Quasi-elastic Scattering in ^{28}Si+^{144}Sm

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Introduction

Sub-barrier fusion studies have regained its importance in the last few years. The enhancement in fusion reactions at sub-barrier energies is a result of the channel coupling which can not be accounted by the single potential model. The single potential barrier (V_b) splits into a distribution of barriers as a result of the coupling of the relative motion between the colliding nuclei to their intrinsic motions as well as direct reaction channels[1**?**–5]. Extraction of barrier distribution from fusion and quasi-elastic (QE) excitation functions is considered as a relevant approach to apprehend the various quantum mechanical aspects of heavy-ion fusion reactions. Understanding the coupling schemes through BD in any reaction is vital as it has a greater influence on the formation probability of compound nuclei. BD helps us to obtain a deeper insight about the nuclear structural and dynamical properties. The BD can be experimentally studied by the measurement of fusion excitation function using relation $D_{fus} = d^2(E\sigma_{fus})/dE$ [1] and the QE excitation function using $D_{qel} = -d(d\sigma_{qel}/d\sigma_R)/dE$ where σ_{fus} and σ_{qel} are the fusion and QE cross-section[3].

In the present work, we have performed an experiment for the QE-measurements for the system ^{28}Si+ ^{144}Sm. It can be noticed that the near-spherical ^{144}Sm target will behave as an inert and thus, the effect of the coupling of different degrees of freedom on BD should be pronounced for the projectile nuclei, only.

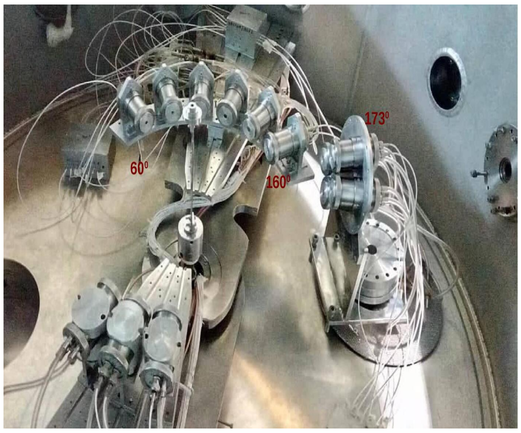

FIG. 1: Arrangement of HYTAR inside GPSC-Chamber

Experimental Set-Up

This experiment has been performed at IUAC, New Delhi using HYTAR [4] detecting system and ^{28}Si beam from pelletron accelerator in General Purpose Scattering Chamber(GPSC). The sandwiched isotopically enriched thin targets of samarium(~ 105 μg/cm^2) were prepared using resistive heating technique at the target lab of IUAC. Beam energy has been varied in steps of 5 MeV ranging from barrier value to 25% below barrier and in steps of 4 MeV from barrier value to 12% above barrier. Four telescope detectors, two of them in plane and other two out of plane, each at an angle of 173° have been arranged in a symmetrical cone geometry. Nine telescopes, six at angles from +60° to +160° with

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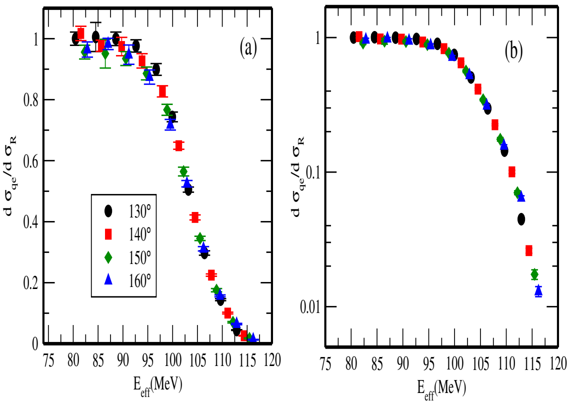

FIG. 2: (a)(b) Experimental Quasi-elastic excitation function at different angles.

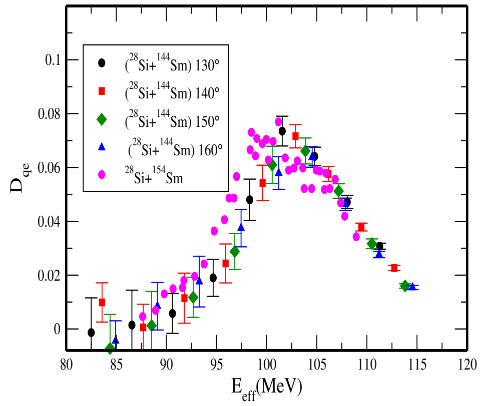

FIG. 3: (a) Preliminary Anglewise Barrier Distribution extracted from measured QE Excitation function compared with Barrier distribution of ^{28}Si+^{154}Sm (Pink Dots).

angular separation of 20° and other three telescopes at angles -30°, -42° and -54°, are placed on the rotatable arms. Two monitor detectors of thickness 300 μm have been placed at $\pm$10° for normalization purpose and to monitor the beam. The angular distribution measurement of QE events has also been measured to study the nuclear potential.

Experimental Analysis

The quasi-elastic excitation function is defined as the sum of elastic,inelastic,transfer excitation function etc.The QE -events have been identified by E-ΔE, 2D spectra. Since the detector cannot be placed at θ = 180° and each scattering angle corresponds to a certain angular momentum, hence a centrifugal correction has been given in the centre of mass energy(E_{cm}) to obtain the BD for l=0. Fig.2(a),(b) shows the excitation function as a function of E_{eff}. By combining the data from all detectors, the QE -excitation function with energy step of less than 1 MeV is obtained. From the measured QE excitation function,it can be observed that the experimental average barrier($\sim$103.4MeV) is almost same as that of its Bass barrier ($\sim$104MeV). Here the average barrier is considered as the energy where the experimental QE excitation function is reduced to a value of 0.5. From experimentally measured QE -excitation function, the preliminary experimental BD has been derived and compared with the BD of the system ^{28}Si+^{154}Sm [4] shown in Fig.3(a) and 3(b). Further, analysis of the data is underway and the details will be presented during the conference.

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