Multi-Nucleon Transfer Reaction Studies on ^{10,11}B+⁴⁰Ca at 50 MeV

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Introduction

Processes in which few nucleons are transferred between projectile and target are one of the dominant reaction channels in heavy ion collisions at energies around Coulomb barrier. Such reactions take place when the surfaces of the colliding nuclei come to distances where the tail of the nuclear wave function starts overlapping thereby, determining the frictional force between the surfaces [1-3]. Single nucleon transfer reaction probes to single particle character of states whereas pairing (p-p, n-n, p-n) or cluster effect can be observed from even number of nucleon transfer reactions [4,5]. Entrance channel properties such as deformation and mass asymmetry affect the formation of compound nucleus (CN) system or а multinuclear system [6,7]. Roy et al. has studied transfer reaction for the systems ${}^{16}O+{}^{27}Al$, ${}^{58}Ni$, ${}^{56}Fe$ (${}^{12}C$, x); x: ${}^{13,11}C$, ${}^{11,10}B$, ${}^{10, 9, 7}Be$, ${}^{8}Be$ and ^{7,6}Li which shows significant properties of Qvalue dependence on transfer processes [8].

In this paper, we have reported experimental details of the ${}^{10,11}B+{}^{40}Ca$ system at energy of 50 MeV in order to study effect of pair transfer on nuclear transfer cross section.

Experimental Details

Experiment was carried out with 10,11 B beam of 4⁺ charge state at incident energy, E_{lab}=50 MeV

obtained from Pelletron accelerator facility at Inter University Accelerator Centre (IUAC), New Delhi, India. Carbon backed (thickness 21.5 μ g/cm²) CaF₂ target of thickness 271.5 μ g/cm² was used for this experiment which was fabricated at target laboratory of IUAC. Beam current was maintained at around 3.0 pnA. Four Silicon Surface Barrier (SSB) detector telescopes of Δ E-E (40 μ m-300 μ m, 15 μ m-300 μ m, 50 μ m-1.5mm, 40 μ m-2mm) configuration were mounted on two movable arms of the General Purpose Scattering Chamber (GPSC) of 1.5 m diameter to detect the transfer products.



Fig. 1 A schematic diagram of the experimental setup at GPSC.

The angular range covered by detectors was from 18^0 to 62^0 . Two monitor detectors (M_Land M_R) were placed at $\pm 10^0$ on the either side of the beam direction for normalization purpose. A schematic diagram of the experimental arrangement is shown in **Fig. 1**.

The products of reactions were collected in the Control Room of IUAC using NIAS-MARS (Multi-parameter Acquisition with Root base Storage) software [9]. Signals from telescopic detectors were fetched into pre-amplifier (Pre-AMP) and then to 16 channel spectroscopic amplifiers (SA) via differential driver (DD). After then the signals from SA were fetched into an Analog to Digital Converter (ADC) and output was collected on computer using NIAS-MARS.



Fig. 2 Typical spectrum observed for ${}^{10}B+{}^{40}Ca$ at 50MeV



Fig. 3 Typical spectrum observed for ${}^{11}B+{}^{40}Ca$ at 50MeV

Result

Well separated transfer bands along with elastic peaks were observed for ${}^{10,11}B+{}^{40}Ca$ as shown in **Fig. 2** and **Fig. 3**. Preliminary data analysis confirms both pickup and stripping channels for the reaction ${}^{10,11}B+{}^{40}Ca$. Further data analysis is going on.

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