Study of α-transfer process in the ^{12}C(^{20}Ne,^{16}O)^{16}O reaction at E_{lab}=150 MeV

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Introduction

Alpha transfer reactions play a major role in the study of astrophysical reactions. This is because alpha capture reactions that take place in helium burning stars often have very low measurable cross-sections at the Gamow energy. As such extrapolation is done from measured data at higher energy that requires as input, the alpha spectroscopic proerties of the mucleus of interest. The alpha spectroscopic properties can be determined from transfer reactions. The ^{12}C(α,γ) reaction at 300 keV [1] is an example where direct measurement of the cross-section at 300 keV is very difficult and extrapolation from higher energy data requires alpha structure information of ^{16}O. These are the alpha partial widths of the unbound and Asymptotic Normalization constant (ANC) of the bound states of ^{16}O. The ANC s are of primary interest as the ^{12}C(α,γ) capture reaction primarily proceeds through two subthreshold states (6.92 and 7.12 MeV) of ^{16}O. The ANC of these two states have been measured in the recent past by mainly ^{12}C(^{6}Li,d) [2] and ^{12}C(^{7}Li,t)[3] reactions. Similar investigations using other reactions are not available in the literature. In this work we present a study of alpha transfer reaction on ^{12}C using the ^{12}C(^{20}Ne,^{16}O)^{16}O reaction at 150 MeV incident energy. There is no available data in the literature on alpha structure states of ^{16}O using the ^{20}Ne+^{12}C system except a few old works [4, 5]. There are some studies [**? ?**] on the same reaction but these studies do not investigate the alpha transfer process.

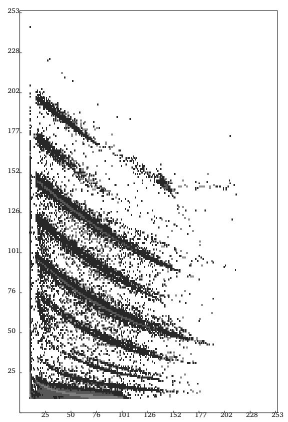

FIG. 1: 2-D energy spectrum of the strip detector ΔE-E (50 μm strip ΔE, 500 μm strip E) telescope for the ^{20}Ne+^{12}C system at Θ_{lab}=19.82^o for $E^{lab}_{^{20}Ne}$=150 MeV.

Experimental Details

The experiment was carried out with ^{20}Ne beam of energy 150 MeV at the Variable Energy Cyclotron Centre (VECC), Kolkata. The target was a 225μg/cm^2 self-supporting ^{12}C. The detection system involved a 16 channel Strip detector ΔE-E telescope (ΔE=50μm and E=500μm) on one arm of the 90 cm scattering chamber. On the other arm two surface

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barrier ΔE-E telescopes (scope ΔE=15μm and E=1000μm) were mounted to detect the ^{16}O fragments in kinematic coincidence with the Strip telescope. The beam current was about 5-8 nA.

Results and Discussions

The inclusive 2-D energy spectrum of the strip detector Θ_{lab}=19.82^o is shown in Fig.1. The Z=2 to Z=10 fragments are nicely separated. Energy calibration was

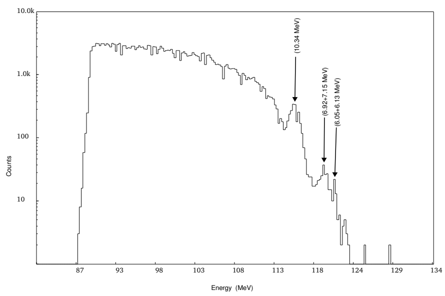

FIG. 2: Energy spectrum of ^{16}O at Θ_{lab}=19.82^o for $E^{lab}_{^{20}Ne}$=150 MeV using strip detector ΔE-E telescope.

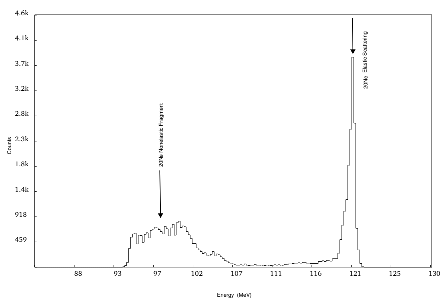

FIG. 3: Energy spectrum of ^{20}Ne fragment in the strip detector

done using elastic scattering from both ^{12}C and ^{197}Au targets and a ^{232}Th source. The projected inclusive energy spectra of the Z=10 and 8 fragments at 19.82^0 are shown in figure 2, Some of the ^{16}O states populated can be clearly seen. Similar analysis for the surface barrier telescopes and for kinematic coincidence is in progress.

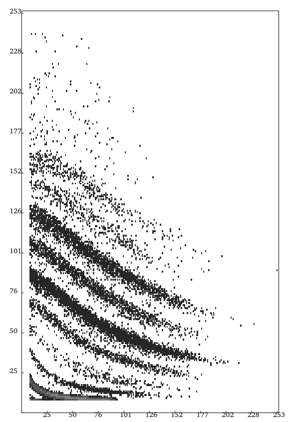

FIG. 4: 2-D Energy spectrum of fragments in one surface barrier telescope at 52^0

Acknowledgments

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