Preliminary analysis of ^{239}Pu(n, xn γ) data for cross section extraction

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Context:

The group Données Nucléaires pour les réacteurs (Nuclear data for reactors, DNR) activities focus on nuclear data for future reactors. The development of new nuclear reactor systems and fuel cycles is mostly done via computer simulations and required high quality evaluated nuclear data. The improvement of these databases requires both experimental and theoretical work, to achieve the goal of reducing uncertainty in nuclear application simulations. In this context, our group focuses on the (n, xn) process by measuring (n, xn γ) reaction cross sections. The combination of our experimental results with predictions from models, allows us to deduce the total (n, xn) reaction cross section[1].

Our measurement programs focus on reactions involving actinides. The experiments take place near the "white" neutron beam facility of GELINA (EC-JRC in Geel, Belgium)[2], where we have developed the GRAPhEME device, comprising a set of planar HPGe detectors and a fission chamber. Particular attention was paid to minimizing all sources of uncertainty linked to our measuring instruments and the environment. During the first campaigns, samples of ^{235}U, ^{232}Th, ^{nat}U, and ^{233}U were placed under the beam. Today, we are studying the high-activity ^{239}Pu nucleus, the fissile core of the innovative U-Pu fuel cycle.

Objectives:

The proposed internship concerns data currently being recorded on ^{239}Pu.

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[1] Measurement of ^{238}U(n, n′ γ) cross section data and their impact on reaction models. M. Kerveno, *et al.* Phys. Rev. C 104, 044605

[2] JRC's Neutron Time-of-Flight Facility (GELINA)

First, the intern will have to familiarize themselves with the general context of nuclear data measurements applied to research on reactors of the future (Uranium-Plutonium cycle, evaluation and measurement of nuclear data, (n, xn) reactions, prompt gamma spectroscopy method...).

Next, the candidate will have to use the analysis tools already developed in the group to identify the γ lines observed in the spectra and conclude on the ^{239}Pu transitions for which an effective cross-section (n, n' γ) can be extracted from the data. Furthermore, the detection efficiency of the setup will be determined and the radioactivity of the sample will also be used to determine precisely the absolute amount of ^{239}Pu in the sample.

Depending on the progress of the work over the time allotted to the internship, work with the TALYS nuclear reaction code and existing databases could be envisaged to calculate the effective cross sections of interest with the reaction models.

Profile of the candidate:

Candidates to the internship are expected to be familiar with programming languages such as C++ and python, as well as analysis tool such as ROOT. An experience in analyzing data from γ ray detectors (spectra) will be an asset. The intern will work autonomously and discuss their finding regularly with the whole research group. They might also have the opportunity to present their results to collaborators during meetings.

Following a successful internship, the work could be continued by a thesis in the same team.