Exclusive measurement of direct- and transfer-breakup reactions for ^{7}Li+^{89}Y,^{93}Nb systems

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Introduction

The process of transfer followed by breakup have been observed in reactions involving weakly bound nuclei recently [1, 2]. In our previous measurements for ^{7}Li+^{89}Y and ^{7}Li+^{93}Nb systems, performed at beam energies 1.3V_B and 1.5V_B [3, 4], the cross-section for 1-p pick-up leading to unbound states was found to be most dominant as compared to 1-n stripping leading to unbound and projectile breakup channels. In the present work, we have extended these measurements to energies $\sim V_B$ and $\sim$1.7V_B for both the systems, to get the excitation function. The role of nuclear structure of the target on the 1n-stripping and 1p-pickup channels will also be investigated in this work.

Experimental Details

The experiment was carried out at 14UD BARC-TIFR Pelletron facility, Mumbai, using ^{7}Li beam of 18 and 30 MeV on both ^{89}Y and ^{93}Nb targets. Self supporting ^{89}Y and ^{93}Nb targets of thicknesses $\sim$2.0 mg/cm^2 and $\sim$1.75 mg/cm^2 respectively were used. Two segmented large area Si-telescopes of active area 5 x 5 cm^2 and five telescope consisting of Si-surface barrier detectors (thicknesses $\Delta E \sim$ 20-50 μm, $E \sim$ 450-1000 μm) were used. Two Si-surface barrier monitor detectors (thicknesses 300 μm) kept at $\pm 20^{o}$ were used for absolute normalisation. The details of the experimental setup are same as given in the previous paper [4].

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Analysis and Result

Particles were identified using energy loss information from ΔE and E for 256 pixel of Si strip detector telescope. A good charge and mass resolution was achieved [3, 4]. The projectile/ejectile breakup channels were identified by making a coincidence between the two fragments, and confirmed from the extracted relative energy (E_{rel}) between the breakup fragments. The E_{rel} distribution of α and deuteron fragments coming from breakup of ^{6}Li* peaks at 0.71 MeV. This indicates that ^{6}Li* is mostly populated in the excited state 3^{+} (E*=2.18 MeV) following the 1n-stripping reaction. In case of the E_{rel} distribution constructed from the two breakup α fragments, the most dominant state is found to be the ground state of ^{8}Be (92 keV) resulting from 1p-pickup reaction. The target excitations were found to peak around the enrgy E*=Q_{gg}-Q_{opt}, as expected from semi-classical theory. Here Q_{gg} and Q_{opt} are ground state Q-value and optimum Q-value respectively. The measured excitation energy distribution for ^{90}Y* and ^{88}Sr* are shown in Fig.1. In addition to E* corresponding to Q_{gg}-Q_{opt}, for ^{89}Y(^{7}Li,^{8}Be)^{88}Sr reaction the target like product is also populated at excitation energies around 1.84 and 7.0 MeV as shown in Fig.1 (b). The differential cross-section for 1n-stripping and 1p-pickup channels have been extracted. For both the reactions the angular distribution are observed to peak around the grazing angle. Measured differential cross-section for 1-p pick-up channel at 23 and 27 MeV for ^{7}Li+^{89}Y system is shown in Fig.2. The elastic scattering cross-section have been measured for both the systems at energies V_B and 1.7V_B, which will be used to fix the optical potential parameters. Along with elas-

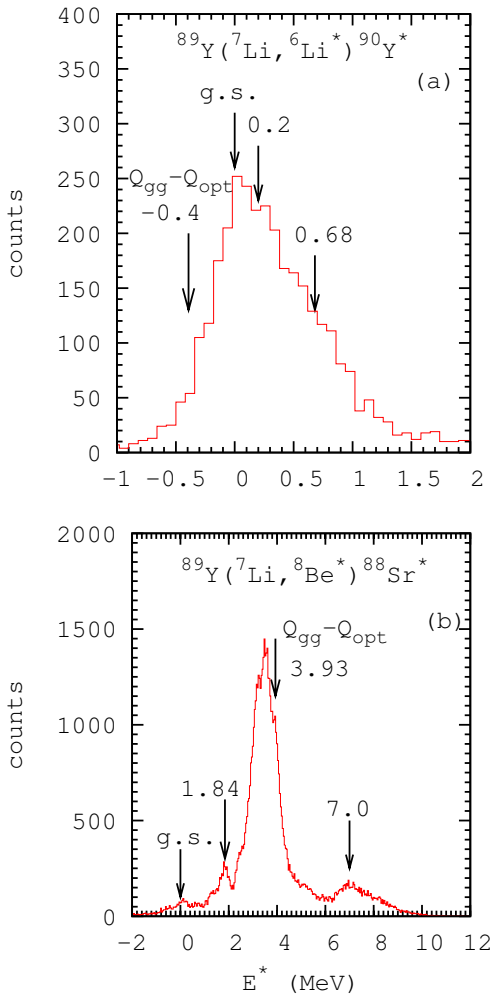

FIG. 1: Measured excitation energy spectrum of target like product for ^{7}Li+^{89}Y reaction at beam energy 23 MeV. (a) ^{90}Y* in 1n-stripping reaction and (b) ^{88}Sr* in 1p-pickup reaction.

tic scattering, inclusive alpha cross-section has also been extracted.

Summary

The breakup channels are identified by detecting the fragments in coincidence and constructing the relative energy distribution of the fragments. The excitation energy distribution of the target like products are extracted and the measured data is consistent with the semi-classical theory. The differential cross-section for 1n-stripping and 1p-pickup channels are extracted for both the systems at beam energies $1.3V_B$ and $1.5V_B$. Data analysis for beam energies at V_B and $1.7V_B$ is in progress. Continuum discretize coupled channels (CDCC) and Coupled reaction channels (CRC) calculations are also in progress to understand the measured data.

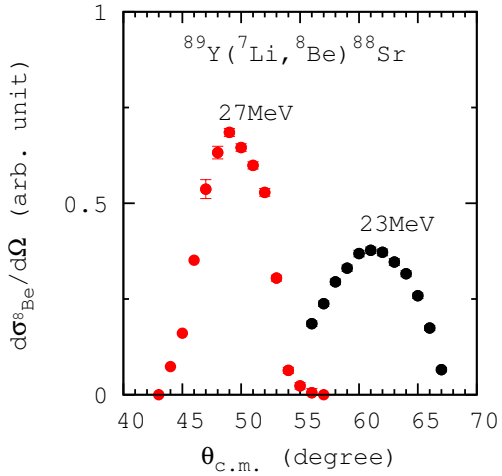

FIG. 2: Measured differential cross-section for 1-p pick-up channel at 23 and 27 MeV for ^{7}Li+^{89}Y.

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