Study of fission fragment mass distributions for the reaction ^{18}O + ^{197}Au

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Introduction

The study of fusion fission dynamics in medium mass nuclei is of great interest due to the observation of many interesting and exciting results. Recent experimental results on ^{19}F + ^{197}Au shows that mass equilibration is slower than the K degrees of equilibration [1, 2]. These results are some what contradictory to the results observed in heavier and highly fissile systems. In order to understand the relaxation mechanism of various degrees of freedom in less fissile systems one has to study both fission fragment angular and mass distributions. We have previously reported the complete K equilibration for the reaction ^{18}O + ^{197}Au through fission fragment angular distribution studies [3]. The entrance channel mass asymmetry of the reaction ^{18}O + ^{197}Au is very much similar to that of the reaction ^{19}F + ^{197}Au, where fission fragment angular distributions show no evidence of pre-equilibrium fission. In order to investigate complete mass equilibration is taking place or not in this reaction, we have studied fission fragment mass distributions for the reaction ^{18}O + ^{197}Au around the coulomb barrier.

Experimental Details

The experiment was performed by using the 15 UD pelletron accelerator facility at the Inter-University Accelerator Centre (IUAC), New Delhi, India, in a 1.5-m-diameter general purpose scattering chamber (GPSC). ^{18}O beam was bombarded on a self-supporting ^{197}Au target of thickness 150 μg/cm^2. The measurements were carried out at a laboratory beam energy range of 78-110 MeV. The beam energies were corrected for the energy loss in the half thickness of the targets. Two large area (20.0 cm X 10.0 cm) position-sensitive multiwire proportional counters (MWPC) [4] were kept at folding angles to detect the fission fragments in coincidence at a distance of 40.0 and 55.0 cm, respectively. Two Si surface barrier detectors at $\pm$ 10 degrees with respect to the beam direction at a distance of 70.0 cm from the target were used to measure the elastically scattered beam particles and to monitor the position of the beam on the target. The time difference method was employed to extract the mass distributions using dc beams [5].

Results and Discussion

The position information of the fission fragments entering the detectors was obtained from the delay line readout of the MWPC wire planes. The central foil of both the MWPCs recorded the timing and energy loss signals. The solid angle of both the MWPCs were determined online by taking elastic scattering data in singles mode below the Coulomb barrier and by using a fission source (^{252}Cf) of known strength in offline mode. The time difference information was obtained by taking the start signal from the anode of

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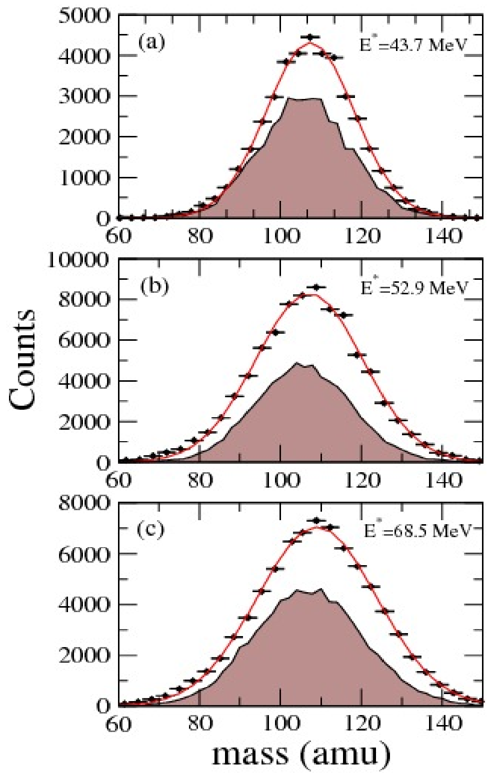

FIG. 1: The mass distributions for the reaction ^{18}O + ^{197}Au with Gaussian fits (continious line) at E* = 43.7, 52.9and 68.5 MeV. The histogram shows the model calculation for full momentum transfer fissions using the statistical model code GEMINI

the back detector and the stop signal from the anode of the front detector after delay. Since we have used time difference method the electronic delay between the timing signals of the two MWPCs is obtained by taking a run for the reaction ^{11}B + ^{197}Au at 75 MeV, where there will be no contribution from non compound nucleus fission. The masses of the fission fragments were reconstructed by using the (θ, ϕ) and the time difference information. By application of proper kinematic transformations and conservation of linear momentum, the mass distributions were obtained [6].

We have done statistical model calculations, the histogram in Fig. 1 shows a model calculation for full momentum transfer fissions using the statistical model code GEMINI, which simulates the decay of compound nucleus by a series of binary decays. The calculated fusion-fission spectrum is shown by the filled area. The continuous line is the Gaussian fit for the mass distributions. We can clearly observe from Fig.1 that the mass widths predicted by GEMINI is consistent with the experimental data, showing only symmetric mass distributions indicating the absence of non compound nuclear fission for the present system. Combining the present results with our previous observations [3] we can conclude that both the mass equilibration and K equilibration is taking place for the reaction ^{18}O + ^{197}Au in the energy range which we have studied.

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