Search for Deeply Bound Kaonic Nuclei at FINUDA Experiment

RIKEN H.Outa

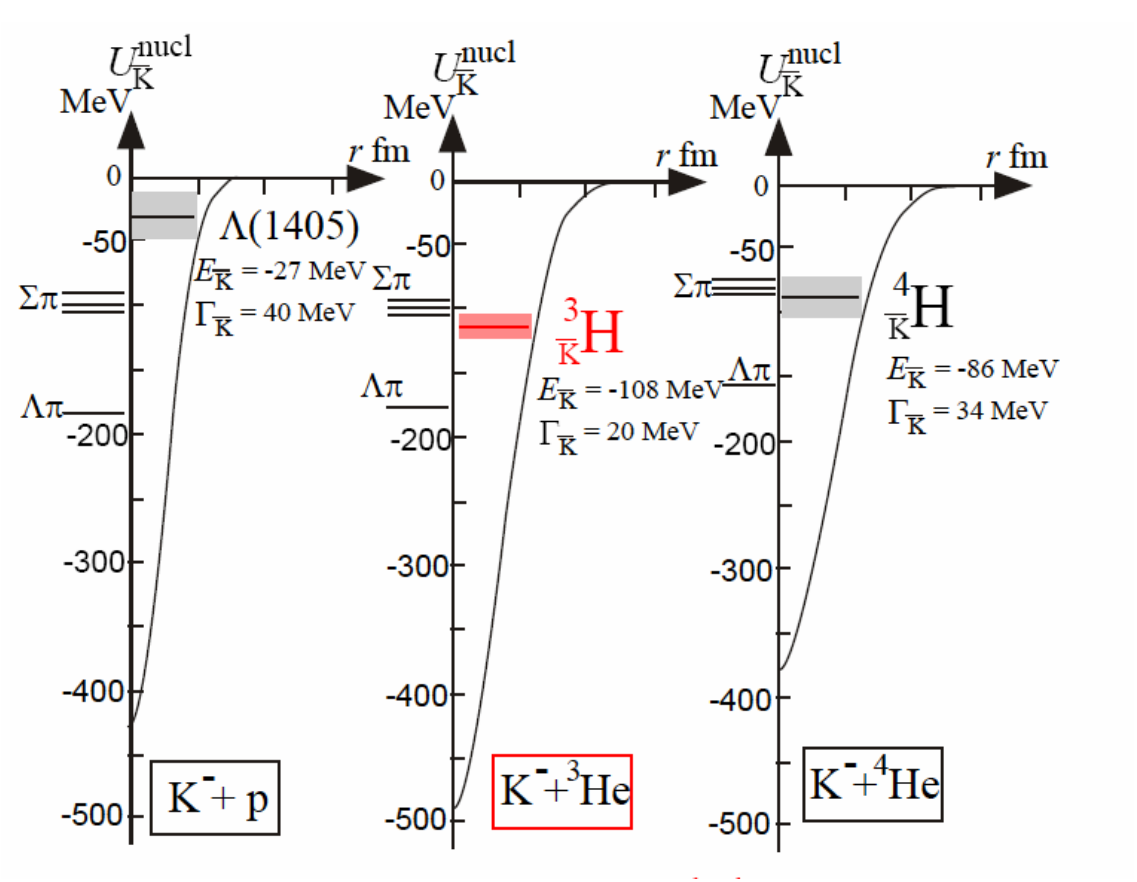
KEK H.Fujioka, T.Nagae, T.Maruta,

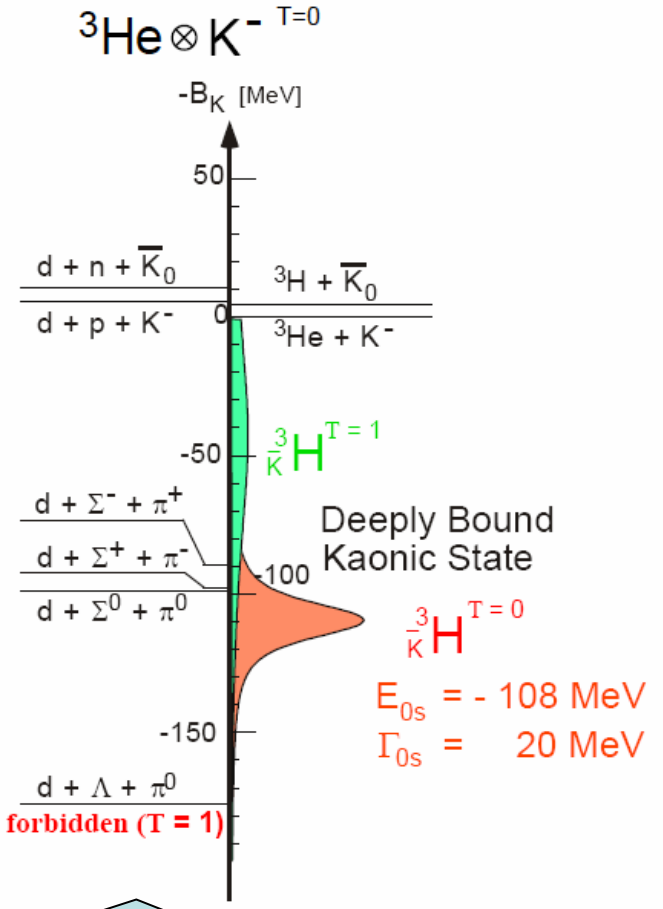
A.Toyoda, M. Sekimoto

for FINUDA collaboration

1. Deeply bound K-nuclei search
2. Tagging method in FINUDA
3. Analysis status (preliminary)

1. Deeply bound kaonic nuclei





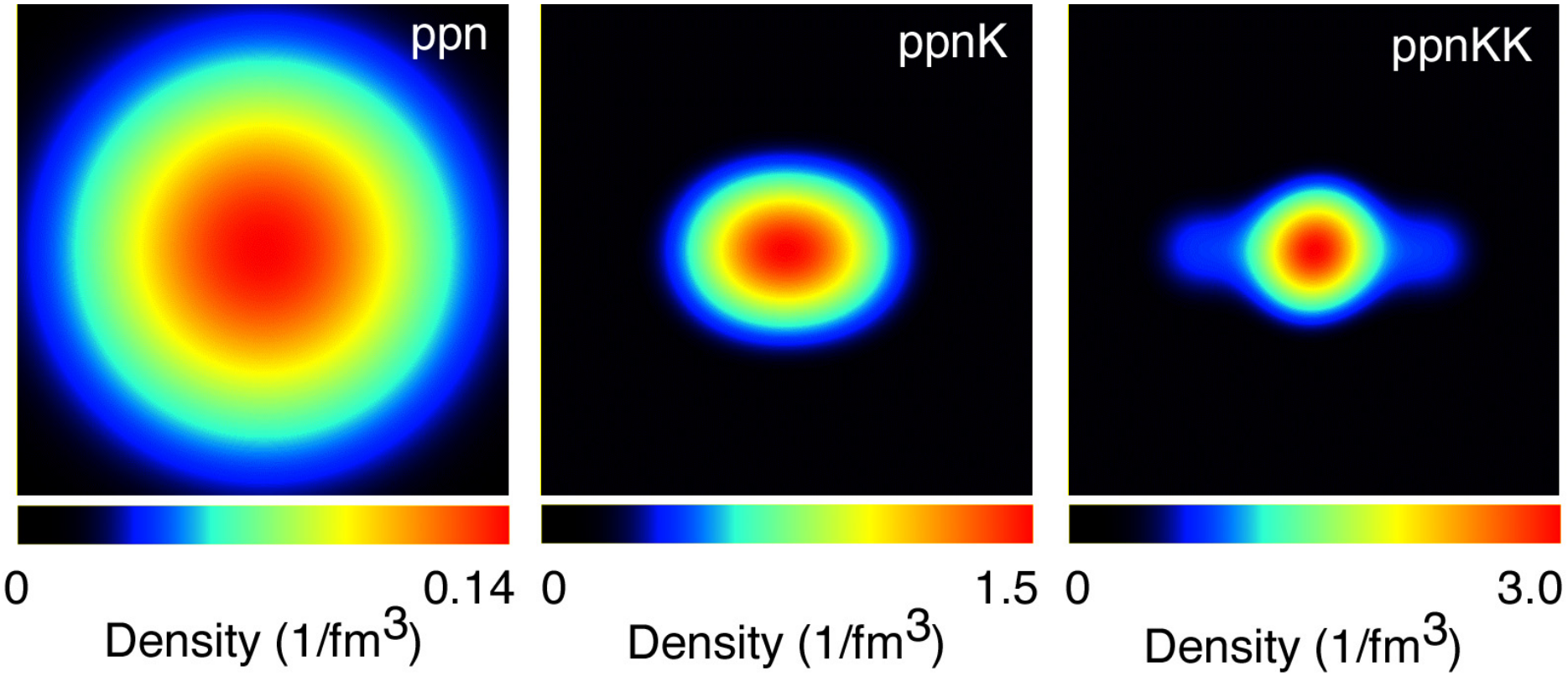
Theoretical prediction by Akaishi/Yamazaki

Strong attraction in I=0 channel → Λ(1405)

Deeply bound state of K- meson In nuclei

High Density & Low Temperature !!

