Effect of continuum coupling on elastic scattering of ^{6}Li+^{64}Ni around the barrier energy

Md. Moin Shaikh and Subinit Roy*
Nuclear Physics Division, Saha Institute of Nuclear Physics, Kolkata - 700064, INDIA

Introduction

A phenomenological model calculation of previously measured elastic angular distribution data of ^{6}Li+^{64}Ni system [1] has shown distinct evidence of breakup in the energy variation of the effective potential strengths at energies near the barrier. Absence of usual energy dependence of the potential strengths near the barrier has also been observed for other targets in the same mass region [2, 3]. This unusual feature of the near barrier behaviour of the potentials in the elastic scattering of weakly bound ^{6}Li projectile is usually explained by strong coupling to the breakup channels [3, 4].

In this context, ^{6}Li we have performed continuum discretized coupled channel (CDCC) calculation for the elastic scattering of ^{6}Li from ^{64}Ni target at incident energies of 13,14,17,19 and 26 MeV. Experiment was carried out at TIFR/BARC Pelletron facility and the details will be found in Ref. [1].

Analysis

The CDCC calculations have been performed using the code FRESCO (Ver FRES 2.4) [5]. The weakly bound projectile ^{6}Li has a two-body $\alpha + d$ cluster structure with the threshold of breakup at 1.47 MeV. The continuum above the threshold was discretized into equal energy bins with ΔE=2.0 MeV. The continuum states with relative angular orbital momentum L=0 to 3 were considered. The resonance states $3^+(\epsilon_{rel}$=0.72 MeV), $2^+(\epsilon_{rel}$ =2.84 MeV) and $1^+(\epsilon_{rel}$=4.18 MeV) in the L=2 continuum were included in the calculation with the energy bin widths being suitably modified to avoid any double counting. At 26 and 19 MeV, continuum excitations were considered upto ϵ^*=12 MeV. At 17 and 14 MeV incident energies the continuum excitations were truncated at 10 MeV while for 13 MeV which is just below the barrier [V_B(lab)=13.9 MeV] upto 6 MeV excitation was considered.

The effective coupling potentials were generated in the cluster folding approach using the global $\alpha-$ and $d-$ optical potentials. The binding potential between the $\alpha + d$ clusters were considered to be L-dependent [6]. Two different α+^{64}Ni global potentials [7, 8] were used in the calculation. It was found that both the global α+^{64}Ni potential strengths had to be renormalized to fit the angular distribution data. The renormalization factors of N_R=0.68 and N_I=2.52 were necessary to fit the angular distribution data at the highest measured incident energy of 26 MeV. The factors were kept fixed for other energies except at the lowest energy of 13 MeV. The paramaters for d+^{64}Ni taken from Ref. [9] were kept unmodified.

Results

The results of the CDCC calculations are shown in Fig. 1 along with measured data from Ref. [1]. The solid and dashed curves correspond to two different $\alpha +^{64} Ni$ global potential sets. As can be seen from the quality of reproduction of the data, the coupling to the non-resonant and resonant states does describe the angular distribution quite well. Both the potentials yield almost similar description of the elastic angular distributions except at lower energis. At 13 MeV where the relative energy between α and ^{64}Ni target is around 8 MeV, the global potential set of Ref. [8] apparently produces a better desciption. Although CDCC calculation produced reasonable description of the data, the energy

*Electronic address: subinit.roy@saha.ac.in

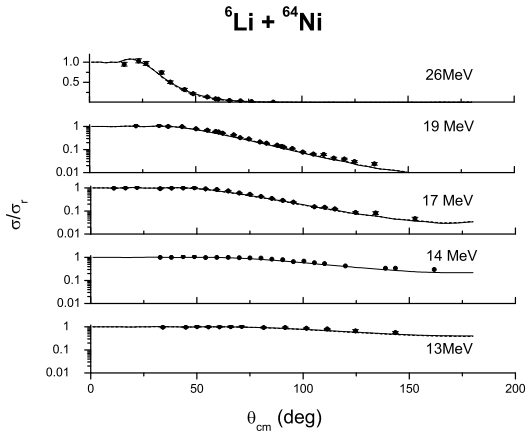

FIG. 1: Elastic angular distributions of ^{6}Li+^{64}Ni with CDCC predictions. Solid curves are with α potentials from Ref. [8] and dashed curves are with potentials from Ref. [7].

dependence of the resultant effective interaction does not corroborate with the derived energy variation of the potential.

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