Measurement of folding angle distribution in ^{28}Si + ^{160}Gd system populating CN ^{188}Pt

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Introduction

The availability of heavy ion beams has renewed the interest in fusion-fission reactions. In heavy ion induced reactions, other main competing process of fusion-fission is quasi-fission (QF) or non-compound nucleus fission at energies especially around the Coulomb barrier [1, 2]. The prominent experimental probes to distinguish fusion-fission and QF are fission fragments mass distribution (FFMD), mass-angle correlations [1, 2]. At low excitation energies, near the Coulomb barrier, fission events can also originate from incomplete momentum transfer along with the full momentum transfer (FMT) reaction channel. These incomplete momentum transfer events needs to be excluded from FMT events. The signature of incomplete fusion or incomplete momentum transfer events can be observed through the analysis of fragments folding angle distribution [3, 4], as the folding angle of fission fragments is related to the transfer of linear momentum from projectile to the fused system. Here, deviation in the folding angle distribution from the single Gaussian can be attributed to the presence of fission events originating from incomplete momentum transfer reaction channel along with the complete fusion-fission or full momentum transfer (FMT) reaction channel [1, 3].

In the present work, in order to investigate the presence of incomplete momentum transfer or incomplete fusion (ICF) fission events we have performed folding angle distributions study of fission fragments produced in reaction ^{28}Si + ^{160}Gd at 49 - 67 MeV of excitation energies.

Experimental Details

The experiment was performed using the General Purpose Scattering Chamber (GPSC) Facility at Inter University Accelerator Centre, New Delhi. ^{160}Gd of thickness 220 $\mu g/cm^2$ on 20 $\mu g/cm^2$ carbon backing was used as target. Pulsed beam of ^{28}Si from Pelletron accelerator, in the laboratory energy range of 120 – 140 MeV, was used as the projectile. Two large area (16 cm x 11 cm) position-sensitive multiwire proportional counters (MWPCs) were used to detect the complimentary fission fragments in coinci-

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dence. Forward and backward MWPCs, while being placed at folding angle, were kept at distances of 38 cm and 33 cm, respectively, from the target. Two silicon surface barrier detectors (SSBD) placed at ±10° with respect to the beam direction were used for beam monitoring.

Analysis and Results

The calibrated position and time of flight (TOF) information from two MWPCs were used to obtain the polar and azimuthal angles (θ, ϕ) of the fission fragments, using kinematic reconstruction method [5].

The measured folding angle distributions (FADs) of fission fragments for reaction ^{28}Si + ^{160}Gd are shown in Fig. 1. The measured FADs are symmetric and well reproducible with the single Gaussian (Red lines). As the deviation of measured folding angle distributions (FAD) from single Gaussian fit would indicated the presence of incomplete fusion events (ICF) [1]. Therefore, the observed symmetric behaviour of FADs signifies the absence of incomplete momentum transfer or incomplete fusion (ICF) events at all studied energies. The measured mean values of folding angle are also in good agreement with the calculated values of folding angle, for symmetric fission [6], assuming full momentum transfer from projectile to the target. These observations of FADs analysis suggest that the contribution, if any, of fission events originated from incomplete momentum transfer fission (ICF) events is negligible or minimal.

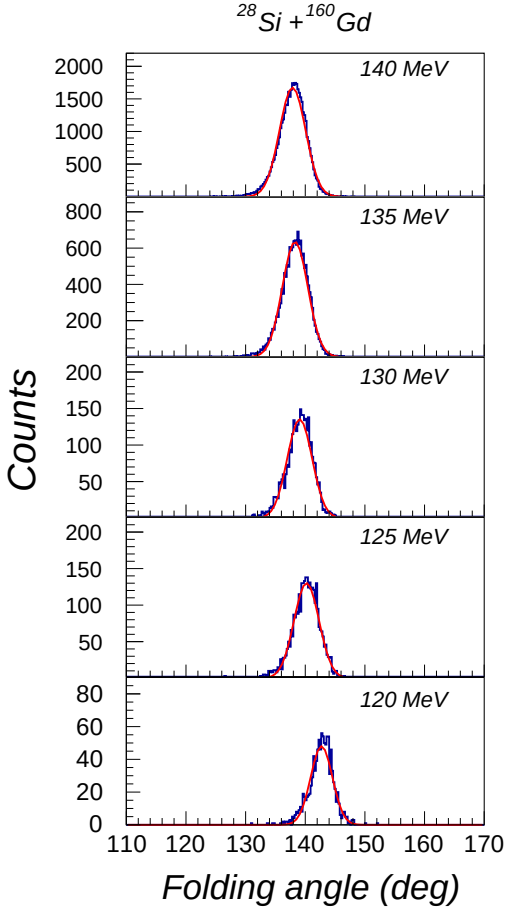

FIG. 1: Folding angle distributions for reaction ^{28}Si+^{160}Gd at different lab energies.

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