

Status Report of E15

M.Iwasaki

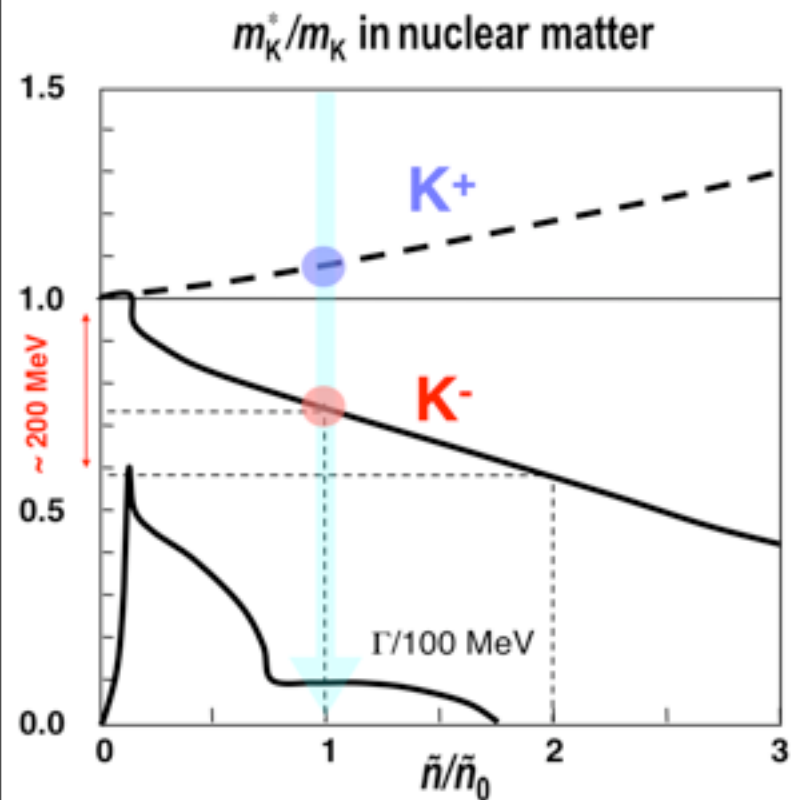
for J-PARC E15 Collaboration

- Introduction
- E15 experiment
- Status of E15
- Preliminary Results of Last Beam Time
- Conclusion

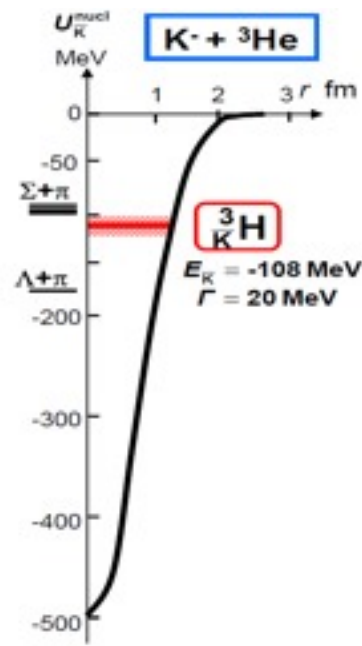
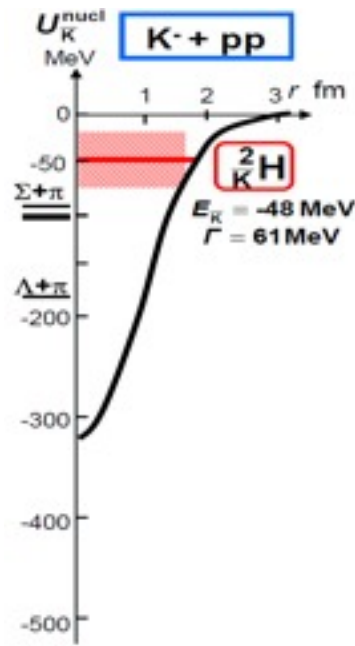
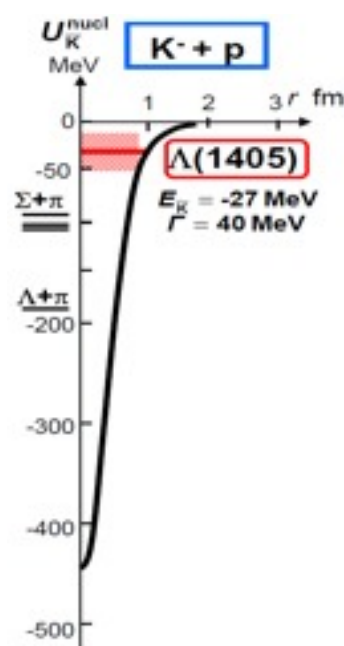
Embedding K^- in nucleus

Motivation of J-PARC E15

- understand $\bar{K}N$ interaction below threshold
- K mass modification / high density matter?



T. Waas, N. Kaiser & W. Weise, Phys. Lett. B379 (1996) 34.



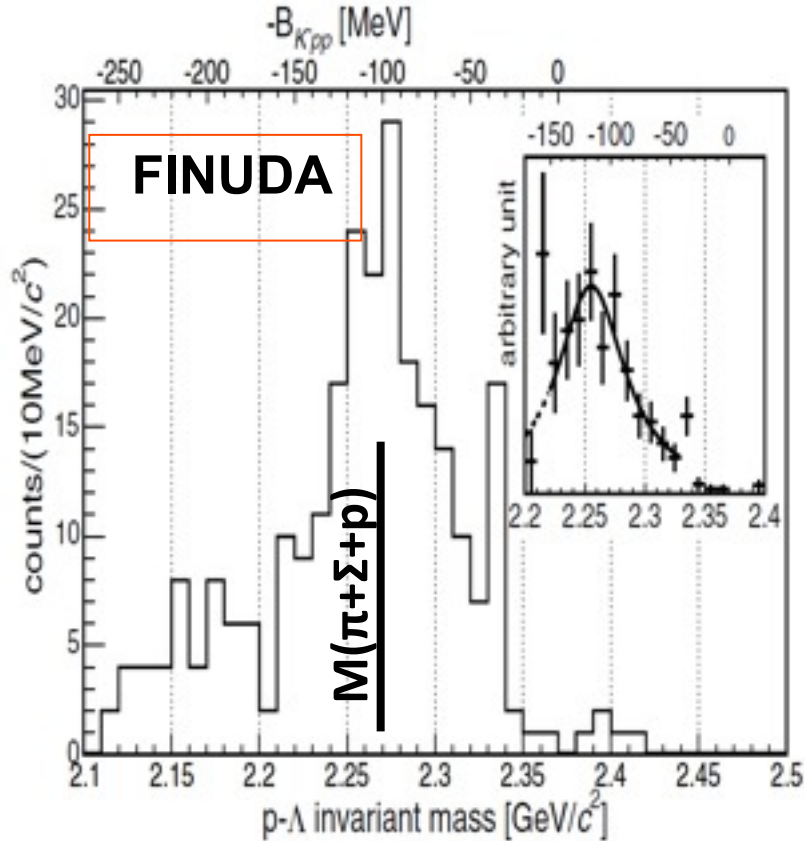
Y.Akaishi & T.Yamazaki, PLB535, 70(2002).

