High precision study of multiple-humped fission barrier landscape with the GBS facility at ELI-NP

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The Extreme Light Infrastructure Nuclear Physics facility, 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. It will host a high power laser system (HPLS) with two amplification arms of 10 PW each and a brilliant gamma-beam system (GBS) [1]. The high spectral density (~10^4 photons/s/eV), high resolution (band width ≥ 0.3%) and high polarization (>99%) of the gamma beams produced by Compton back scattering of laser photons off a relativistic electron beam [2], will allow precise photo-nuclear measurements in the 0.2-20 MeV energy range.

One of the experiments, which is under preparation at the GBS, aims at high resolution study of transmission resonances as a function of energy for light actinide nuclei, aiming at investigation of the multi-humped fission barrier landscape. The study includes mass, atomic number, angular and kinetic energy distribution of fission fragments following the decay of the states in the different minima of the potential energy surface (PES) [3]. It addresses dynamic and clusterization effects in super- and hyper-deformed states. Studies of rare and exotic fission modes, such as true ternary fission, collinear cluster tripartition and highly asymmetric fission, are also part of the program.

For these studies, we are developing a detector array, called ELI-BIC, which includes a set of four double-sided Frisch-gridded Bragg spectrometers. Each spectrometer will be coupled with eight ΔE-E detectors for the study of ternary fission events.

GEANT4 simulations providing expected beam profile at the target position, estimates of the fission fragment emission rates, their mass and charge distribution, release efficiency from the target, fragment paths and ionization in the gas chamber, will be presented for ^{238}U and ^{232}Th target materials.

The ELI-BIC array is being built in collaboration with MTA-ATOMKI, Debrecen. The present status of development of the set-ups and results from test experiments, demonstrating the performance of the detectors, will be presented.

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