

J-PARC K1.8BRビームラインにおける 液体 ^3He 標的へのK-ビーム照射実験(I)

徳田 真 (東工大)

for E15 collaboration

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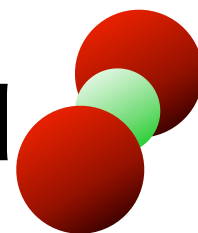
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(J-PARC E15 Collaboration)

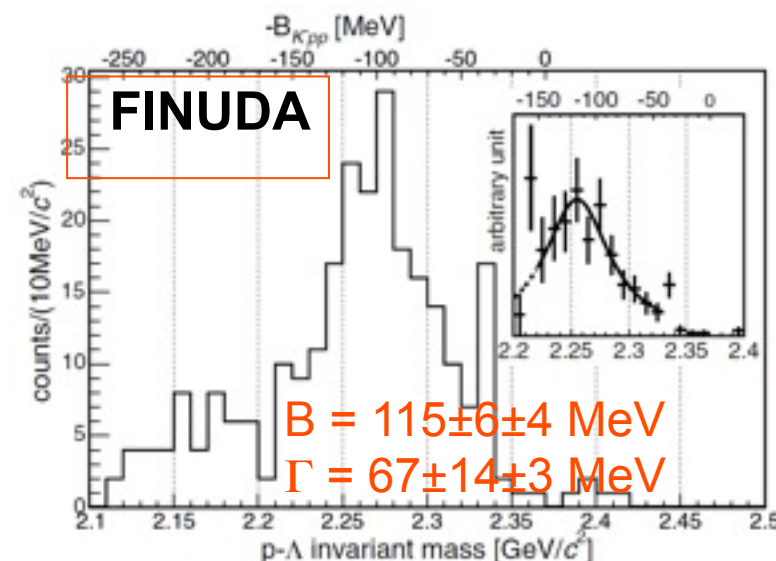
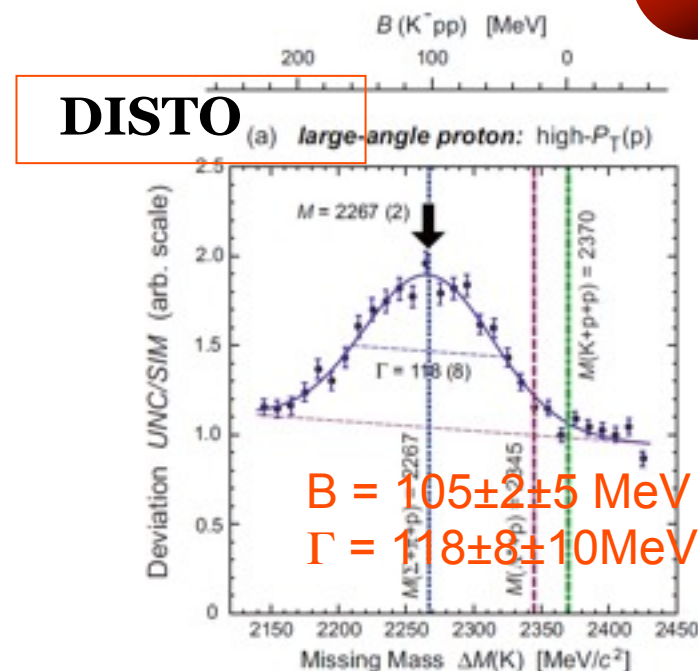
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The simplest kaonic nuclei $\bar{K}NN$



chiral & energy dependent	B.E.[MeV]	Γ [MeV]
N. Barnea, A. Gal, E.Z. Liverts(2012)	16	41
A. Dote, T. Hyodo, W. Weise(2008,09)	17-23	40-70
Y. Ikeda, H. Kamano, T. Sato(2010)	9-16	34-46
$\Lambda(1405)$ ansatz	B.E.[MeV]	Γ [MeV]
T. Yamazaki, Y. Akaishi(2002)	48	61
N.V. Shevchenko, A. Gal, J. Mares(2007)	50-70	90-110
Y. Ikeda, T. Sato (2007,2009)	60-95	45-80
S. Wycech, A.M. Green (2009)	40-80	40-85

