Effect of breakup couplings on the elastic scattering for ^{6}Li+^{112}Sn system

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Introduction

The investigation into mechanisms of reactions with weakly bound projectiles (WBP) around Coulomb barrier energies has been a topic of intense interest in recent times. A variety of processes such as, elastic scattering, complete and incomplete fusion, inclusive and exclusive breakup, transfer have been studied in reactions using WBP in this context [1, 2]. Breakup and transfer processes have been found to significantly affect other processes such as, elastic scattering, α production, complete and incomplete fusion [2]. Elastic scattering data are expected to be useful for constraining the potential parameters used in the calculations.
In present work, an attempt has been made to explore the breakup coupling effects on elastic scattering in ^{6}Li+^{112}Sn system.

Calculation Details

To investigate the effect of projectile breakup on elastic scattering, the Continuum Discretized Coupled Channel calculations (CDCC) have been carried out. Coupled Reaction Channel calculations were performed using the computer code FRESCO (version FRES 2.9)[3]. The coupling scheme used here is similar to that described in earlier work [4, 5].
The calculations assumed a two-body $\alpha - d$ cluster structure for the ^{6}Li nucleus. The binding potentials for all the bound and continuum cluster states were the well-known potentials from Ref. [6]. The real and imaginary part of required fragment-target potentials $V_{\alpha-t}$ and V_{d-T} in cluster folding model were taken from Sao Paulo potential formalism [7]. The strength of real and imaginary part kept as $N_R = 1.0$ and $N_I = 0.78$. Thus there are no free parameters used in the calculations.

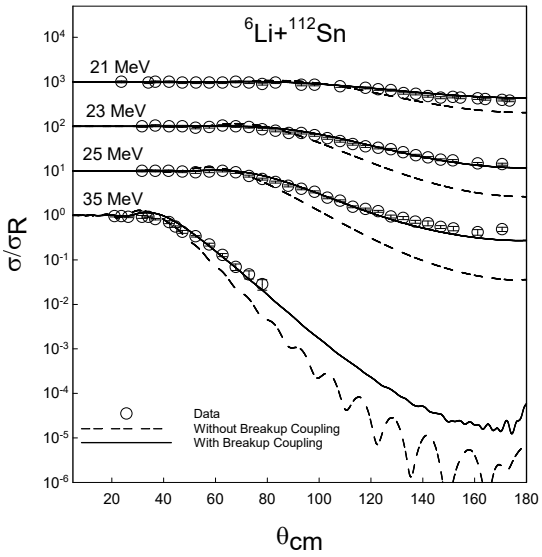

FIG. 1: Elastic scattering data for $^{6}Li + ^{112}Sn$ compared with the calculations [8]

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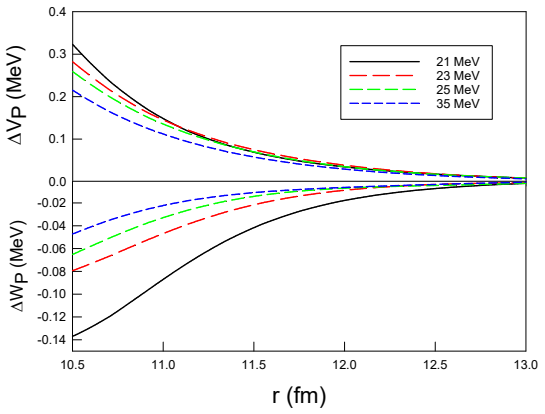

FIG. 2: Real and imaginary parts of dynamic polarization potentials due to breakup at four different energies 21, 23, 25 and 35 MeV

Results and Discussion

The elastic scattering data available for ^{6}Li+^{112}Sn system at 21, 23, 25 and 35 MeV [8] are utilized to see the effect of breakup on the elastic scattering angular distributions. As depicted in the FIG. 1 our results show good agreement for all energies with the data. Dashed lines are the calculations with bare potential without including any continuum couplings. The coupling effects are evident at all energies.

To understand the coupling effects for the elastic scattering angular distribution in a better way, we have investigated the behavior of the dynamic polarization potential (DPP) generated due to these couplings. The DPP in FRESCO is derived as an L-independent weighted mean local potential from TELP [9] with the weights proportional to the calculated partial reaction cross-sections. The DPPs produced as an effect of breakup in the vicinity of strong absorption radii are shown in FIG. 2. It is evident from FIG. 2 that breakup coupling gives rise in repulsive real and attractive imaginary DPP. Similar trend is observed in other work [10].

Summary

In summary, we show that a good explanation of elastic scattering data is obtained using CDCC calculations with no free parameters. Investigation of the breakup coupling effects for studying the target dependence for medium mass target is in progress.

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