Contribution ID: **53** Type: **Talk**

Exploring the Unknown Λn Inteaction

Tuesday 3 September 2019 16:15 (25 minutes)

No published data for Λn scattering exist. A relativistic heavy-ion experiment [1] has suggested that a Λnn bound state has been seen. If that were the case, our knowledge of the nn interaction would permit one to use that Λnn bound state energy to generate strong constraints on the Λn interaction. JLab would be an ideal facility to obtain such data using the ^{3}H(e,e'K$^+$)$^3_\Lambda$n reaction. However, at least four theoretical analyses based on a pairwise nn and Λn interaction hypothesis have cast serious doubt on the bound-state assertion [2-5]. However, there could exist a three-body Λnn resonance. Such a resonance could be used to constrain the Λn interaction.

We discuss calculations for the Λnn system using pairwise interactions of rank-one, separable form that fit effective range parameters of the nn system and those hypothesized for the as yet unobserved Λn system based upon two different Nijmegen one-boson exchange potentials [6,7], a J\"{u}lich one-boson exchange potential [8] and a chiral ΛN potential [9], each of which is fit the known Λp scattering data. The use of rank-one separable potentials allows us to analytically continue the Λnn Faddeev equations into the second complex energy plane in search of resonance poles, by examining the eigenvalue spectrum of the kernel of the Faddeev equations.

Although none of the potential models utilized (each based upon the nominal Λp scattering length and effective range) predict a physical resonance pole, scaling of the Λn interaction by as little as $\sim$5\% (well within the Λp scattering data uncertainties), does produce a resonance in the Λnn system. This suggests that one may use photo (electro) production of the Λnn system as a tool to examine the strength of the Λn interaction. In particular, an experiment using K$^+$ electro production from tritium at Jefferson Lab has been performed in an effort to explore the Λnn final state (physical resonance or sub-threshold resonance); modeling the position and width of the spectrum would provide significant constraints on the scattering length and effective range of the heretofore unmeasured Λn interaction.

1. C. Rappold, {et al.}, "Search for evidence of $^3_\Lambda n$ by observing $d + \pi^-$ and $t + \pi^-$ final states in the reaction of ^{6}Li+^{12}C at $2A$ GeV", Phys. Rev. C {88}, 041001(R) (2013).
2. H. Garcilazo, and A.Valcarce, "Nonexistance of a Λnn bound state", Phys. Rev. C {89}, 057001 (2014).
3. E. Hiyama, S. Ohnishi, B. F. Gibson, and Th. A. Rijken, "Three-body structure of the $nn\Lambda$ system with $\Lambda N - \Sigma N$ coupling", Phys. Rev. C {89}, 061302(R) (2014).
4. A. Gal, and H. Garcilazo, "Is there a bound $^3_\Lambda$n?", Phys. Lett. {B736}, 93 (2014).
5. I. R. Afnan and B. F. Gibson, "Resonances in the Λn System", Phys. Rev. C. {92}, 054608 (2015).
6. M. M. Nagels, T. A. Rijken, and J. J. de Swart, "Baryon-baryon scattering in a one-boson-exchange-potential approach, II. Hypron-nucleon scattering", Phys, Rev. D {15}, 2547 (1977).
7. T. A. Rijken, V. G. J. Stoks, Y. Yamamoto, "Soft-core hypron-nucleon potentials", Phys. Rev. C {59}, 21 (1999).
8. J. Haidenbauer and Ulf-G. Mei\ss ner, "J\"ulich hypron-nucleon model revisited", Phys. Rev. C {72}, 044005 (2005).
9. J. Haidenbauer, {et al.}, "Hypron-nucleon interaction at next-to-leading order in chiral effective field theory", Nucl. Phys. A {915}, 24 (2013).

Author: Dr GIBSON, Benjamin (Physical Review C)

Presenter: Dr GIBSON, Benjamin (Physical Review C)

Session Classification: Parallel Session Tuesday: Hyperon interactions and hypernuclei

Track Classification: Invited