AMD calculation *by* Dote *et. al.*



B ~ 10 MeV

center ~ ρ_0

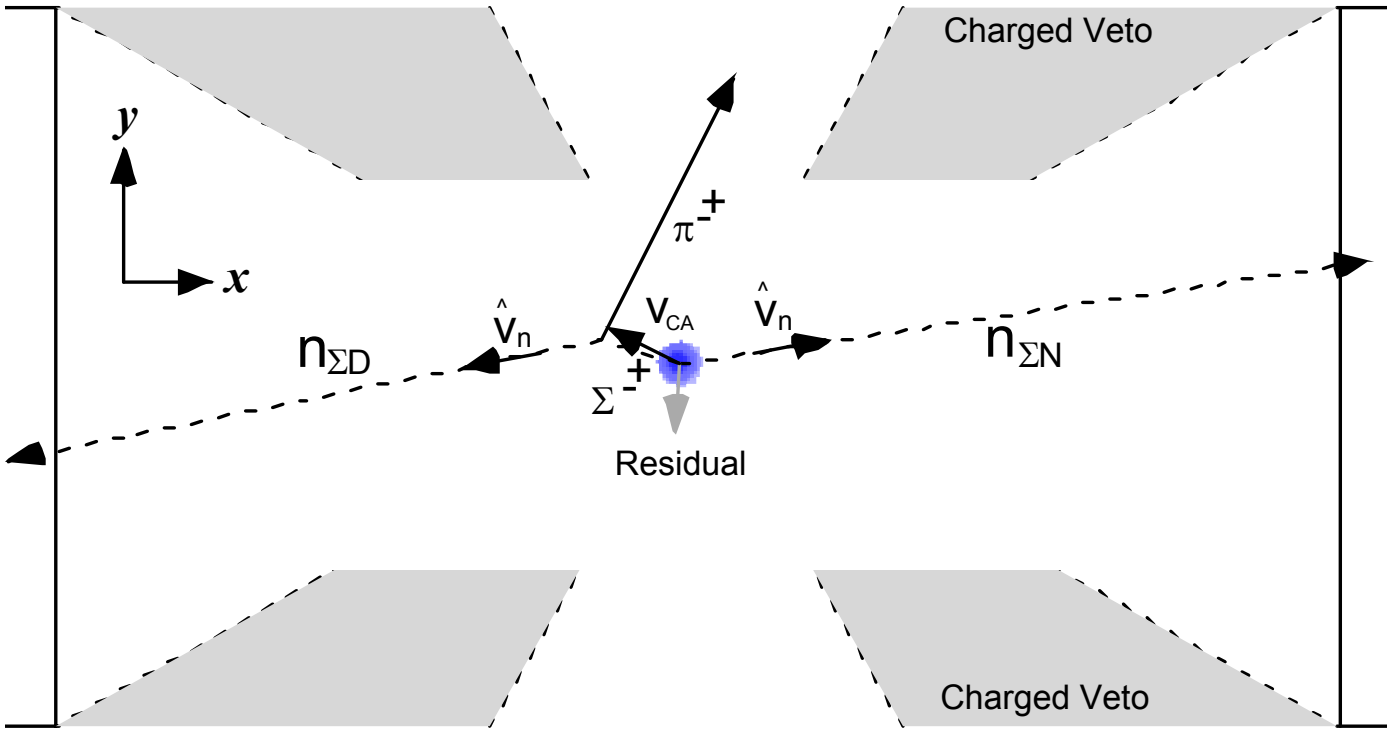
B ~ 120 MeV

center ~ 10 ρ_0

B ~ 220 MeV

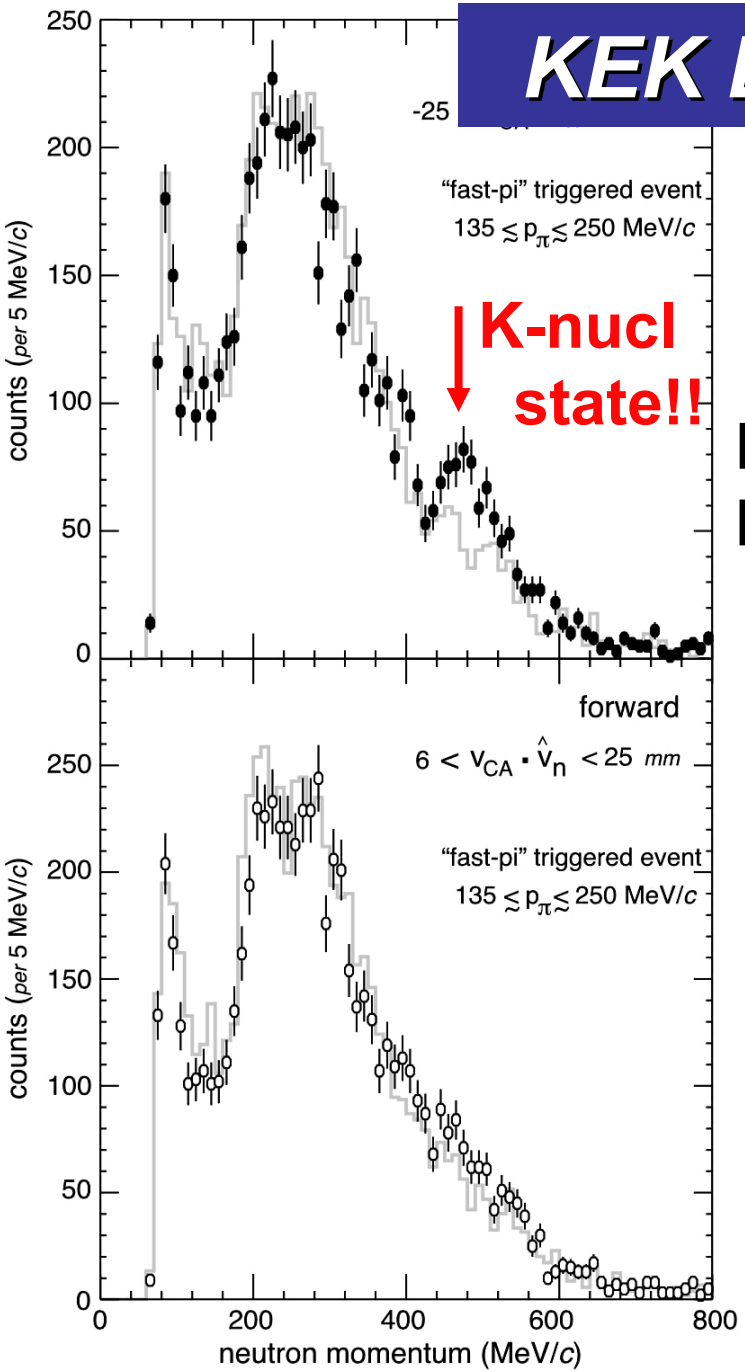
center ~ 20 ρ_0

KEK E471 ^{4}He(stopped K^-,n)

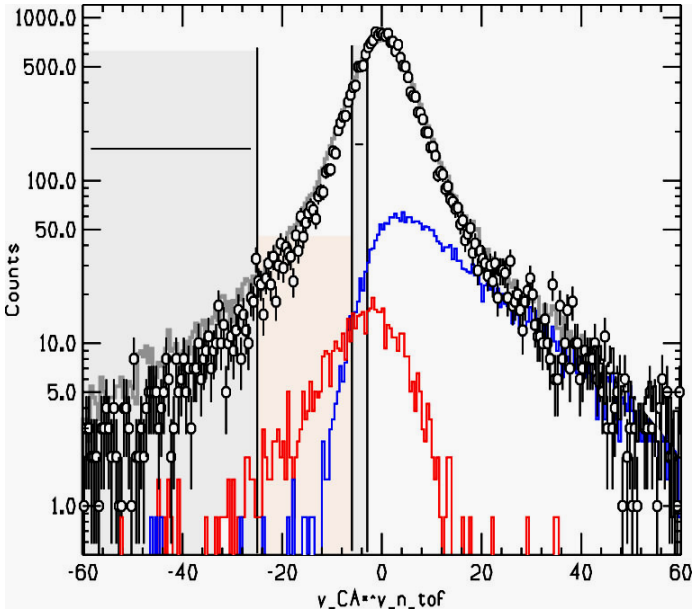


Neutron detection with backward hyperon decay tagging

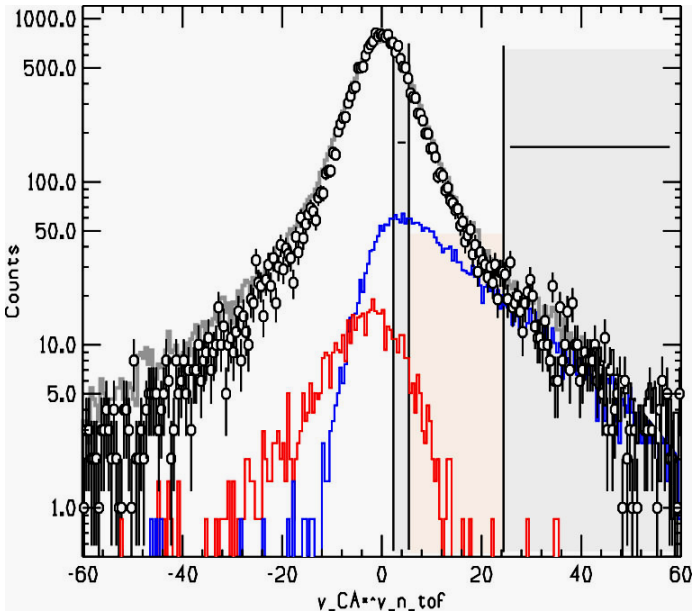
KEK E471 ^{4}He(stopped K^-,n)

