Entrance channel dependance in ^{36}S+^{186}W and ^{32}S+^{186}W reactions

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Introduction

Elements up to Z=118 (Os) have been synthesized in the laboratory. A significant hurdle in the synthesis of new SHE is a non-equilibrium process called quasifission. Quasifission is a process where projectile target system does not reach the compound nucleus (CN) configuration. Dinucleus formed after the capture reseparets into fission-like fragments. Quasifission is a dynamical process with strong entrance channel dependence. Here we report fission/fission-like fragment mass distribution measurements for ^{36}S+^{186}W and ^{32}S+^{186}W reactions in the excitation energy (E*) range 36-54 MeV and 42-63 MeV, respectively.

Experimental details and analysis

The experiment was performed at the Heavy Ion Accelerator Facility of the Australian National University. Pulsed beams of ^{36}S and ^{32}S from 14 UD Pelletron accelerator were further boosted in energy by the superconducting linear accelerator. Isotopically enriched ^{186}W (thickness 94 µg/cm^2 with a carbon backing of 40 µg/cm^2) was used for the measurements [1]. The binary fragments were detected using the CUBE spectrometer, consisting of three multiwire proportional counters (MWPCs). The position and timing signals obtained from the fission detectors were used to generate the mass angle distribution (MAD) for the binary fragments [2]. The measurements were performed at lab energies ranging from 144.6 MeV To 169 MeV for the ^{32}S+^{186}W reaction and 150.9 MeV to 170.6 MeV for the ^{36}S+^{186}W reaction.

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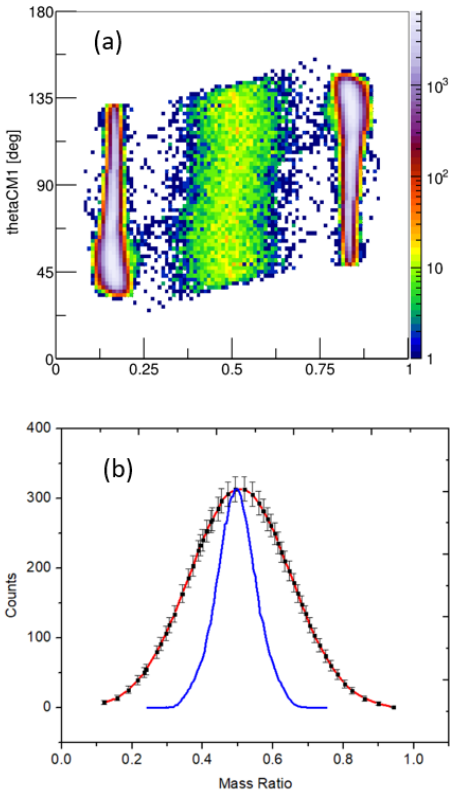

FIG. 1: (a) MAD scatter plot and (b) MR distributions for the ^{32}S+^{186}W reaction at E*=41.9 MeV. Gaussian fit to the data and GEF MR distribution are also shown.

Results

The Mass Ratio (MR) distribution is obtained by projecting the mass angle distribution (MAD) on to the MR axis and are fitted using a Gaussian function. MAD and MR distribution for the ^{36}S+^{186}W reaction at 41.9 MeV excitation energy are shown in FIG 1. MR distribution generated using GEF [3] calculation is also shown in FIG 1(b). Experimental distribution and the theoretical distribution are fitted with a Gaussian distribution. The standard deviation (σ_{MR}) of this Gaussian fit represents the width of the fragment mass distribution. This (σ_{MR}) for both the reac-

tions are shown in FIG 2 and are compared with theoretical GEF calculations.

Signatures of quasifission have been observed in the MR distribution of ^{36}S+^{186}W and ^{32}S+^{186}W reactions in the present study. There is an evident mass angle correlation observed in this measurement a larger mass ratio width compared to theoretical calculation is also observed for both the reactions. The experimental width is observed to increase with increasing excitation energy which could be due to the temperature dependance of the fragment mass width. From the theorectical and experimental σ_{MR} the probability of quasifission is estimated. The quasifission probability ranges between 10% to 22% for the ^{36}S+^{186}W reaction and 17% to 27% for ^{32}S+^{186}W reaction.

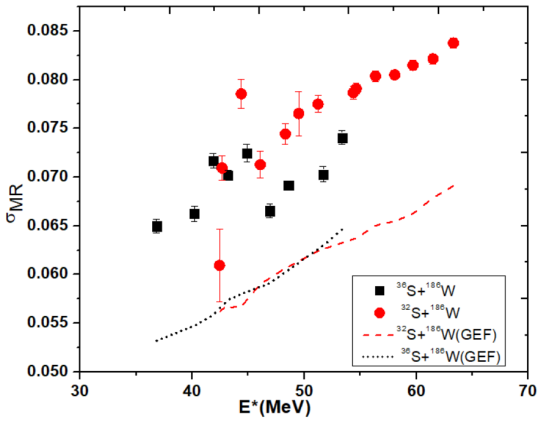

FIG. 2: Experimental and theoretical σ_{MR} at different E* (MeV) for the ^{36}S+^{186}W and the ^{32}S+^{186}W reactions.

Further, we studied the systematics of the mass ratio width for different reactions here. We have considered the reaction of various projectiles with ^{186}W in this study. Hence the dependence on the details of the target nucleus could be minimized in this systematics. A clear dependence on Z_pZ_t of the reaction is seen with σ_{MR} vales. For all the reactions, $\alpha < \alpha_{BG}$ so quasifission is present for all the cases, including ^{24}Mg + ^{186}W reaction. The σ_{MR} values are very low for the ^{27}Al and ^{24}Mg induced reactions. On the other hand, the very high σ_{MR} is observed in ^{40}Ca, ^{48}Ti induced reactions indicating a larger presences of quasifission [2][4][5][6][7][8][9].

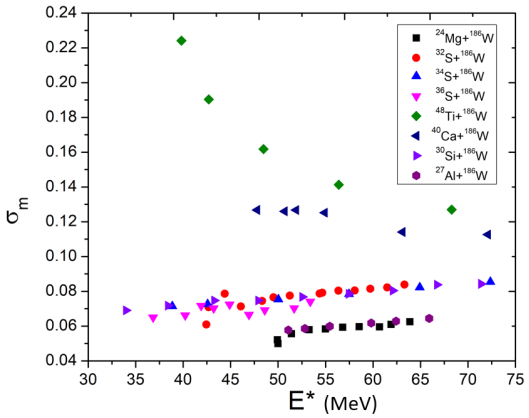

FIG. 3: Width of the fragment mass distribution as a function of E*(MeV) for various reactions using ^{186}W as the target.

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