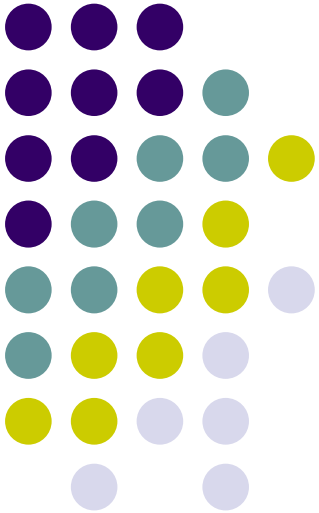
φ中間子工場における K中間子の深い 束縛状態の探索(3)

藤岡 宏之 (東大院理)
永江 知文, 應田 治彦,
豊田 晃久, 丸田 朋史
(FINUDA Collaboration)

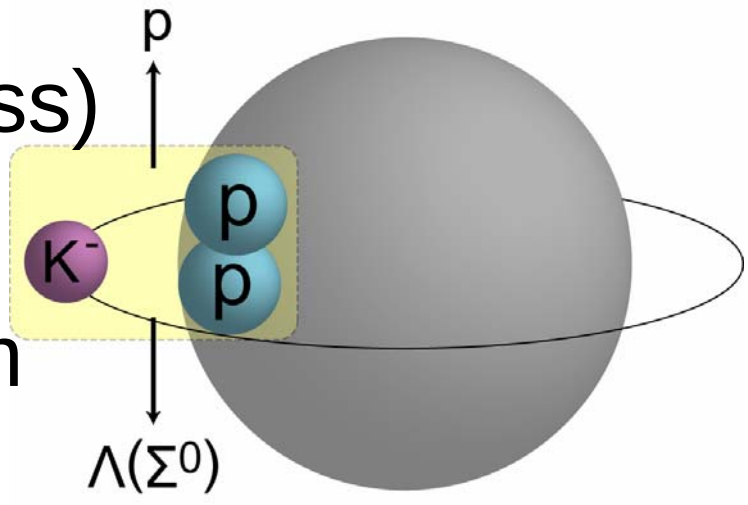


