CDCC Calculation for Elastic Scattering and Fusion on ^{6}Li+^{28}Si

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Introduction

The light nuclei with two cluster configuration exhibit appreciable probability of breakup in a collision process because of small separation energy of the configuration. The presence of breakup subsequently influences the outcome of the collision of these weakly bound projectiles in a way not observed in case of their strongly bound counter parts.

The effect of breakup on elastic scattering induces a distinct variation of the interaction potential strength as the bombarding energy is decreased towards the barrier. Most of the studies in the direction have been performed with heavier targets [1–4]. But the nature of energy variation of the interaction potential is expected to show a dependence on the target mass as well. Recent reports [5, 6] on ^{6}Li+^{28}Si system indicate that direct reaction processes like breakup and/or transfer dominate over the fusion reaction process in determining the energy dependence of the interaction potential near the barrier.

In this context we present here a systematic continuum discretized coupled channel (CDCC) calculation for our measured elastic angular distribution for the system ^{6}Li+^{28}Si. The primary motivation is to investigate the effect of continuum coupling on the energy variation of the effective interaction potential around the Coulomb barrier energy.

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Analysis of the results

Elastic angular distributions for ^{6}Li+^{28}Si were measured at above barrier energies [7] at the Pelletron accelerator at IUAC, while results for near barrier energies were taken from [8]. Details of the experiment and the analysis procedure are given in [9].

The effect of breakup on elastic scattering was investigated using the continuum discretized coupled-channels (CDCC) approach with the code FRESCO. In CDCC calculation, two body cluster structure, *i.e*, (α+d) for ^{6}Li were considered, where coupling potentials were generated from emperical (α+^{28}Si) [10], (d+^{28}Si) [11] optical potentials with decay scheme of [12]. However, for ^{6}Li+^{28}Si, L= 0 to 3 nonresonant and resonant states had been considered where as resonance state at 5.65 MeV (1^{+}) for L= 2 was excluded. At highest bombarding energy excitation of upto 12 MeV was considered and the upper limit was suitably truncated at lower bombarding energies. In order to match the elastic angular distribution at the highest bombarding energy, the normalization factors N_R= 0.7 and N_I= 2.8 were taken for the input real and imaginary potentials for α+^{28}Si and were kept fixed for all energies. The CDCC estimates and previous calculation with OM2 type potential parameters [9] are shown in Fig. 1. The resultant CDCC calculation at lower energies seems to fail to predict the measured elastic angular distributions.

The energy dependences of effective potential, *i.e*, the bare potential plus the polarization potential due to breakup, were extracted from the elastic angular distributions predicted by CDCC by a search routine us-

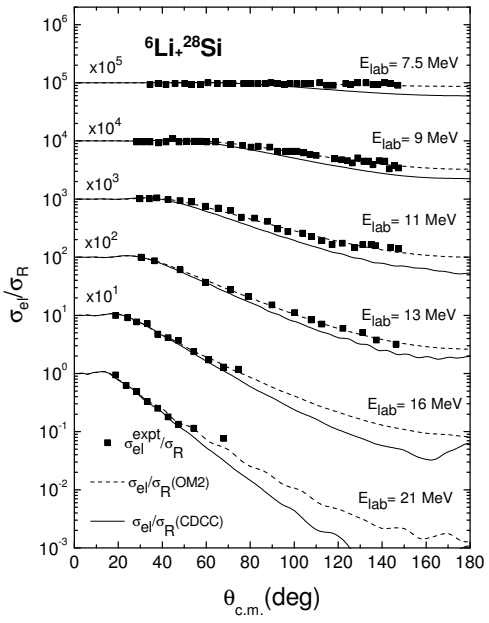

FIG. 1: Elastic angular distribution OM2 potential and CDCC calculation for ^{6}Li+^{28}Si compared with measured data [13].

ing the code SFRESCO. The fusion cross section estimated from SFRESCO from extracted elastic angular distribution due to breakup (from CDCC), which shows agreement with measured data at higher energies and underestimation at lower energies. The estimated reaction cross sections from SFRESCO and from ECIS94 are also found to be in agreement.

Results

The CDCC model prediction appears to describe well the measured elastic angular distributions at higher incident energies. But at lower energies, the model predictions clearly underestimate the data. The energy variations of the effective potential components obtained from CDCC calculation follow the trend observed in the data extracted for ^{6}Li+^{28}Si. The behaviour of the effective potential that includes the effect of breakup coupling indicates that the small discrepancy may be due to existence of other direct reaction channels like transfer channel at low energies. The estimated fusion from the SFRESCO also indicates the existence of other direct reaction channel at near barrier energies.

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