Improved $^{3}_{\Lambda}\mathrm{He}(K^{-},\Lambda p)n$ Spectroscopy to Search for the KNN Bound State with J-PARC E15-2nd Data

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KbarN Interaction and Kaonic Nuclei

- **KbarN interaction**
  - **On / Above threshold**
    - **Well studied**
      - » Low-energy scattering
      - » X-ray from Kaonic atoms
    - **Kbar – Nucleon**
      - » Attractive in I=0
    - **Kbar – Nucleus**
      - » Attractive
  - **Subthreshold**
    - **Not well understood**

- **Bound state of K^- – Nucleus?**
  - **Kaonic nucleus**
    - **Consist of Baryon and Meson**
    - **Deeply bound**
    - **High density**

Information of KbarN interaction in subthreshold region

Start with the "*simplest*" KbarNN system

Situation of K^-pp bound state

- **Theoretical calc.**

Bound state exists

KbarN interaction model

E-dep. / E-indep.

- **Experiments**

Reports structure / ***NO structure***

J-PARC E27

$d(\pi^+, K^+)X$

DISTO

$pp \to \Lambda p K^+$

FINUDA

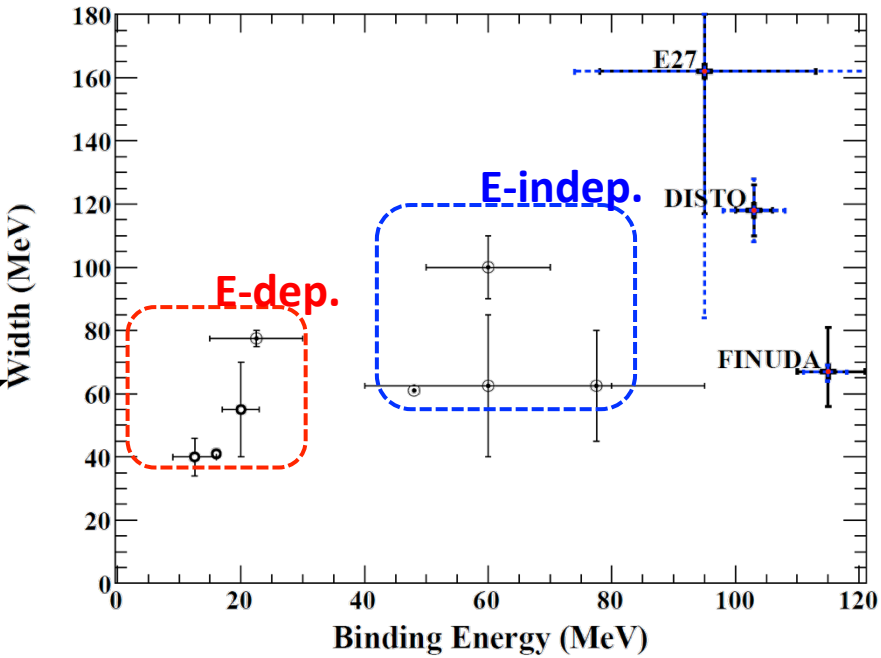
$(stopped\ K^-, \Lambda p)$

