PROSPECTIVES OF PHOTOFISSION STUDIES WITH BRILLIANT NARROW-WIDTH GAMMA-BEAM AT THE NEW ELI-NP FACILITY

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ELI-NP, which is expected to become operational in 2018, is a state-of-the-art laboratory dedicated to promote nuclear physics research with extreme electromagnetic fields [1]. It will host a high power laser system (HPLS) with two amplification arms of 10 PW each and a brilliant gamma-beam system (GBS). The intensity and energy resolution parameters of the GBS will allow precise photo-nuclear measurements in the 0.2-20 MeV energy range. The intense (~10^4 photons/s/eV), narrow band width (≥0.3%), highly polarized (>99%) gamma-beam will be produced by Compton back scattering of laser photons off a relativistic electron beam [2].

One of the experimental programs, which is under preparation at the GBS, is focused on photofission studies and aims at high resolution studies on mass, atomic number, angular and kinetic energy distribution of fission fragments following the decay of the states in the 1^{st}, 2^{nd}, and 3^{rd} minima of the potential energy surface (PES) in the region of the light actinides [3]. It addresses dynamics and clusterization effects in super- and hyper-deformed states, since fission-barrier parameters can be extracted. Measurements of absolute photofission cross-sections, studies of rare fission events, such as ternary fission, highly asymmetric fission, etc, are aimed be carried out, too. Highlights of the experimental program will be discussed.

For the realization of these studies, two experimental set-ups are being developed. The first set-up, the ELI-BIC array, includes a set of four double-sided Frisch-grid Bragg spectrometers for the study of transmission resonances. Each spectrometer will be coupled with 8 ΔE/ E detectors for the study of rare photofission events. The second set-up, the ELITHGEM array, is a 4π spectrometer consisting of THGEM detectors for studies of the angular distribution of the fission fragments.

GEANT4 simulations, providing estimates the fission fragment emission rates, their mass and charge distribution, fragment paths, stopping, ionization and energy deposition in the gas chamber, will be presented. Estimates of the background effects due the production of charged particles by the interaction of the gamma beam with the gas atoms in the chamber, the window of the chamber, and the electrodes inside the chamber, will be reported, too.

The ELI-BIC and ELITHGEM arrays are being built in collaboration with MTA-ATOMKI, Debrecen. Results from test experiments, demonstrating the performance of the detectors, will be presented.

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