Study of fission dynamics in the light Actinides

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Introduction

In recent years, the synthesis of Super Heavy Elements (SHE) has become topic of great interest in the field of nuclear research. In heavy ion induced reactions, the probability of formation of SHE's depends on the competition between fusion and fission dynamics. Several reports indicate that the compound nucleus formed in the fusion-fission process may decay through fission without complete equilibration of all degrees of freedom [1]. Even though nuclear fission was discovered eighty years ago, several efforts are still going on to understand the puzzling features exhibited by fission phenomenon [2]. Dynamical models predict that non-compound nucleus fission occurs in reactions with charge product $Z_1Z_2 \geq 1600$, but recent results indicate that, it can also occur at much lower Z_1Z_2 values [1, 2].

The dependence of excitation energy on the fission fragment (FF) mass yields is another important aspect in fission studies. It is well established that, in actinide nuclei asymmetric FF mass yield distributions dominate at lower excitation energies and transform into symmetric mass yield distributions with increasing excitation energy [3]. This transformation in the FF mass yield distributions has been interpreted as due to a weakening of the shell effects with increasing excitation energy [4].

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However, the quantitative understanding of the shell damping as a function of excitation energy remains an open problem. In this context, in order to understand the shell effects and dependence of excitation energy on FF mass yield distributions, we have measured the fission fragment mass yield distributions for the reactions ^{30}Si+^{194,198}Pt around the Coulomb barrier energies.

Experimental Setup

The experiment was performed at Inter University Accelerator Centre, New Delhi, India by using the 15UD Pelletron-LINAC accelerator facility. Pulsed beam of ^{30}Si was bombarded on isotopically enriched ^{194,198}Pt targets of $\approx 200\ \mu$g/cm^2 thickness deposited on $\approx 25\ \mu$g/cm^2 thick ^{12}C backings. The com-

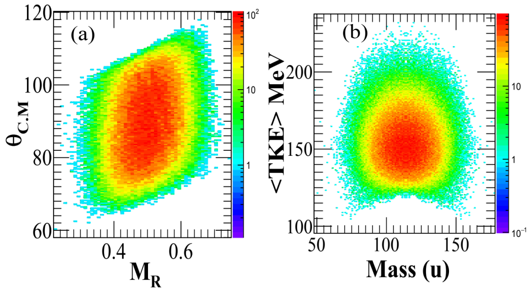

FIG. 1: (a) Mass angle correlation and (b) 2D mass -TKE distribution for the reaction ^{30}Si + ^{198}Pt at an excitation energy (E^*) 41.5 MeV.

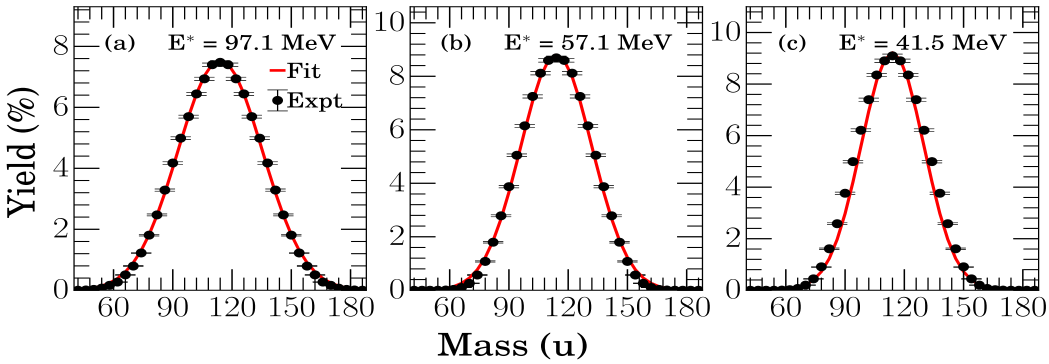

FIG. 2: (a)-(c): Fragment-mass distributions for the reaction ^{30}Si + ^{198}Pt reaction at E*'s of 97.1 MeV, 57.1 MeV and 41.5 MeV.

plimentary fission fragments were detected in coincidence by using two large-area position-sensitive Multi-Wire Proportional Counters (MWPCs) of active area 20 cm × 10 cm positioned at folding angle. The MWPCs were mounted on either side of the beam direction on two rotatable arms at a distance of 30 cm from the target. From the position and Time Of Flight (TOF) information of fission fragments, the masses and total kinetic energy (TKE) of the fragments were reconstructed by using the simple two body kinematics for binary fission [5].

Results and Discussions

Typical mass-angle distribution (MAD) for the reaction ^{30}Si + ^{198}Pt at an E^* of 41.5 MeV was shown in Fig. 1(a). In the present studies, we didn't observe any mass angle correlations, indicating the absence of fast quasi-fission. In Fig. 1(b), we have plotted the mass-TKE distributions, the experimental mean TKE distributions has a similar value estimated from the Viola systematics [6].

Fig. 2 shows the FF mass yield distributions measured for the same reaction at E^*'s of 97.1, 57.1 and 41.5 MeV. The experimental mass yield distributions are well described by a single symmetric Gaussian fit. Further, the shape of the mass distributions remains unchanged except at the lowest E* = 41.5 MeV. Here, the mass yield distribution tends to deviate slightly from symmetric Gaussian fit, which may be due to the influence of shell effects at around Coulomb barrier energies. Different contributions of FF mass yield distributions with multiple Gaussian fits will be extracted, in order to disentangle symmetric and asymmetric yields along with their mass widths for the reactions ^{30}Si + ^{198,198}Pt at beam energies ranging from 135 MeV to 208 MeV. The results will be presented at the symposium.

Acknowledgments

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