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GEANT4 TOOLS FOR THE DESIGN AND ANALYSIS OF PHOTO-FISSION EXPERIMENTS AT ELI-NP

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A rich photo-fission program is proposed at the new Extreme Light Infrastructure - Nuclear Physics (ELI-NP) facility in Magurele-Bucharest, Romania. It is based on the highest brilliance gamma beam system (GBS) that will be available at ELI-NP with energies up to 20 MeV.

In one type of experiments, radioactive ion beams (RIBs), formed from the fission fragments produced by irradiation of uranium targets with high-energy photons, will be used to study exotic neutron-rich nuclei. The other major photo-fission experimental program will study open issues in our current understanding of fission, like transmission resonances in the fission isomeric shelf, ternary fission, and others.

The IGISOL beam line uses a cryogenic gas cell to stop and extract the photo-fission fragments used to form RIBs. A Geant4 module was developed to design this gas cell and maximize the RIB rates. To improve the ion energy-loss calculations, various parameterizations of the ionic charge state were implemented and compared to existing data. For this experimental program, we will present simulated ion production rates and efficiencies.

As a precursor to the experimental photo-fission studies at ELI-NP, a neutron-induced fission experiment on 233U has been performed at the research reactor in Budapest, Hungary, in order to test and develop data acquisition systems, data analysis methods and to have a reference point for the simulated results. The recorded gamma-ray spectrum has been unfolded from detector response using the matrix inversion method obtained after a full GEANT4 implementation and simulation of the experimental setup. Preliminary results for gamma-ray multiplicity and average total energy per fission event are presented, emphasizing the use of GEANT4 as an important tool for data analysis.

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