Determining the Unknown Λn Interaction by Investigating the Λnn Resonance

Update on E12-17-003 Experiment

(Data Taken: October 31 to Nov. 26, 2018)

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JLUO Meeting
Jefferson Lab
o6/25/2019

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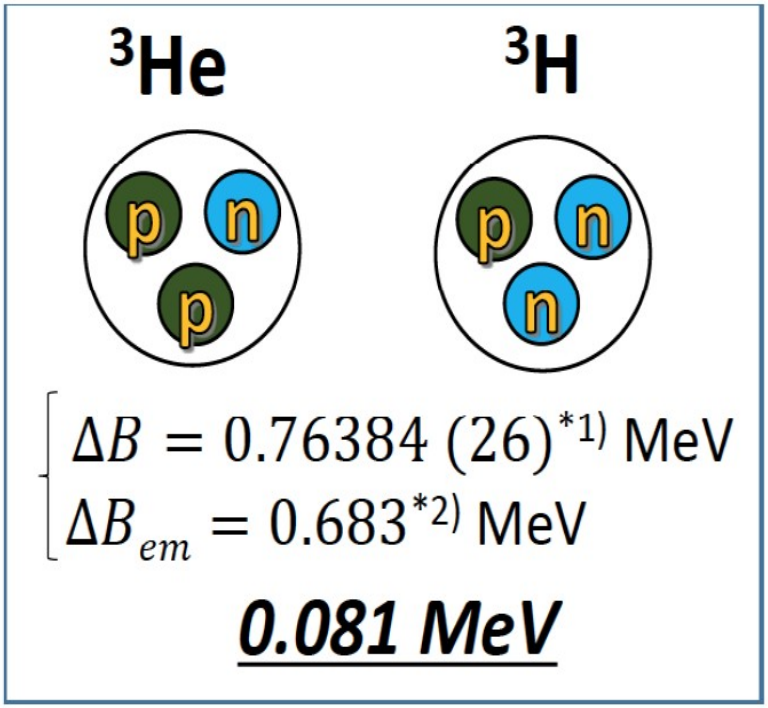
Charge Symmetry Breaking

N-N Interaction

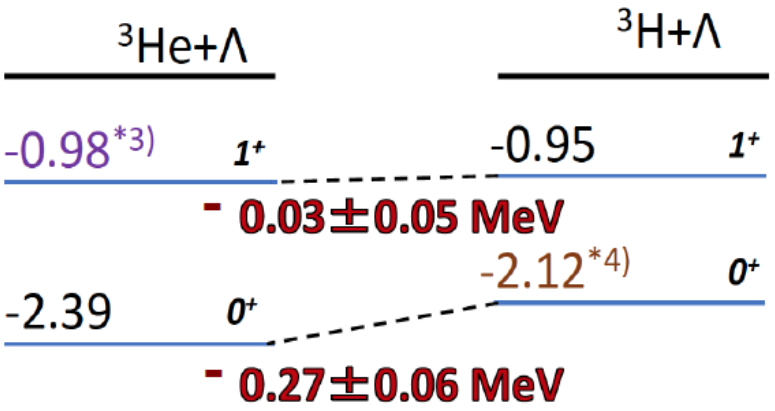


$$\Delta B = 0.76384\ (26)^{*1)}\ \text{MeV}$$
$$\Delta B_{em} = 0.683^{*2)}\ \text{MeV}$$

0.081 MeV

*1) J.H.E. Mattauch *et al.*, Nucl. Phys. **67**, 1 (1965).
*2) R.A. Brandenburg *et al.*, NPA **294**, 305 (1978).

