NEUTRON INDUCED FISSION STUDIES AT THE CERN N_TOF FACILITY

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The study of neutron-induced fission is important in a variety of fields of basic and applied nuclear physics. For fundamental research it provides important information on properties of nuclear matter and fission process, while for cutting-edge nuclear technology it is a key ingredient for the design and operation of current and innovative nuclear reactors as well as for the transmutation of nuclear waste and nuclear fuel cycle investigations.

The n_TOF neutron time-of-flight facility makes use of the CERN Proton Synchrotron accelerator. It became operational in 2001 and provides pulsed neutron beams with high instantaneous neutron flux, based on the spallation induced by 20 GeV/c bunches of $7-8 \times 10^{12}$ protons impinging on a massive lead target. The facility has undergone a major upgrade during the recent long shutdown of CERN and a new spallation target has been successfully installed and commissioned during autumn 2021.

A major part of the scientific program of n_TOF involves the study of neutron-induced fission reactions, in order to provide high-accuracy and consistent experimental data on fission cross sections and other fission observables over a wide neutron energy range, from thermal to GeV ([1] and references therein, [2-4]). Depending on the actinide and the observable(s), either the experimental area 1 (EAR1), located at approximately 200 m distance from the neutron production point, or the new experimental area 2 (EAR2), located at approximately 20 m on top of the lead target, are utilised. The long flight path of EAR1 provides excellent energy resolution and wide neutron energy range, reaching the GeV region. The EAR2 is typically preferred when high activity or very low mass actinide targets are available and/or when the cross section is very low, or even unknown, thanks to the very high flux with respect to EAR1. Various experimental setups are used, depending on the observables to be measured [1]. A long series of isotopes have been studied from the natural Pb and Bi to the actinides ^{230,232}Th, ^{233,234,235,236,238}U, ^{237}Np, ^{240,242}Pu, ^{241,243}Am, and ^{245}Cm. The neutron induced fission cross section datasets, typically measured relative to a standard reaction (such as ^{235,238}U(n,f), ^{10}B(n,α), ^{7}Li(n,t), n-p scattering [5]), are made publicly available to the scientific community via the IAEA EXFOR database.

An overview of the fission studies performed will be presented and discussed, with a short description of the latest highlights, the various detection systems and data analysis techniques used, as well as the future perspectives of fission measurements at n_TOF. Emphasis will be also given to the innovative characteristics of the new spallation neutron source, the unique features of the PS accelerator in terms of energy, intensity, and duty cycle of the primary beam, that allow to collect high-accuracy, high-quality nuclear data.

REFERENCES

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