New data

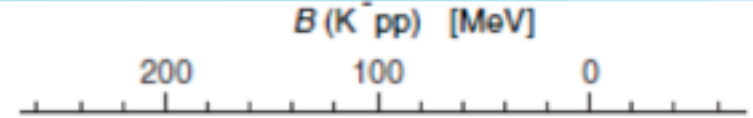
DISTO

$p(p, K^+) X @ T = 2.85 \text{ GeV}$

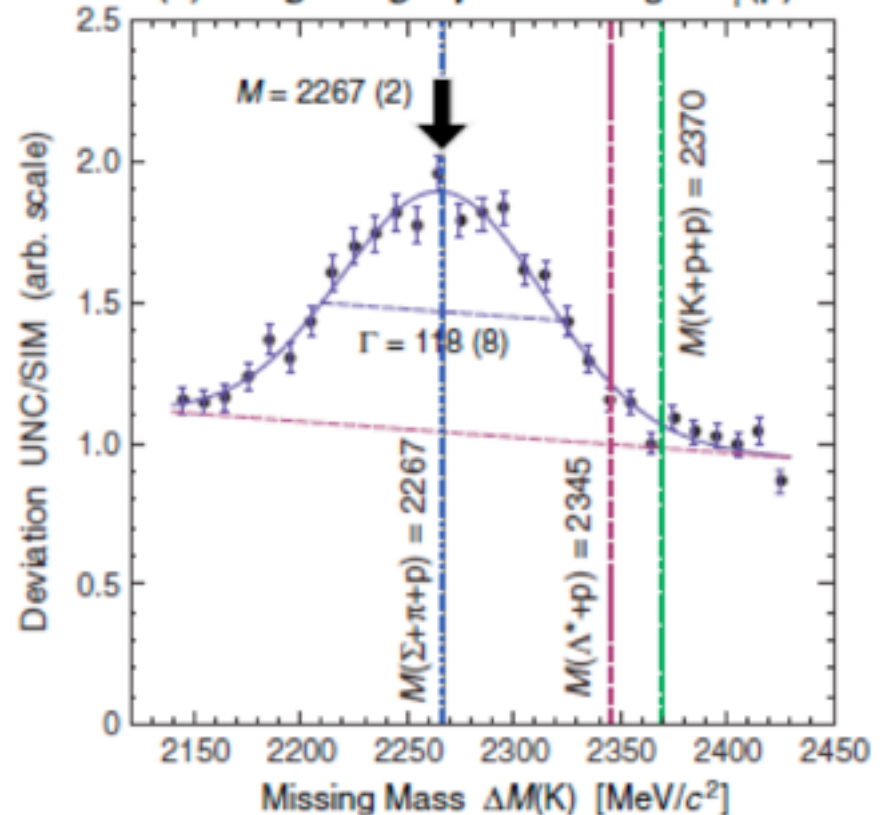
“ Λp ” invariant mass @ K^- at rest



$B_K = 115 \pm 6 \pm 4 \text{ MeV}$
 $\Gamma_K = 67 \pm 14 \pm 3 \text{ MeV}$
 ($M_{ppK} = 2255 \pm 6 \pm 4 \text{ MeV}$)



(a) large-angle proton: high- $P_T(p)$

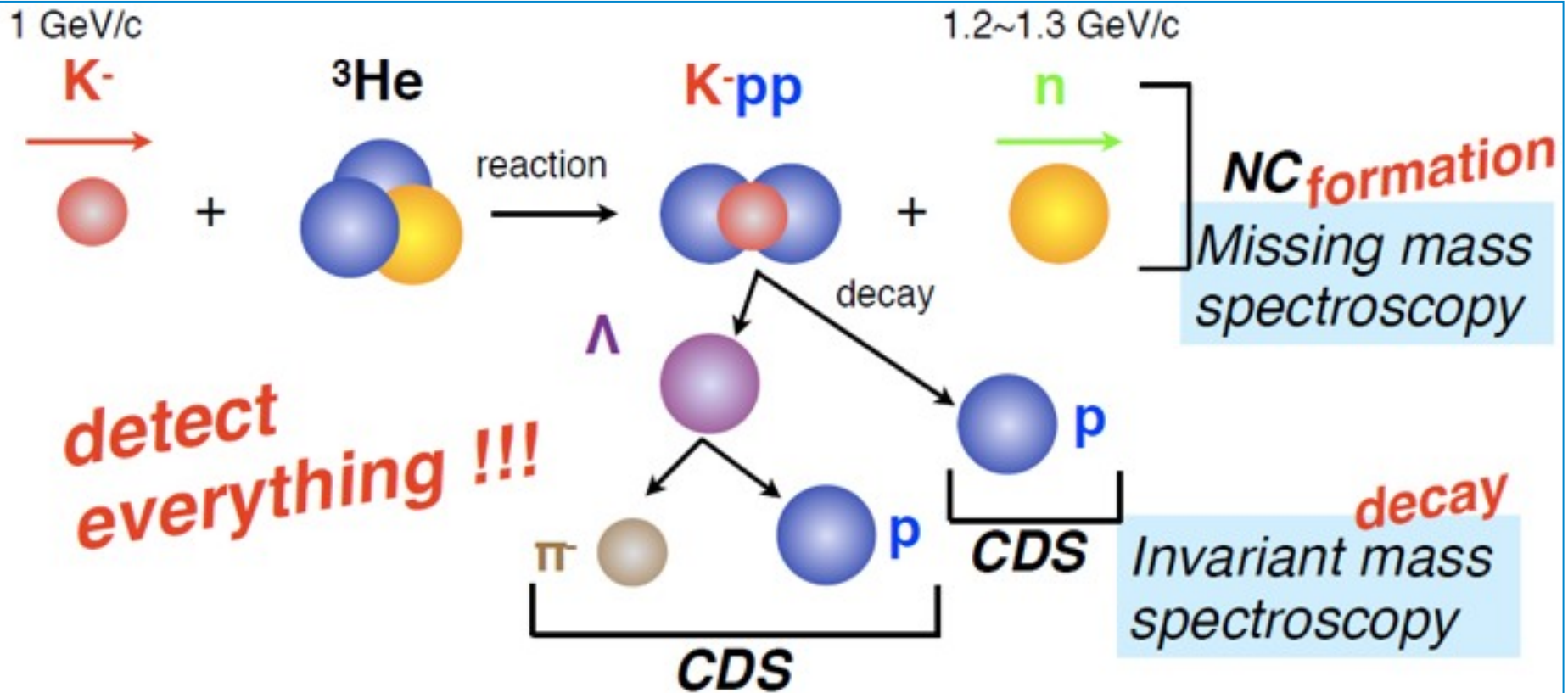


T.Yamazaki et al., PRL104(2010)132502

$M_x = 2267 \pm 3 \pm 5 \text{ MeV} !$
 ($B_K = 103 \pm 3 \pm 5 \text{ MeV}$)
 $\Gamma_x = 118 \pm 8 \pm 10 \text{ MeV} !$

Experimental Principle

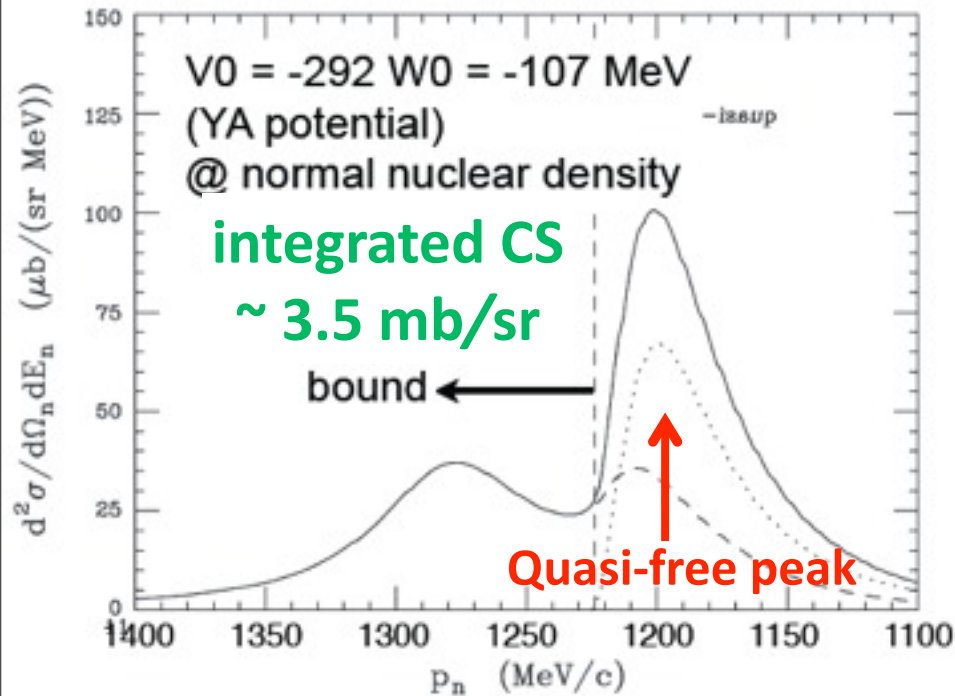
A search for the simplest kaonic nucleus, K^-pp ,
using ${}^3\text{He}(in\text{-flight } K^-,n)$ reaction