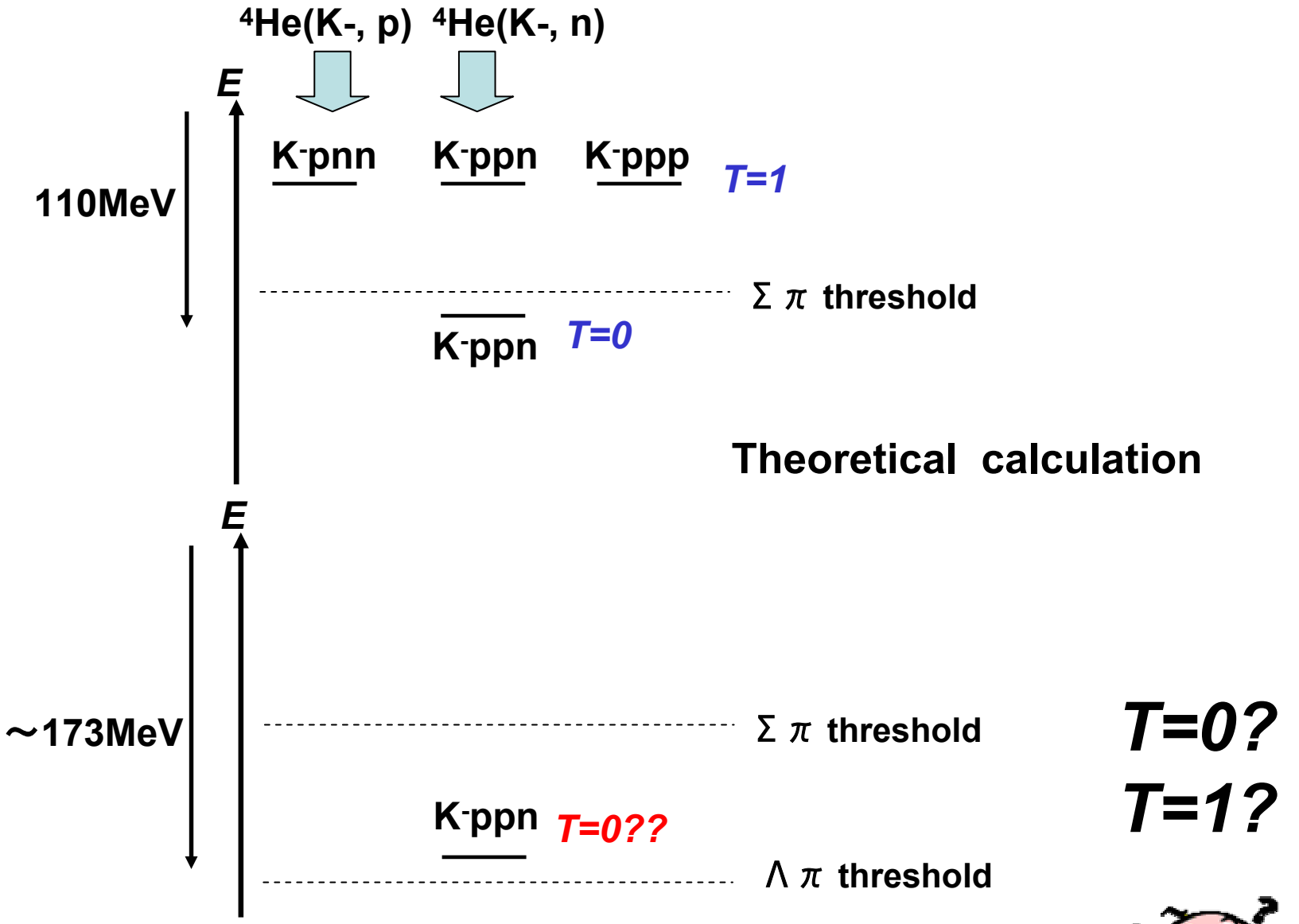


Backward hyperon



Forward hyperon (BG)

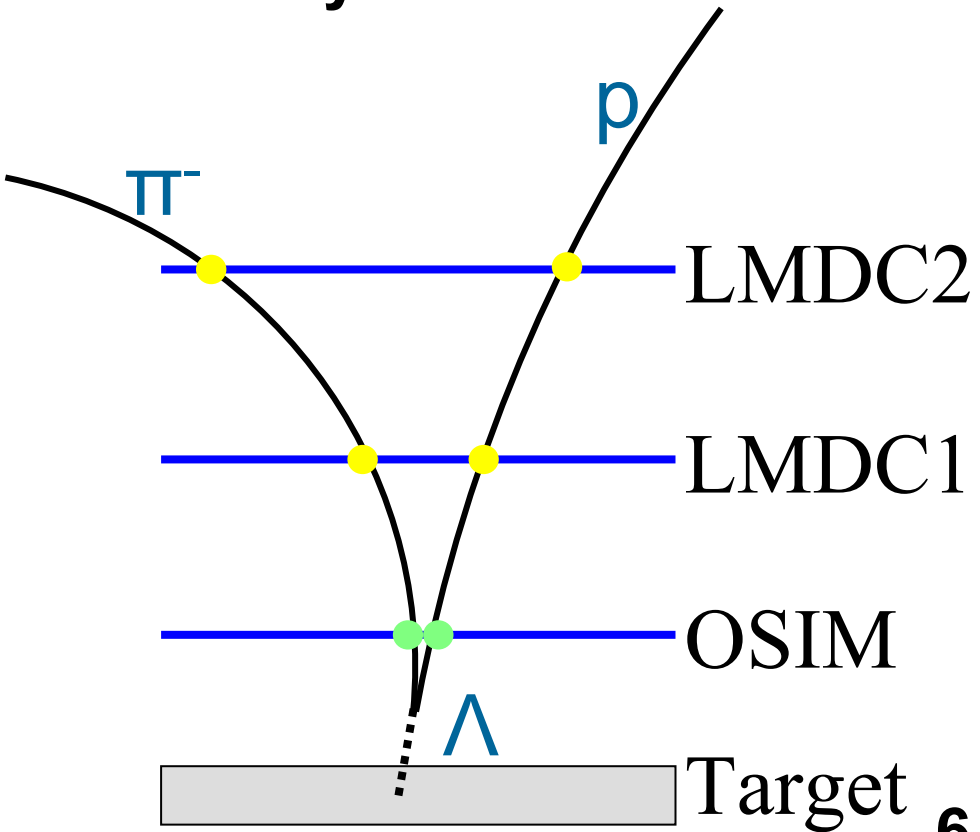



4He(K-, p)
4He(K-, n)
E
K-pnn
K-ppn
K-ppp
T=1
110MeV
Σ π threshold
K-ppn
T=0
Theoretical calculation
E
~173MeV
Σ π threshold
K-ppn
T=0??
Λ π threshold
T=0?
T=1?
Result…

2. K-nucl. State Search in FINUDA

1. Can <u>simultaneously</u> take both of
   (stopped K^-,p) and (stopped K^-,n) spectra
   on many target nuclei with wide acceptance

2. Can directly tag Λ from the decay of K-nucl.



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★Major BG in high momentum proton

