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High-Resolution Hypernuclear Spectroscopy at JLab Hall A. Results and perspectives

Franco Garibaldi (INFN Roma1), on behalf of the Jlab Hall A hypernuclear collaboration

Hypernuclear spectroscopy via electromagnetic induced reactions is a valuable and powerful way to study hypernuclei, hadronic systems with non-zero strangeness content, providing an alternative to the hadron induced reactions mainly studied so far. Electron-induced hypernuclear spectroscopy has been studied in Hall A at Jefferson Lab [1] on three nuclei, ^{12}C, ^{16}O, and ^{9}Be with unprecedented resolution and with an improved particle identification system, using a RICH detector, in order to unambiguously identify kaons, thus allowing the measurement of high-quality, almost background-free, hypernuclear spectra. Two superconducting septum magnets were added to the existing apparatus in order to permit particle detection at very forward angle providing a reasonable counting rate. These studies have provided the first quantitative information on core-excited states in hypernuclei. In the case of oxygen, a waterfall target has been employed allowing for the simultaneous measurement of hypernuclear production on oxygen and of elementary kaon-Λ electro-production on protons: a crucial measurement to disentangle the contribution of the elementary reaction from the measured hypernuclear production cross section, yielding direct access to the nucleus-hypernucleus transition structure. A Λ binding energy value for $^{16}_{\Lambda}$N calibrated against the elementary (e, e′K^{+}) reaction on hydrogen, has been obtained. Final results for ^{12}C, ^{16}O, ^{9}Be will be presented [1-3]. Results of Hall C experiments will be presented in another talk in this Conference. Since it is essential for further theoretical study of hypernuclei to collect enough information about L production on nucleons and about excitation spectra of a wide variety of Λ hypernuclei, a continuation of the successful hypernuclear program at JLab is very desirable. For these reasons Hall A and Hall C Jefferson Lab hypernuclear collaborations decided to merge and propose a new layout for the 12 GeV Jefferson Lab era that has the advantages of both the experimental setups. In fact the new experimental design not only widens and deepens the physics range but also dramatically improves production yield and efficiency allowing to study both mass spectroscopy on a wide range of nuclei (from few body to ^{208}Pb) and pion decay spectroscopy at the same time [4]. Figs.1, 2 show the results obtained for ^{12}C and ^{16}O. Fig. 3 shows the new layout.

Fig.1 $^{12}_{\Lambda}$B excitation-energy spectrum

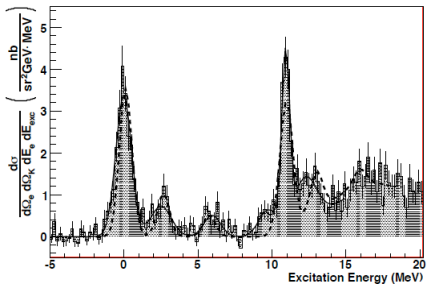


Fig.2 $^{16}_{\Lambda}$N binding-energy spectrum

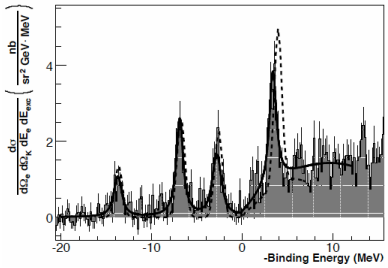
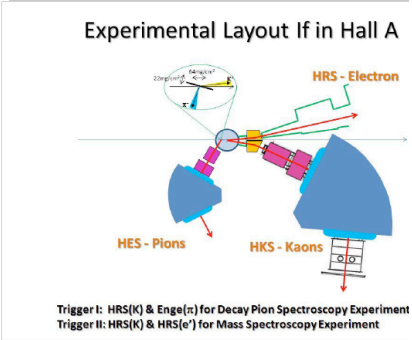


Fig 3 The new experimental layout



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2. M. Iodice et al., Phys. Rev. Lett. 99, 052501 (2007).
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4. G.M. Uricuoli et al. High Resolution Spectroscopy of $^{9}_{\Lambda}$Li by Electroproduction (in preparation)
5. P. Bydžovski,, F. Cusanno, F. Garibaldi, J.J. LeRose, P. Markowitz, D.J. Millener, S.N. Nakamura, J. Reinhold, and L. Tang. Letter of Intent to JLAB PAC39 for Study with High Precision on Electro-production of Λ and Σ Hypernuclei in Full Mass Range