Internship M2 2021-2022

Refurbishing of a scintillator system to profile the neutron beam at the long flight path of NFS

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The activities of the Données Nucléaires pour les réacteurs[1] group (Nuclear data for reactors, DNR) register in the topic of nuclear data for future reactors. The precise study and optimization of these new systems and fuel cycles require higher quality evaluated nuclear databases, used in simulations. This improvement implies to work both on experimental aspect and on theoretical nuclear process description. At stakes, there is a need for a significant reduction of uncertainties from new nuclear data. In this context, our team focused on improving the knowledge of the (n, xn) process. To that end, we use the prompt gamma spectroscopy method, which allows us to measure (n,xn γ) reaction cross sections. By combining the experimental results with predictions from models (to fill in missing information), we can deduce the (n, xn) reaction cross section[2].

Our experimental program is expanding with the opening of a new neutron beam facility in the French Ganil (Grand Accelerateur National d'Ions Lourds in Caen). The Neutron For Science[3] facility will produce neutron using, either, Deuterium on Beryllium or, Proton on Lithium, reactions. The resulting beam will have a peak intensity at high energy (15 to 30 MeV depending on the production method), much higher than the beam our group have been using in previous measurements. This opens up the possibility to perform high precision measurements of cross section for the (n, 2n γ) and (n, 3n γ) reaction channels.

A test run of γ ray detection has been performed in the NFS hall in September 2021 and shown that our method for measurement of (n, xn γ) cross-sections will be possible at

1 http://www.iphc.cnrs.fr/-Donnees-Nucleaires-pour-les-Reacteurs-.html
2 M.Kerveno, M. Dupuis, et al., PRC 104 044605 (2021)
3 https://www.ganil-spiral2.eu/scientists/ganil-spiral-2-facilities/experimental-areas/nfs/

NFS. To ensure the maximum detection efficiency, we need the precise knowledge of the neutron beam profile around our detectors. To that end, we intend to characterize the beam at the end of the long flight path (30 meters) of the neutrons.

This will be done using a scintillator bar connected to two photo-multipliers (PM) that has been used before in the GELINA facility (EC-JRC in Geel, Belgium). This setup called Samanta (Scintillator ArM for Analysis of Neutron Tracks Area) has been left unused for some time and need a complete refurbishment before being sent to the NFS beam hall. The PMs need to be recoupled to the scintillators and they will be connected to a modern Faster[1] acquisition system.

The internship work consists in refurbishing the setup, testing it in the laboratory and prepare it to be used in the NFS experimental area. It is a great internship for students who like to work on experimental equipment. In the end, the intern will have the opportunity to make a great and lasting contribution to a new experimental installation by making possible the precise characterization of the beam.

[1] faster.in2p3.fr/