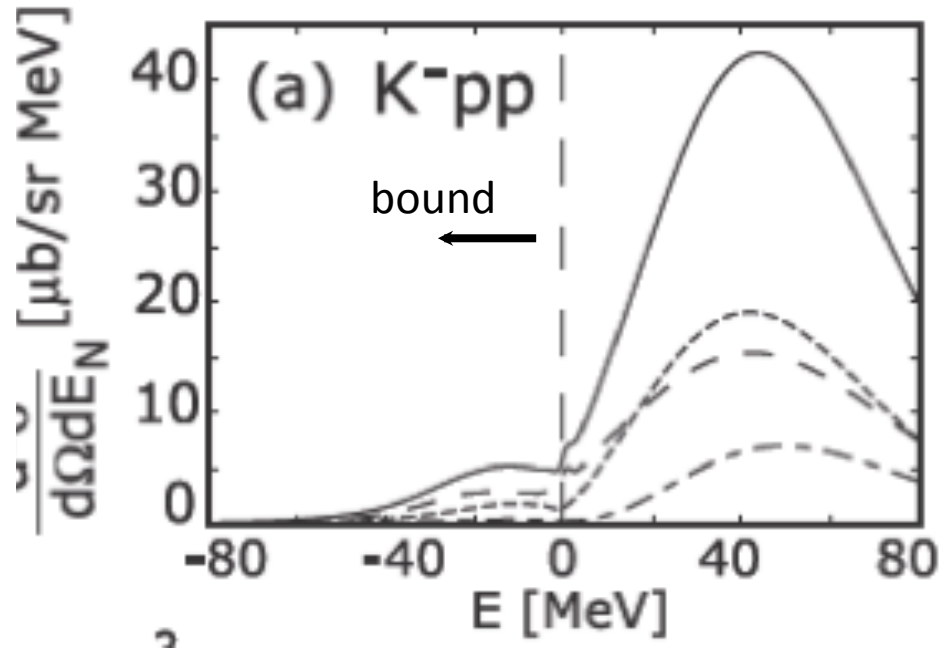
- two-nucleon absorption
 - hyperon decays
- CAN be discriminated kinematically**

1: Semi-Inclusive ${}^3\text{He}(K^-,n)$

Calculated formation-spectra for ${}^3\text{He}$ (in-flight K^-,n)



T.Koike and T.Harada., *PLB652* (2007) 262

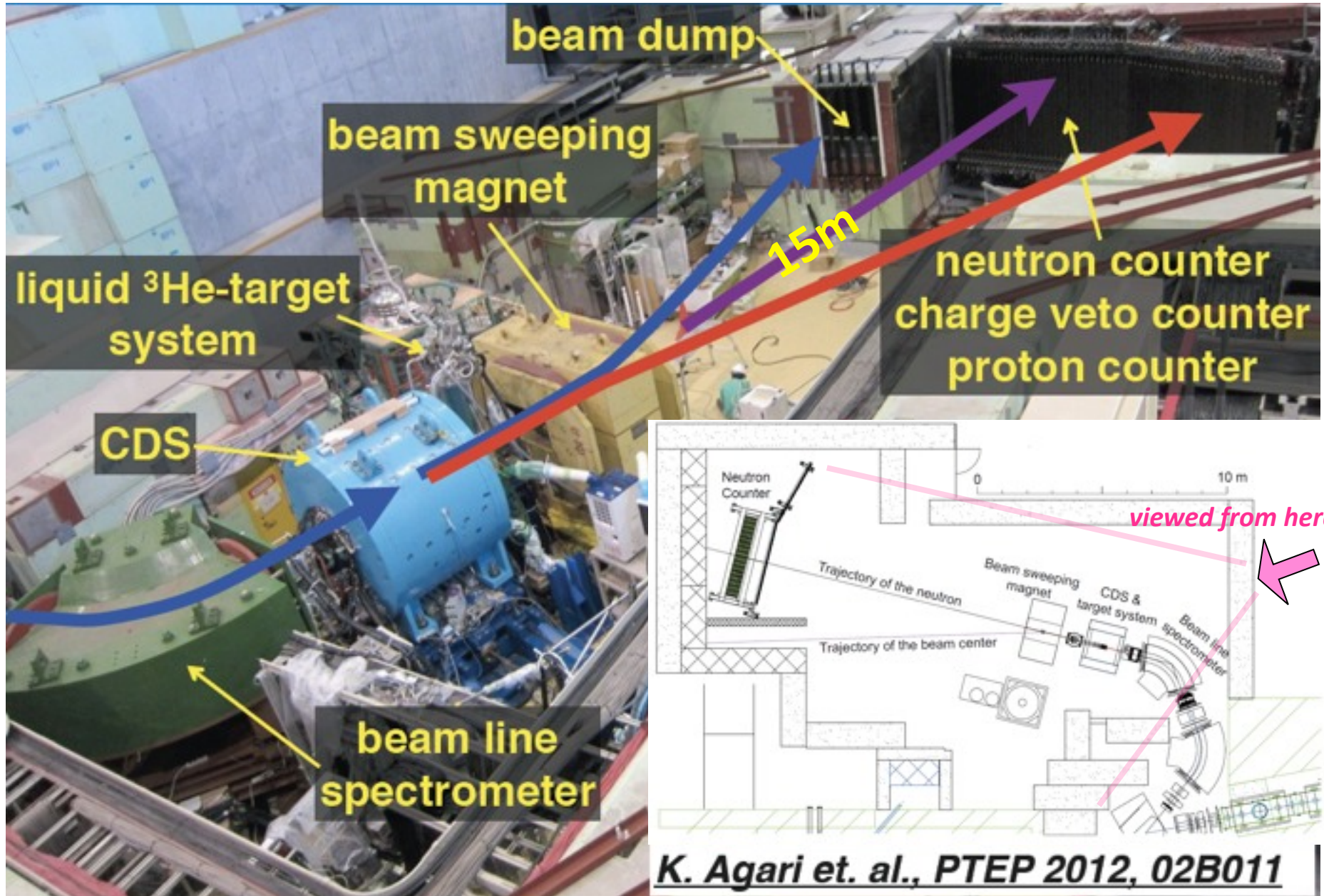


J. Yamagata-Sekihara, D. Jido, H. Nagahiro, and S. Hirenzaki

PHYS. REV. C **80**, 045204 (2009)

**If right, we can measure
the bound structure!**

Experimental Setup



Very preliminary results on ${}^3\text{He}(\text{K}^-, \text{n})$

- Accumulated data
 - w/ liquid helium-3 target: ~1% of original proposal

period	primary beam intensity	duration	Kaons on target
March, 2013	14.5 kW (18 Tppp, 6s cycle)	30 hours	0.9×10^9
May, 2013	24 kW (30 Tppp, 6s cycle)	88 hours	4.0×10^9

production target: Au 50% loss, spill length: ~2s, spill duty factor: ~45%

E15^{1st} is proposed as a first step using 2% of full E15

We could have data \lesssim 50% of E15^{1st}

Inclusive ${}^3\text{He}(\text{K}^-, \text{n})\text{X}$ spectrum (w/ charged particle in CDS)

(isospin) Inclusive ${}^3\text{He}(\text{K}^-, \text{p})\text{X}$ spectrum *in progress*

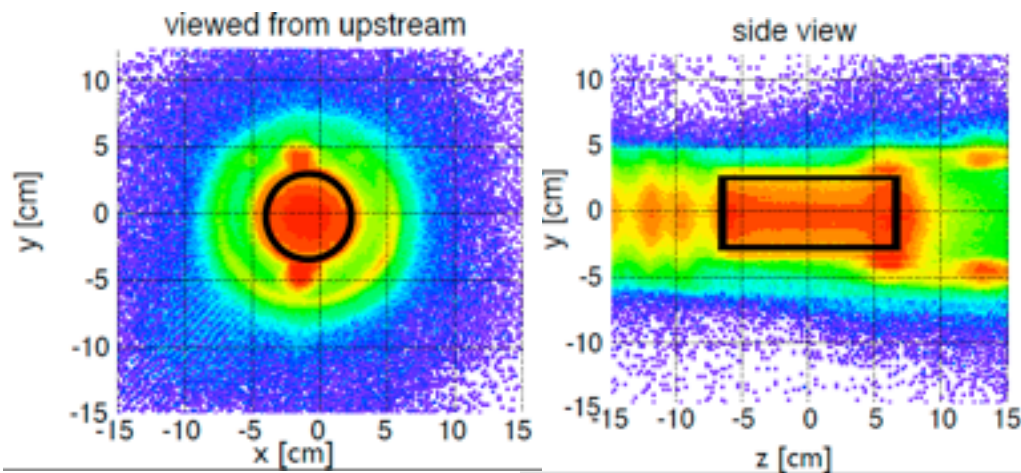
Exclusive channel in ${}^3\text{He}(\text{K}^-, \text{n})\text{X}$