LEPS

$p(\gamma, \pi^- K^+)X$

HADES

$pp \to \Lambda p K^+$

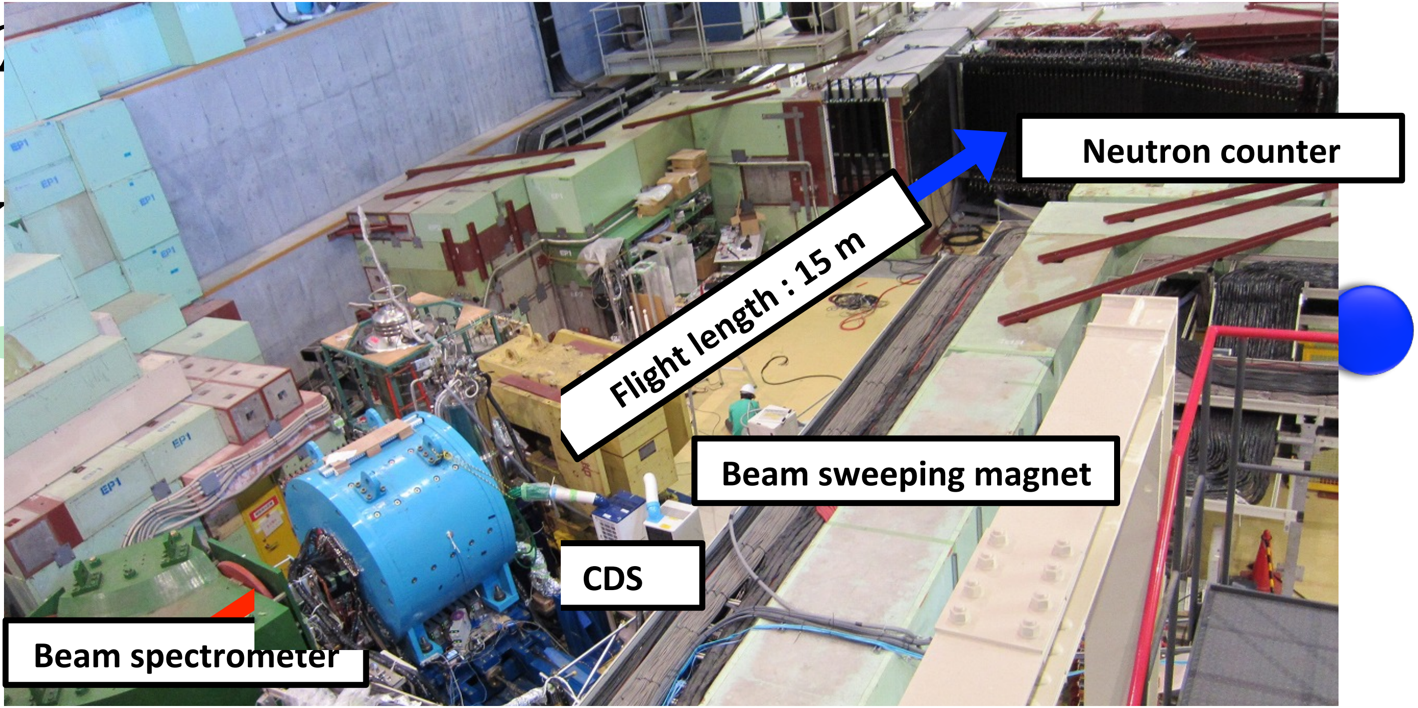


J-PARC E15 Experiment

◆ Searching for $K^{-}pp$

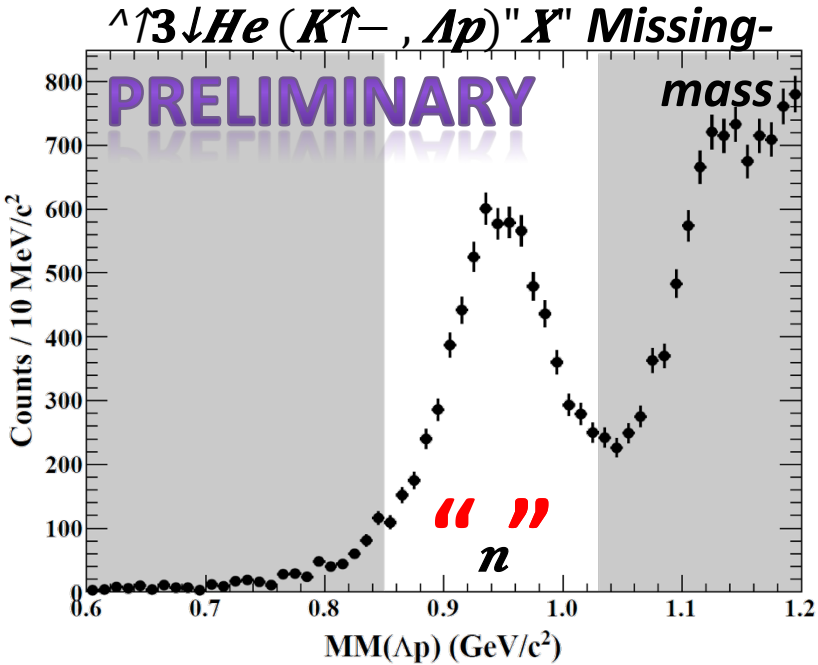
▶ (

K



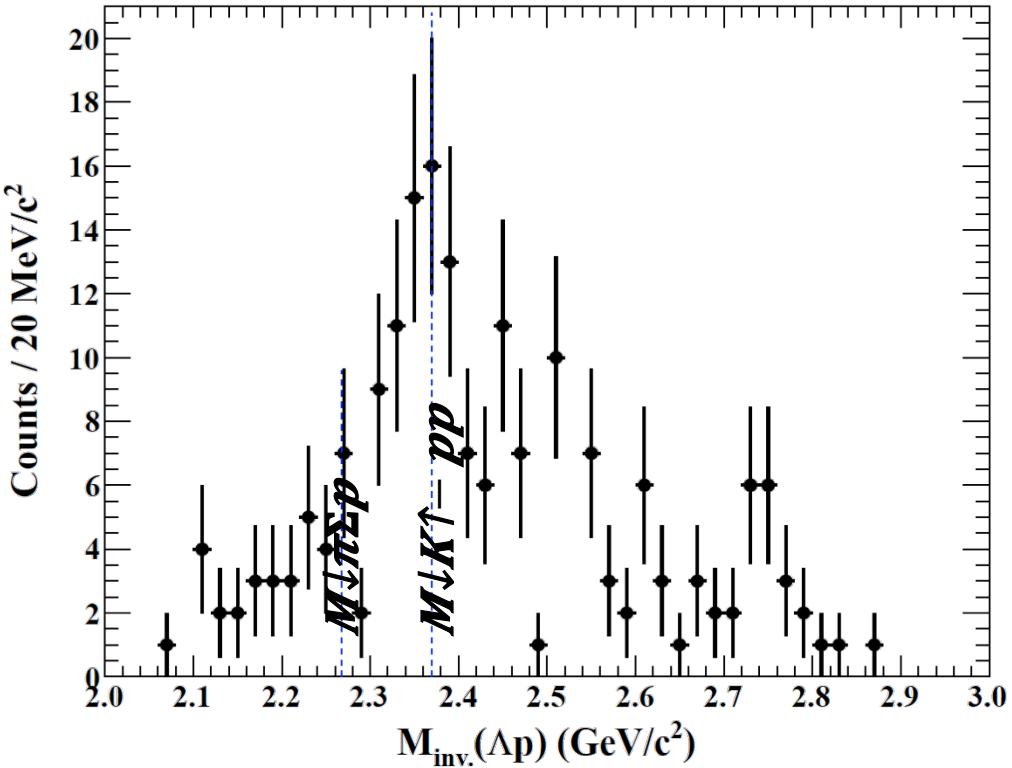
J-PARC E15 Experiment

- Λp invariant mass spectroscopy in $^{3}_{}\mathrm{He}(K^-, \Lambda p)$"$n$" reaction
  - πpp event selection in CDS
  - $\Lambda \to \pi^- p$-pair selection
    - Likelihood method
  - Missing neutron selection
    - $0.85 - 1.03\ \mathrm{GeV}/c^2$



