Extreme Light Infrastructure - Nuclear Physics (ELI-NP) /

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Evaluation of a research project, entitled

"Investigation of Prompt Fission Neutron Emission in Fission (ENGREN)",

proposed by Shakir Zeynalov (PhD), senior scientist at Frank Laboratory of Neutron Physics at Joint Institute for Nuclear Research (FLNP JINR), Dubna, *et al.*

Upon request by Dr. Zeynalov himself, I provide below an evaluation of his proposed research project.

With the above-mentioned project, Dr. Zeynalov proposes to investigate correlations between fission fragment properties and prompt neutron multiplicity from the reaction n + ^{235}U. The intended measurements are supposed to be performed at the IREN facility in Dubna with incident neutrons ranging from thermal energies up to 100 eV. For this purpose a dedicated setup, allowing coincidence measurements between fission fragments and prompt fission neutrons, has been developed and will be used. The setup consists of a twin Frisch-grid ionization chamber, containing the target, and a considerable number of liquid scintillation detectors of BC501 type for neutron detection, allowing for neutron-γ separation by pulse shape discrimination.

The study of prompt-fission neutron emission (among other phenomena) is an important field of research from both the basic research and the nuclear applications' point of view. Prompt neutrons, in particular their multiplicity and energy distribution, may provide information about both formation and de-excitation of fission fragments, the sharing of excitation energy and the timescale of the fission process. For nuclear modeling and an improved evaluation of nuclear data, the knowledge on fluctuations of the prompt-fission multiplicity as a function of different parameters is requested. Among those parameters, incident neutron energy as well as fission fragment properties like mass and total kinetic energy must be mentioned.

In their application, Zeynalov *et al.* give an overview on the present situation regarding prompt fission neutron data depending on fission fragment properties – in particular multiplicity as function of total kinetic energy, supported by numerous references. They also describe how their proposed experimental program with a new dedicated setup will provide data with higher accuracy than preceding studies, e.g. the works by A. Göök *et al.*. Compared to the latter study, this work will employ 32 detectors for prompt neutron detection instead of 23. At the same time, the distance between neutron detectors and fission sample, in the previous work about 50 cm, is here reduced to 17 cm. Moreover, in a first step the amount of target material is planned to be 230 mg ^{235}U, which however needs to reduced significantly in order to be able to measure fission-fragment mass and kinetic energy. Still, more target material is expected than the 1.9 mg ^{235}U as used in A. Göök *et al.*'s work. Together with the expected neutron beam intensity of about 2 × 10^{11} /s /4π, all the above-mentioned improvements are very promising to obtain correlation data with ten times better statistics.

As mentioned before, precise knowledge on fluctuations of the prompt-fission multiplicity as a function of different parameters is of utter importance for nuclear modeling and a reliable evaluation of nuclear data. With the experimental program proposed here, the authors are aiming at improving currently available data significantly. Hence, the new expected data will serve as benchmark for a better theoretical description in the future. As a consequence, I personally support this proposal and recommend granting for both beam time and funding.

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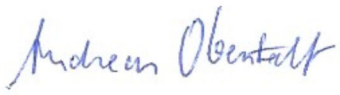

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