Understanding the fission mechanism of ^{257}Md nuclei

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Over the years, a large number of experiments have been performed to study the dynamics of fusion-fission mechanism in heavy ion induced reactions. These studies are important for better understanding of the reaction dynamics involved in the formation of super heavy elements in laboratory. Apart from pure fusion-fission, the existence of pre-equilibrium fission (PEQ) and quasi-fission (QF) add further complexity to the reaction dynamics. They are found to be the competing reaction channels for light ion induced reactions with actinide targets. Though many studies have been performed in this mass region, there are still inconsistency in the results of many of these reactions. For example, the angular anisotropies of fission fragments measured in reactions ^{19}F, ^{16}O, ^{12}C + ^{232}Th, ^{238}U [1,2,3] have been found inconsistent with the statistical saddle point model (SSPM) predictions. It has been reported that PEQ fission mechanism, i.e., departure from K equilibration before fission events might be responsible for these anisotropies. However for reactions of ^{19}F, ^{16}O, ^{12}C on ^{232}Th [4], the mass distribution of fragments showed evidence of QF, i.e., no mass equilibration before fission.

In the recent work, presence of QF is evident in the reaction ^{18}O+^{232}Th as compared to the ^{12}C+^{238}U system[5]. Hence for understanding this mass region, we performed the mass distribution of ^{257}Md nuclei fission fragments. These nuclei were produced through the reaction ^{19}F+^{238}U.

Measurements of fission fragments coming from reaction ^{19}F + ^{238}U was carried out at the 15UD Pelletron accelerator facility of Inter University Accelerator centre(IUAC),New Delhi. Pulsed beam of ^{19}F ranging in energies from 90 MeV to 120 MeV was used to bombard the ^{238}U targets. Width of ^{19}F pulsed beam was 1ns with the seperation of 250 ns. Typical beam intensity was 1-2 pna. The targets were thickness about 110 μg/cm^2 on carbon backing of thickness 20 μg/cm^2. The backing faced the down stream. The complimentary fission fragments were detected in two large area (20 cm $\times$ 10 cm) X-Y position sensitive multi-wire proportional counters(MWPCs) mounted inside the 1.5 m diameter general purpose scattering chamber. The MWPCs were kept at folding angle, with the forward detector centered at mean scattering angle $\theta = 35^\circ$ and azimuthal angle ϕ =90° and back detector kept at θ=120° and azimuthal angle ϕ=270°. The MWPCs were placed at 35 cm in the forward and 28 cm in the backward respectively. Front detector placed at 35 cm from target covers the scattering angle form 25°-60° and the and the back detector at 140° at 27 cm from target. The detectors covered angular range from 25°-45° in the forward and 110°-140° in the backward.

The fission events are separated from full momentum transfer fission using the experimentally determined velocity vector components of the fissioning nucleus. From the calibrated X and Y position signals, the polar angles (θ, ϕ) are extracted. Fission fragments

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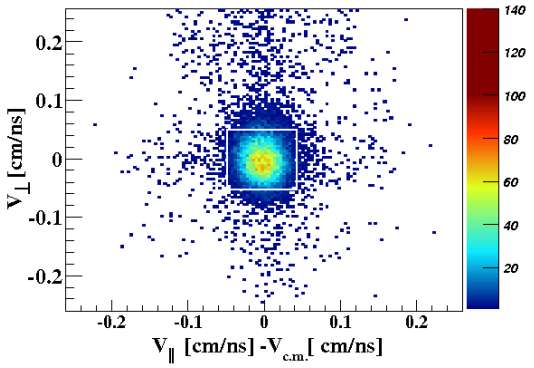

FIG. 1: Measured distribution of FFs velocity components at below barrier. Full momentum transfer fission events are shown inside rectangular box.

velocities in laboratory frame are calculated by using polar angles and Viola systematics. These velocities are converted into $V_\parallel$, $V_\perp$ and $V_{c.m.}$, component of fission fragments as well as the velocities in centre of mass frame. $V_\parallel$ are adjusted such that it became equal to $V_{c.m.}$, which is condition for full momentum transfer in fission process which has been as shown in inside the rectangular gate of Fig1. Only he events within the rectangle marked as FF were used to gate the mass spectrum.

Mass variance of fission fragments for ^{19}F+^{238}U reaction has been measured around the sub-barrier energies. Mass variance are found to be consistent with those found in systems ^{12}C+^{238}U and ^{16}O+^{238}U around sub-barrier energies. Similar trends of mass variance for reactions ^{19}F, ^{16}O, ^{12}C + ^{232}Th has been observed (Fig 2). This trend can be attributed due to the predominance quasifission. Details of present study will be shown in conference.

We are thankful to the Pelletron staff at IUAC, New Delhi, especially R. Joshi and A. Sarkar, for their effort in providing stable pulsed beam throughout the experiment. One of the authors (RD) acknowledges the financial support from Council of Scientific Research, Govt. of India.

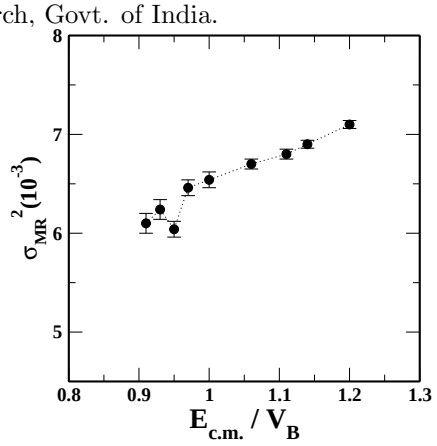

FIG. 2: Mass variance of FFs from ^{257}Md nuclei is shown against reduced bombarding energies.

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