

Exploring fusion-fission behavior in the reaction $^{19}\text{F} + ^{197}\text{Au}$

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Introduction

In recent years, the dynamics of heavy ion induced fusion-fission reaction processes has been extensively investigated both experimentally as well theoretically. Fission Fragments mass distributions, mass-angle and mass-energy correlations, and neutron multiplicities are the key observables for these studies [1–6]. These observables are highly sensitive to the entrance channel parameters such as entrance channel mass asymmetry (α), charge product ($Z_P Z_T$, where, Z_P , Z_T are the atomic numbers of projectile and target, respectively), excitation energy, angular momentum, and the underlying shell effects of the compound nucleus. The entrance channel mass asymmetry with respect to the Businaro–Gallone mass asymmetry (α_{BG}) plays a major role in deciding the fate of a dinuclear system—whether it evolves into an equilibrated compound nucleus or splits into fission-like fragments before complete equilibration in all mass and shape degrees of freedom, a process known as quasifission. A systematic understanding of these factors not only improves the predictive power of statistical models, such as the liquid drop model (LDM) and its refinements, but also helps in bench-marking ad-

vanced theoretical approaches like the statistical saddle-point model and transport-based descriptions. In this work, we have reported the mass-energy distribution of fission fragments for $^{19}\text{F} + ^{197}\text{Au}$ reaction system, at 47.7 MeV of excitation energy.

Experimental Details

The experiment was performed at Inter University Accelerator Centre, New Delhi, using pulsed beam of ^{19}F from Pelletron accelerator, in the laboratory energy of 90 – 118 MeV. A self-supporting ^{197}Au target of thickness 250 $\mu\text{g}/\text{cm}^2$ was used. Two large area (20 cm x 10 cm) position-sensitive multiwire proportional counters (MWPCs) were used to detect the complementary fission fragments. These detectors were mounted at folding angle on the movable arms at the distance of 63.5 cm and 51.5 cm, respectively. Complete details of experimental setup is given in ref. [2].

Analysis and Results

From the recorded position and time of flight signal of fission fragments, from two MWPCs, in co-incidence, the velocities of complementary fission fragments were obtained, using kinematic reconstruction method. The masses of complementary fis-

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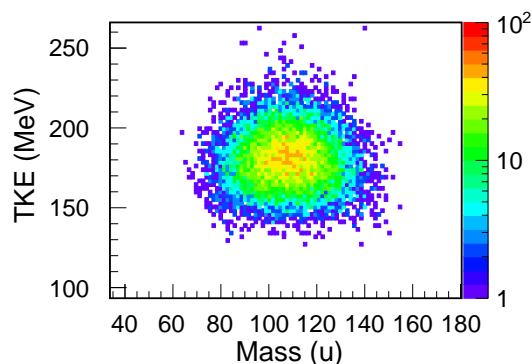


FIG. 1: Mass energy distribution for reaction $^{19}\text{F}+^{197}\text{Au}$ at excitation energy (E^*) = 47.7 MeV.

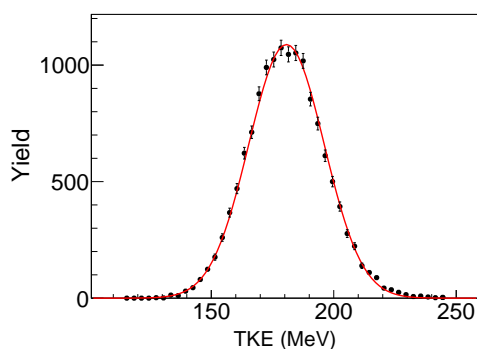


FIG. 2: TKE distribution for reaction $^{19}\text{F}+^{197}\text{Au}$ at excitation energy of 47.7 MeV. Solid red line represents the Single Gaussian fit to the data.

sion fragments were obtained using velocity ratio method [7]. Then, kinetic energies of fission fragments were obtained using fragment masses and their velocities in center-of-mass frame, for each fission event.

The measured mass-energy distribution for reaction $^{19}\text{F} + ^{197}\text{Au}$ have typical triangular shape as expected for LDM based nuclear fission, as depicted in Fig. 1, at an excitation energy of 47.7 MeV. The measured TKE

distribution is symmetric and single Gaussian type (see Fig. 2), but mean value of TKE is somewhat higher than that predicted from Viola systematics (*approx* 160 MeV) [8], this could be due to quasifission or non-compound nuclear fission. In an earlier study of the experimentally measured fission fragments mass distributions [4], for the same reaction system, width of fragments mass distributions were found to be broader which was attributed to quasifission or non-compound nuclear fission processes.

We have presented the preliminary results in this submission. The Complete detailed analysis at all studied energies is under progress.

Acknowledgments

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