Effect of breakup couplings on elastic scattering and fusion in ^{7}Li+^{232}Th system

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Introduction

Weakly bound nucleus like ^{7}Li have a predominant cluster structure of α+t with very low separation energy (S$_\alpha$=2.47 MeV). This nucleus can break easily in the field of another nucleus and hence alter the reaction mechanism. In the present work, we study the effect of breakup couplings on elastic scattering and fusion cross sections around the Coulomb barrier for ^{7}Li+^{232}Th system where measured data is available [1, 2].

Continuum Descretized Coupled Channel (CDCC) Calculations

Continuum Descretized Coupled Channel calculations were performed using the code FRESCO (version FRES 2.9) [3]. The coupling scheme used in CDCC is similar to that described in earlier works [4, 5]. The calculations assumed a two-body $\alpha - t$ cluster structure for the ^{7}Li nucleus. The continuum above the breakup threshold was discretized into bins of constant momentum width k=0.20 fm^{-1}, where $\hbar k$ is the momentum of α+t relative motion. The binding potntials for all the bound and continuum cluster states were the well-known potentials from Ref. [6]. The real part of required fragment-target potentials $V_{\alpha-t}$ and V_{t-T} in cluster folding model were taken from Sao Paulo Potential formalism [7]. For imaginary part, wood-saxon type potential with parameters W=40.0, r_w=1.0 and a_w=0.4 was considered.

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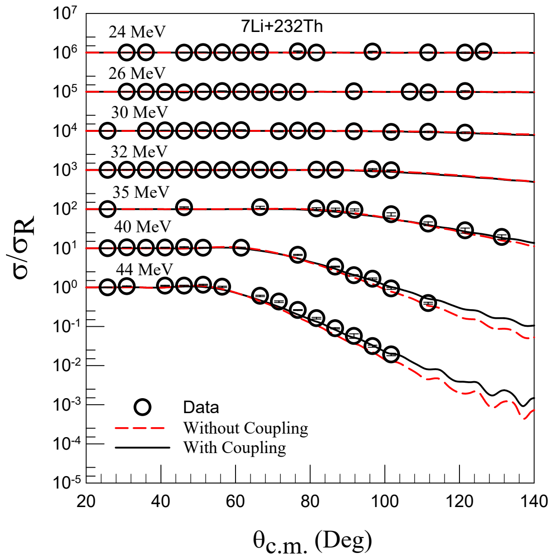

FIG. 1: Elastic scattering data [1] are compared with the coupled channel calculations for ^{7}Li+^{232}Th system.

Results and Discussion

The elastic scattering data available for ^{7}Li+^{232}Th system at different energies [1] are utilized to see the effect of breakup on the elastic scattering angular distributions. As depicted in the Fig. 1, the calculations with breakup couplings (solid lines) shows a good agreement with the data at all the energies. Red dashed lines are the calculations with bare potential (without breakup couplings). To gain a clear understanding of the coupling effects on elastic scattering angular distribu-

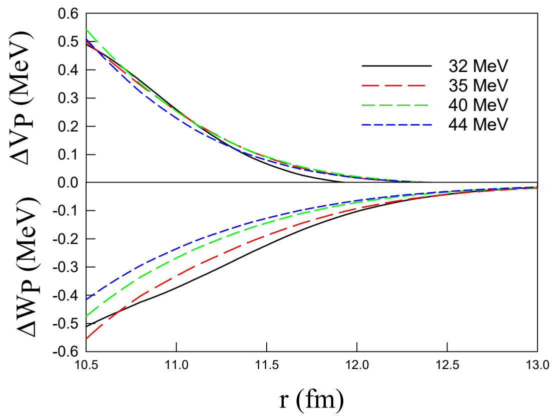

FIG. 2: Real and imaginary parts of dynamic polarization potentials (DPP) due to breakup are shown at four different energies 32, 35, 40 and 44 MeV

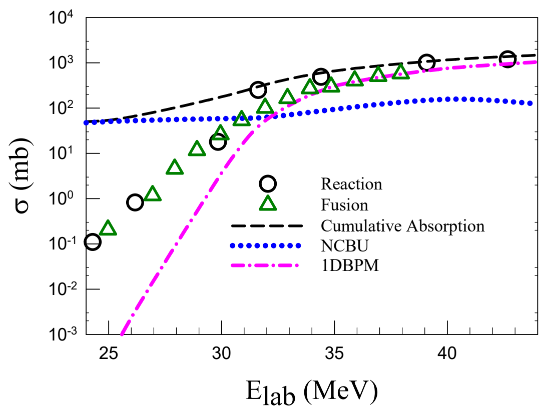

FIG. 3: The calculated total fusion cross-sections (σ_{fus}) obtained from cumulative absorption are compared with the experimental fusion and reaction cross section data [1, 2]. NCBU and 1DBPM calculations are also shown with dotted and dashed dot lines respectively.

tions, the behavior of the dynamic polarization potential (DPP) resulting from these couplings at energies close to the Coulomb barrier is investigated. In FRESCO, the DPP is derived as an L-independent weighted mean local potential from TELP [8], with the weights based on the calculated partial reaction cross-sections. The DPPs resulting from breakup effects, near strong absorption radii, are shown in Fig. 2. From the figure, it is seen that the breakup coupling induces a repulsive real and an attractive imaginary component in the DPP. This observed trend is in agreement with results from other studies [9]. In Fig. 3, the measured fusion and reaction cross sections for ^{7}Li+^{232}Th system [1, 2] are compared with the cumulative absorption cross section from FRESCO, which show a good matching at higher energies and overprediction at sub-barrier energies. In the figure, the cross sections from Non-capture breakup (NCBU) and 1DBPM fusion cross sections are also shown. 1DBPM fusion cross sections reproduces the experimental fusion data at above barrier energies while underpredict at sub-barrier energies. Similar behaviour is observed in earlier work [10].

In summary, we demonstrate the effect of breakup couplings on both elastic scattering and fusion using CDCC calculations. The details of calculations and further results will be presented.

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