Signature of incomplete fusion in α-channels of ^{6}Li+^{93}Nb reaction*

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Heavy-ion induced reactions pave the way for understanding the underlying reaction dynamics; amongst others, the weakly bound (^{6,7}Li) induced reactions have gained special attention over the past few years. Mechanisms like complete fusion (CF), incomplete fusion (ICF), nucleon transfer, and the effect of inelastic degrees of freedom on fusion data have been put forth [1]. The present abstract discusses the signature of ICF observed in α-emitting channels of ^{6}Li reaction on ^{93}Nb within 24–43 MeV energy. The experiment was carried out at the BARC-TIFR Pelletron facility, Mumbai, India, employing the activation technique followed by off-beam γ-spectroscopy to measure the residual cross sections. The details of the experimental technique can be found elsewhere [2].

To elucidate the underlying mechanisms in ^{6}Li+^{93}Nb reaction, the measured data have been compared with theoretical estimations from Hauser-Feshbach and Weisskopf-Ewing formalism-based EMPIRE3.2.2 and ALICE23 codes, respectively, working in the framework of CF dynamics. Different level density (LD) models like enhanced generalized superfluid model (EGSM), Gilbert-Cameron (GC) model in EMPIRE code and Fermi gas (FG) model, Kataria-Ramamurthy (KR) model in ALICE code have been adopted for the data reproduction. A fair degree reproduction of measured n-channel data ($\Sigma\sigma_{xn}$; x=4,5) by EMPIRE EGSM LD compared to others (see Fig. 1(a)) implies the mere role of CF mechanism in the population of Ru radionuclides via n-channels. Thus, EMPIRE EGSM was opted as favourable LD for the analysis in other channels. The comparison of measured α-channel data ($\Sigma\sigma_{\alpha 2n,\alpha p2n}$) with optimal theoretical estimations in Fig. 1(b) hints at the role of breakup fusion (ICF) process in addition to CF process in the population of ^{93m}Mo and ^{92m}Nb residues, owing to the low breakup threshold of ^{6}Li projectile [3]. Thus, α-channel data enhancement has been observed relative to the theory (which predicts CF cross sections). Subsequently, we have estimated the α-channel ICF cross sections (red circular symbols in Fig. 1(b)) employing the data reduction method [3]. The assessed α-channel ICF strength fraction (F_{ICF}) (Fig. 1(c)) obeys an increasing trend with projectile energy evident of an increasing ^{6}Li breakup (α+d) probability with energy in line with earlier published results [3].

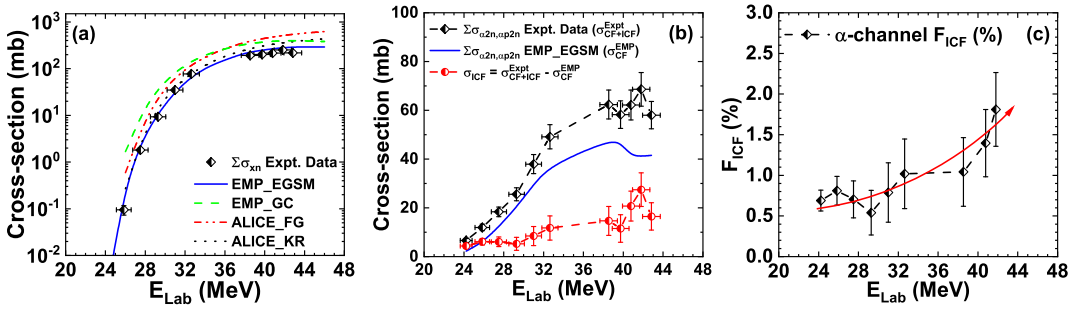

FIG. 1. Measured xn-channel (x=4,5) data (Fig. (a)) and α-channel data (Fig. (b)) in comparison with theoretical estimations. Fig. (c) displays the variation of F_{ICF} with bombarding energy.

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