Advanced Scintillator Readout for Fast-Timing Experiments and Application to the N=82 Region At FIPPS

This thesis proposes the experimental investigation of neutron-rich exotic nuclei produced by neutron-induced fission of actinide targets. The nuclei will be studied with gamma and ultra-fast timing spectroscopy. The latter has been proved to be a successful tool for neutron-rich nuclei at the border of stability. Together with the knowledge of the level structure of the nuclei probed, this method allows for the determination of nuclear lifetimes of excited nuclear states, which provides a model-independent method of measuring nuclear transition rates. The proposal is based on the successful experienced gathered during the EXILL-FATIMA campaign at the ILL PF1B beam line in 2013, and the subsequent data analysis. The performance of that campaign with fission on ^{235}U and ^{241}Pu targets will be enhanced in the FIssion Product Prompt gamma-ray Spectrometer, FIPPS, part of the ILL Endurance programme. Ultra-fast timing spectroscopy takes advantage of fast, highly performing scintillating crystals for gamma detection. For a full exploitation of the fast-timing method we propose the technical development of magnetically compatible crystal readout systems, and the digital processing of the fast scintillation signals. These can be of general application at FIPSS and other fast-timing setups. The work will be aimed at the development of a gamma-detection system based on $LaBr_3$(Ce) crystals making use of SiPMs, focused at eventually standing magnetic fields, and to the development of a fast-scintillation digital signal processing for both time and energy while maintaining the spectroscopic properties. The development will be applied to the study of neutron-rich Te and Sb isotopes populated in fission of actinide targets and FIPPS, making use of the capabilities of this new device.