Λ-N Interaction

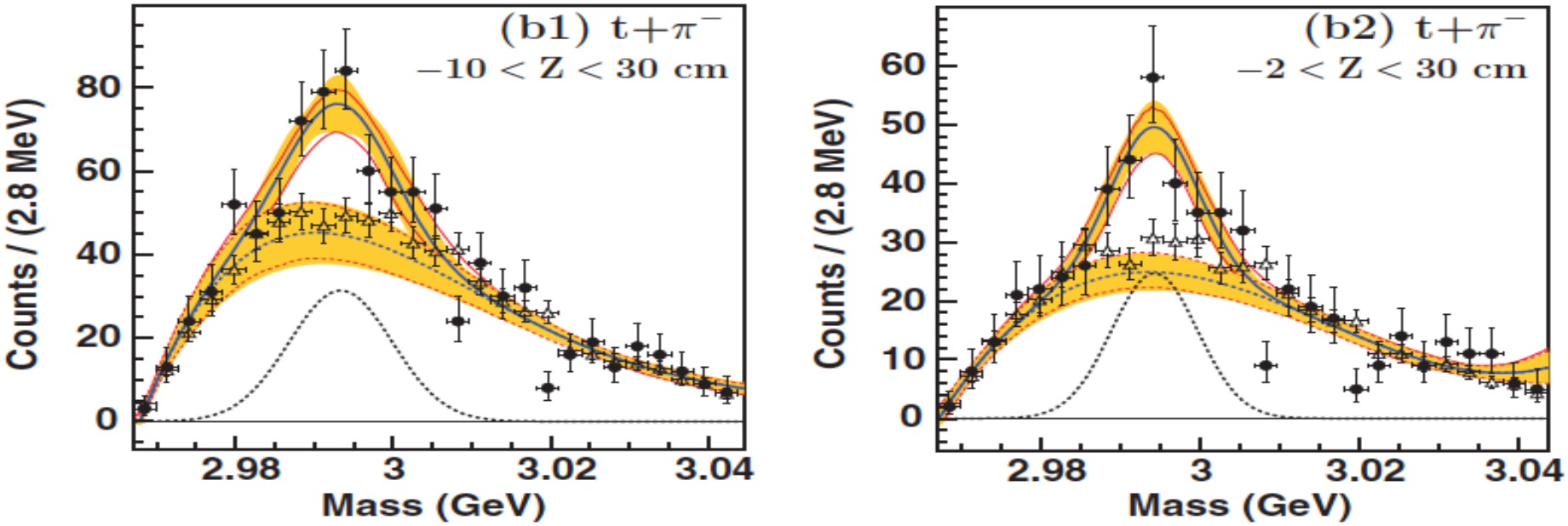


3) T.O. Yamamoto *et al.*, Phys. Rev. Lett. **115**, 222501 (2015).
4) A. Esser *et al.*, Phys. Rev. Lett. **114** 232501 (2015).

- For A =4 isospin mirror pair of hypernuclei $^4_\Lambda He$ and $^4_\Lambda H$ there is significant charge symmetry breaking in the order of about 270 keV.
- Currently Λn interaction doesn't exist and it is treated to have the same properties as that of Λp interaction.
- Experimental data on Λn interaction may shed light on the origin of CSB.

Approach to Access Λn Interaction

^{6}Li (2A GeV) on ^{12}C target and study the invariant mass of final state particles

