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The neutron-induced fission cross section on 235U measurement at the n_TOF facility at CERN

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The neutron time-of-flight facility, n_TOF, at CERN, offers the possibility to study neutron-induced reactions thanks to the extremely wide neutron energy spectrum available in its experimental area, from thermal up to GeV. Already since the year 2001, the n_TOF Collaboration has been producing relevant nuclear data for fundamental nuclear physics, technology and astrophysics.
In particular, an extensive programme of neutron-induced fission measurements has being carried out on major and minor actinides, as well as on few lighter elements characterised by a high fission threshold. Together with the features of the neutron beam, the measurements have benefited from high performance detection and acquisition systems specifically developed at n_TOF.
Among these activities, given its importance as main reference, the 235U(n,f) cross section is still deeply studied in different energy regions and using several detector concepts. At n_TOF, this cross section was measured, as a function of the energy, as ratios to 238U(n,f), 10B(n,a), 6Li(n,t) cross sections. More recently, a dedicated measurement campaign was carried out to provide accurate and precise cross section data of the 235U(n,f) reaction in the high energy region from 10 MeV to 440 MeV relative to the neutron-proton elastic scattering cross section.

The experimental apparatus used for this measurements, which involved the effort of several research institutions (INFN, PTB and IPN, in addition to CERN), consisted of three flux detectors and two fission detectors. This allowed to simultaneously record the number of neutrons impinging on the 235U samples (incident neutron flux), as well as fission events. The neutron flux measurement is based on the neutron-proton elastic scattering reaction and it exploits the detection of the recoil protons from a polyethylene target using three Proton Recoil Telescopes. The fission events have been recorded with a fission ionization chamber, as well as by a parallel plates avalanche counters (PPAC) detectors, specifically designed for operation at n_TOF [1,2].

An initial introduction to the _TOF fission program will be followed by a focus on the 235U(n,f) measurement in the high-energy region. The experimental apparatus and data analysis and the results will be presented [3]. In addition, a comparison with current model descriptions of the fission process at high neutron energies will be included in the comparison with the experimental results obtained at n_TOF.

[1] A. Manna, on behalf of the n_TOF Collaboration, Journal of Instrumentation 18 (04), P04024
[2] E. Pirovano, on behalf of the n_TOF Collaboration, Journal of Instrumentation 18 (11), P11011.
[3] A. Manna, E. Pirovano, submitted for publication (2024)

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