Invariant-mass spectroscopy for K^-pp bound system

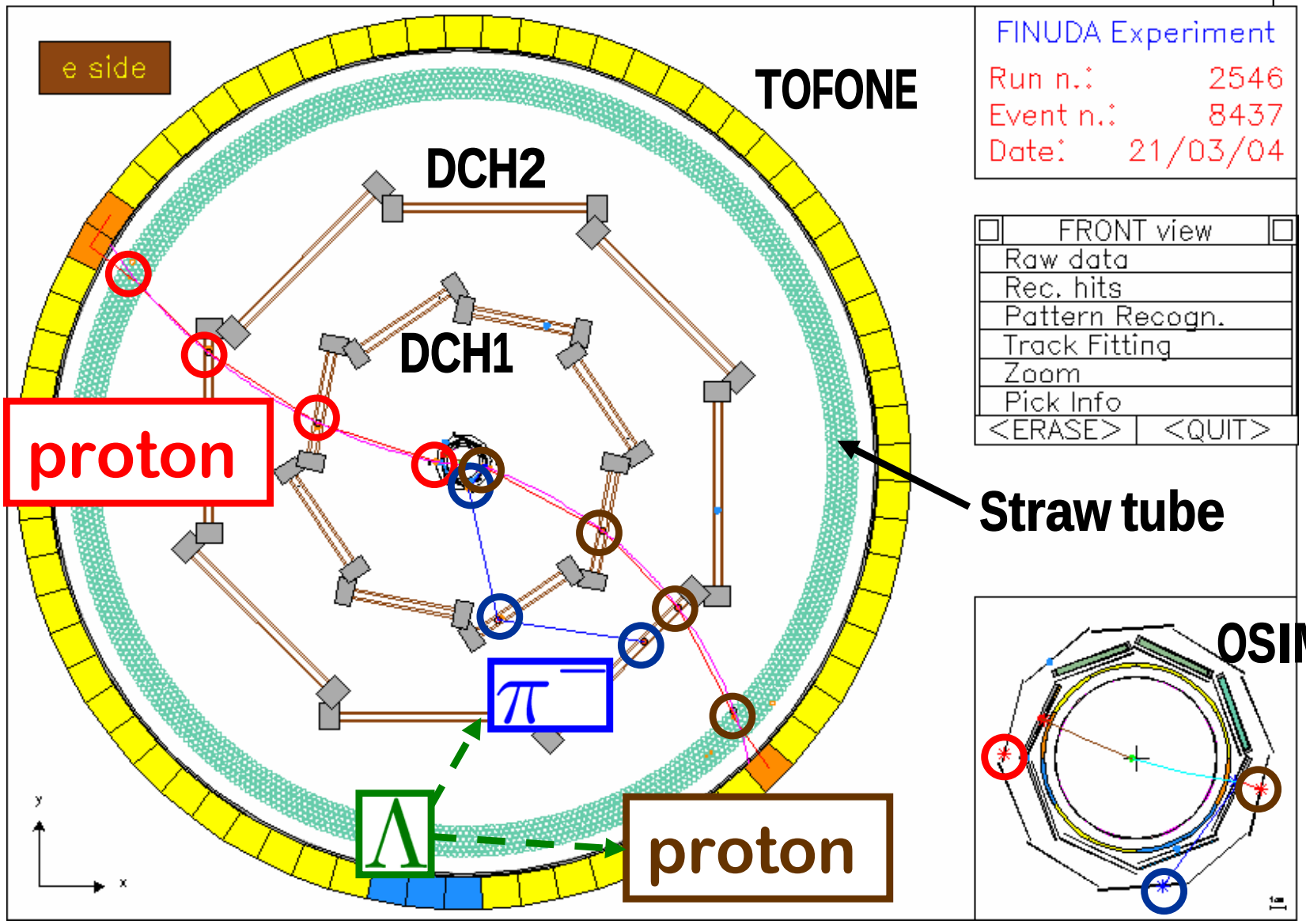
$$K^- pp \rightarrow \Lambda + p$$

- The lightest system beyond $\Lambda(1405)(=K^-p)$
- All decay particles are charged (p, p, π^-)

