Fission Fragment mass distribution ^{187}Ir

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Introduction

Recently there is an unexpected observation of asymmetric mass spilt in case of neutron-deficient ^{180}Hg, for which two doubly-magic ^{90}Zr fragments were expected from both liquid drop as well as spherical shell model point of view [1]. This observation has recommence interest in fission of nuclei in preactinide region both theoretically and experimentally. Further experimental studies have established the presence of asymmetric fission in the preactinide region in general. Role of different proton and neutron shells, e.g. $Z \approx 36$ [2],$N =$ 52-56 and $Z = 42$-46 [3] have been proposed to interpret these experimental observations. However, it is still not clear what drives the asymmetry in fission of preactinides. Hence more measurements are required in this region. With this motivation we have carried out measurement to study fission fragment mass distribution of ^{187}Ir.

Experiment and Data Analysis

The experiment was performed at BARC-TIFR-PLF,Mumbai. The ^{175}Lu (97.41% enriched) target of thickness 250 μg/cm^2 deposited on 170 μg/cm^2 thick Al backing was mounted such that the incoming beam was first faced by the target. The pulsed beam of ^{12}C was bombarded on target at energies 58, 65, 70 and 75 MeV. The corresponding excitation energies were 38.7, 45.2, 49.9, 54.6 MeV respectively. Two position sensitive MultiWire Proportional counters (MWPC's) of active area 125 mm X 75 mm were used for detection of fission fragments . MWPC's were kept at angles 113^0 and -50^0 at distance 24 cm from the target. Two SSB detectors were kept at angles $\pm 20^0$ for beam current monitoring purpose. One BaF_2 detector was placed near to beam dump to monitor the RF timing. The cathode timings for both MWPC's were recorded in coincidence with RF signal. The positions of fission fragments were readout through delay line chips. The time-of-flights(TOF) of the fragments were extracted from respective cathode signals. Fission events could be clearly separated from the quasi-elastic events using the TOF information. The velocities of the fragments were extracted using their position and TOF information. The correlation plots of parallel and perpendicular components of velocity i.e. V_{par}/V_{cn} vs. V_{per} and Total phi vs. folding angle confirmed the full-momentum transfer events in the reaction. The mass of the fragment(A_1) was calculated using TOF difference method.The corrections due to energy loss of fragments in the target and backing foil are done on event by event iteratively using range-energy tables calculated using SRIM software [4].

Results and discussions

No correlation was observed in the mass vs. angle plot, indicating the absence of fast quasi-fission. The measured mass distributions along with previous measurement [5] with increasing excitation energy above saddle point are shown in Fig.1. The positions of the different neutron and proton shells, assuming unchanged charged distribution(UCD), expected to contribute are also marked with vertical lines[2, 3, 6]. Excess yield could be found corresponding to these shells. The single Gaussian fit(top) and resid-

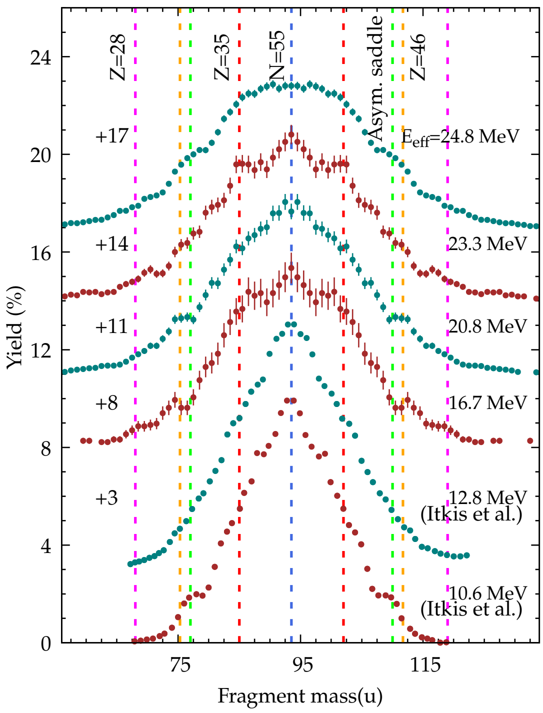

FIG. 1: The experimental mass distribution with increasing excitation energy above saddle (E_{eff})

uals(bottom) are shown in Fig. 2 for 58 MeV beam energy. The predictions of GEF code[8] are also shown.The width of the mass distributions could be fitted well with the statistical relation as shown in Fig.3, indicating the dominance of liquid drop behaviour.

Summary

The fission fragment mass distribution have been measured at excitation energies down to 16.7 MeV above saddle point. The measured mass distributions indicate the role of several proton and neutron shells. The behaviour of the mass width suggests the dominance of liquid drop behaviour.

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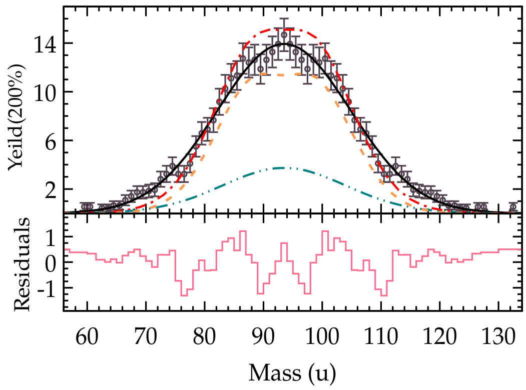

FIG. 2: Predictions of GEF compared with measured mass distribution at E_{eff} = 16.7 MeV[top panel]. The continuous curve is a single Gaussian fit to the data. The dot-dashed, dashed, dot-dot-dashed curve are total, Asym., and Sym., contributions of GEF respectively folded in 2.8 u mass resolution. The residuals of single Gaussian fit are shown in bottom panel

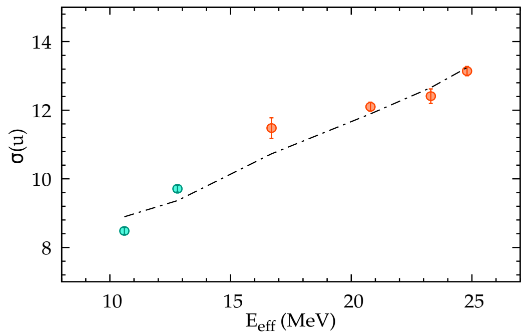

FIG. 3: The experimentally extracted widths σ (u) plotted as function of E^*_{eff} (MeV). The dot-dashed line is the calculated widths using statistical relation

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