Study of Light Λ-Hypernuclei Using Precision Spectroscopy of Charged Mesonic Decay Pions at JLAB

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on behalf of the JLAB E08-012 collaboration

We proposed to the JLAB PAC33 for studying the charged mesonic weak decay pions from Λ-hypernuclei with a dedicated spectrometer. Due to large momentum transfer as well as high beam intensity, the quasi-free Λ hypernuclear production yield will be much higher than that from other mechanisms with hadronic beams. Some of these highly excited systems from quasi-free production cascade instantaneously to variety of light hypernuclei, possible for certain highly exotic ones, through nucleon emission or fragmentation processes. The Lorentz boost will push most of the pion background to the forward direction, while most of the long lived hypernuclei stop in the thin target foil then decay weakly from ground or long lived low lying states. For light hypernuclei, charged pions from weak mesonic decay provide an excellent tool to measure the binding energy of these states as commonly done in emulsion experiments. The proposed experiment at JLAB can reach high resolution (~130 keV FWHM) and high precision (< ±20keV), both capable to exceed significantly the quality limit of emulsion data. The precision allows a recheck on the basic YN interaction models that were built and tested by emulsion results and a more accurate measurement of the charge symmetry breaking such as that often referred by $\Delta B({}^{4}_{\Lambda}H - {}^{4}_{\Lambda}He)$. Secondly, the fragmentation process may be a better way to produce highly exotic neutron rich hypernuclei that are impossible to be produced directly from the primary reactions. Although heavy ion collision is planned to be used to search and study such hypernuclei, but the level of precision may be key factor. The talk will present the basic ideas of the proposal which was conditionally approved by PAC33 which recommended a beam test. A parasitic test run plan in Hall A will be presented.