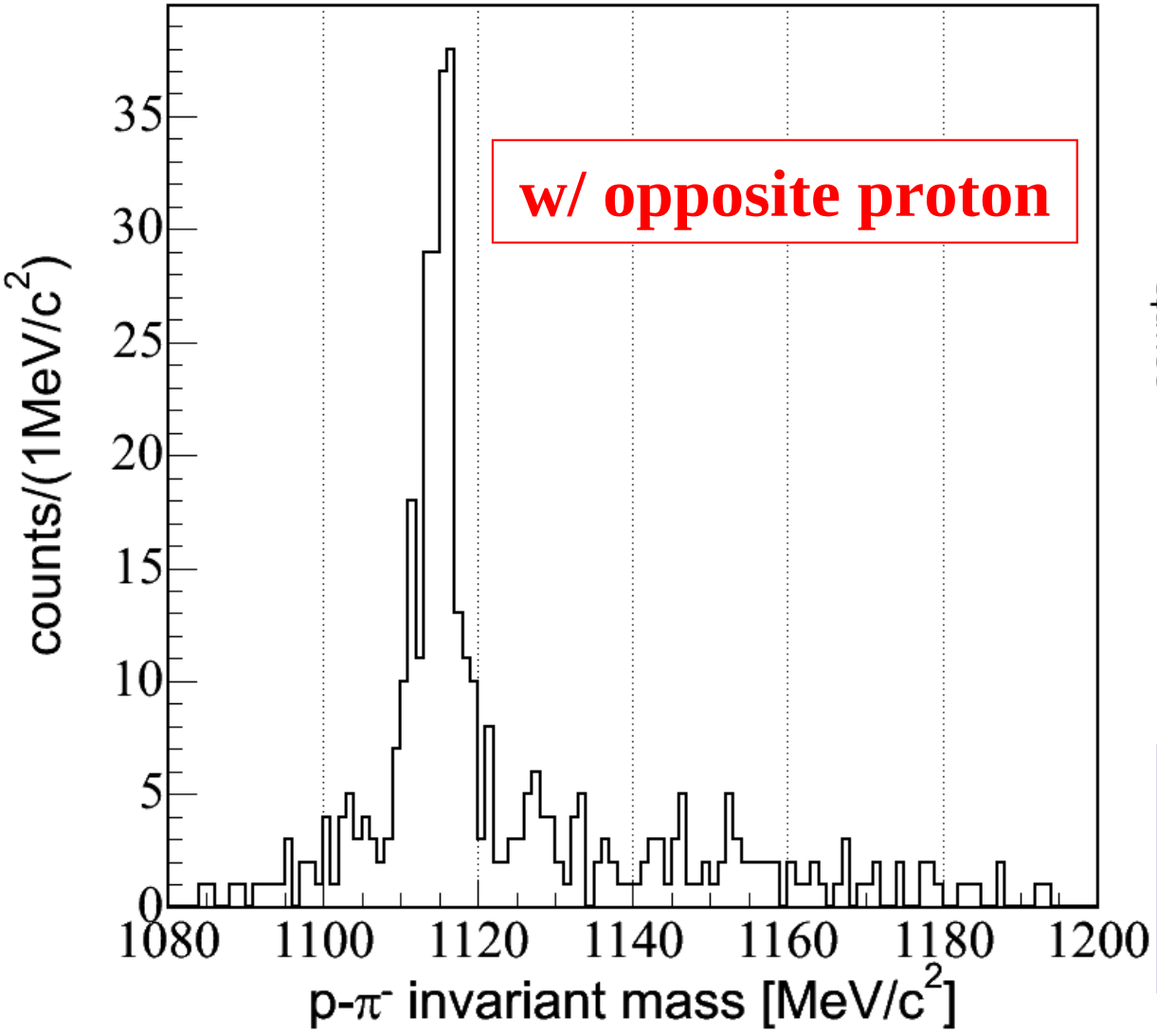
- Λ tagging (p-π^- invariant-mass)
- Back-to-back Λ-p selection
- Λ-p invariant-mass spectrum

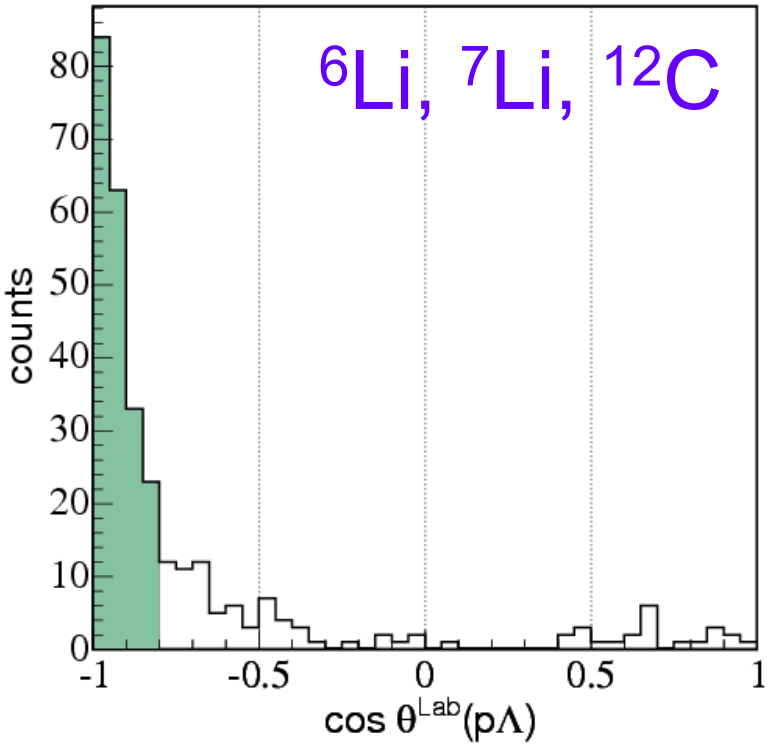


Event display ($K^-pp \rightarrow \Lambda + p$)