E15-1st Result

Y. Sada, et al, Prog. Theor. Exp. Phys. (2016) 051D01

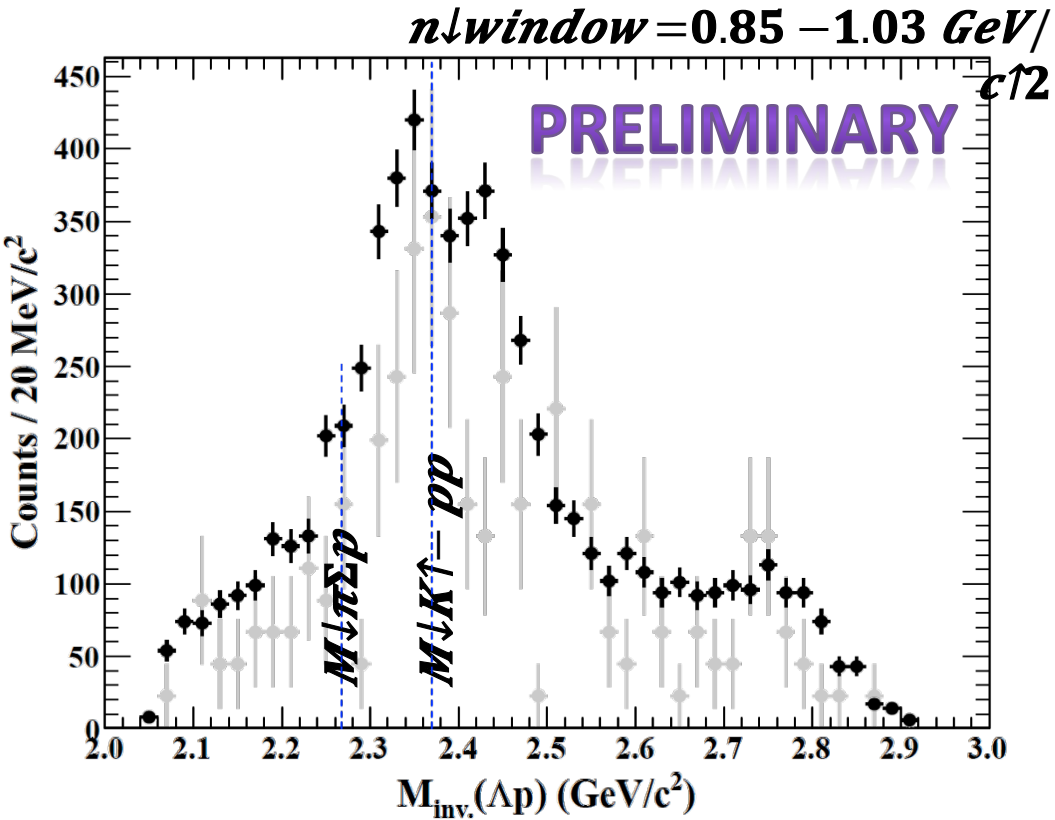


- **E15-2nd experiment**
  - » ×30 Λpn events

Increasing Statistics

- **E15-1st experiment**
  - Λp invariant mass analysis in $^{3}_{\Lambda}$He(K^-, Λp)"n"
  - Assuming simple Breit-Wigner
    - » B.E. : 15 MeV, Width : 110 MeV

