Study of Heavy-Ion Induced Fission Dynamics Using Charged Particle Emission as a Probe

Since the discovery of nuclear fission by Hahn and Strassmann in 1939, an extensive amount of experimental and theoretical research has been carried out to understand the complex fission dynamics. A systematic study of particle emission provides finer details about complex fission dynamics. During the fusion-fission process, various particles (n, p, α, and γ-rays) are continuously emitted from various stages. In the case of charged particle emission, it is observed that particles are also emitted when two fragments are just in touching configuration termed as ternary emission. Recently, the use of α-particle emission as a probe has revealed a new signature of non-equilibrium fission. Intriguingly, neutron emission does not display sensitivity to this fine signature of non-equilibrium fission. Exploring such a rare phenomenon through other charged particle emissions, such as protons, would be of considerable interest for benchmarking and further understanding these intricate processes.

We have measured proton energy spectra in coincidence with fission fragments in 16O + 232Th reaction at a beam energy of 96 MeV. The proton multiplicity spectra are analyzed within the framework of moving-source fit. In addition to the typical pre- and post-scission components, the spectra cannot be fitted without incorporating a component that exhibits characteristics of charged particle emission near the scission stage, known as ternary emission. This marks the first time observation of unambiguous ternary proton emission in a heavy-ion induced fission reaction. The attributes of ternary protons align consistently with those of ternary α-particle emissions in heavy-ion induced fission.

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