Λ tagging and back-to-back Λ-p selection

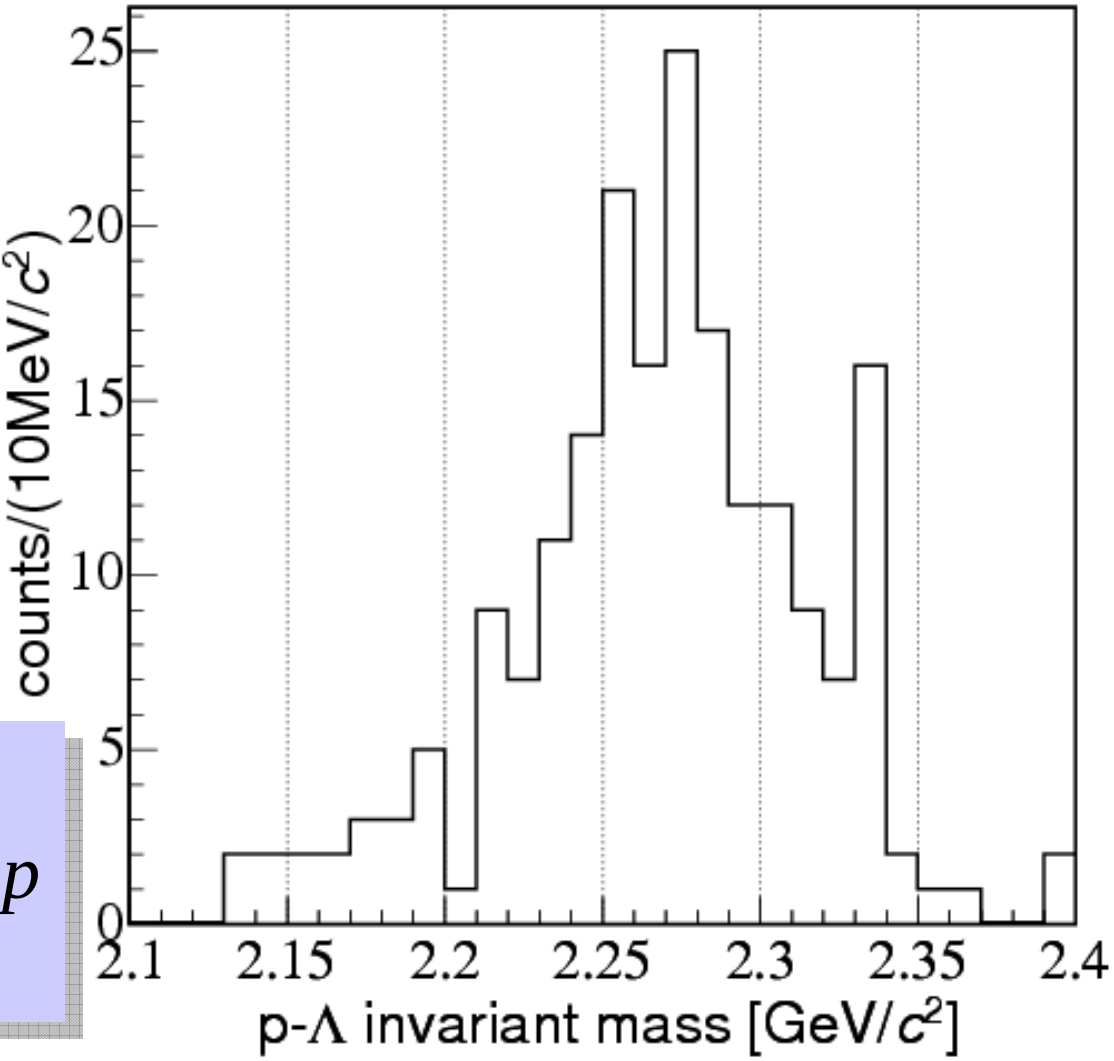




Mass gate for Λ

$$m_\Lambda \pm 5\,\mathrm{MeV}/c^2$$

Invariant-mass spectrum (acceptance uncorrected)

