Study of breakup and transfer breakup reactions in ^{7}Li+^{198}Pt system around the Coulomb barrier

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In continuation of our study on the effect of continuum states on nuclear reactions, exclusive measurements have been carried out for ^{7}Li+^{198}Pt system at and above the Coulomb barrier. This measurement is complementary to our earlier measurement for ^{7}Li on medium mass target ^{93}Nb [1]. The earlier measurements were limited to beam energies above 1.3 times of the Coulomb barrier, on the other hand the present measurements were carried out at beam energies of V_B, $1.1V_B$ and $1.3V_B$. One of the reason for the choice of ^{198}Pt as target is that, the complete and incomplete fusion cross-sections are available for ^{7}Li+^{198}Pt system [2]. The present measurement along with available data will shed light on the relative importance of different channels on reaction mechanism.

The experiment was carried out at 14UD Pelletron Linac facility-Mumbai, using ^{7}Li beam of energies 28, 30 and 36 MeV. Self-supporting rolled foil of ^{198}Pt (95.7% enriched, $\sim$1.3 mg/cm^2 thick) was used as a target. Two segmented large area Si-telescopes of active area 5 x 5 cm^2 (thicknesses ΔE $\sim$50 μm, E $\sim$1500 μm) were used for coincidence measurement of the outgoing fragments. Two Si-surface barrier detectors (thicknesses 300 μm) kept at $\pm 20^{o}$ for normalization and beam monitoring. The data were collected in an event by event mode, with the trigger generated from E detectors. Multiplicity threshold (M), M=1 was kept for elastic scattering measurement and M=2 for the measurement of breakup fragments in coincidence.

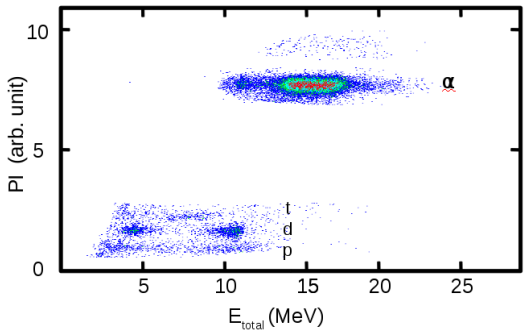

FIG. 1: Particle identification vs total energy with multiplicity two for reactions ^{7}Li on ^{198}Pt at beam energy E_{beam}=28 MeV.

The strips were calibrated using the known alpha energies from ^{7}Li+^{12}C reaction at 28 MeV. Energy loss information from ΔE and E detectors were used to generate particle identification parameter (PI). PI were generated using the algorithm given in Ref. [3]. A good charge and mass resolution was achieved, which allowed the identification of all isotopes of hydrogen (Fig.1).

The energy correlation spectra of exclusive breakup fragments are presented in Fig.2. One proton pickup channel leads to the creation of ^{8}Be, which breaks into two α particles. The kinetic energies of these α particles detected in coincidence are shown in Fig.2(a). Strongly populated band corresponds to formation of ^{8}Be and ^{197}Ir both are in its ground state, while relatively less populated band corresponds to ^{197}Ir in excited state. The coincident events between α and d correspond to breakup of ^{6}Li from its first resonant state 3^{+} (2.18 MeV) following the one neutron transfer

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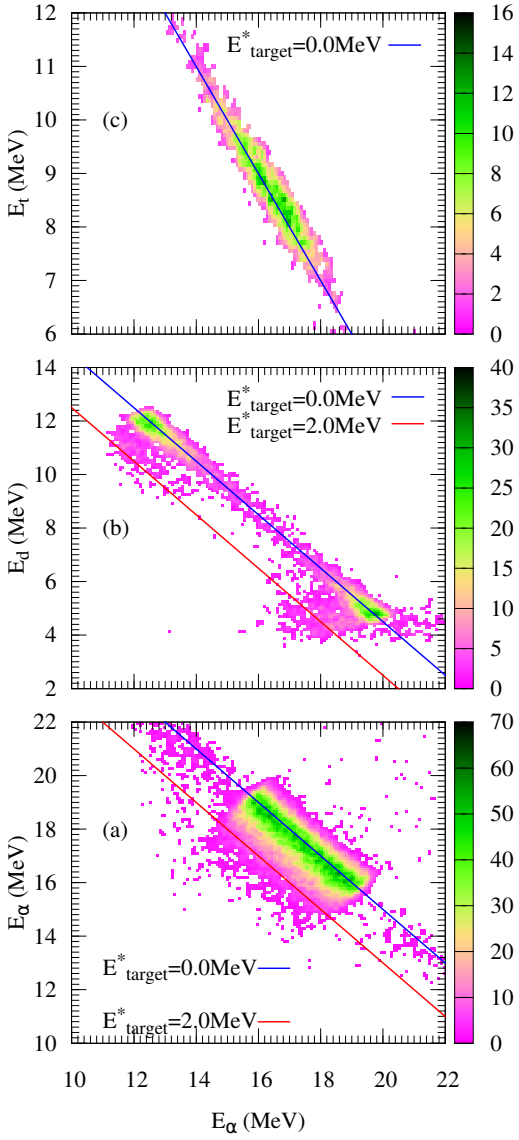

FIG. 2: Energy correlations of breakup fragments for ^{7}Li on ^{198}Pt measured at E_{lab} = 28 MeV.

^{198}Pt(^{7}Li,^{6}Li*) reaction. The α-d correlation spectra as shown in Fig.2(b), two localized contributions high (low) energy α (d) and low (high) energy α (d) were observed. High (low) energy α (d) are due to α particles moving in the forward direction in the α-d center of mass system and high (low) energy d (α) are due to d particles moving in the forward direction in the α-d center of mass system. Two distinct bands in the correlation spectrum guided by blue and red lines as shown in Fig.2(b) were due the population of ^{199}Pt to its ground state and excited state of excitation energy E^{*} = 2 MeV, respectively. The coincidence between α-t were from the direct breakup or sequential breakup of ^{7}Li due to the Coulomb excitation to its continuum and first resonance state at 4.63 MeV, respectively. As shown in Fig.2(c), only high (low) energy α (t) events were detected, in case of low (high) energy α (t) events energy of α particles were not enough to pass through the ΔE ($\sim$50 μm) detectors.

In summary, an exclusive measurement for direct and transfer breakup cross-sections for ^{7}Li+^{198}Pt reaction was performed. Different reaction channels were identified. The yields of two α-particles in coincidence was found to be more than the othar coincident channels. The Differential cross-sections of all the channels will be presented along with a comparison with results for ^{7}Li+^{93}Nb.

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References

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