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High-precision measurement of neutron-induced fission cross sections and angular distributions

Among the various observables of fission, cross sections are among the most directly connected to applications, especially nuclear energy. The requirement on precision has become more and more stringent over time, with aims as low as 3% for neutron-induced reactions. This is a considerable experimental challenge, since one must deal with radioactive materials and perform measurements using an unstable particle, the neutron, across large ranges of incident energy.

The n_TOF facility at CERN emerged in the 2000s as one of the best facilities for such measurements. There, the by-then IPN Orsay nuclear data team conducted a successful experimental program based on Parallel Plates Avalanche Chambers and electroplated, ultra-thin actinide targets. The unique method, based on the simultaneous detection of both fission fragments, allowed to precisely control the detection efficiency, to access to 10 orders of magnitude of neutron energies and to deal with very events frequencies in the MHz range.

The results on cross sections are being integrated in nuclear libraries, and the techniques developed for this program find new lives at many other neutron facilities, especially the NFS line in GANIL.

One of the highlights of this work was the measurement of fission angular anisotropies, a phenomenon that impacts the cross section measurements but also offers a unique probe on the nuclear structure.

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