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# Fission studies of $^{197}$Tl

Asymmetric fission in mass pre-actinide region is a topic of current interest in fission studies. The important observation in this mass region is the asymmetric fission of neutron deficient nuclei. Andreyev et al. [1] have reported asymmetric fission fragment mass distribution in the β delayed fission of 180 Hg nucleus about a decade ago. The observed asymmetric mass distribution has been satisfactorily explained by the evolution of multi-dimensional potential energy surface as a function of time [2–4]. However the role of shell structure of the nascent fragments could not be well explained by the existing theoretical models. Further more the studies in this direction have revealed that the asymmetric fission in this mass region is not only governed by the N/Z and excitation energy of the fissioning nucleus but also on the dynamics of the entrance channel before forming the CN. It have also been observed that the presence of non-compound nuclear reactions cannot be ruled out at below barrier energies which also contribute to the wider mass distribution. The low excitation energy at which such phenomenon normally occurs is very difficult to achieve using heavy ion induced reactions. β delayed and electromagnetic induced fission [1] are the only ways to reach such low excitation energies experimentally. The difficulty in such reactions in the Mercury region and low statistics of the data obtained makes it difficult to get any conclusive statement regarding the occurrence of asymmetric mass fission and various factors that influences it. Nevertheless quite a few number of experiments have been carried out using heavy ion induced fusion reaction to produce neutron deficient nuclei in this mass region [5–7]. It has been observed that at very low excitation energies the measured fission fragment mass distribution could be explained only by evoking asymmetric fission mode along with symmetric fission mode. However it is not true for all the cases and considerable low statistics obtained in these measurements makes it difficult to draw a definite conclusion. In this scenario a systematic study of fragment mass distribution near the fission barrier is of utmost importance.

In order to understand the dynamical and entrance channel effects of this phenomenon, we have carried out studies on $^{197}$Tl. $^{197}$Tl is a potential candidate for looking for asymmetric fission and it was reported earlier that another isotope of Thallium, $^{201}$Tl goes through the asymmetric fission path at lower excitation energies [8–10]. $^{197}$Tl was populated through two reactions ($^{16}$O + $^{181}$Ta and $^{19}$F + $^{178}$Hf) which are lying on either side of Businnaro-Gallone critical mass asymmetry. The study was carried out at the reduced beam energies in the range of 0.85 to 1.15. The fission fragment mass distribution, mass-angle correlation and total kinetic energy distribution were measured and these are considered as reliable probes to study the dynamics of heavy-ion induced fission reactions. It was observed that the width of the FF mass distribution measured agreed with the theoretical predictions based on standard saddle point model till near Coulomb barrier and was found to the slightly higher than theoretical predictions, when the excitation energy is further reduced. The broadening of the mass distribution can also be an indication of quasi-fission especially at below Coulomb barrier. However, the mass-angle correlations does not show any asymmetry with respect to 90 degree in the centre of mass and this indicates absence of quasi-fission. The results of the this study will be presented in detail in the conference.

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