Study of ^{7}Be + p elastic scattering at 5 MeV/A

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Introduction

Proton scattering of exotic unstable nuclei in inverse kinematics is widely used to study such nuclei [1]. A systematic $p-$ scattering study of a loosely bound stable nucleus and its radioactive mirror counterpart throws light on the reaction dynamics as we move towards the driplines. The elastic scattering is known to be affected by the coupling to reaction channels, which usually results in an enhancement of the total reaction cross section [2]. Several works with the stable weakly bound ^{6,7}Li nuclei at near barrier energies have been carried out in this regard [3]. We investigate ^{7}Be, the radioactive mirror nucleus of ^{7}Li, at similar energies (E_{cm} = 4.4 MeV). In addition, the ^{7}Be + p elastic data will be useful in the study of the ^{7}Be(d,p)^{8}Be transfer reaction [4]. In this work, we highlight the results of our experiment at the HIE-ISOLDE facility in CERN to study the proton scattering off ^{7}Be in inverse kinematics.

Experimental setup

A large array of double sided Silicon-strip detectors (DSSD) covering lab angles $8° - 165°$ was used to detect the scattered protons from the ^{7}Be at a beam energy of 5 MeV/A. We used a 15 μm thick CH_2 target in the experiment. The typical beam intensity was about 5×10^5 pps. The detailed experimental setup is described in [4, 5].

Analysis and discussion

The scattering of the protons off ^{7}Be takes place in inverse kinematics. Thus it leads to kinematic compression, scattering all the protons within 90° in lab. At the lab angles of $8° - 25°$, the elastic peak from ^{7}Be + p scattering is distinctly visible in each ring of the forward annular S3 detector. Fig. 1 shows the energy spectrum at $\theta = 25°$ showing the elastically scattered protons off ^{7}Be. The elastic ^{7}Be scattered from ^{12}C in CH_2 target can also be seen in the figure. It may be noted that we could not separate the bound excited state

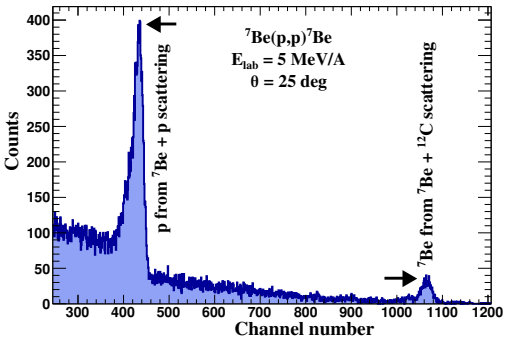

FIG. 1: Energy spectrum (in raw channels) for 5 MeV/A ^{7}Be on CH_2 target showing elastic protons and ^{7}Be at $\theta = 25°$ in the S3 detector.

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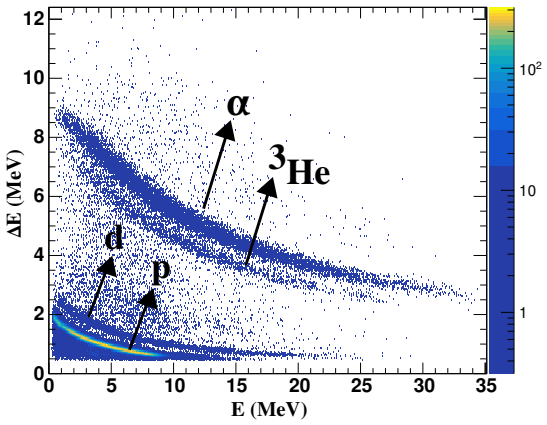

FIG. 2: A typical $\Delta E - E$ spectrum from the experiment.

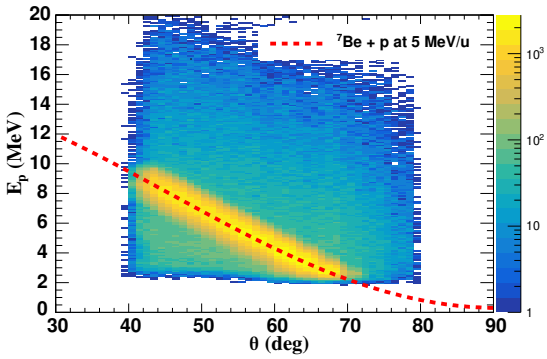

FIG. 3: E_p vs θ plot of protons from ^{7}Be + p elastic scattering at E_{lab}= 5 MeV/A. The red dotted line represents the corresponding kinematics.

of ^{7}Be at 0.429 MeV ($1/2^-$) from the ground state. Thus, the present scattering data correspond to quasi elastic scattering of ^{7}Be + p at 5 MeV/A. At the pentagon detectors ($\theta = 40°-80°$), the protons are identified from the $\Delta E - E$ spectra. A typical $\Delta E - E$ spectrum for one of the pentagon DSSDs is shown in Fig. 2. It shows the light ejectiles such as p, d, ^{3}He and α. To identify the elastic protons, we select the protons from the $\Delta E - E$ spectrum and then plot their total energy (E_p) versus the scattering angle (θ). We observe a clear kinematic band corresponding to the elastic events as shown in Fig. 3. The absolute normalization is obtained by the scattering of ^{7}Be from C of CH_2 and a ^{208}Pb target. The data analysis has been carried out in the CERN ROOT framework [6]. Further analysis is in progress to obtain the angular distributions and the optical model parameters.

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