Measurement of $^{242}Pu(n,f)$ in the [1;2MeV] energy range

L. Mathieu[1), M. Aïche[1), P. Marini[1), O. Bouland[2), C. Chatel[3), S. Czajkowski[1), D. Kattikat-Melcom[1), T. Kurtukian[1), S. Oberstedt[4), I. Tsekhanovich[1)

1) Univ. Bordeaux, CNRS, LP2I, UMR 5797, F-33170 Gradignan, France
2) CEA, DES, IRESNE, DER, SPRC, Physics Studies Laboratory, Cadarache, F-13108 Saint-Paul-lez-Durance, France
3) Université de Strasbourg, CNRS, IPHC/DRS UMR 7178, 23 Rue du Loess, F-67037 Strasbourg, France
4) European Commission, DG Joint Research Centre, Directorate G - Nuclear Safety and Security, Unit G.2 SN3S, 2440 Geel, Belgium

mathieu@lp2ib.in2p3.fr

Abstract: The design of new generation nuclear reactors using fast neutrons requires highly accurate cross-section measurements in the MeV energy range. The ^{242}Pu fission cross section is of particular interest for nuclear waste production, as this isotope is a gateway to the production of heavier actinides like ^{243}Am. There are discrepancies around 1 MeV incident neutron energy between libraries and among experimental data. Some data suggest the presence of a strong structure between 1 and 1.2 MeV whereas such structure is barely visible on data from P. Salvador [1]. The shape of this structure is also very different between ENDF/B-VIII and JEFF-3.3.

The large majority of the ^{242}Pu(n,f) measurements have been carried out relative to the ^{235}U(n,f) secondary-standard cross section. This introduces a strong correlation between independent measurements based on the same standard. Moreover, the ^{235}U(n,f) cross section also exhibits structures, in particular a steep increase of +10% at 1 MeV. Therefore, we aim to measure the ^{242}Pu(n,f) cross section relative to the primary-standard H(n,n) cross section, by using a proton recoil detector. This standard has a very high accuracy (0.4%) [2], is independent of other measurements, and is structureless.

An experiment has been carried out in October 2022 at the MONNET facility [3] in JRC-Geel. This facility can produce a quasi-monoenergetic neutron beam via the T(p,n)^{3}He reaction in the MeV energy range. The experimental setups consisted in a ^{242}Pu sample positioned in front of two solar cells in order to detect fission fragments. The neutron flux was converted to protons via an elastic scattering nuclear reaction on a H-rich foil. The proton recoil detector was a Si detector placed downstream the target. Measurements have been performed with incident neutron energies from 0.9 MeV to 2.0 MeV. The experimental setup will be presented, and the analysis procedure will be detailed.

[1] P. Salvador Castiñeira et al., Phys. Rev. C 92, 044606 (2015)
[2] A.D Carlson et al., Nucl. Data Sheet (2018)
[3] S. Oberstedt et al., Technical Report, IAEA (2014)