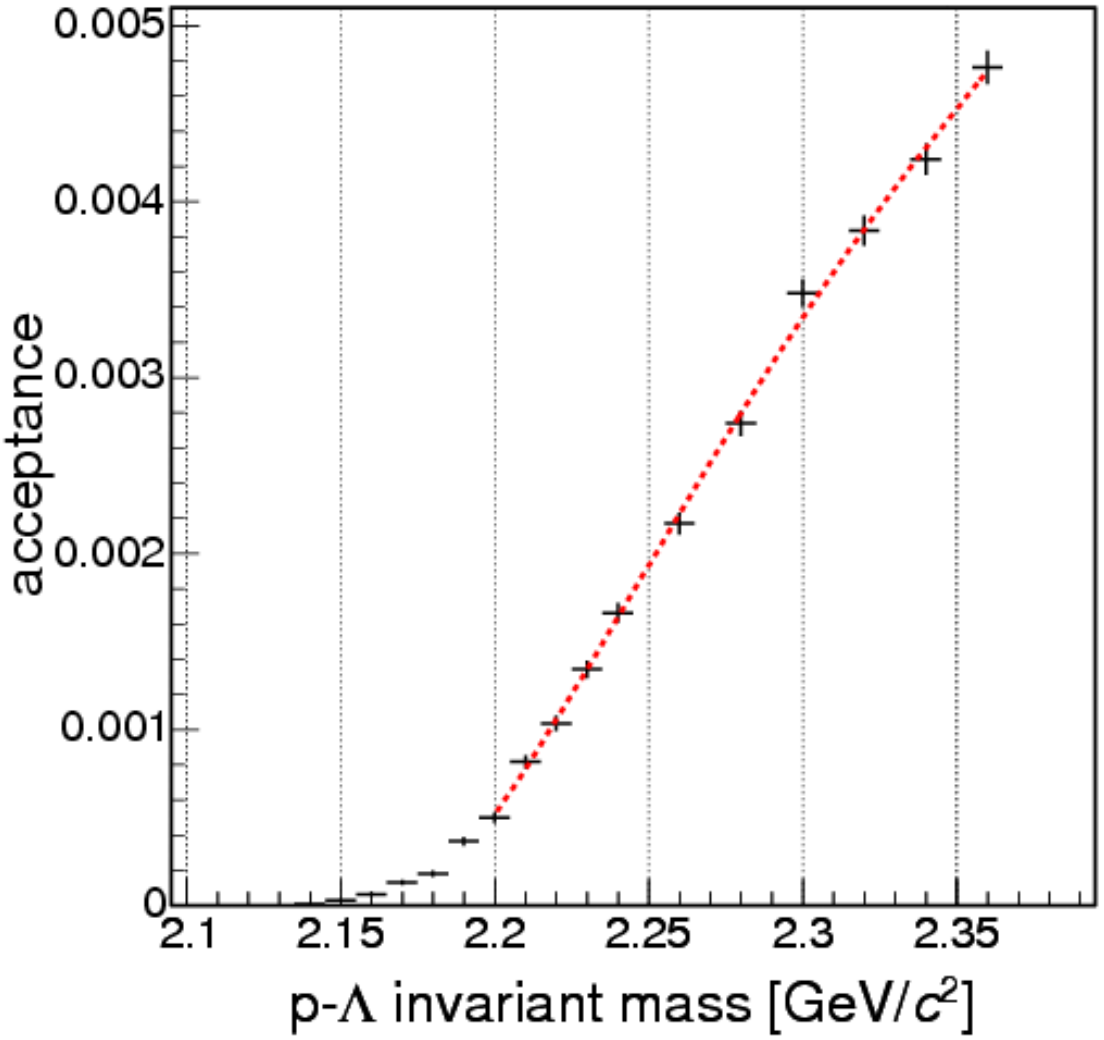


Significant mass decrease from the threshold of K^-+p+p ($2.37\mathrm{GeV}/c^2$)

Acceptance correction

- The cut-off is due to Λ detection threshold.
- Dependence on
  - K^- vertex position
  - Λ-p opening angle
  - total momentum

