Barrier distribution from back angle quasi-elastic excitation function for ^{7}Li+^{64}Ni system

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1. Introduction

Barrier distribution (DB) function has evolved as an effective experimental tool to investigate the channel coupling effect in heavy ion collision at near barrier energies [1, 2]. The distribution function can be obtained from the precisely measured fusion excitation function D_{fus} [1] or it can be derived from the measurement of back-angle quasi-elastic excitation function D_{qel} [3]. In collisions involving only strongly bound systems both the distributions should have similar behavior with the distributions peaking at the Coulomb barrier energy. Deviation is expected for the collisions where non-fusion reaction channels are present with cross section comparable to fusion [4]. The deviation will increase with the increase of the strength of non fusion channel.

The influence of breakup of weakly bound nuclei on fusion and elastic scattering at near barrier energies has been extensively studied in last few decades [5]. Consequently, the barrier distribution studies have been extended to systems involving weakly bound projectiles [6] to understand the effect of coupling to breakup. Barrier distribution from back angle quasi-elastic excitation function measurements have also been performed to probe the effect of breakup on the effective interaction potential for weakly bound systems [7–11].

In a previous work [12], we extracted DB from measured fusion [13] and quasi-elastic [12] excitation functions for the system ^{6}Li+^{64}Ni and compared. It is observed that D_{qel} peaked at energy 450 keV lower compared to the peak of D_{fus} for this projectile target system. Shift of 3 MeV was observed for the system ^{6}Li+^{208}Pb [10], whereas a shift of 1.5 MeV was reported for the system ^{9}Be+^{208}Pb [11]. The breakup threshold of the projectiles ^{6}Li and ^{9}Be are 1.47 MeV and 1.67 MeV, respectively. It is expected that the observed shift in the peak locations of DB from two different sources for weakly bound projectiles will depend upon the breakup threshold and also on the target mass.

In this context, we present a study of barrier distribution functions from back angle quasi-elastic scattering and previously measured fusion [14] excitation functions for the system ^{7}Li+^{64}Ni and a comparison with the system ^{6}Li+^{64}Ni [12].

2. Experiment and Analysis

The experiment was carried out at the Pelletron Linac Facility in Mumbai. The ^{7}Li beam with energy varying from 12 to 24 MeV was bombarded on a self-supporting ^{64}Ni target of thickness 507 μg/cm^{2}. Two $\triangle E$-E telescopes were placed at ± 170 ° with respect to the beam direction. Two monitor detectors were placed at $\pm 20^{o}$ about the beam axis for normalization purpose.

3. Results and Discussions

The experimental back angle quasi-elastic excitation function is defined as the sum of elastic and inelastic excitation functions in the present work. The plot of quasi-elastic excitation functions is shown in the upper panel

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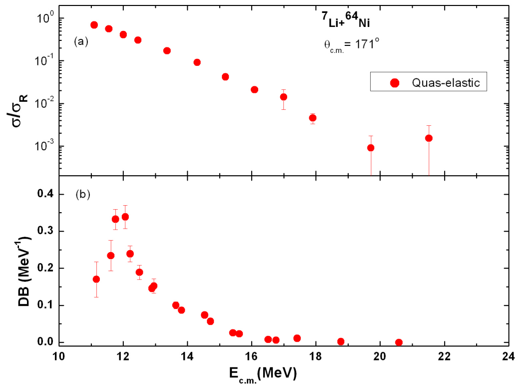

FIG. 1: (a) The ratio to Rutherford back angle quasi-elastic excitation function at 171° for the system ^{7}Li+^{64}Ni. (b) Corresponding barrier distribution.

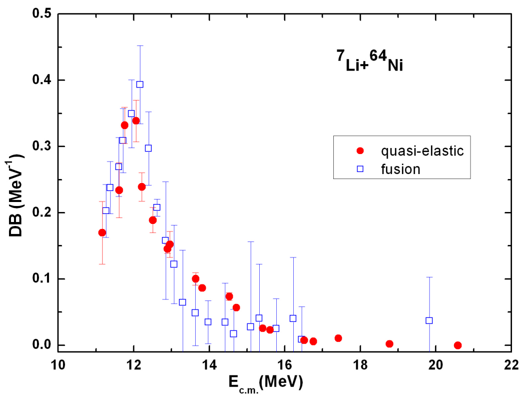

FIG. 2: Barrier distributions extracted from both quasi-elastic (solid bullets) and fusion(open squares) excitation functions for ^{7}Li+^{64}Ni system.

of Fig. 1. The extracted barrier distribution from quasi-elastic excitation function (D_{qel}) is shown in the lower panel. The distribution D_{qel} peaked at 12.20 MeV and is very close to the Coulomb barrier of the system.

Fig. 2 compares the barrier distributions extracted from both quasi-elastic (solid bullets) and fusion (open squares) excitation functions for the system ^{7}Li+^{64}Ni. It is clearly observed that the barrier distribution from fusion excitation function for ^{7}Li+^{64}Ni system is very similar to that from quasi-elastic excitation function that depicts the distribution of reaction thresholds at low energies. This observation is contrary to that for the system ^{6}Li+^{64}Ni, where the two peaks are located at different bombarding energies. Model predictions of the observed effect of breakup threshold is in progress.

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