$K^- NN \rightarrow \Lambda p$

or $\Lambda \rightarrow p\ \pi$

→ Λ &p goes to <u>back-to-back</u>

★ Signal

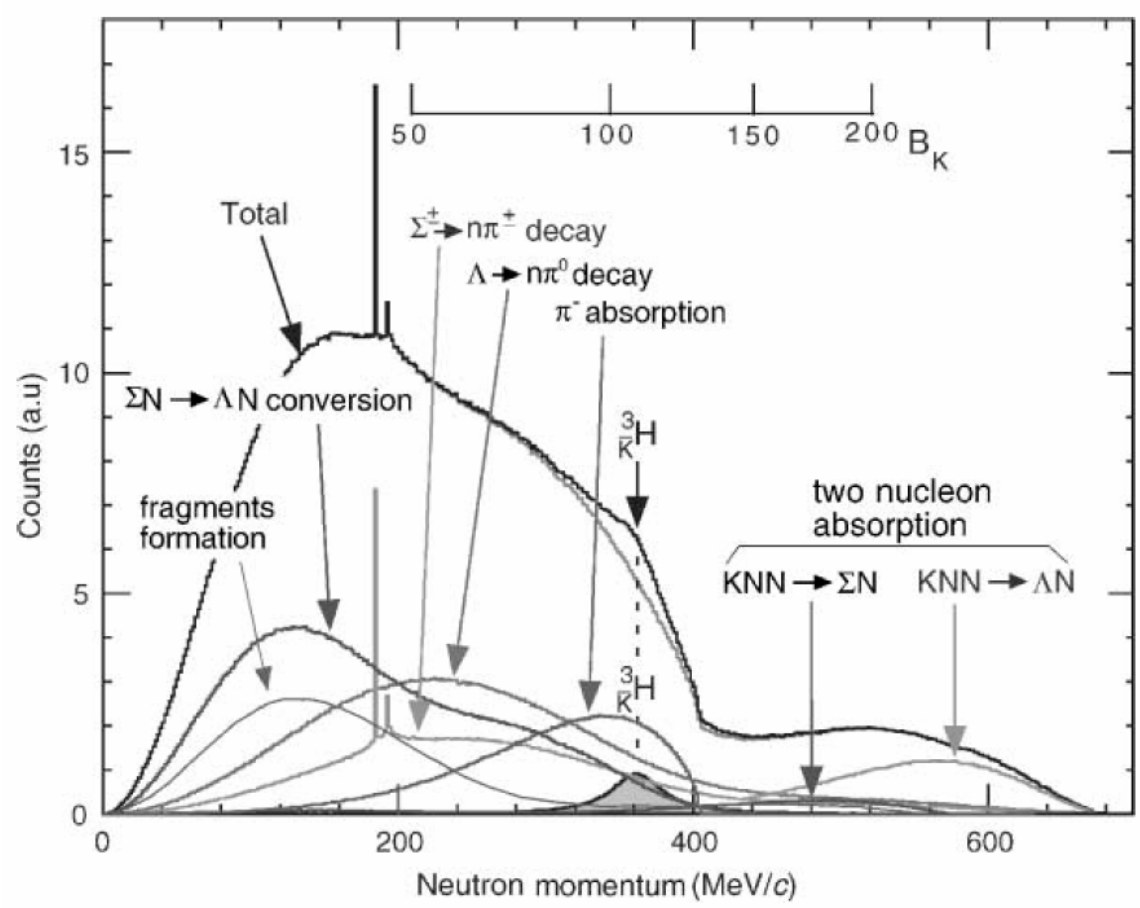
$K^- + A \rightarrow$ K-nucl + p

K-nucl → Λ + X

→ Λ &p weaker angular correlation

} Improve S/N

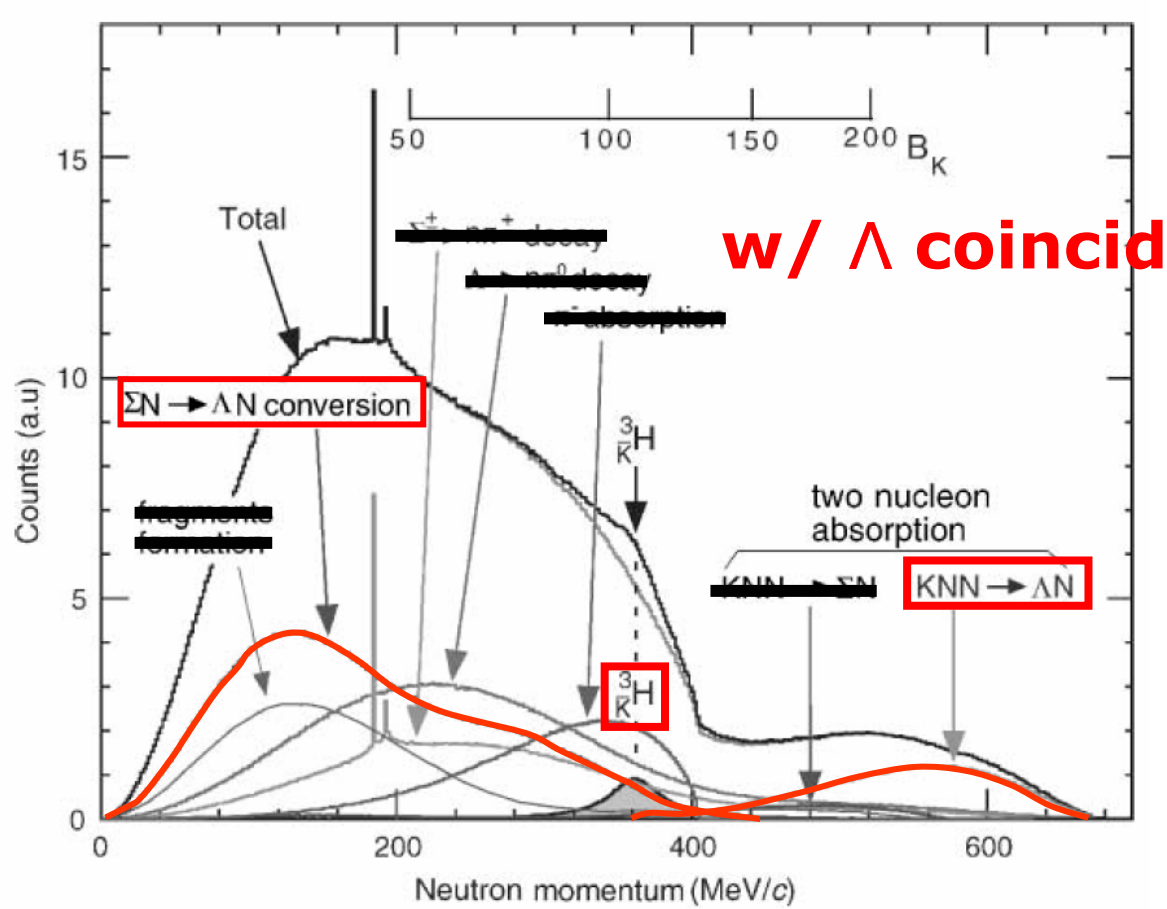
