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High Precision Spectroscopy of Light Lambda hypernuclei at Jefferson Lab

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Content

Missing mass spectroscopy of Lambda hypernuclei at Jefferson Lab (JLab) has been instrumental in advancing the study of the Lambda-nucleon interaction. The high-precision and high-intensity electron beam available at JLab allows us to perform hypernuclear missing-mass experiments via the (e,e'K^+) reaction. We utilize magnetic spectrometers, HES and HKS, specifically designed and constructed for hypernuclear measurements. Furthermore, a new pair of charge separation magnets, PCS, has been developed for an experimental campaign scheduled to commence in 2027 at JLab's Experimental Hall C.

In the forthcoming experiment at JLab Hall C, hypernuclei with a broad mass number range from A = 6 to 208 will be examined, achieving an experimental resolution of 0.6 MeV in full width at half maximum (FWHM). This high resolution is made possible by the high-resolution spectrometers and the superior quality beam at JLab. Additionally, an energy accuracy of 100 keV or better is achievable due to a dedicated calibration technique established in previous experiments.

The masses and energy levels of light systems are particularly significant for studying the Lambda-nucleon interaction, as the data can be compared with theoretical calculations with relatively less uncertainty than heavier systems. Specifically, light Lambda hypernuclei, such as ${}^{6}_{\Lambda}$He, ${}^{9}_{\Lambda}$Li, ${}^{11}_{\Lambda}$Be, and ${}^{12}_{\Lambda}$B, are planned to be measured alongside other heavier systems, ${}^{27}_{\Lambda}$Mg, ${}^{40,48}_{\Lambda}$K, and ${}^{208}_{\Lambda}$Tl, through missing mass spectroscopy. The measurement of light hypernuclei is expected to provide new insights into charge symmetry breaking in the Lambda-N interaction and reveal intriguing nuclear features such as deformations due to alpha clusters. I will present an overview of the upcoming JLab hypernuclear project, including the experimental apparatus and anticipated results, particularly for the light hypernuclear systems.

Field of Research: Production, structure and decay of hypernuclei / Interactions of mesons and baryons with strangeness / Strangeness in astrophysics and in extreme forms of matter / Future experiments and facilities
Experiment / Theory: Experiment
Contribution Type: Invited talk

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