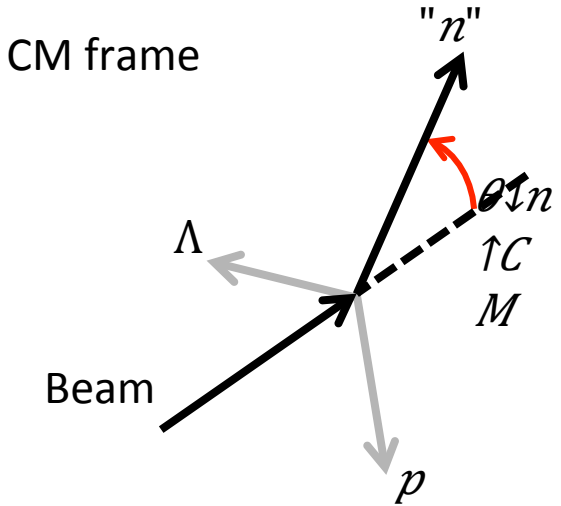
E15-2nd Result

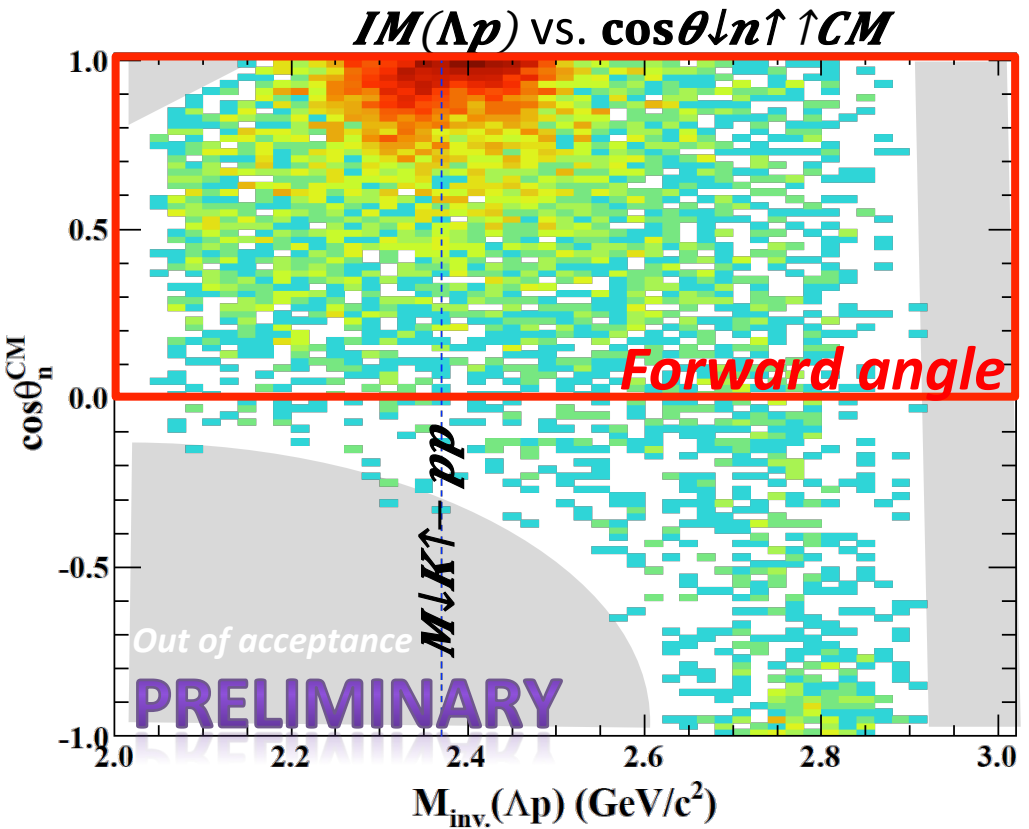


- **E15-2nd experiment**
  - » ×30 Λpn **events**
- Consistent with the E15-1st result
- Structure around $M\downarrow K\uparrow - pp\uparrow$

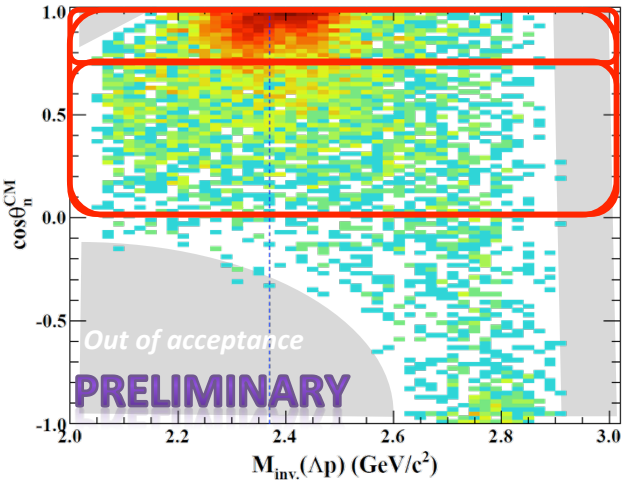
$IM(\Lambda p)$ vs. $\cos\theta_{n}^{CM}$ Plot