Single neutron spectrum from ^{4}He(stopped K^-,n) — Simulation



NIM A 473(2001)286

Search region for monochromatic peak

Single neutron spectrum from ^{4}He(stopped K^-,n) — Simulation



w/ Λ coincidence

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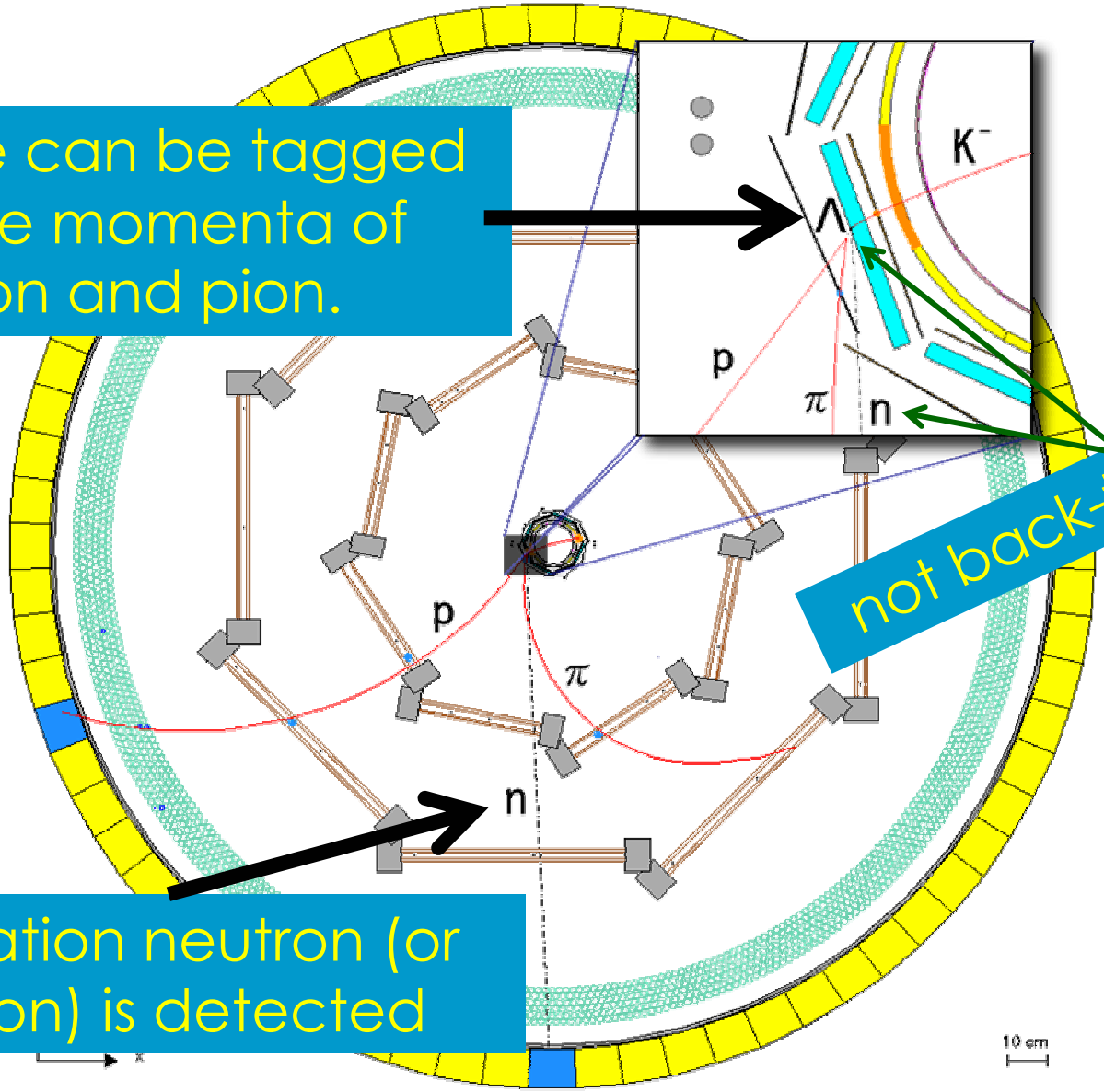
Search region for monochromatic peak