${}^3\text{He}(\text{K}^-, \text{n}) \Lambda \text{p}$ (cf. FINUDA / DISTO)

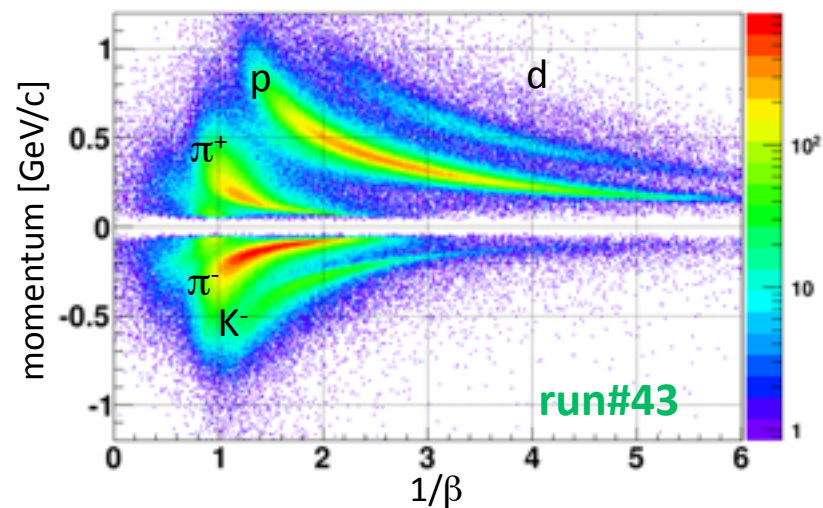
${}^3\text{He}(\text{K}^-, \text{n}) \Sigma^\pm \pi^\mp \text{p}$ *in progress*

