Structure of ^{17}B studied by the quasifree neutron knockout reaction[†]

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The halo structure of weakly bound nuclei has been a topic of great interest in recent decades not only as a novel phenomenon in itself, but also provides an important terrestrial model system to study the correlations and properties of dilute neutron-rich matter.[1)]

In the present work, we have studied the structure of the halo nucleus ^{17}B by using the quasi-free (p, pn) reaction. This study concerns a kinematically complete measurement, combining the high-intensity beams provided by the RIBF and the state-of-the-art detector instruments including the vertex-tracking liquid hydrogen target MINOS, in-beam γ-ray spectrometer DALI2, and the SAMURAI spectrometer.[2)]

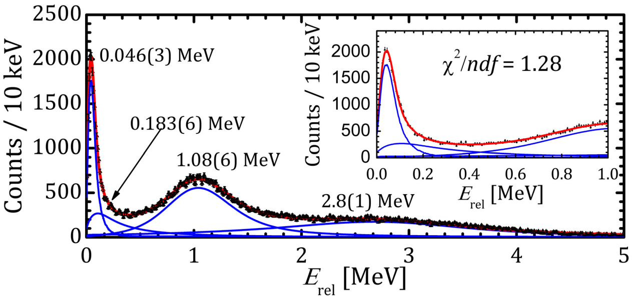

Fig. 1. ^{16}B $E_{\rm rel}$ spectrum fitted with a sum of four resonances (inset is a zoom-in view of the 0–1 MeV region).

Shown in Fig. 1 is the relative-energy ($E_{\rm rel}$) spectrum of ^{15}B+n. It is well fitted using four ^{16}B resonances, after considering the experimental acceptance and resolutions. For each state of ^{16}B, the transverse momentum distribution and production cross section were analyzed by the distorted-wave impulse approximation (DWIA) reaction model.[3)] And the corresponding $1s_{1/2}$ and $0d_{5/2}$ spectroscopic factors of the knockout neutron were thus determined, giving a surprisingly small $1s_{1/2}$ component ($\sim$9%) in ^{17}B.

Our finding of such a small $1s_{1/2}$ component and the previously reported halo features in ^{17}B (*e.g.*, Ref. 4)) can be well explained by the deformed relativistic Hartree-Bogoliubov theory in continuum (DRHBc),[5)] revealing a definite but not dominant halo component in ^{17}B. Our result gives the smallest s- or p-orbital component among known nuclei exhibiting halo features and implies that the dominant occupation of s or p orbitals is not a prerequisite for the occurrence of halo. The halo component, whether or not dominant, results in a distinctive diffused surface and, thus, manifests itself in reactions sensitive to the surface properties.

References

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