Typical Event (Simulation)

Λ particle can be tagged from the momenta of proton and pion.



not back-to-back !!

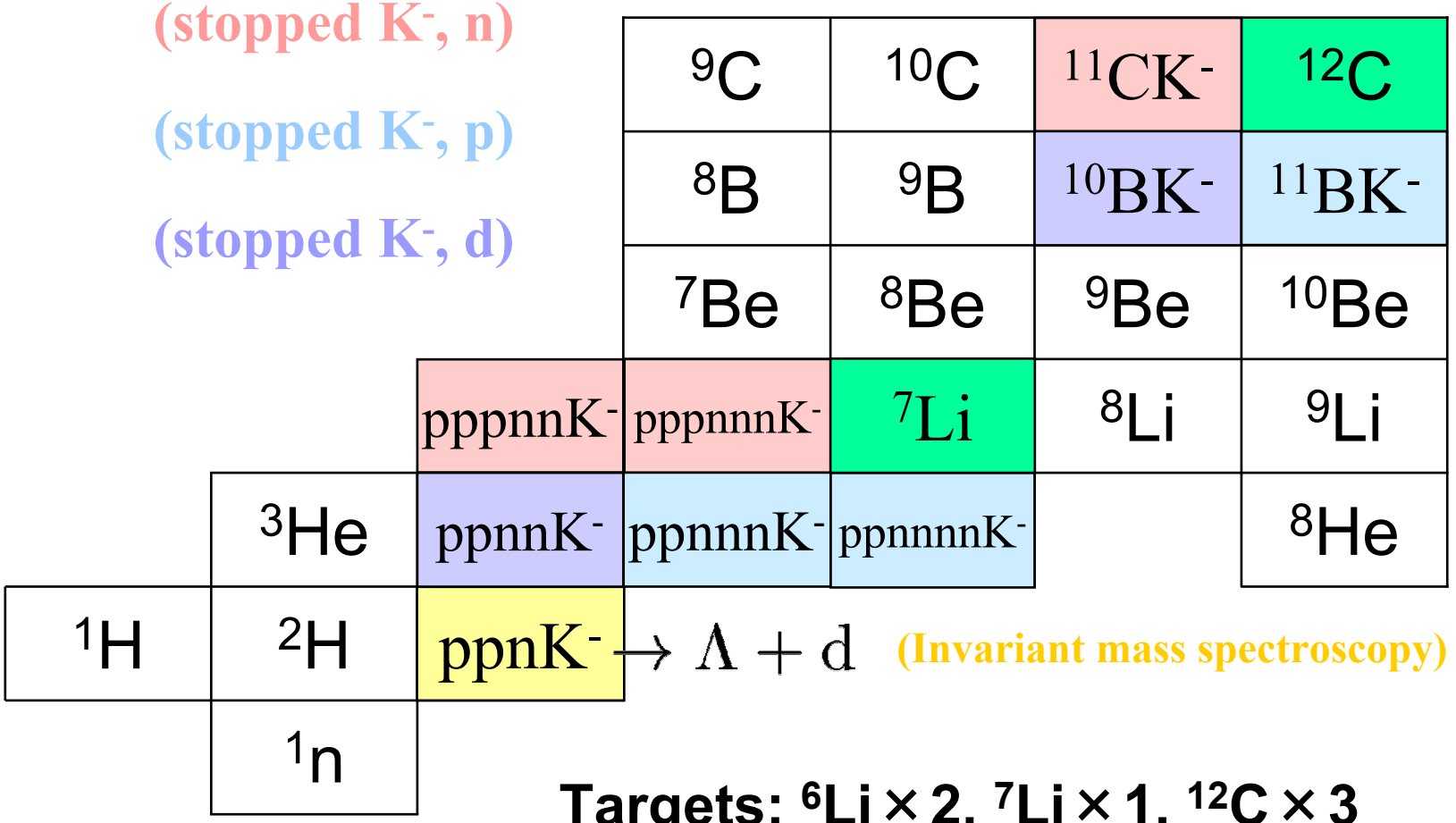
Formation neutron (or proton) is detected

Chart of Deeply Bound Kaonic Nuclei

(stopped K^-, n)

(stopped K^-, p)

(stopped K^-, d)



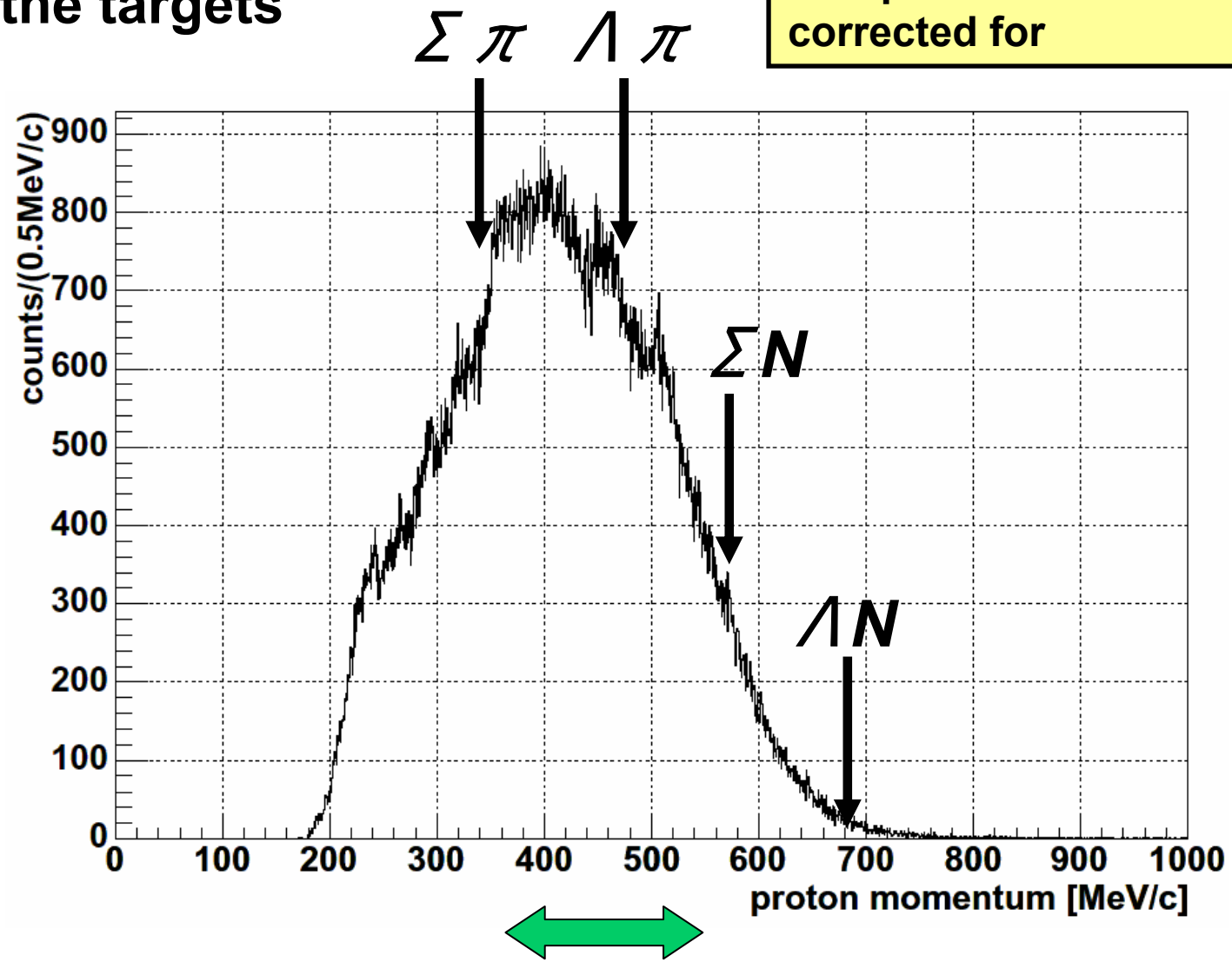
$ppnK^- \rightarrow \Lambda + d$ (Invariant mass spectroscopy)