CDS Performances

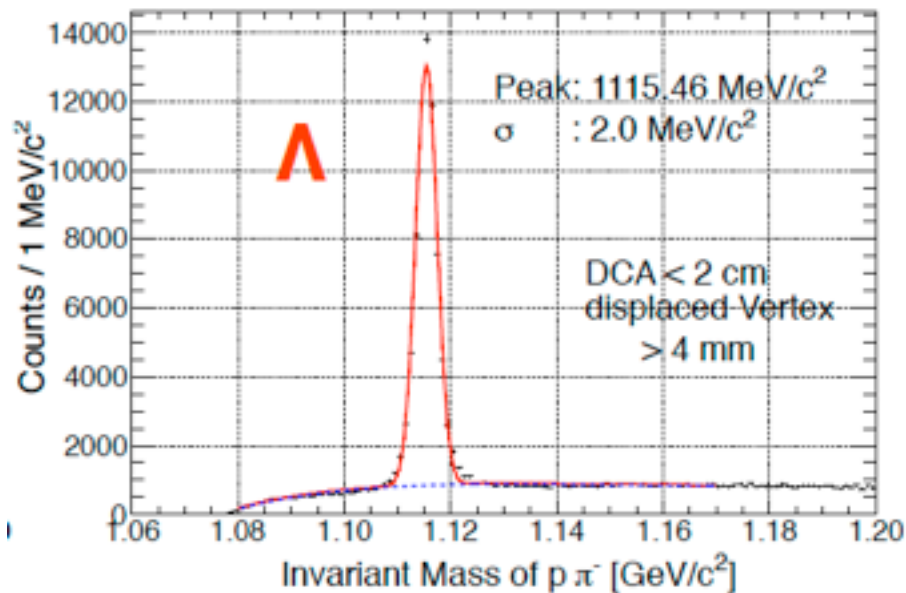
event vertex



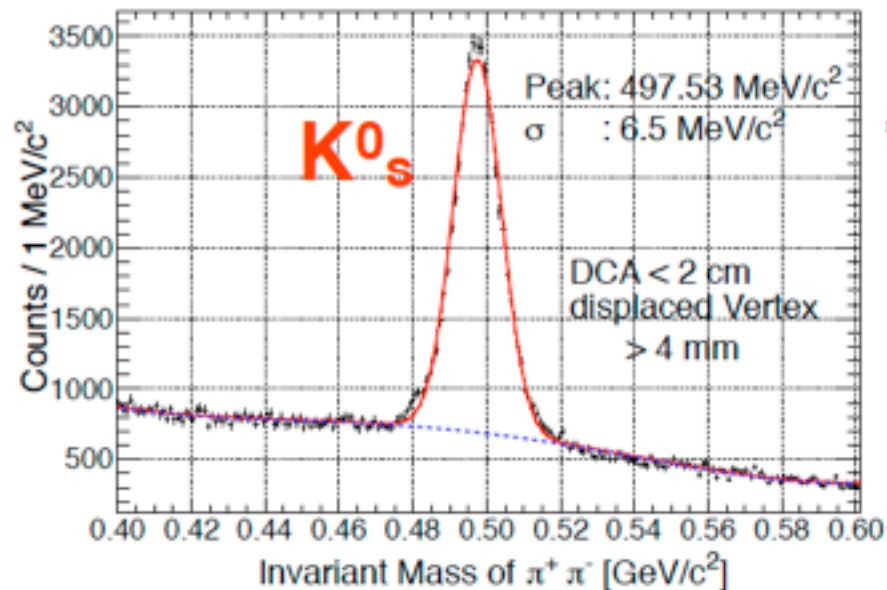
pid in CDS



$p\pi^-$ invariant-mass spectra



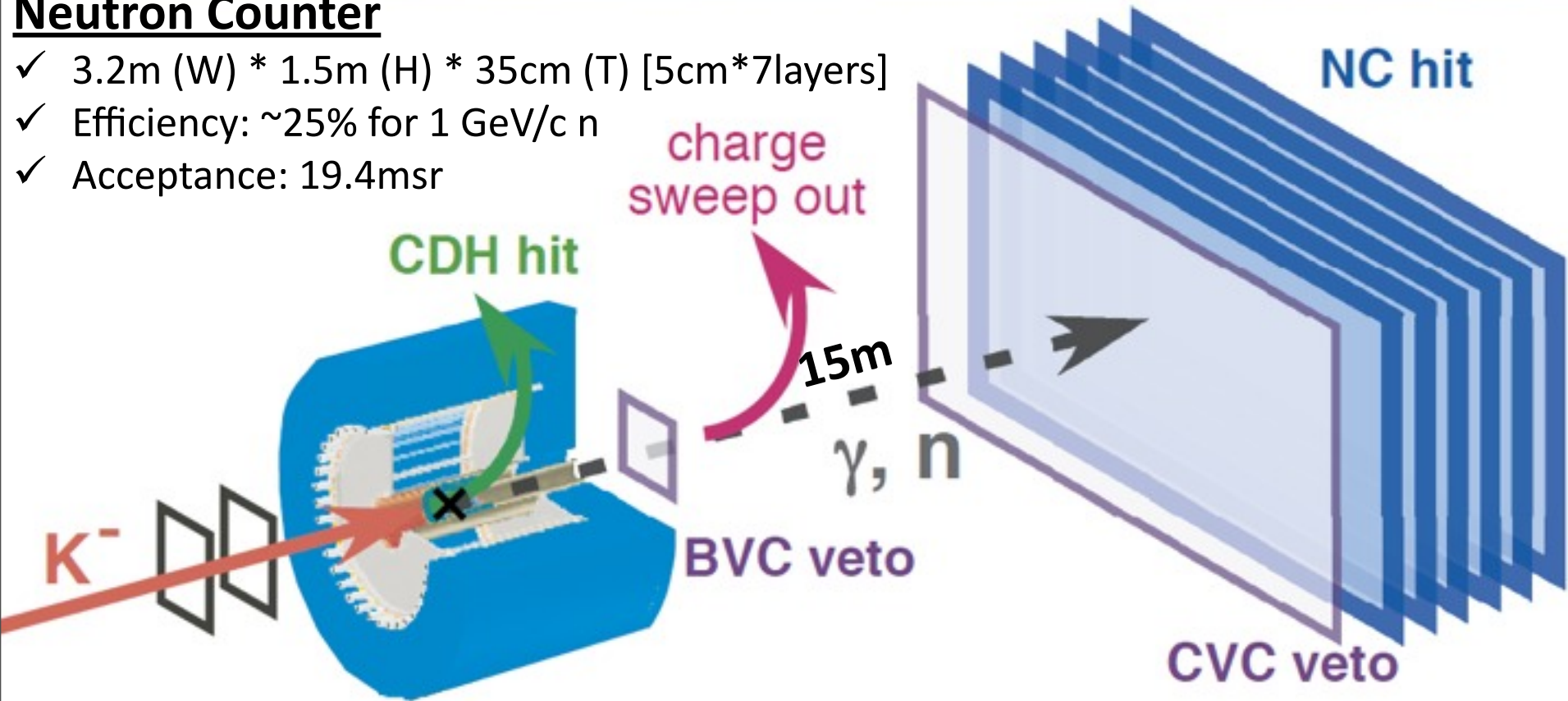
$\pi^+\pi^-$ invariant-mass spectra



Forward Neutral Particles

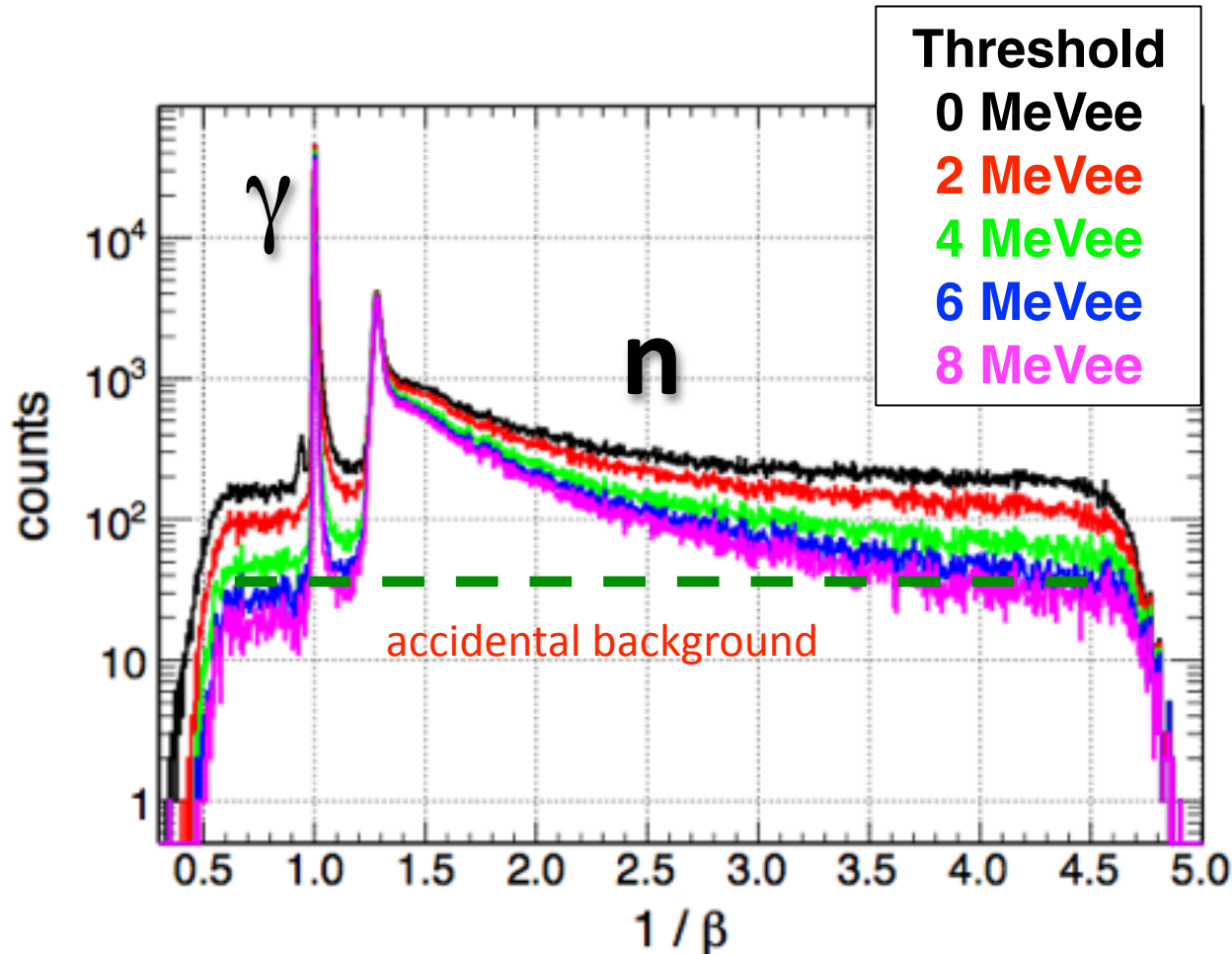
Neutron Counter

- ✓ 3.2m (W) * 1.5m (H) * 35cm (T) [5cm*7layers]
- ✓ Efficiency: ~25% for 1 GeV/c n
- ✓ Acceptance: 19.4msr



- ▶ Neutron momentum is determined by TOF method
- ▶ **require at least 1 track in CDC** to reconstruct the reaction vertex → flight length *energy-loss correction for K*

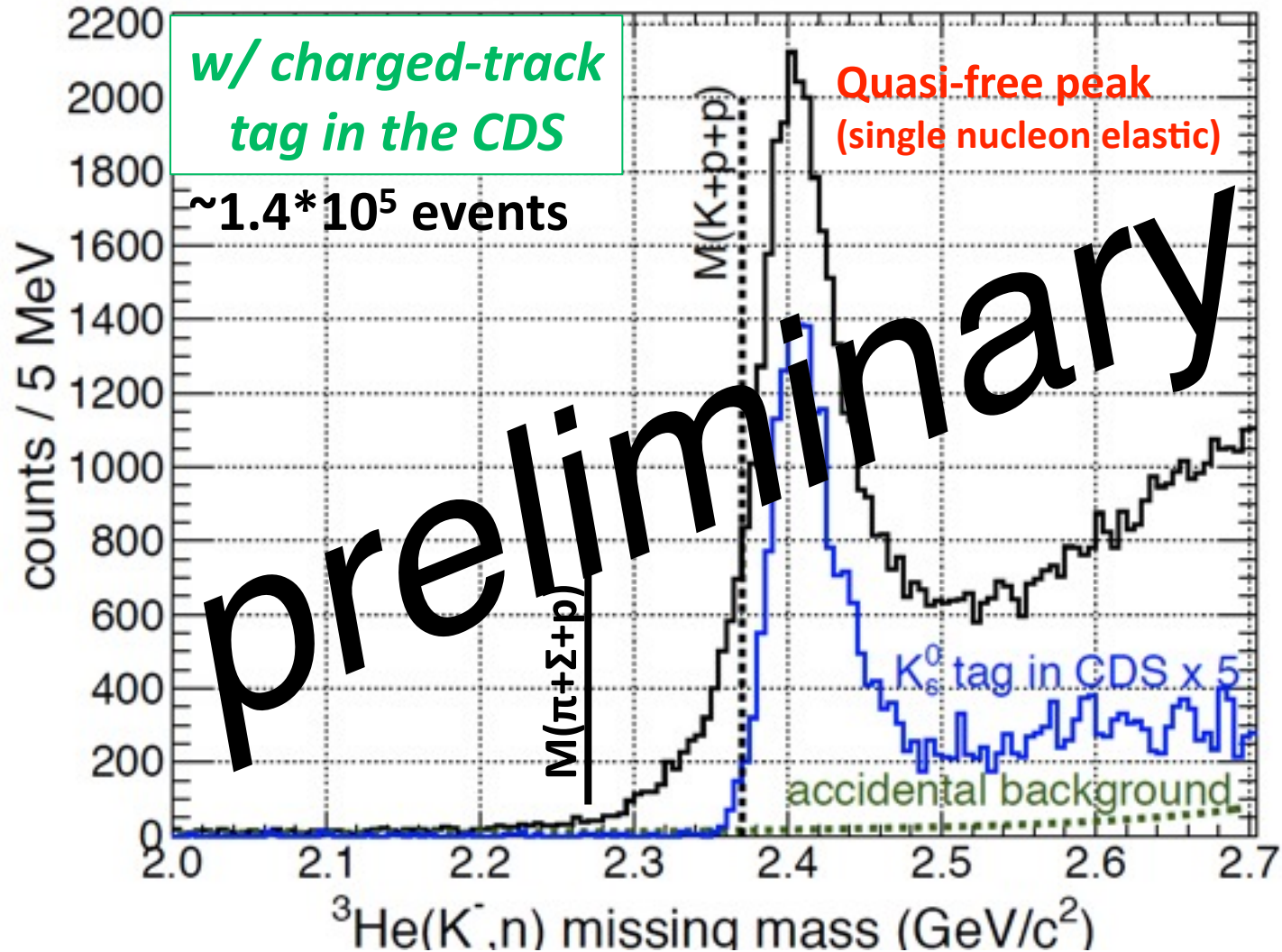
Forward Neutral Particles



- ✓ Set threshold to 5 MeVee
- ✓ good S/N ratio of ~ 100 @ QF neutron peak
- ✓ $\sigma_{\text{TOF}} \sim 160\text{ps} \rightarrow \sigma_{\text{M.M.}} \sim 10\text{MeV}/c^2 @ 1\text{GeV}/c$

