Fission fragment angular distribution measurements in ^{18}O + ^{194}Pt reaction

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Introduction

Systematic studies of fission fragment angular distribution at energies around the Coulomb barrier in heavy ion induced fission reactions can serve as an effective tool in understanding the fission dynamics. Heavy ion induced fission fragment angular distribution is anisotropic in nature [1]. The transition state model such as Statistical Saddle Point Model (SSPM) relates fission fragment anisotropy to the fundamental nuclear properties such as the moment of inertia, the total angular momentum of the compound nucleus (CN) and the temperature at the saddle point. Experimental observation of anomalously large anisotropy [2] in heavy ion induced fission reactions reveals the fact that overcoming the interacting barrier will not always ensure the formation of CN. Here, we report fission fragment angular distributions measurements of ^{18}O + ^{194}Pt reaction, populating the CN ^{212}Rn. The basic motivation of the present study was to find out whether non-compound nuclear events are present in this reaction at energies around the Coulomb barrier. The measurements were carried out in the energy range 5% below to 10% above the Coulomb barrier.

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Experiment Details

The experiment was performed using the general purpose scattering chamber of the BARC-TIFR 14UD Pelletron accelerator facility at Mumbai. ^{18}O beam (dc) in the energy range 78.2 - 87.3 MeV was used to bombard on ^{194}Pt target (300 μg/cm^2 thick target

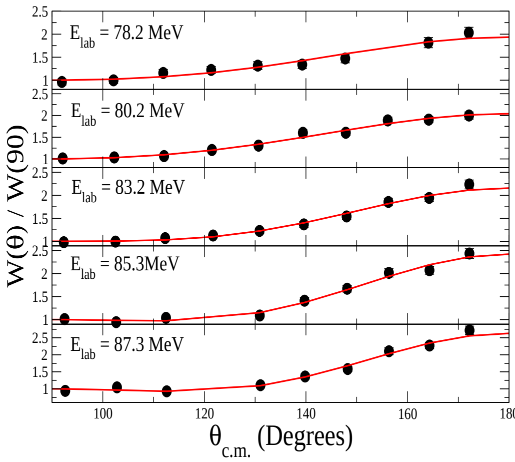

FIG. 1: The angular distribution of the fragments at different projectile energies. Solid lines are the fits using standard expression.

on 20 μg/cm^2 thick carbon foil). Bombarding energies were corrected for the energy loss in target in the analysis. The fission fragments were collected using three collimated $\triangle$E - E silicon detector telescopes consisting of 15 -

20 μm thick $\triangle$E detectors and 300 - 500 μm thick E detectors. These telescopes subtended equal solid angles and were placed on the same side of the movable arm. Two silicon surface barrier detectors were mounted at a distance of 42.0 cm at an angle of $\pm 20^0$ with respect to the beam direction and were used to monitor the beam. Angular distribution of the fission fragments were measured from 80^0 to 170^0 in the laboratory frame at 10^0 intervals. The relative solid angles of the telescopes were taken care of by measuring the data at overlapping angles.

Analysis and Results

The measured fission fragment angular distributions were transformed from laboratory to center-of-mass frame using Viola systematics for symmetric fission [3]. Fig.1 shows the angular distributions of the fragments in center-of-mass at different beam energies along with fitting (solid line) using the standard expression for fragment angular distribution [4]. The experimental fission fragments angular anisotropies were obtained from the ratio $\frac{W(180)}{W(90)}$. According to SSPM the angular anisotropy is given by A = $1 + \frac{<l^2>}{4K_0^2}$ where K_0^2 is the variance of the K distribution [5]. The fission $< l^2 >$ values were obtained from the statistical model code PACE [6] using CN spin as the input. The CN spin distribution was obtained from CCFULL [7] by reproducing fusion cross sections [8]. Rotational coupling of target nuclei was included in CCFULL calculations. The fission barrier height, rotational energy and effective moment of inertia were calculated following the prescription of rotating finite range model [9]. Fig.2 (a) shows the experimental fission cross sections as a function of center-of-mass energy and solid line represents the PACE prediction. Fig.2 (b) represents experimental fission angular anisotropy along with SSPM predictions. No significant deviation in experimental angular anisotropy from SSPM prediction has been observed in the entire energy range of the present study.

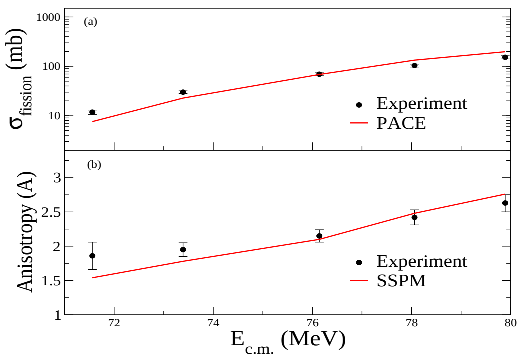

FIG. 2: The fission cross sections and anisotropy at different beam energies compared with PACE and SSPM respectively.

Conclusion

Fission fragment angular distributions were measured for ^{18}O + ^{194}Pt in energy range 78.2 - 87.3 MeV. The normal nature of angular anisotropy suggests that the reaction proceeded through true CN formation. The present results are consistent with result obtained from fission fragment mass distribution measurements carried out for reaction using other isotopes of Platinum [10, 11].

References

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