Targets: ^{6}Li × 2, ^{7}Li × 1, ^{12}C × 3
^{27}Al × 1, ^{51}V × 1

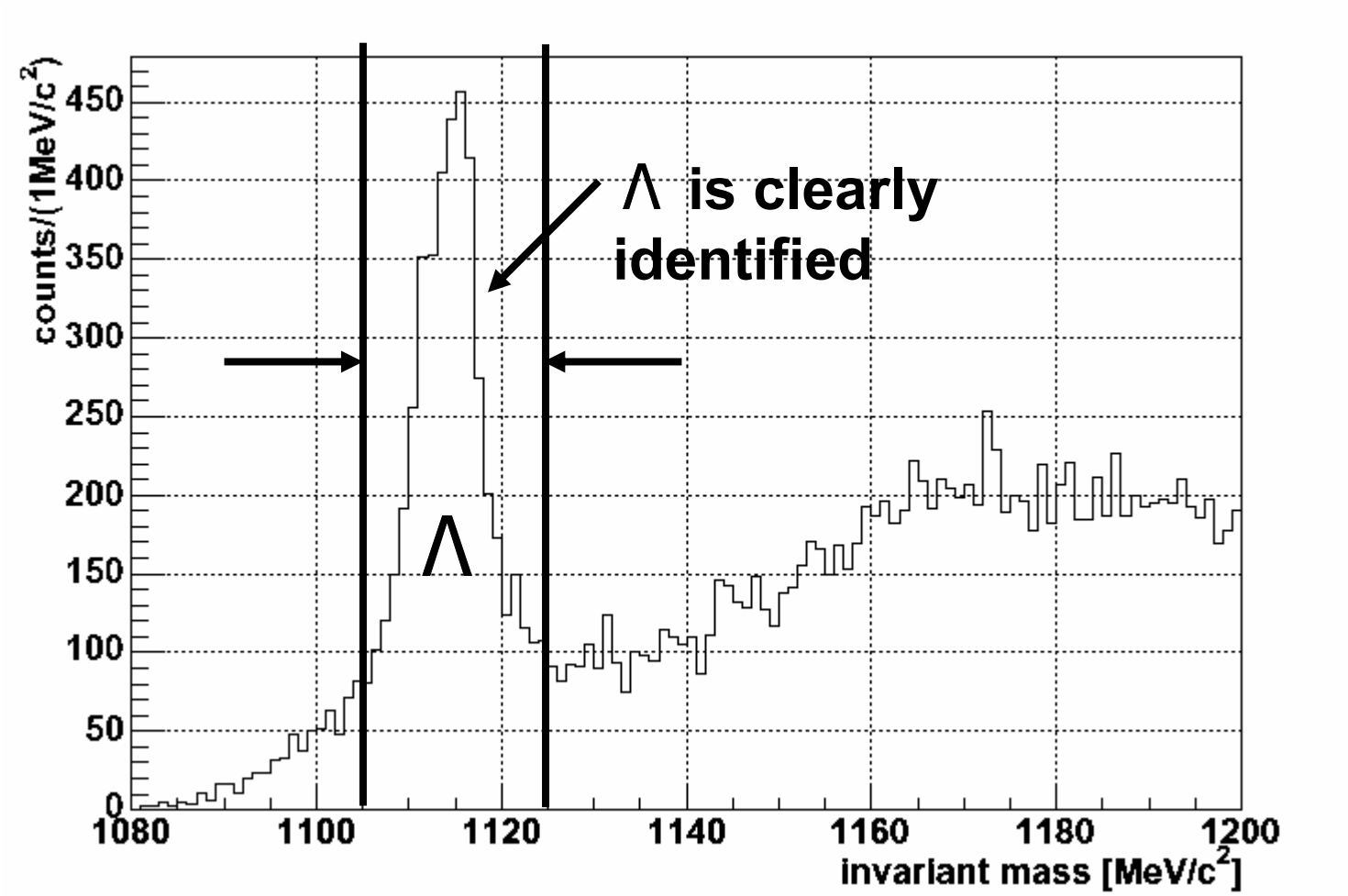
3. Analysis Status (Very Preliminary)

