Mass distribution studies in the fission of ^{216}Ra compound system

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Introduction

Understanding of the mechanism of fusion-fission process is one of the major goal of contemporary nuclear physics. Quasi-fission (QF) is the main inhibition to complete fusion, when an energetic projectile approaches the target [1]. The very existence of the process is the main hurdle in synthesizing the super heavy elements (SHE). So, several groups around the world are trying to understand the underlying mechanism of the process [2–4]. Fission fragments mass and angular distributions are considered as one of the main tools to investigate such processes. In order to look for the signature of QF and its possible dependence on the excitation energy, we have measured the fragment mass distributions arising from the fission of ^{216}Ra compound system populated using ^{12}C+^{204}Pb reaction.

Experimental Details

The experiment was performed using pulsed beam of ^{12}C (E_{lab} = 68, 71, 75, 79, 87, 91, and 95 MeV) obtained from 15UD Pelletron of Inter University Accelerator Centre (IUAC), New Delhi. The ^{204}Pb of thickness 200 μg/cm^2 sandwiched between carbon foils was used in the experiment. Two multi-wire proportional counters placed on movable arms were used to detect the complementary fission fragments. Fragments time-of-flight (TOF) was recorded with respect to the r.f. signal obtained from the Pelletron. More details about the experimental setup can be found elsewhere [5].

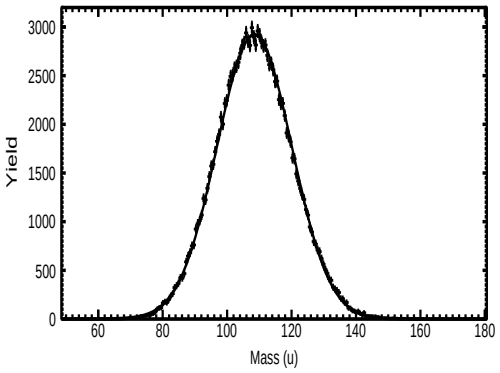

FIG. 1: Fragments mass distribution at laboratory energy of 95 MeV. The continous line is the Gaussian fit to the data.

Results and Discussion

The mass distributions of fission fragments were deduced from the observed TOF spectra using the time difference method [6]. Figure 1 shows the fragments mass distribution ob-

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tained at lab energy of 95 MeV. The continous line represents the Gaussian fit to the data.

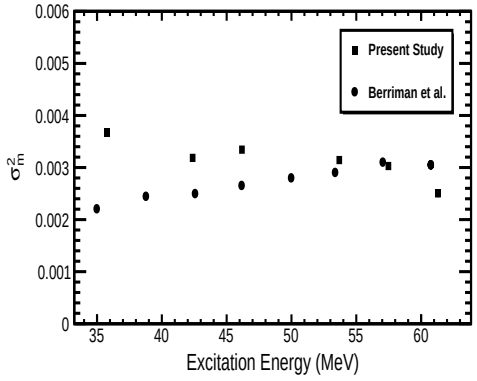

FIG. 2: Measured variance of normalized fragment mass distributions as a function of excitation energy.

Mass variance deduced from the normalized fragment mass distributions for the present reaction is plotted in Figure 2. As is evident from this figure, over the entire measured energy range, variance does not show any appreciable change with the increase in excitation energy of the compound system. This could be interpreted as the absence of non-compound fission events in the present reaction for the studied energy range

The mass variance for the present reaction as studied by Berriman et al., is also shown in the Fig. 2. The comparison of the two studies clearly shows that the trend of increase in variance with excitation energy observed in earlier studies is not reproduced by the present study. Further analysis is in progress.

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References

[1] A. C. Berriman et al., Nature 413, 144 (2001).
[2] T. K. Ghosh et al., Phys. Rev. C 69, 031603(R) (2004).
[3] Hinde et al., Phys. Rev. Letts. 100, 202701 (2008).
[4] C. Yadav et al., Phys. Rev. C 86, 034606 (2012).
[5] Hardev Singh et al., Phys. Rev. C 78, 024609 (2008).
[6] R. G. Thomas et al., Phys. Rev. C 77, 034610 (2008).