Preliminary Result 1: ${}^3\text{He}(\text{K}^-, \text{n})$

Semi-inclusive ${}^3\text{He}(\text{K}^-, \text{n})$ $\sigma_{\text{M.M.}} \sim 10 \text{MeV}/c^2 @ 1 \text{GeV}/c$



Inclusive ${}^3\text{He}(K^-, n)X$ spectrum

(w/ charged particle in CDS)

Neutron events in sub-threshold region!

below K_{pp} ($= 2730.2 \text{ MeV}/c^2$)

beyond experimental resolution

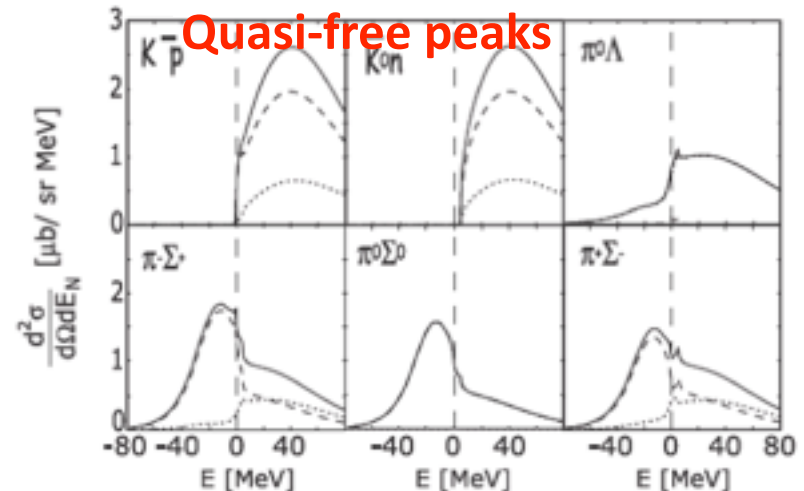
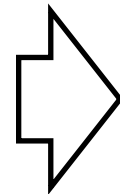
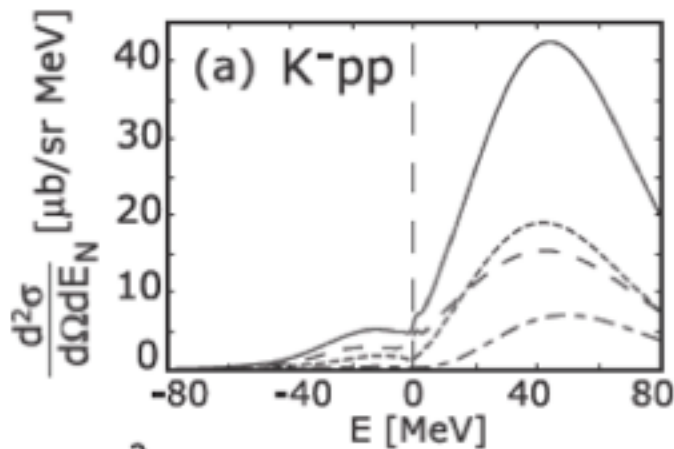
$\bar{K}N$ attraction / strong imaginary part exist



Exclusive analysis by specifying final state

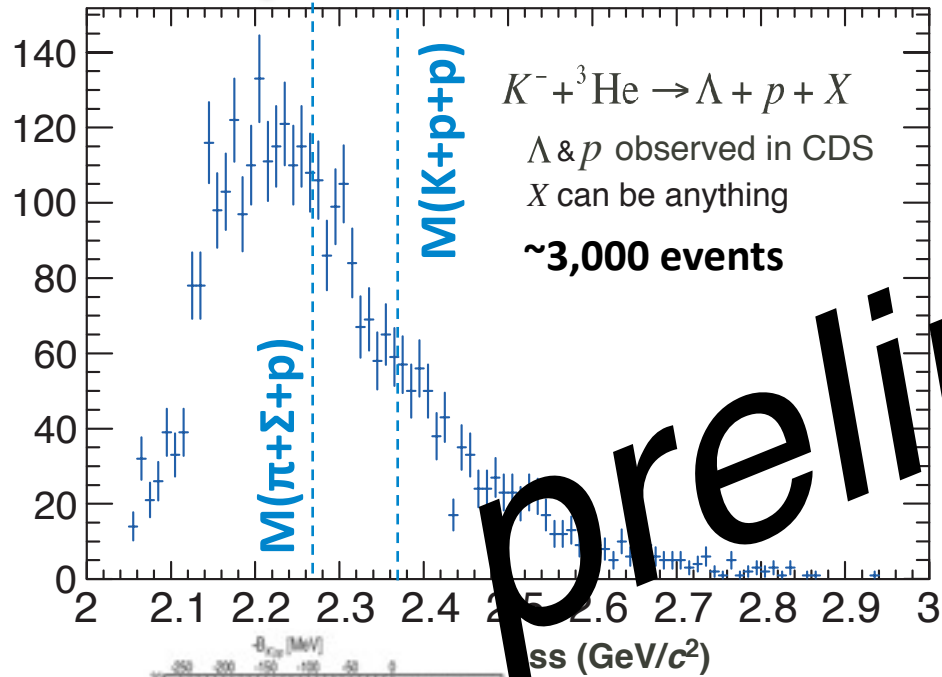
PHYS. REV. C **80**, 045204 (2009)

J. Yamagata-Sekihara, D. Jido, H. Nagahiro, and S. Hirenzaki

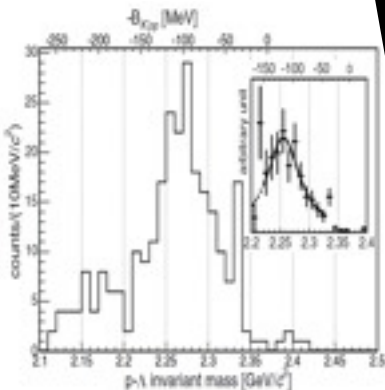
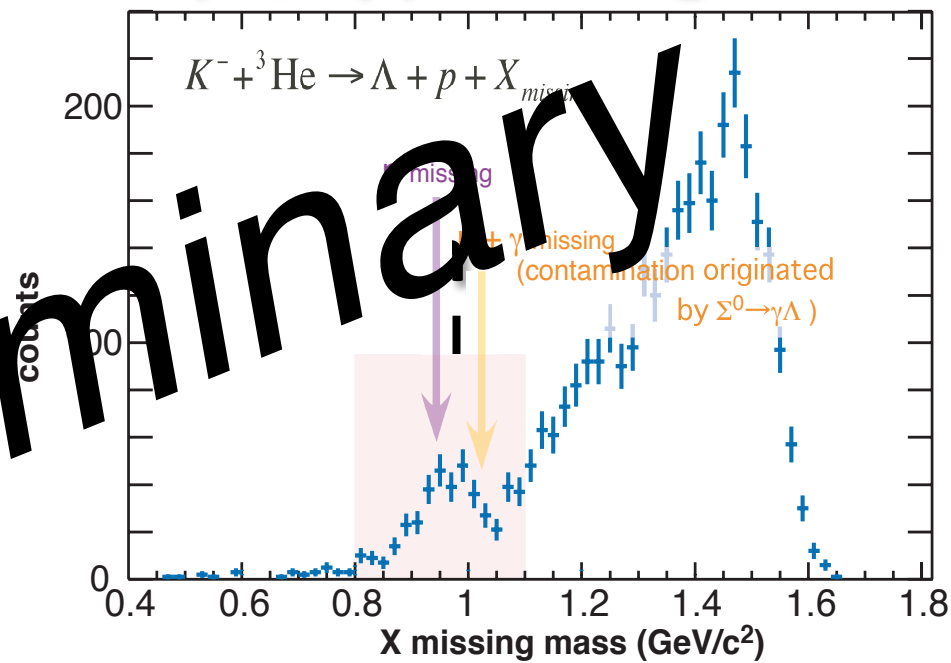


