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Extracting short-range physics of halo nuclei through elastic and breakup angular distributions

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The ratio method [1-3] is a novel method to extract important structural information of halo nuclei, such as binding energies and ANCs (Asymptotic Normalizing Coefficients). It is based on the Recoil Excitation Breakup (REB) model [4], which predicts that the uncertainty of halo structures related to the reaction dynamics is strongly reduced by taking the ratio of angular distributions for breakup and scattering. Accordingly, this new reaction observable exhibits a largely improved accuracy compared to traditional methods, such as Coulomb breakup. We will present the first experimental test of the method for the 11Be + 12C collision at Elab=20 MeV/u. The experiment was performed at the Texas A&M University cyclotron. Angular differential cross sections for elastic and inclusive neutron breakup cross sections were measured with a Si + phoswich detector array, BlueSTEAl [5], at CM angles =10-30 deg. The measured cross sections were well-reproduced by theory calculations using CDCC and Dynamical Eikonal Approximation (DEA) [6]. The ratio of the inclusive breakup to elastic cross section demonstrates the validity of the new method. Further calculations have shown that it is independent of optical potentials used to describe the projectile-target interaction and is sensitive to the halo structure. We have extended our analysis to available 11Be + 208Pb data, confirming that the ratio method works well both for nuclear-dominated and Coulomb-dominated reactions. This augurs well for our plan to extract structure information of further exotic halo nuclei (e.g., A=20-40). In this contribution, we will present the research results above and discuss our future plans to apply the ratio method with exotic beams at FRIB.

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Collaboration

Primary authors: OTA, Shuya (Brookhaven National Laboratory); CAPEL, Pierre (Johannes Gutenberg-Universität Mainz); Dr CHRISTIAN, Gregory (St. Mary's University); Dr HAGEL, Kris (Texas A&M University); Ms HARRIS, Emily (Texas A&M University); Mr LUO, Zifeng (Texas A&M University); Dr MCCUTCHAN, Elizabeth (Brookhaven National Laboratory); Mr ROOSA, Michael (Texas A&M University); Dr SAASTAMOINEN, Antti (Texas A&M University); Dr SCRIVEN, Dustin. P. (Texas A&M University)

Presenter: OTA, Shuya (Brookhaven National Laboratory)

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