Simultaneous description of ^{6,7}Li+^{28}Si scattering and fusion

Mandira Sinha[1], H.Majumdar[1,2],* Subinit Roy[1], P.Basu[1], S.Santra[3], V.V.Parkar[3], K.S.Golda[4], and S.Kailas[3]

[1] *Nuclear Physics Division, Saha Institute of nuclear Physics, Kolkata - 700064, INDIA*
[2] *R.K.Mission Vivekananda University, Belur Math, Howrah- 711202, West Bengal, INDIA*
[3] *Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai- 400085, INDIA and*
[4] *Inter-University Accelerator Centre, New Delhi- 110067, INDIA*

Introduction

In phenomenological model analysis optical potential parameters obtained from fitting of elastic scattering data are essential to understand nuclear-nuclear interaction. Specially the scattering measurements involving weakly bound nuclei, e.g. ^{6,7}Li, became important due to influence on the fusion process of couplings both to collective degrees of freedom and to breakup/transfer channels. Hence simultaneous analysis of elastic scattering, breakup and fusion is necessary for proper description of the reaction mechanism. There are few attempts in this line with measurements and analysis for heavy target (e.g. ref [1]) and medium mass target [2] where a consistent set of parameters were used to simultaneously describe scattering and fusion. But there is no such work in the light mass target region.

Experiment and results:

In this perspective we have measured elastic angular distributions for ^{6,7}Li+^{28}Si at certain energies in the interval E_{lab}= 11- 26 MeV and experimentally extracted total fusion cross-sections in the energy range E_{lab}= 7- 26 for ^{7}Li+^{28}Si [3] and in E_{lab}=7- 24 MeV for ^{6}Li+^{28}Si [4]. The elastic angular distributions were measured at IUAC Pelletron (New Delhi) and at BARC-TIFR Pelletron (Mumbai). The data at other energies were taken from ref [5] for analysis.The Si-target of thickness 150μg/cm^2 sandwiched between Au layers were used. The scattering functions were measured at different angles varying from θ_{lab} = 15.5°- 94.5° in small steps. A typical 2-D spectrum is shown in Fig. 1. The data were then analysed using the phenomenological Woods-Saxon type potential employing the code ECIS94 where rotational coupling of 2^+ state of the target with β_2= -0.407 was taken into account. Two sets of OM potential parameters with surface (OM1) and volume type (OM2) imaginary potentials were obtained from the best fit procedure. Table 1 shows typical values of the parameters for surface type potential for ^{7}Li+^{28}Si at thre representative energies. Fig. 2 displays the elastic angular distributions along with theoretical fits with the relevant potentials. Solid squares are our data; open circles are from

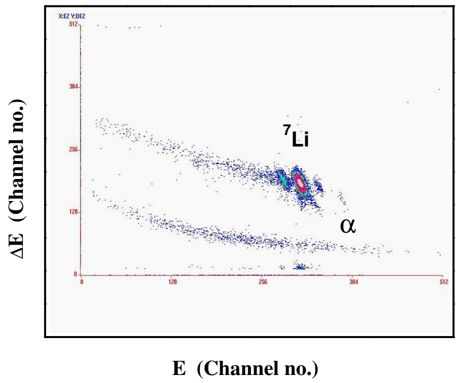

FIG. 1: Two dim. (E vs ΔE) spectrum for ^{7}Li+^{28}Si of telescope T1 at an angle θ_{lab} = 25° and for projectile energy E_{lab}= 13 MeV.

*Electronic address: harashit.majumdar@saha.ac.in

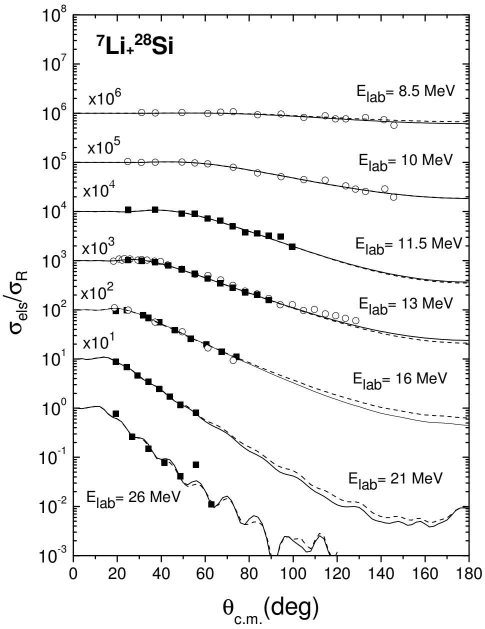

FIG. 2: Elastic angular distribution of ^{7}Li+^{28}Si with theoretical predictions.

TABLE I: Optical Model (OM1) phenomenological potential parameters of surface type for ^{7}**Li**+^{28}**Si** with volume imaginary potential, W_F= 50 MeV, r_F= 1.0 fm, a_F= 0.40 fm. where radius is given by $R_{0,s}$= $r_{0,s}(A_P^{1/3} + A_T^{1/3})$.

E_{lab}	V_0 (MeV)	r_0 (fm)	a_0 (fm)	W_s (MeV)	r_s (fm)	a_s (fm)	σ_R^{el} (mb)
8.5	4.8	1.12	0.89	1.13	1.14	0.82	108
21	31.6	1.03	0.78	8.18	1.09	0.72	1283
26	47.8	1.02	0.78	9.39	1.09	0.69	1510

[5] and dashed and solid lines represent fits with parameters OM1 and OM2 respectively. The reaction cross-sections were extracted using both sets of potentials and are similar to each other; however values are larger for ^{6}Li than those for ^{7}Li

Analysis and Discussion :

As at high energy the OM potential may be treated as bare potential, this is used to calculate the 1D BPM predictions for fusion cross-section. We used OM2 volume type imaginary potential parameters to find the fusion cross-sections employing the new version of CC-FULL. Preliminary calculation showed that these estimates yield similar fits but overestimated compared to experimental data for ^{7}Li+^{28}Si at 21 and 26 MeV, but the result is poorer at 16 MeV. For ^{6}Li+^{28}Si, there is also over estimation of fusion yields at 16 MeV. The detailed analysis incorporating relevant coupling effects are in progess. Energy dependence of the potentials showed some features distinctive from those observed with heavy/medium targets bombarded with stable or loosely bound projectiles.

References

[1] B.T. Kim *et al.*, Phys. Rev. **C 65**, 044616 (2002).

[2] C.Beck *et al.*, Phys. Rev. **C 75**, 054605 (2007).

[3] Mandira Sinha *et al.*, Phys. Rev. **C 76**, 027603 (2007) ; Phys. Rev. **C 78**, 027601 (2008).

[4] Mandira Sinha *et al.*, Eur. Phys. J. **A 44**, 403 (2010).

[5] A Pakou *et al.*, Phys Lett **B 556**, 21 (2003); Phys. Rev. **C 69**, 054002 (2004).