

Spin distribution in fusion reaction $^{30}\text{Si}+^{170}\text{Er}$

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1. Introduction

The effect of shell closure in the compound nucleus (CN) on the fusion-fission dynamics is of great importance. It is also interesting to know whether shell closure provides enhanced survival probability for the evaporation residue (ER).

The study of angular momentum involved in the fusion process is very useful in this regard. Higher the angular momentum, lesser is the depth of the fusion pocket (which vanishes above critical angular momentum, l_{crit}) and lower is the fission barrier. This makes the fusion impossible for larger angular momenta. On the other hand, if dissipation is present in the system, fission probability is reduced and the probability for ER formation is enhanced.

ER cross sections and spin distributions for ^{200}Pb have been studied [1, 2] at IUAC with two entrance channels using the HIRA [3] and the 14 element BGO multiplicity filter. We have taken up the system $^{30}\text{Si}+^{170}\text{Er}$ which is more symmetric and has larger angular momentum available in the entrance channel. The fusion and fission cross sections for this particular system [4] are available in literature. In the present experiment, spin distribution was measured by ER gated γ -multiplicity measurement.

2. Experimental details

^{170}Er of thickness $130 \mu\text{g}/\text{cm}^2$, sandwiched between two layers of ^{12}C of thickness $45 \mu\text{g}/\text{cm}^2$ (entrance) and $23 \mu\text{g}/\text{cm}^2$ (exit), was mounted in the target chamber of the HYbrid Recoil mass Analyzer (HYRA) [5] at IUAC. Pulsed beam with pulse separation of $2 \mu\text{s}$ and energies ranging from 132 to 166 MeV was taken from the Pelletron+LINAC (1st module) combination.

HYRA was operated in gas-filled mode. To detect the γ -rays from the ERs, the combined facility of the HYRA and the TIFR 4π spin spectrometer [6, 7] (presented in this Symposium in detail by N. Madhavan *et al.*) was used. The target was at the geometrical centre of the spin spectrometer. The spin spectrometer consists of 32 NaI detectors, out of which 28 detectors were used in the present study. The ERs were detected at the focal plane of HYRA with the help of a multi-wire proportional counter (MWPC) and a two-dimensional position sensitive silicon detector.

To separate the ERs (resulting from complete fusion) from other events, time of flight (TOF) method was used. Two time to amplitude convertor (TAC) spectra were recorded: (a) RFTAC with the focal plane MWPC timing as the start and the RF signal as the stop and (b) MTAC with the focal plane MWPC timing as the start and the OR of timing from the NaI detectors as the stop. These two TAC spectra helped to separate out the ER γ -rays from the background.

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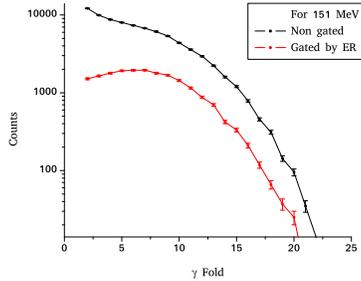


FIG. 1: γ Fold distribution, raw and ER-gated, for 151 MeV.

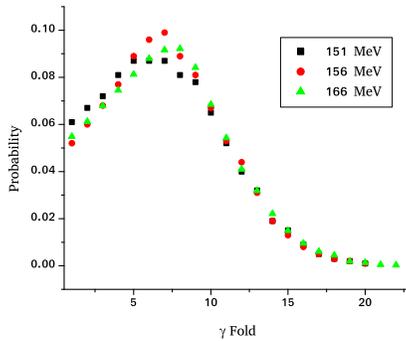


FIG. 2: Gated fold distribution for three different energies. 0th, 1st and 2nd folds are exptapolated.

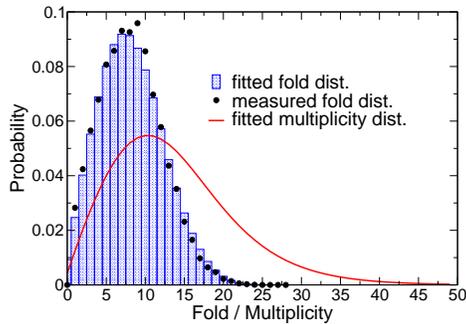


FIG. 3: Fold distribution for 156 MeV, measured and fitted, and the corresponding multiplicity distribution.

3. Preliminary results

The γ -fold spectrum gated with MTAC gave the fold distribution of ERs only. Fold spectra, raw and ER-gated for 151 MeV are shown in Fig 1. ER gated fold distributions for different energies are shown in Fig. 2. A preliminary estimation of multiplicity distribution, extracted from measured fold distribution at 156 MeV is shown in Fig. 3. Here the multiplicity distribution was assumed to have the shape of a Fermi function. Also, we assumed that the detectors were identical and the weighted average of the efficiencies was used in the calculation, which is not the actual case [8]. The experiment was performed recently and the analysis is in progress.

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