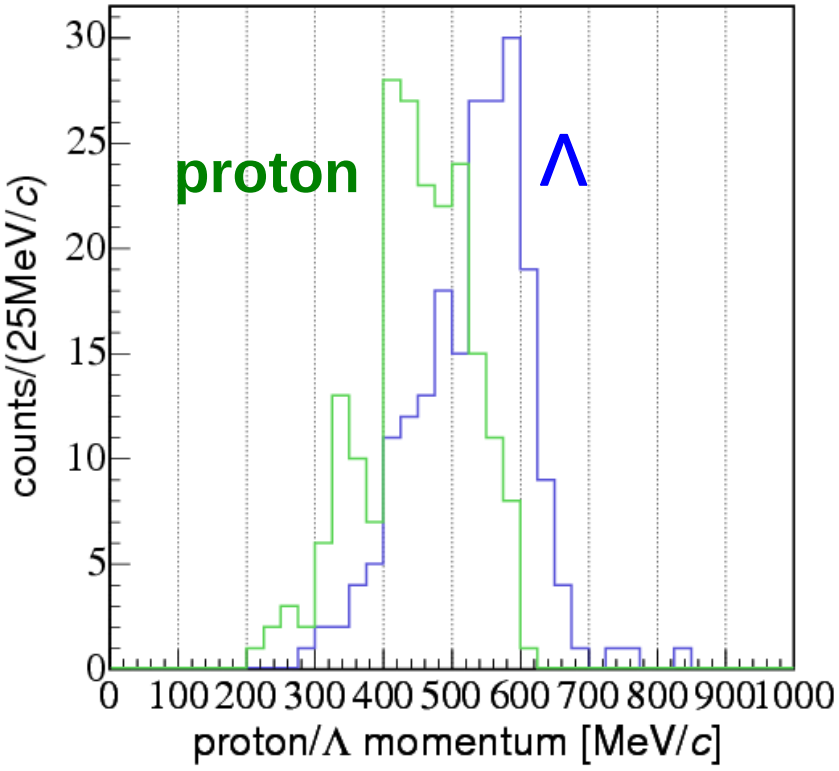
is found to be small.



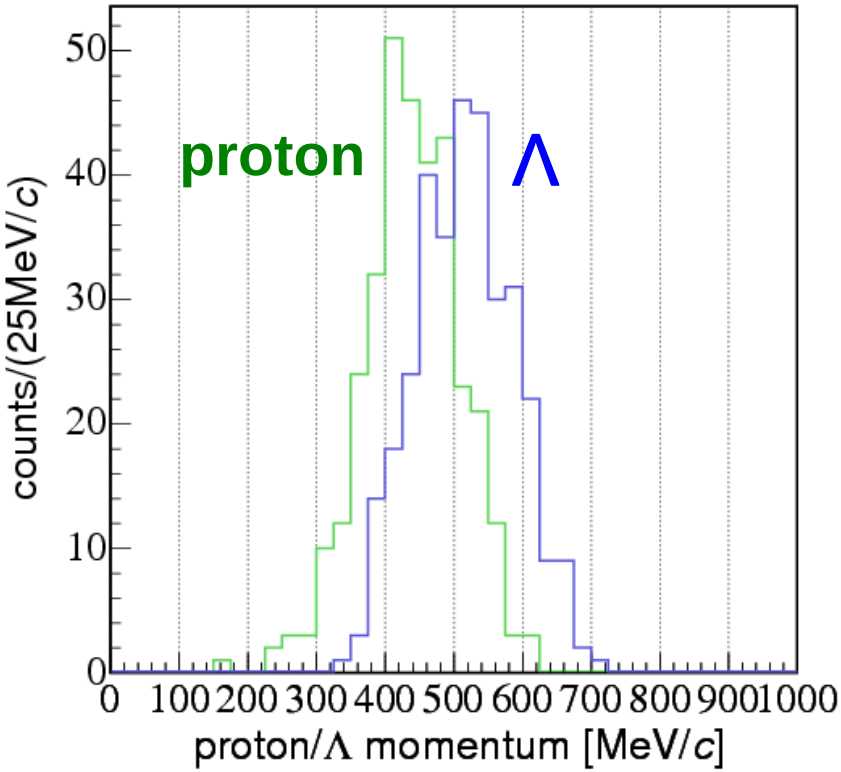
Monte Carlo simulation (momenta of decay particles)

- The discrepancy of the peak positions is due to the different acceptance of Λ and proton.

