REACTION CROSS SECTIONS FOR $^{13-15}B$ AND ONE NEUTRON HALO IN ^{14}B

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The reaction cross section (σ_R) measurements at intermediate energies have been used to deduce matter densities based on the Glauber-type calculation. This method is a powerful tool to study the surface structure of nuclei, which takes advantage of the high sensitivity of σ_R to dilute densities at intermediate energies. We have deduced nucleon density distributions of some exotic light nuclides and have clarified those distinctive structures such as proton and neutron halos by using this method [1].

It is quite important to discuss proton and neutron density distributions respectively for understanding halo and skin structures in detail. Recently, we have developed the new method for the separation of proton and neutron density distributions by utilizing the proton-neutron asymmetry of nucleon-nucleon total cross sections in the intermediate energy region [2,3]. In this method, we employed proton targets as proton-neutron asymmetric targets in addition to conventional nuclear targets. Proton targets are the most appropriate ones for the asymmetric target because they are the most proton-neutron asymmetric targets.

For ^{14}B, some experimental studies were performed so far. Results of electromagnetic moments [4] and one-neutron (1n) knockout/adding reactions [5] point out a large contribution of $2s_{1/2}$ orbital in a valence neutron configuration though the valence neutron is sitting in $1d_{5/2}$ orbital in a naive shell model. Thus, an inversion of $2s_{1/2}$ and $1d_{5/2}$ orbital may occur in ^{14}B. Moreover, 1n separation energy S_{1n} of ^{14}B is so small as S_{1n} =0.970(21) MeV [6]. Therefore, ^{14}B is one of the candidates for the 1n halo nucleus. On the other hand, σ_R for ^{14}B at relativistic energy are not so large in comparison with neighboring nuclei, ^{13}B and ^{15}B [7].

In the present study, we measured σ_R for $^{13-15}B$ on proton, Be, C, and Al targets by the transmission method at several energies in the intermediate energy (50-120 MeV/nucleon) region. The experiments were carried out at the HIMAC heavy ion synchrotron facility at National Institute for Radiological Sciences (NIRS), Japan. The σ_R on a proton target were derived by subtracting σ_R on C from polyethylene (CH_2).

The present σ_R for ^{14}B are largely enhanced in comparison with ^{13}B and ^{15}B. Matter, proton, and neutron density distributions of $^{13-15}B$ were deduced respectively through the χ^2-fitting procedure with the modified Glauber calculation [8]. Moreover, spectroscopic information of a valence neutron in ^{14}B was also obtained in this procedure, which is in good agreement with results of 1n knockout/adding reactions. The deduced neutron density distribution for ^{14}B has a large tail, which can be referred to as a 1n halo.

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