(Stopped K-,p) spectrum for ALL the targets

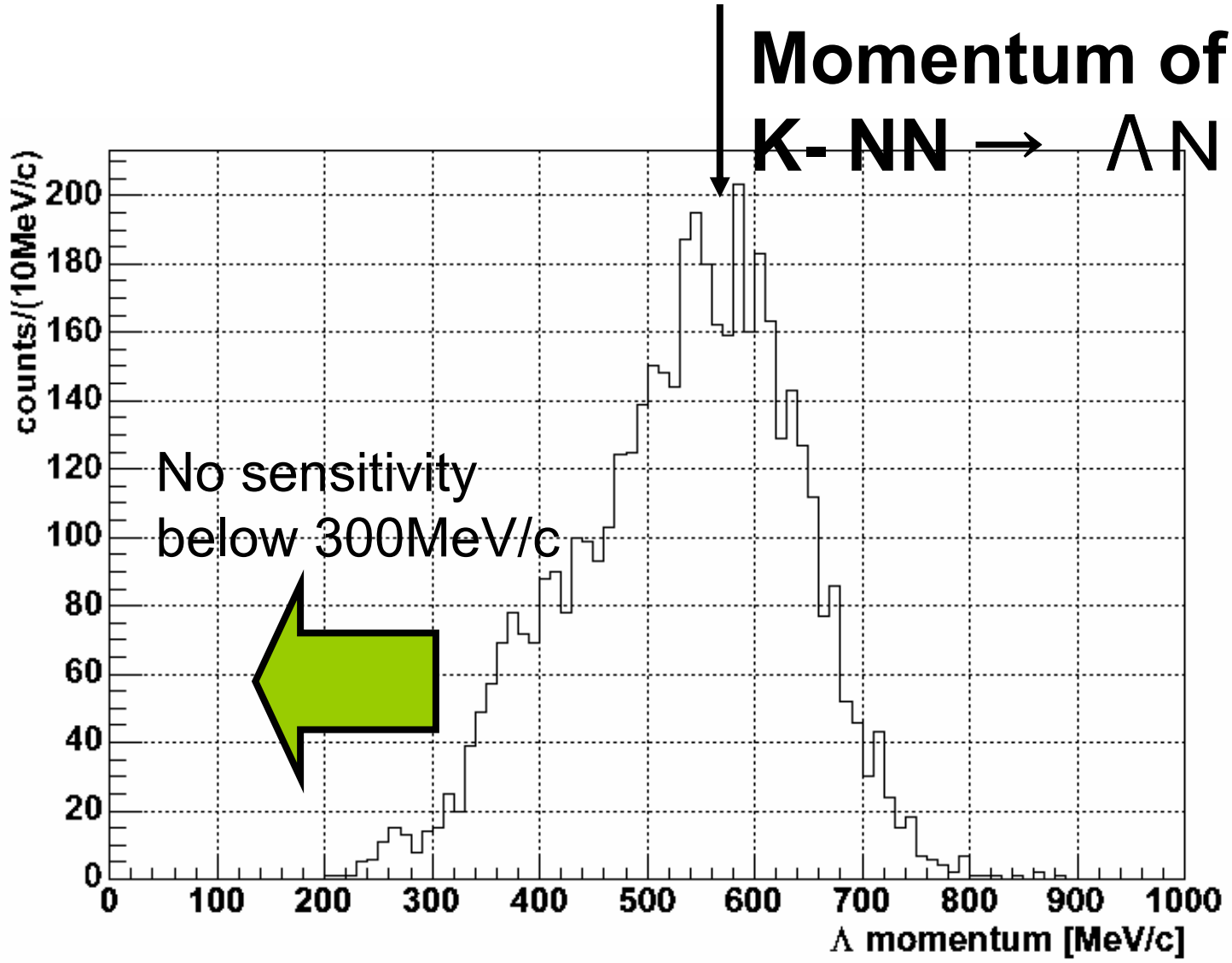
Momentum-dependent acceptance must be corrected for



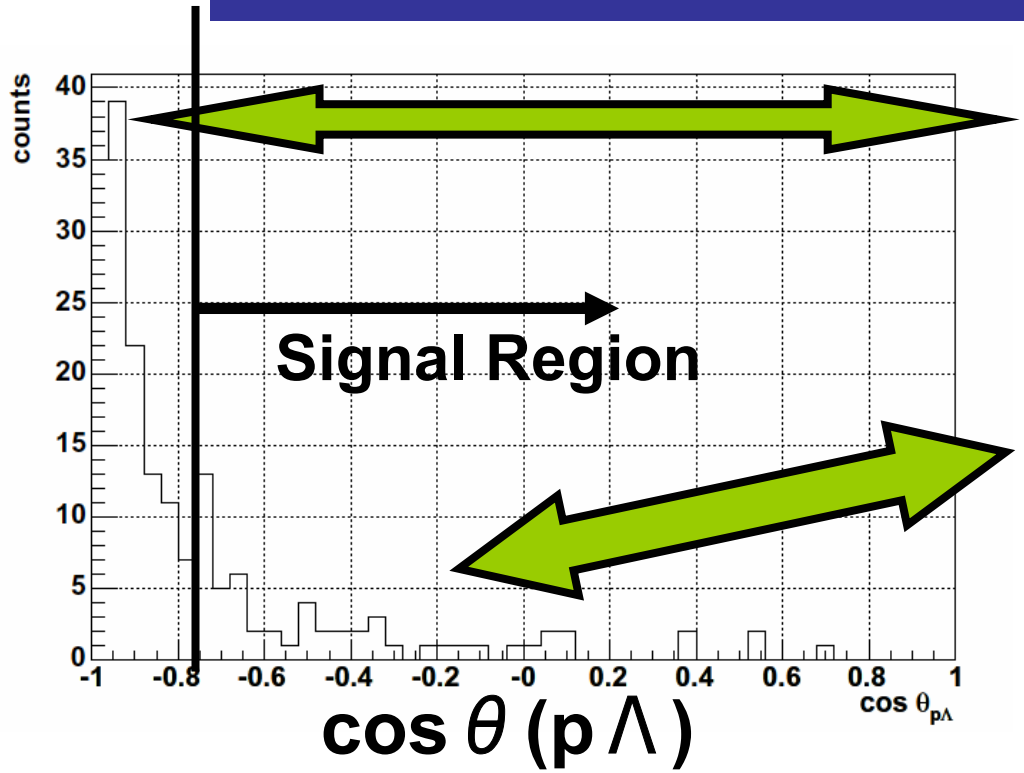
Reconstructed Λ Invariant Mass (FINUDA data; preliminary)



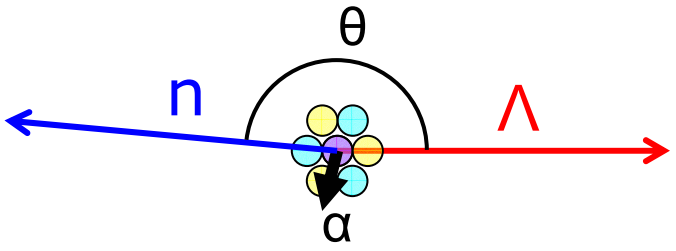
Reconstructed Λ Momentum (preliminary)



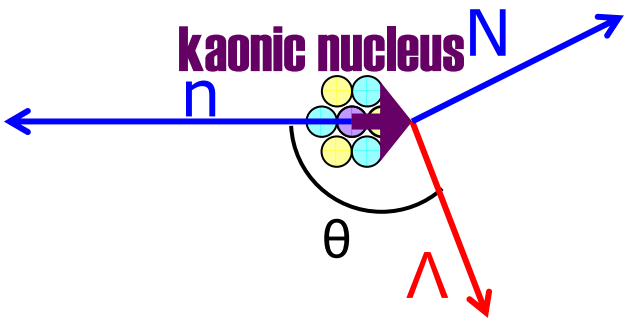
Λp opening angle distribution (Preliminary)



Kaon Two-nucleon Abs.



kaonic nucleus event



Poor statistics at this moment….

→ Tracking program in still in progress
→ Loosen selection condition； increase Λ efficiency
→ More data taking on light targets

Summary

Search of deeply bound kaonic nuclei started at FINUDA experiment

1. Search for ***mono-energetic peaks*** in (stopped K-,p) & (stopped K-,n) spectra
   w/ Λ-tagging
   w/ $\cos\theta_{N\Lambda}$ cut

2. Clean Λ identification
   → $K^-pp \rightarrow \Lambda p$

3. Analysis is in progress