Preliminary Result 2: ${}^3\text{He}(K^-, \Lambda p)$

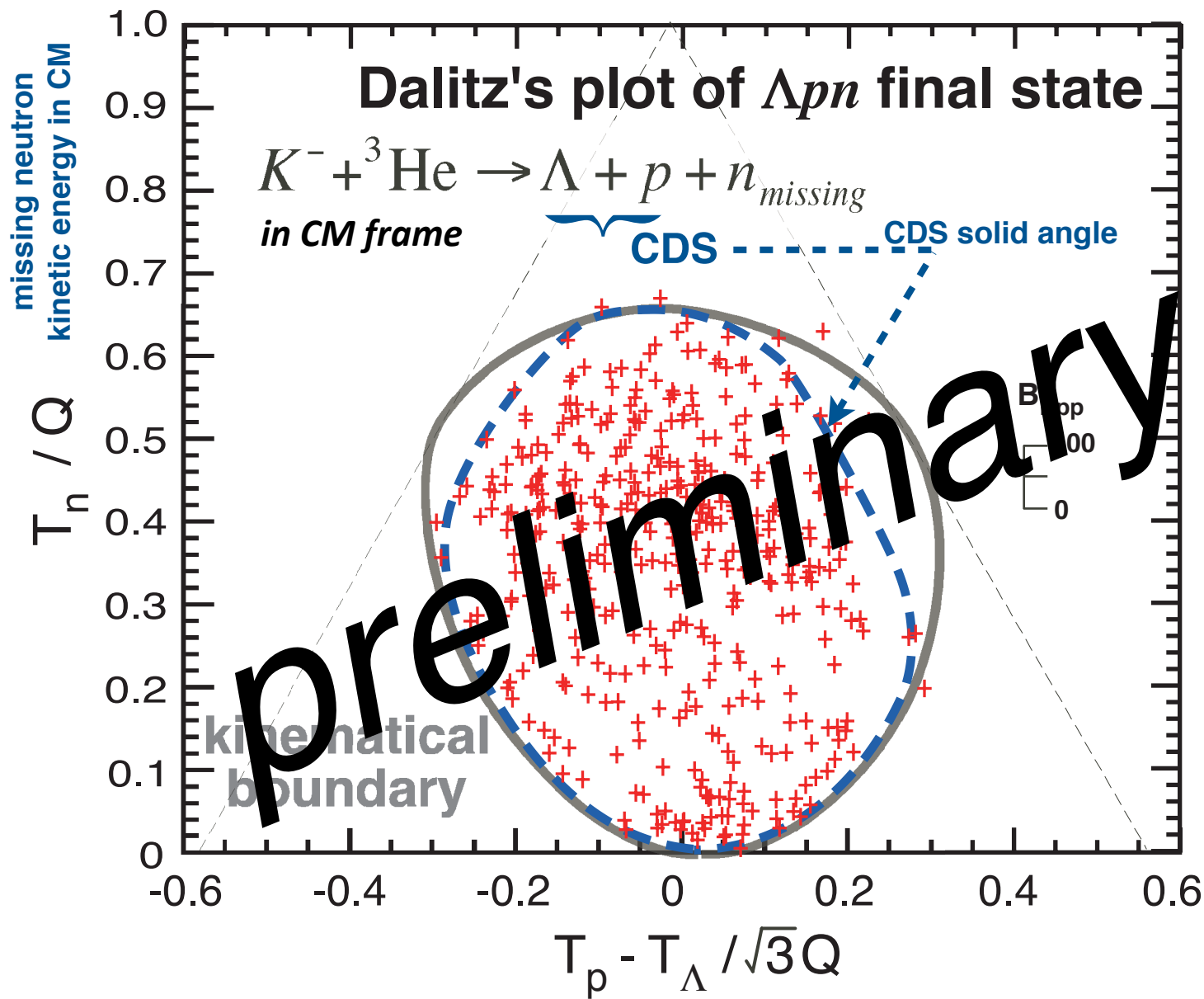
Λp invariant mass



${}^3\text{He}(K^-, \Lambda p)$ missing mass

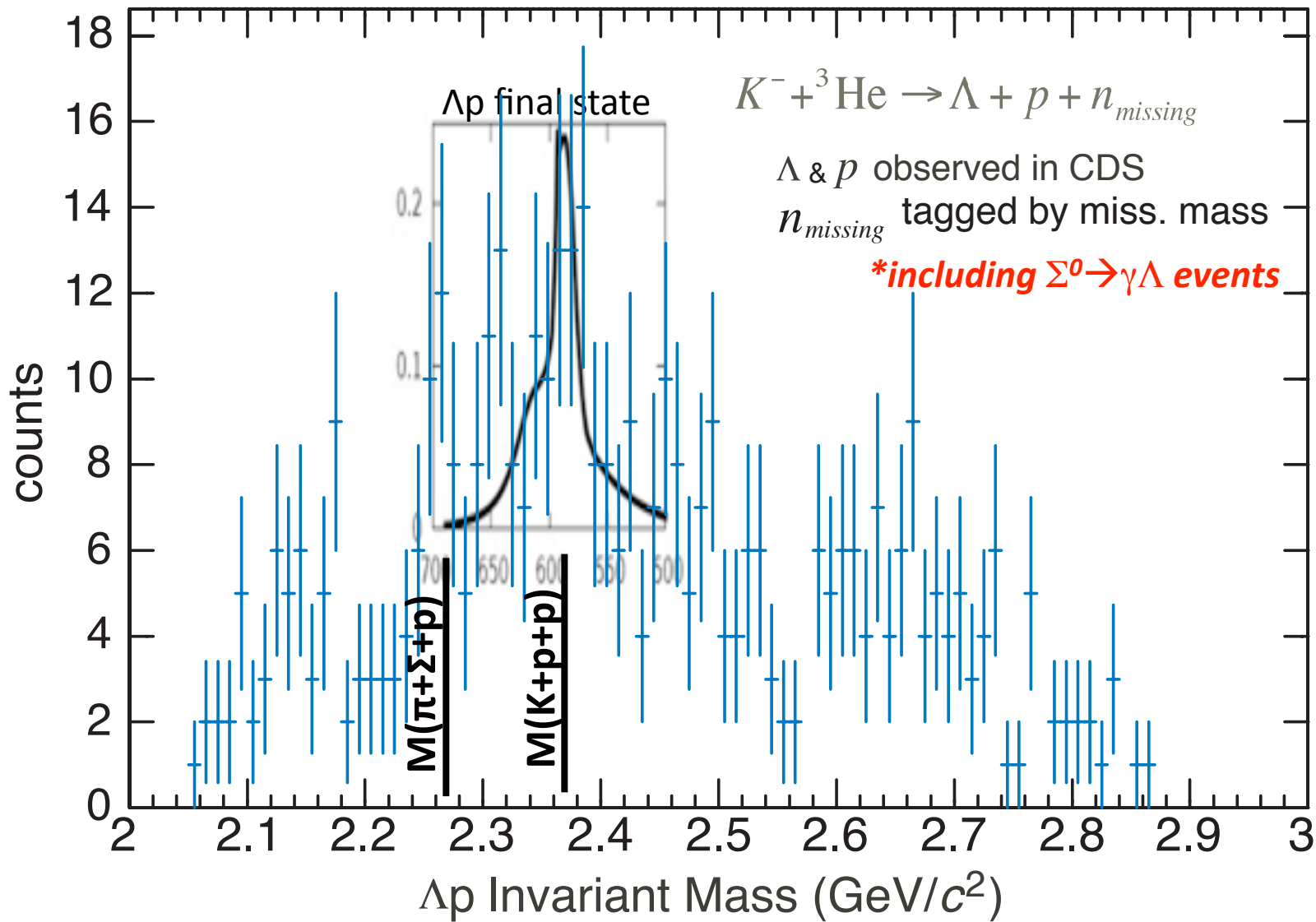


preliminary



preliminary

Λp invariant mass spectrum



Conclusion

Semi-inclusive n spectrum

${}^3\text{He}(\text{K}^-, \text{n})\text{X}$ missing mass obtained clearly

$\bar{\text{K}}\text{N}$ attraction / strong imaginary part exist

${}^3\text{He}(\text{K}^-, \text{p})\text{X}$ is in progress

Exclusive channel

${}^3\text{He}(\text{K}^-, \text{n})\Lambda \text{p}$ channel was examined

${}^3\text{He}(\text{K}^-, \text{n})\Sigma^\pm \pi^\mp \text{p}, \dots$ is in progress

Need substantially more statistics!

