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Hypernuclear halos

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The phenomenon of neutron halos was discovered in light-mass nuclei at the limit of nuclear existence. Historically, ^{11}Li was the first halo nucleus discovered from interaction cross section measurements by Tanihata et al. Understood as a universal feature of bound baryonic systems, halos are also predicted in hypernuclei, while no direct experimental evidence has been obtained so far. The lightest predicted hypernuclear halo is the hypertriton, $^{3}_{\Lambda}$H, where predictions for its matter radius vary between 4–10 fm, depending on the binding-energy.

The HYDRA (HYpernuclei Decay at R3B Apparatus) physics program within the R^{3}B collaboration will focus on studying the decay spectroscopy of hypernuclei produced from heavy-ion collisions at GSI/FAIR. The program aims at measuring with high resolution the in-flight pionic decay of light- and medium-mass hypernuclei. To achieve that, a pion tracker is conceived as a time projection chamber (TPC) inside the GLAD magnet of the R3B setup. The first experiment of HYDRA, foreseen in 2025, aims at the matter radius of $^{3}_{\Lambda}$H from the measurement of its interaction cross section (ICS). Due to the low production cross section of hypernuclei and their very short lifetime, a direct measurement of their ICS is difficult. To overcome that, a new experimental method has been developed, adapting the ICS measurement to hypernuclei which will allow to make a conclusion on the halo or non-halo character of $^{3}_{\Lambda}$H. The method and its sensitivity to the ICS, investigated with detailed realistic simulations of the experimental conditions will be presented.

Collaboration

R3B

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