(data)



(MC)

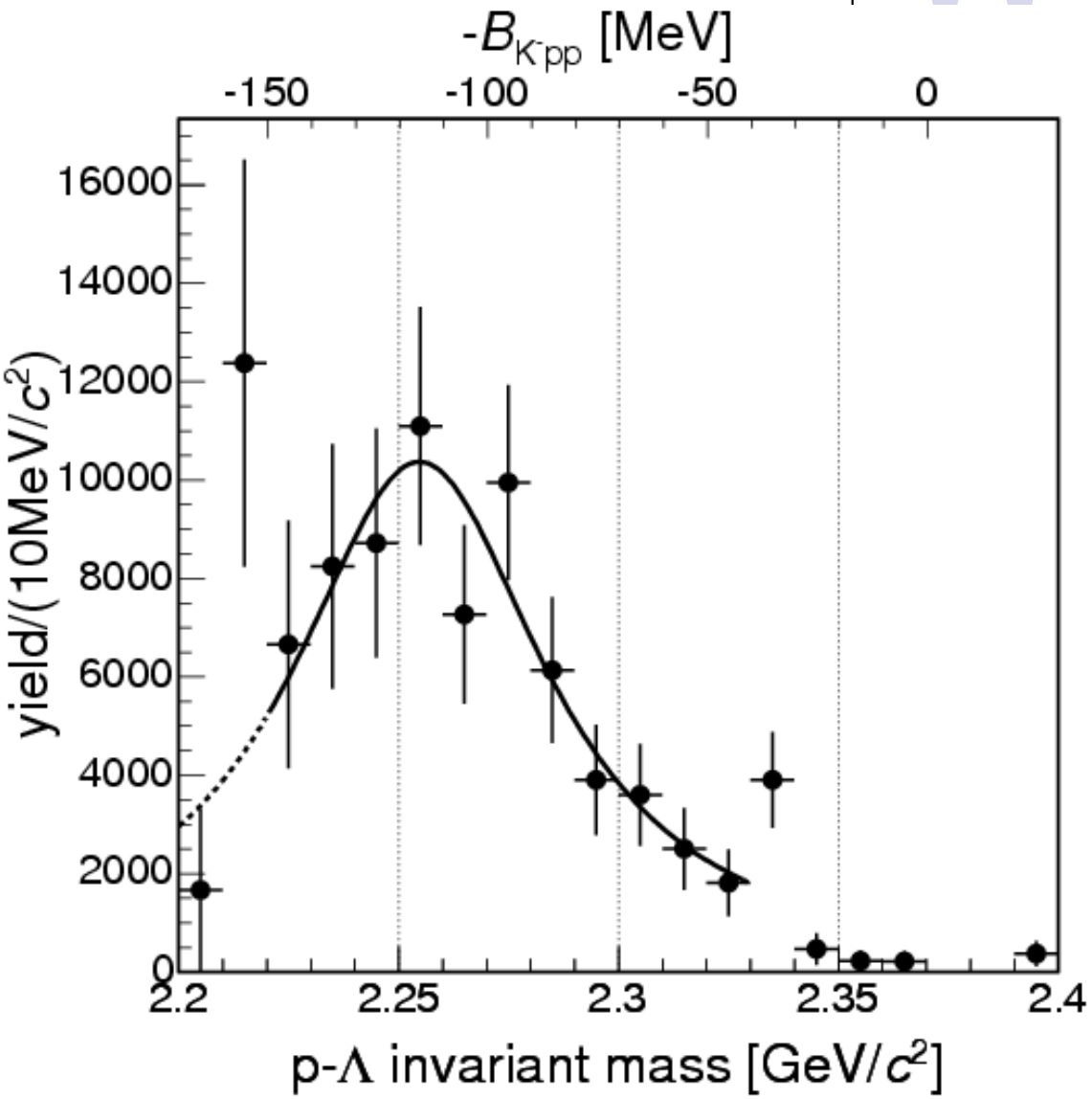


Acceptance-corrected invariant-mass spectrum

$$B = 115\,^{+6}_{-5}\,^{+3}_{-4}\ \mathrm{MeV}$$
$$\Gamma = 67\,^{+14}_{-11}\,^{+2}_{-3}\ \mathrm{MeV}$$