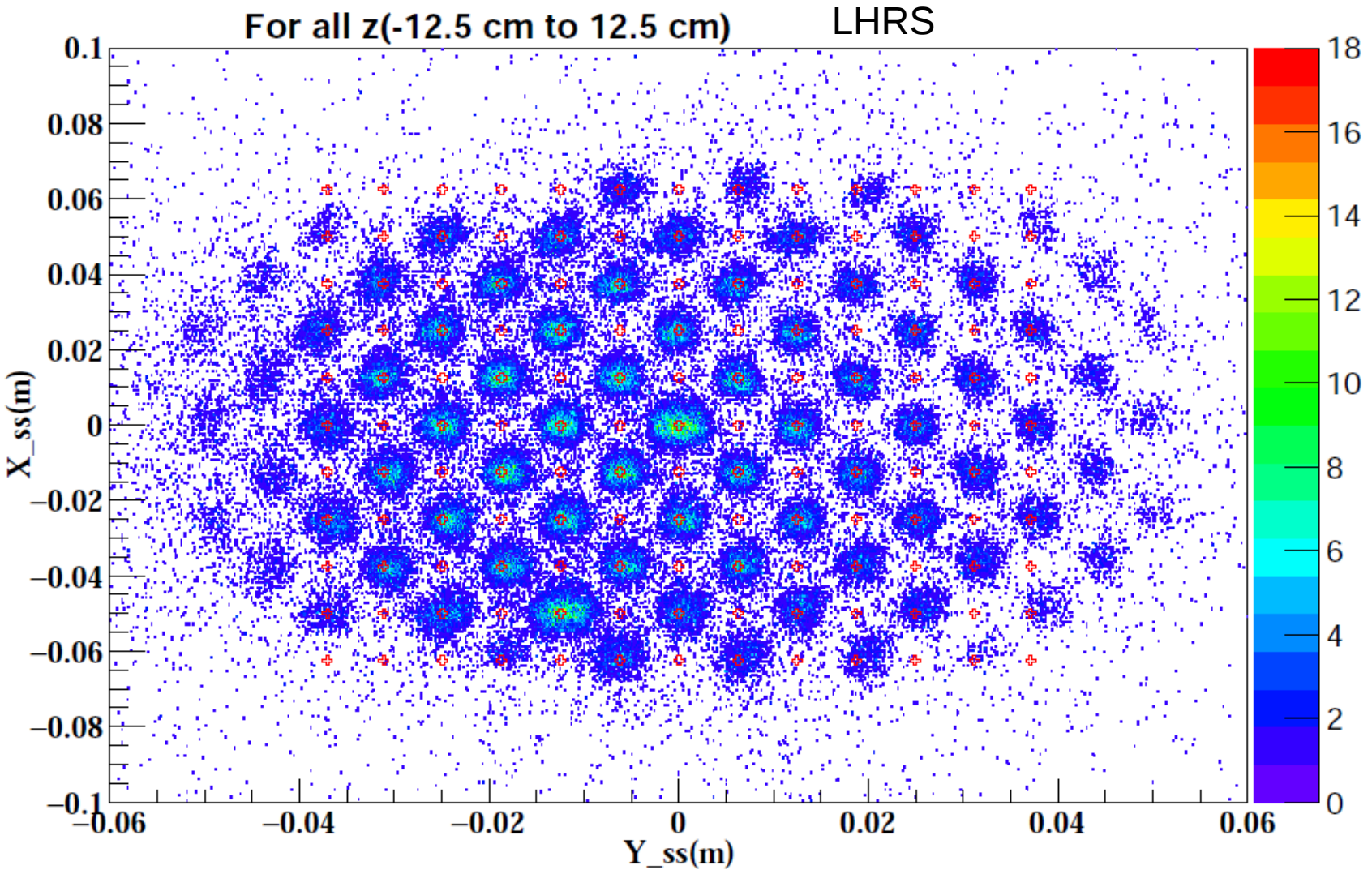


*C. Rappold et al., Phys. Rev. C **88**, 041001(R) (2013)*

- It was claimed to be a bound state.
- All the theoretical studies ruled out bound **Λnn** system.
- However, some theoretical studies indicated that **Λnn** resonance may likely exist and by measuring the binding energy and the natural width of such state, it is possible to extract the **Λ-n** interaction
- Hall A with tritium target aimed for this purpose; if it does exist and its binding energy and natural width are determined, we may for the first time provide direct experimental information which can be used for theoretical investigation on **Λ-n** interaction

Current Analysis

- The Z- vertex reconstruction is done in each arm with good resolution(σ ≈ 5.2 mm)
- The angle reconstruction in left arm is done(dispersive plane σ ≈ 3 mrad and non dispersive plane σ ≈ 2mrad)
- In the right arm the angle reconstruction is in progress.



Conclusions

- Recent precise experimental results show that charge symmetry breaking (**CSB**) is much more significant in **Λ-N** interaction
- From the GSI experiment, there is an indication of either **Λnn** resonance or a bound state exist.
- The $ee'K^+$ doing at Jlab is the best way to conform whether such state exist or not.
- The experiment E12-17-003 ($ee'K^+$) was carried out successfully in hall A with tritium target in November 2018.
- The detailed analysis is in progress.

Thank You