop an AI-based algorithm to recognize fission solely based on ν -Ball2 response function. The development of this AI model investigates the impact of each fission observable in fission event recognition and their correlations. Once the algorithm is trained, it could be applied to various fissioning systems without the need for an ancillary fission tag detector, such as the dFGIC.

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