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sd-shell evolution in neutron-rich 13B and 16C via direct reactions

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In unstable nucleus, single particle orbitals undergo rearrangement, leading to various shell evolution phenomena. In order to investigate the sd-shell structure in ^{13}B, we need to find all the s- and d-wave state in ^{13}B. So for searching the missing positive parity state in ^{13}B with a configuration of $^{12}\mathrm{B}_{\mathrm{g.s.}} \bigotimes d_{5/2}$, a ^{13}B($d$, d') inelastic scattering experiment was carried out using a 23 MeV/nucleon ^{13}B beam by EN-course (exotic nuclei) beam line at the Research Center for Nuclear Physics (RCNP), Osaka University. Several states at excitation energies of 3.6(1), 4.2(1), 5.4(2), and 6.5(2) MeV in ^{13}B were observed in its excitation energy spectra, which were derived from the energies and angles of the scattered deuterons from ^{13}B using the missing mass method. To determine the parity of each populated state, the inelastic scattering differential cross sections (DCSs) were compared to the distorted wave Born approximation (DWBA) calculations.The 5.4- and 6.5-MeV states were inferred to be positive parity states and considered as potential candidates for the missing d-wave neutron excitation state. The gap between s- and d-shell in ^{13}B and the systematic behaviour of neutron-rich Boron isotopes were also investigated based on the experimental findings.

And in order to investigate whether or not the sd-shell inversion in ^{16}C, We conducted a $^{15}\mathrm{C}(d,p)$ Experiment with a radioactive beam of ^{15}C at 28.5 MeV/nucleon at the RIBLL1 beamline in the Institute of Modern Physics(IMP), Lanzhou at 2022. As of now, I have completed the normalization and calibration of detectors, particle identification, and reconstructed the excitation energy spectrum of ^{16}C using the missing mass method. The ground state and the 3.03 MeV excited state of ^{16}C can be seen in the excitation spectrum, but further analysis is required to determine if this reaction channel generates the 5.45 MeV state or not.

Section

Nuclear structure: theory and experiment

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