Study of breakup coupling in ^{6}Li + ^{116}Sn reaction

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Introduction

The availability of radio active ion beams (RIBs) have enhanced the importance of reaction studies with stable weakly bound nuclei (^{6,7}Li, ^{9}Be) due to the similarity in structural properties of stable and unstable weakly bound nuclei that can serve a testing ground for unstable weakly bound nuclei. More recently, in case of stable weakly bound or radioactive nuclei, there has been great interest in studying breakup channels from both the experimental and the theoretical points of view. The lower breakup threshold of these nuclei leads an enhancement and/or suppression in the fusion cross sections [1].

In the present work, we are studying breakup coupling effects on elastic scattering angular distributions and also calculated the breakup α particles cross section by means of preliminary continuum descritized coupled channels (CDCC) calculations for ^{6}Li+^{116}Sn system. The calculated breakup α particles cross section are compared with the experimental ones at various bombarding energies. The experimental details for the measurement of alpha particles are given in the Ref. [2]. The spectra were recorded in the bombarding energy range from 21.0 to 40.0 MeV.

In order to obtain breakup α cross sections, the ^{6}Li nucleus is treated as an α-core plus one d with a separation energy of 1.47 MeV. In the CDCC calculation with ^{6}Li-projectile, the potentials for α/d + ^{116}Sn have been taken of Woods-Saxon form with $V_\circ$ = 107.42 MeV, $r_\circ$ = 1.151 fm, $a_\circ$ = 0.678 fm and $V_\circ$ = 85.93 MeV, $r_\circ$ = 1.361 fm, $a_\circ$ = 0.578 fm respectively. The imaginary parts for α/d + ^{116}Sn,

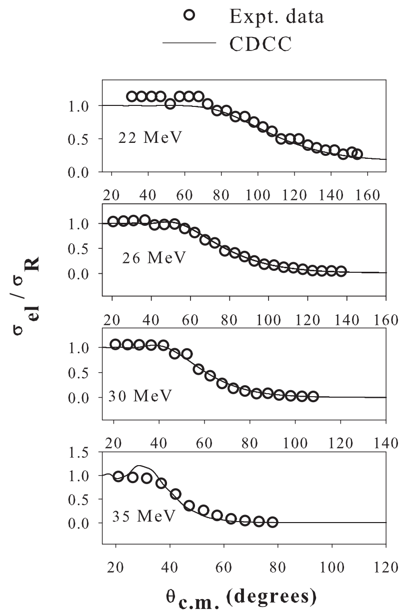

FIG. 1: Elastic scattering angular distribution along with CDCC calculations for ^{6}Li+^{116}Sn system.

$V_\circ$ = 13.50 MeV, $r_\circ$ = 1.412 fm and $a_\circ$ = 0.299 fm and $W_\circ$ = 16.60 MeV, $r_\circ$ = 1.470 fm and $a_\circ$ = 0.598 fm respectively. The potentials for the ground state and resonant states of ^{6}Li-projectile have been taken from the Ref. [3]. The scattering wave functions in the solution of coupled-channels calculations were integrated up to 200 fm in steps of 0.05 fm and the relative angular momentum is taken up to 150$\hbar$.

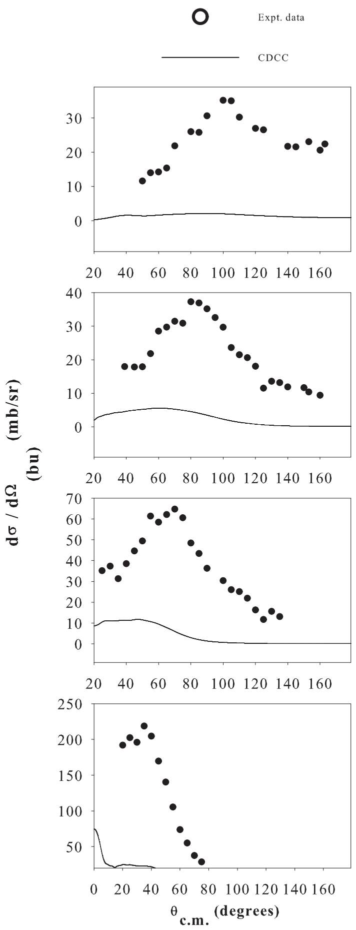

FIG. 2: α-particles cross sections along with the CDCC calculations for ^{6}Li+^{116}Sn system.

Fig. 1 shows breakup coupling effects on elastic scattering angular distributions at various bombarding energies for ^{6}Li + ^{116}Sn system. It is observed that the results of present CDCC calculations can nicely reproduce the experimental elastic scattering angular distributions. Also, the experimentally obtained α particles cross sections are compared with the calculated ones.

Fig. 2 represents experimentally obtained α particles cross sections along with the CDCC calculations. One can observe that the present CDCC calculations underestimate the experimentally obtained α particles cross sections. This suggests that the experimentally obtained α particles may have different origins such as various evaporation channels, breakup followed by transfer etc [4, 5]. A detailed study on all the possible reaction channels that contribute the observed α particles will be presented during the symposium.

References

[1] B. B. Back, H. Esbensen, C. L. Jiang, and K. E. Rehm, Rev. Mod. Phys.**86**, 1, 317 (2014).

[2] N. N. Deshmukh, S. Mukherjee, D. Patel*et.al.*, Phys. Rev. C **83**, 024607 (2011).

[3] A. Diaz-Torres, I. J. Thompson, and C. Beck, Phys. Rev. C **68**, 044607 (2003).

[4] D. H. Luong, M. Dasgupta, D. J. Hinde*et.al.*, Phys. Rev. C **88**, 034609 (2013).

[5] D. Patel *et.al.*, Phys.Rev. C **89**, 064614 (2014).