Elastic scattering and two neutron transfer in the ^{6}He + ^{120}Sn reaction

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Introduction

With the improvement of accelerator facilities around the world, the study of nuclear reactions with radio active ion beams has been improved considerably [1]. The interesting aspect of elastic-scattering studies involving ^{6}He is that the projectile consists of an α core plus two neutrons forming a bound three-body Borromean system, which may effect the reaction mechanism by the rearrangement of neutrons. In the past a large yield of α particles has been observed for the reaction ^{6}He+^{120}Sn around the Coulomb barrier and it is found that neutron stripping transfer reactions are probably the dominant reaction mechanism contributing to the observed α yields [2]. Further the theoretical cross sections and experimental cross sections differ by a factor of 10, indicating that two neutron transfer plays a vital role in reproducing the experimental cross sections. In this context, we performed an experiment to extend the data for elastic scattering, as well as α production cross section for the reaction ^{6}He+^{120}Sn at different energies around the coulomb barrier.

The experiment was performed in two phases by using the RIBRAS (Radioactive Ion Beams in Brasil) facility at São Paulo University [1, 3]. In the first phase of the experiment, we measured the elastic scattering and α-particle production for the ^{6}He+^{120}Sn reaction at 22.2 MeV, by using the two solenoids of the RIBRAS facility and in the second phase we used only one solenoid to measure the α-particle production at three different energies 20.3, 22.4 and 24.5 MeV. The elastic scattering and

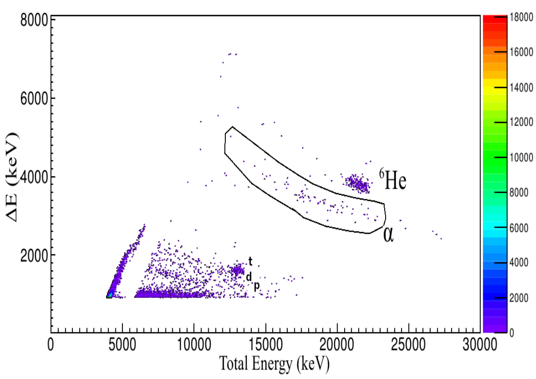

FIG. 1: ΔE - E_{total} spectra with ^{120}Sn target.

α-production measurements at different ener-

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gies were carried out by using four ΔE(25 - 50 μm)-E(1000 μm) silicon detector telescopes. Fig. 1 shows a bidimensional ΔE-E spectrum measured with ^{120}Sn target and using the two solenoids at 36^0.It is well known that the energies of the α particles produced in a reaction depends on the kinematics of the reaction and the excitation energies of the nuclei populated in the exit channel. In the previous studies on the reaction ^{6}He + ^{120}Sn, by using simple Q-optimum considerations, It is observed that the α particles are most probably produced in neutron (2n, 1n) stripping reactions to excited states of ^{122}Sn and ^{121}Sn [2]. Further it is

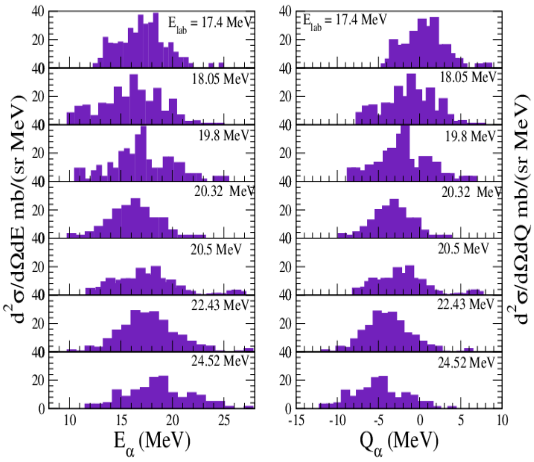

FIG. 2: The energy distributions of the α particles (left) along with the Q-optimum considerations.

found that the calculated cross sections from theoretical predictions are found to be of the order of a few tens of millibarns, where as the experimentally extracted cross sections are in the order of hundreds of millibarns. As the direct breakup mechanism alone cannot explain the observed experimental results, theoretical predictions are done for the two neutron transfer channels and found to be reproducing the experimental results. In order to compare the present results with the existing ones, we analyzed our data through Q-optimum considerations by interpreting the α particles are coming from the two neutron ^{120}Sn(^{6}He,α)^{122}Sn stripping reaction. According to the kinematics, it is expected that the α particle energy distribution is centered at $Q_\alpha = 0$ for two neutron transfer process. The experimentally extracted energy distributions of the α particles along with the Q-optimum considerations are shown in Fig. 2. It can be observed, that at lower energies (near to the coulomb barrier) the α particle energy distributions agrees with the Q-optimum considerations ($Q_\alpha \sim 0$) indicating the dominance of 2n transfer channels. But with increasing energy, It indicates that other reaction mechanisms (inelastic breakup process) are responsible for the production of large number of α particles. It is interesting to observe that even though the Q-optimum value is negative at higher energies, the α particle production cross section is very large. Data analysis is in progress and the results will be presented in the conference.

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