Neutron opening angle

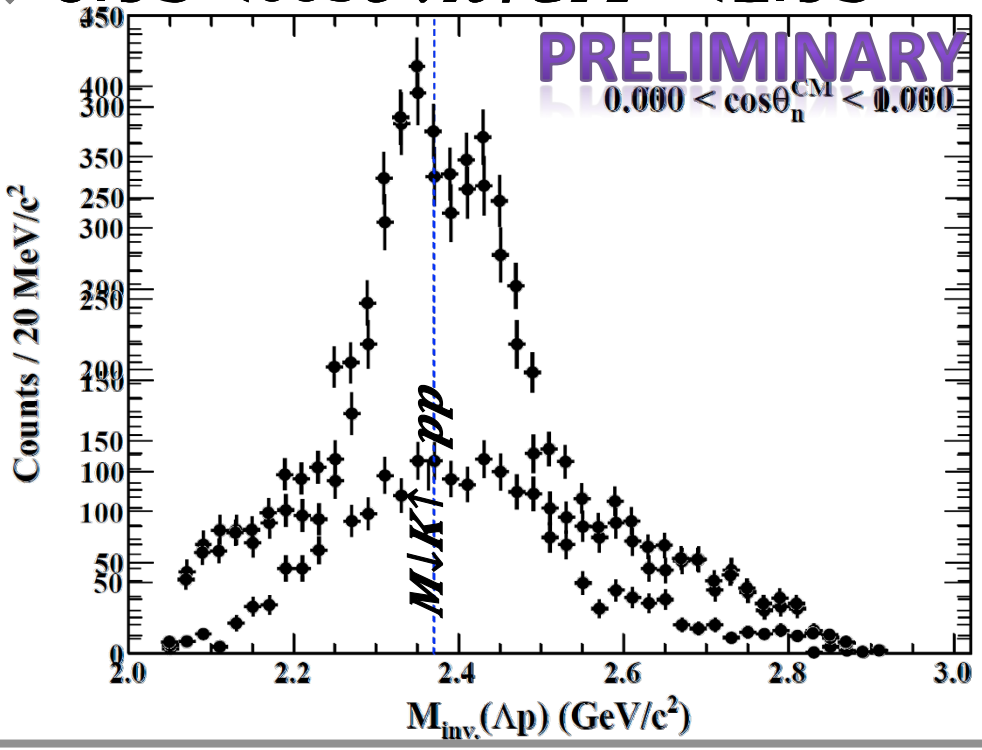




$\cos\theta_{n\uparrow}^{CM}$ Sliced $IM(\Lambda p)$

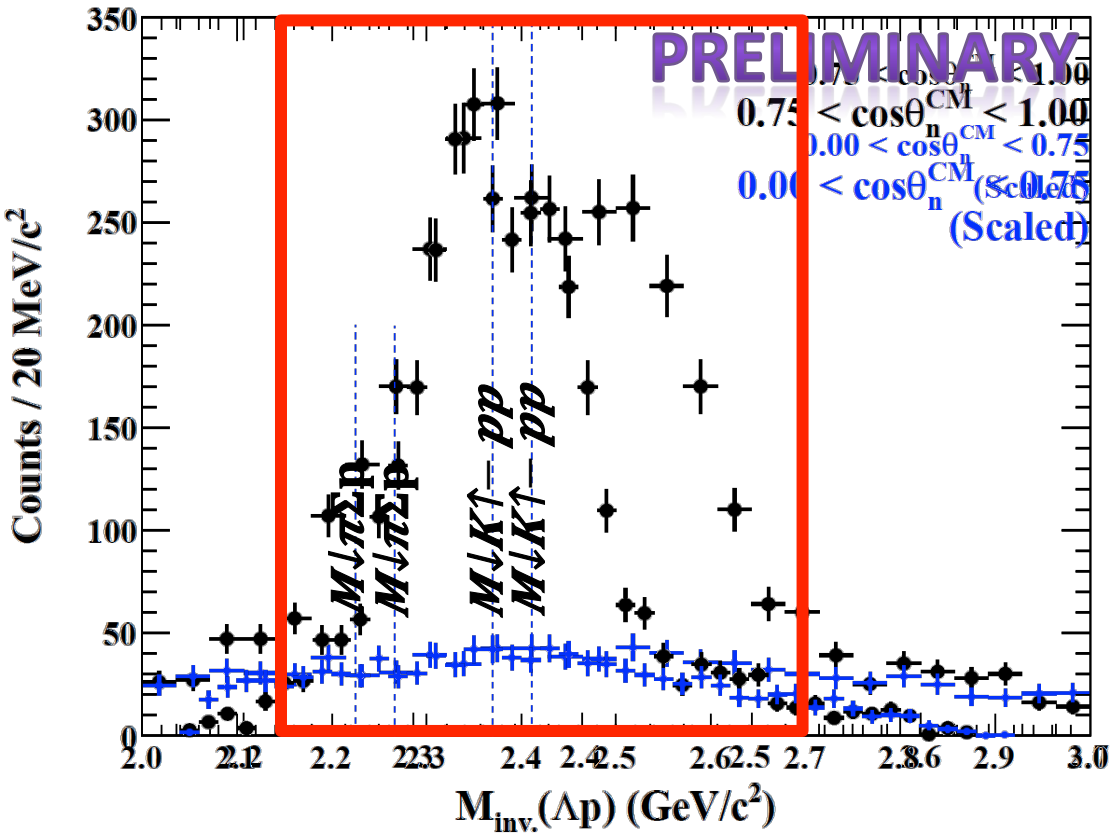


- $0.00 < \cos\theta_{n\uparrow}^{CM} < 1.00$

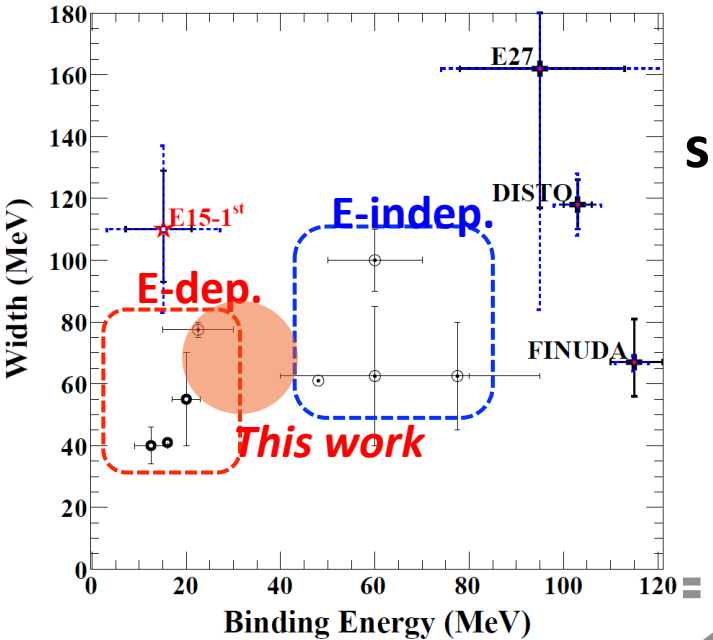


2 peaks +3NA

$\cos\theta_{n\uparrow}^{CM}$ Sliced $IM(\Lambda p)$



2 peaks observed



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Summary

are observed.

- Located in the forward region ($\cos\theta_{n}^{CM} > 0.75$)
- Peak below threshold could be $K^{-}pp$ state.

◆ Detailed analysis is ongoing.

Thank you for your attention

~ The E15 collaboration ~

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