The J-PARC E15 Collaboration

<http://ag.riken.jp/J-PARC/collaboration/>

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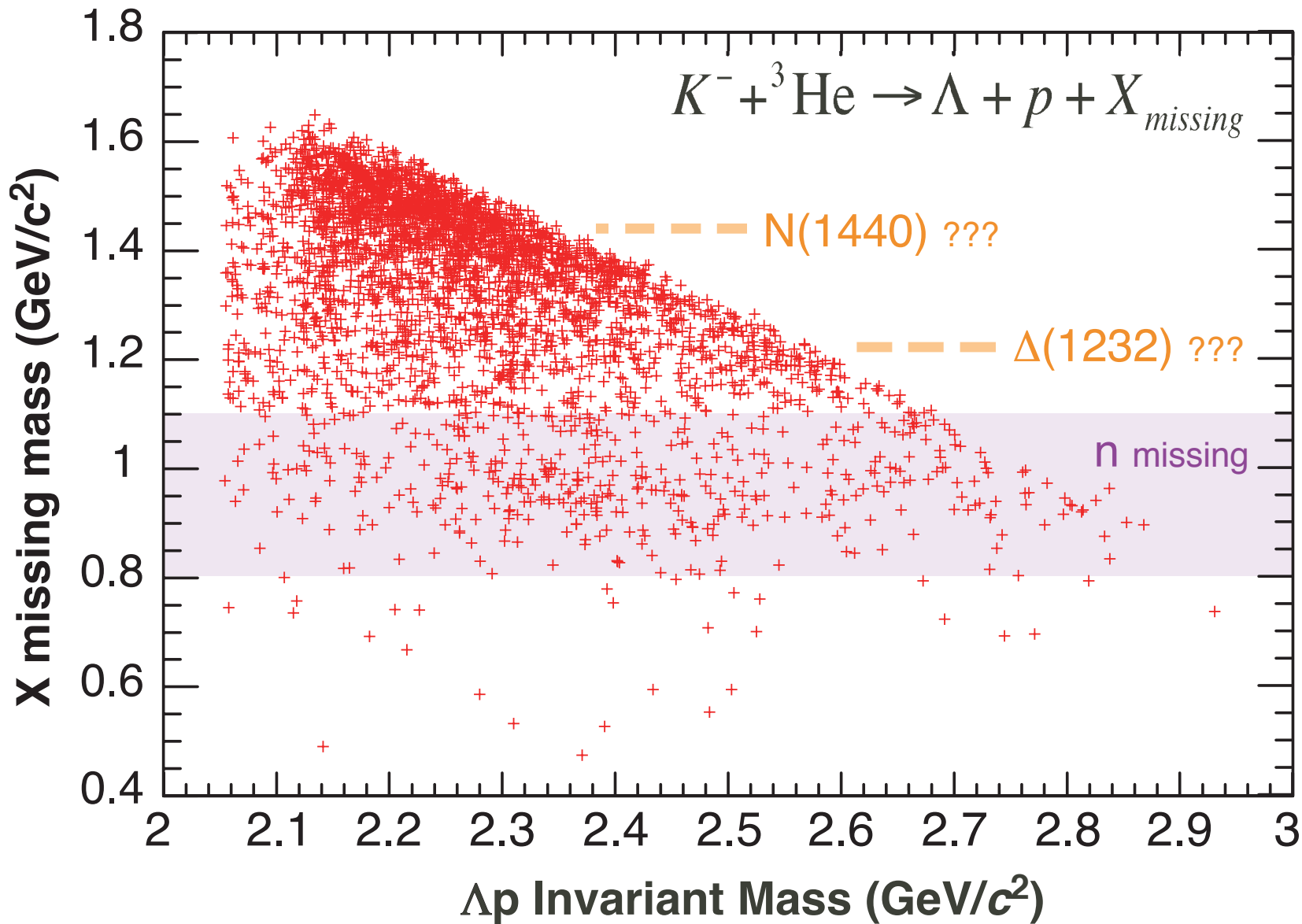
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(*) Spokesperson

(\$) Co-Spokesperson

Thank you !

backup



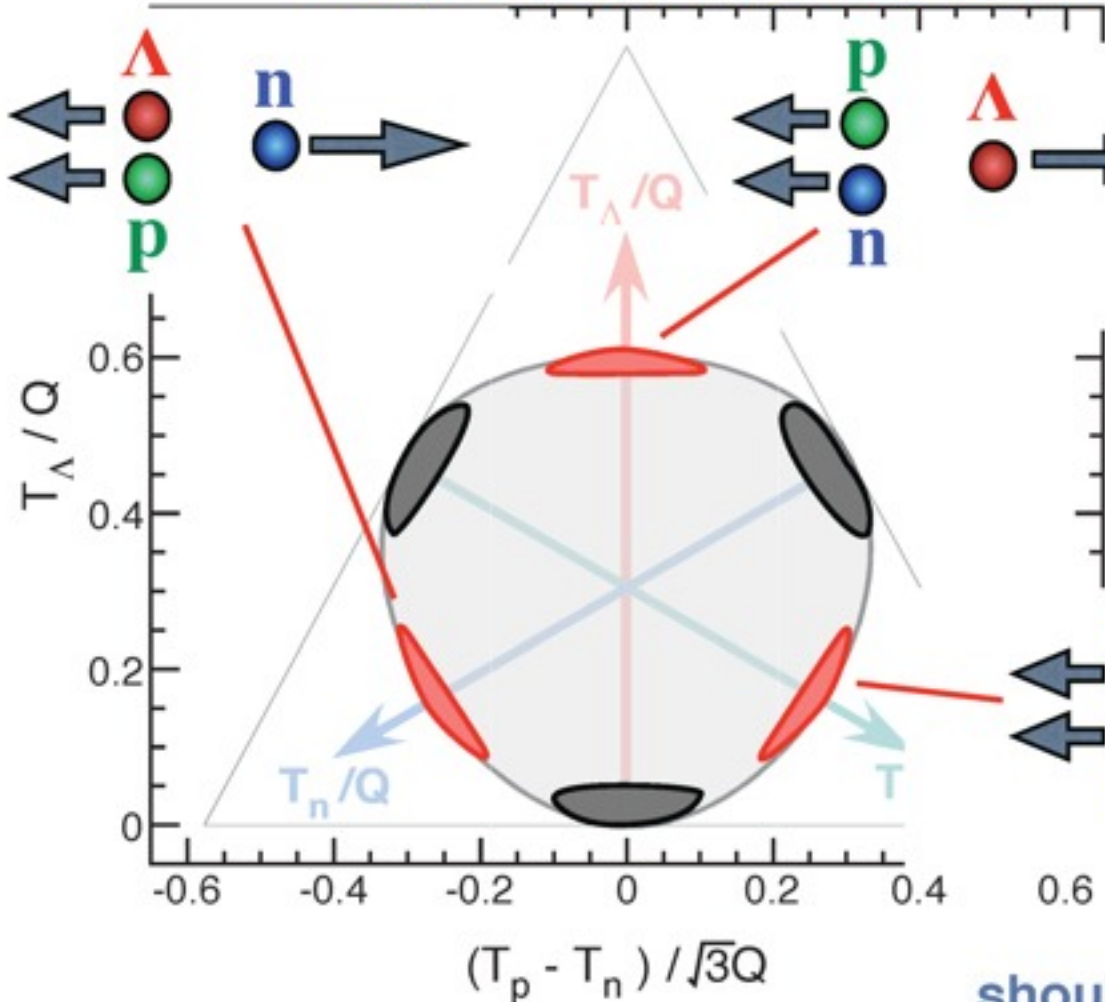


Λ pn events Two Nucleon Correlation

D. Gotta, et al, PL 112B, 129 (1982)

π absorption on ^3He at rest

3-body Phase Space (Dalitz's plot) at CM



Λ
 n
 p

two-nucleon correlation
can be studied
should be weak @ 1GeV/c, though