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Experimental Explorations at the Proton Dripline using One- and Two-Nucleon Knockout Reactions on 17Ne

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Studying nuclear systems at the limit of stability and beyond has had a large impact on the understanding of the ingredients to the nuclear force, in particular since the availability of more and more exotic radioactive beams has increased in recent years at international rare-beam facilities. While at the neutron-rich side of the nuclear chart the binding potentials are shallow - leading to well-established halo phenomena in combination with difficulties to determine the location of the n-dripline - on the proton-rich side the situation is quite reversed: The p-dripline is known, up to Z=91, while halo-states find it hard to evolve due to the additional Coulomb barrier. Around here is were the presented study is located: an experimental investigation of the structure of the Borromean p-dripline nucleus 17Ne, and the connection to its neighbours beyond the dripline.

Within the R3B collaboration, we have studied nuclear breakup of high-energy (500 MeV/u) 17Ne beams utilising the R3B-LAND complete kinematics reaction setup at GSI.
One-proton knockout on 17Ne, crossing the p-dripline along Z, allowed us for studying in detail the unbound 16F system and extracting, for example, the s/d configuration mixture in the 17Ne ground-state, which is the key quantity determining its discussed 2p halo structure. An analysis of the 15O-p relative energy spectrum, the 16F momentum distributions and profile, combined with the obtained total and partial cross sections and spectroscopic strength give a consistent picture.

Beyond that, we were able to observe and study 1n and 2n knockout reactions on 17Ne, crossing the proton-dripline along N, and populating the unbound nucleus 16Ne and, as the very first observation of this nucleus, also 15Ne.
We have measured the 16Ne and 15Ne three-body energy spectra in terms of 14,13O+2p, extracted position and width of their ground and first two excited states, and used the f-p-p three-body correlations to deduce properties of their decay mechanism.

A comparison to the 17Ne three-body continuum spectrum will be attempted, together with an outlook on further interesting decay channels accessible within our data.

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