Theoretical calculation

$$B = 48\,(86)\ \mathrm{MeV}$$
$$\Gamma = 61\,(58)\ \mathrm{MeV}$$



Future study with FINUDA

K^-pp pp: $I = 1$

$\rightarrow \Lambda + p$

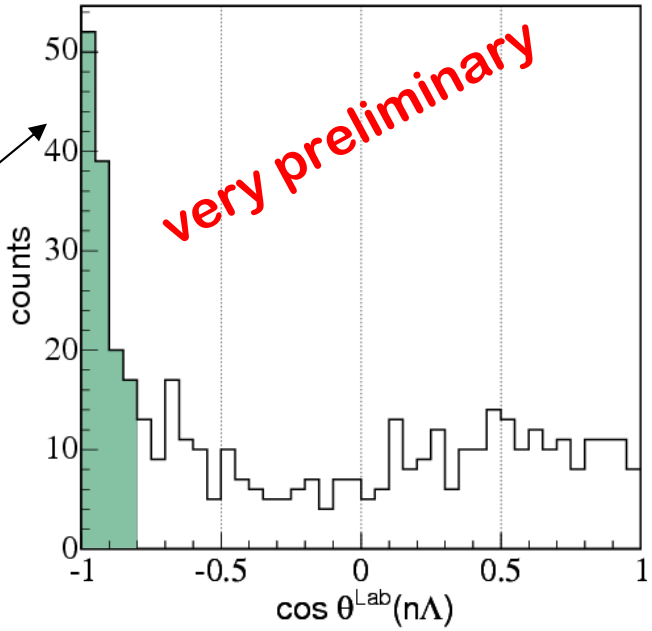
$\rightarrow \Sigma^0 + p$

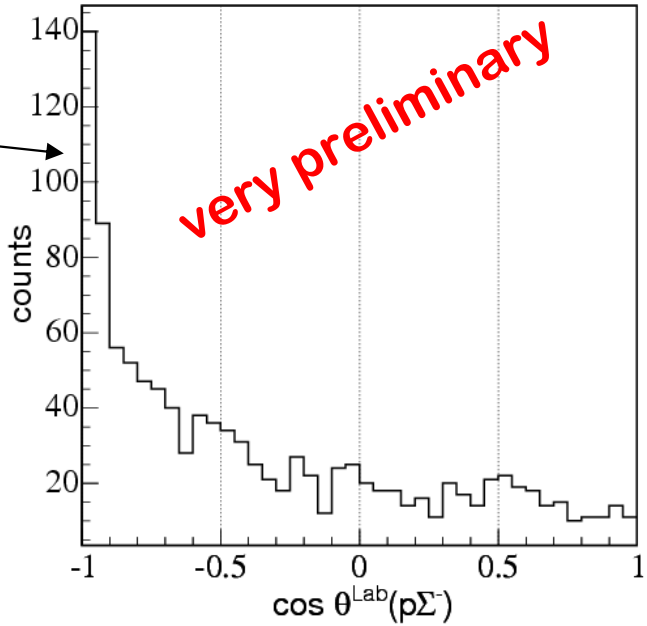
K^-pn pn: $I = 0,\ 1$

$\rightarrow \Lambda + n$

$\rightarrow \Sigma^0 + n$

$\rightarrow \Sigma^- + p$





Isospin dependence of $\bar{K}N$ interaction

Summary

- We observed *back-to-back Λ-p coincidence events* in K^- absorption at rest with the FINUDA spectrometer, for the first time.
- The Λ-p invariant-mass distribution suggests the existence of a *K^-pp bound system* with

$$B = 115\,^{+6}_{-5}\,^{+3}_{-4}\,\mathrm{MeV} \text{ and } \Gamma = 67\,^{+14}_{-11}\,^{+2}_{-3}\,\mathrm{MeV}.$$

- The deep binding indicates the $\overline{\mathrm{K}}$-nucleus potential is "*very deep*", not "*shallow*".