Understanding of fission dynamics from fragment mass distribution studies

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Abstract:

Nuclear fission is a complex process involving large scale collective rearrangement of nuclear matter. The shape of the fissioning nucleus evolves in the multidimensional space of relative separation, neck opening, mass asymmetry and deformation of the fragments. Various types of nuclear shape deformation have been observed from the fission fragment spectroscopy studies, which provide crucial information in the understanding of the dynamics of the fission process [1-4]. The fission fragment mass and charge distributions are decided during saddle to scission transition and are directly related to the scission configuration. Several nuclear models have been put forward to describe the fission fragment mass distribution as well as shape deformation of the fragments [5]. The width of the fission fragment mass distribution is related to the fission process and provides information on the type of fission reactions.

Fission process also offers an opportunity to study the interplay of the structure and dynamics in the fission process. Recently, the accelerator-based experiments are performed to populate the high-spin states for studying the mass distribution from the spectroscopy measurements to understand the signature of the reaction mechanism. Fine structure dips have been observed in the fragment mass distribution, corresponding to fragment shell closures at Z=50 and N=82 in ^{208}Pb,^{238}U(^{18}O,f) reactions, indicating the evidence for a new feature of "shape inhibition" of closed shell nuclei at the scission point [6-8]. The role of nuclear shell structure as well as importance of shape deformations in the fission fragment mass distribution will be discussed. Some recent results on the fission fragment spectroscopy studies, employing γ-γ coincidence technique for fragment mass measurement using thermal neutrons from reactor, will be presented [9].

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