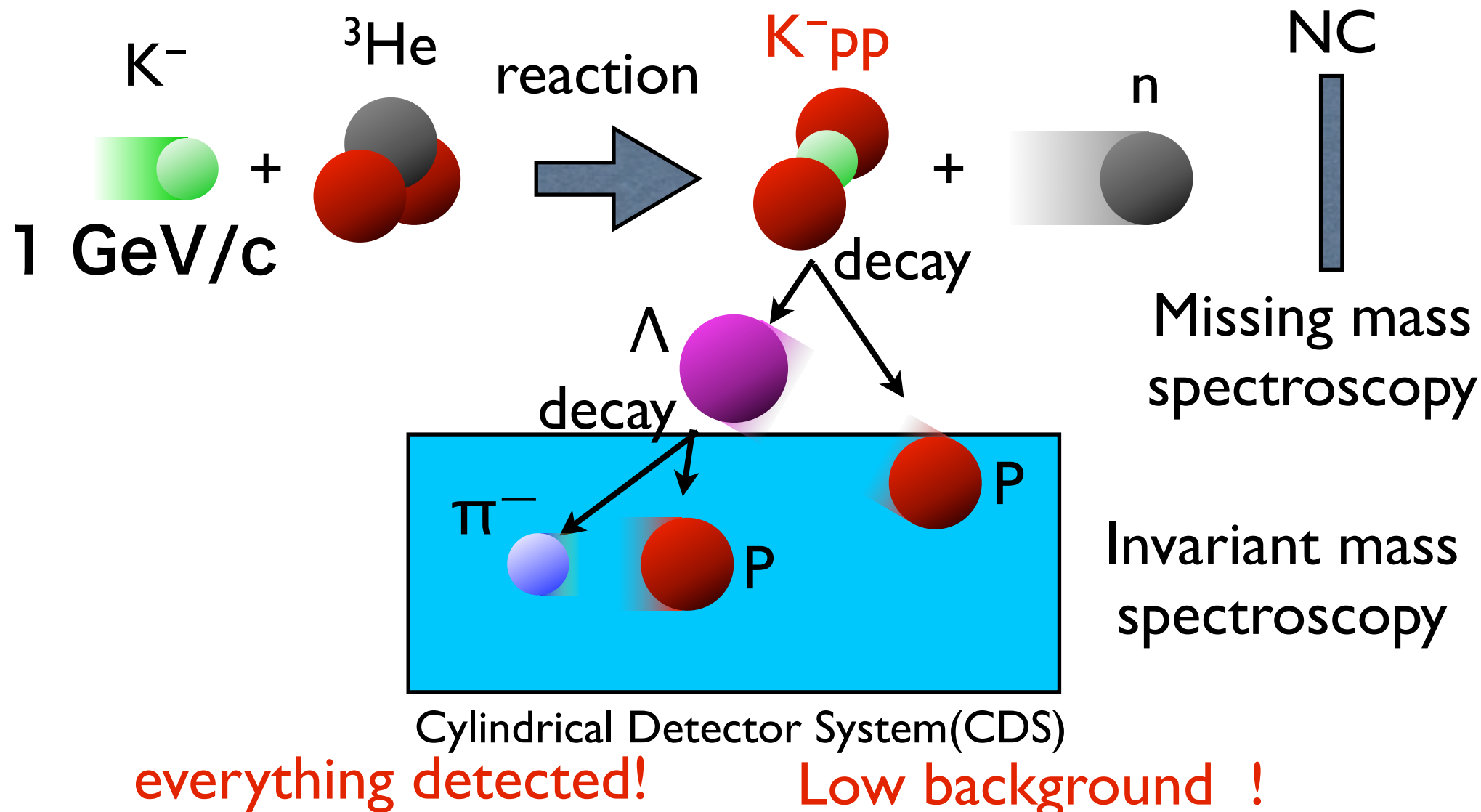
- Many theoretical calculations
- Little experimental information
- bound or not? B.E. and width?



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J-PARC E15 experiment

A search for the simplest kaonic nucleus K^-pp



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J-PARC E15 1st stage physics run

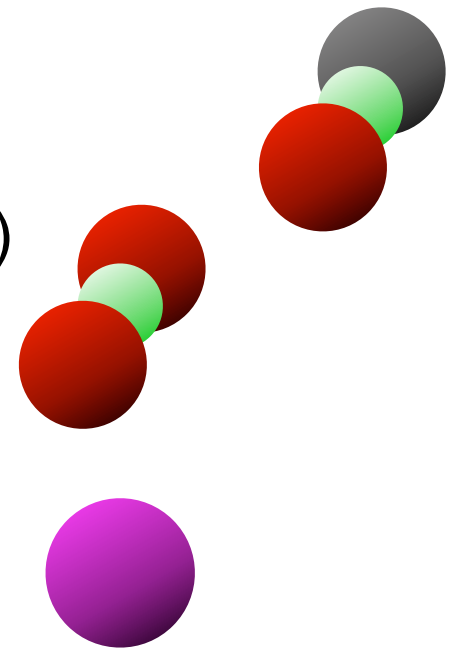
- Accumulated data
 - w/ liquid helium-3 target: ~1% of original proposal

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

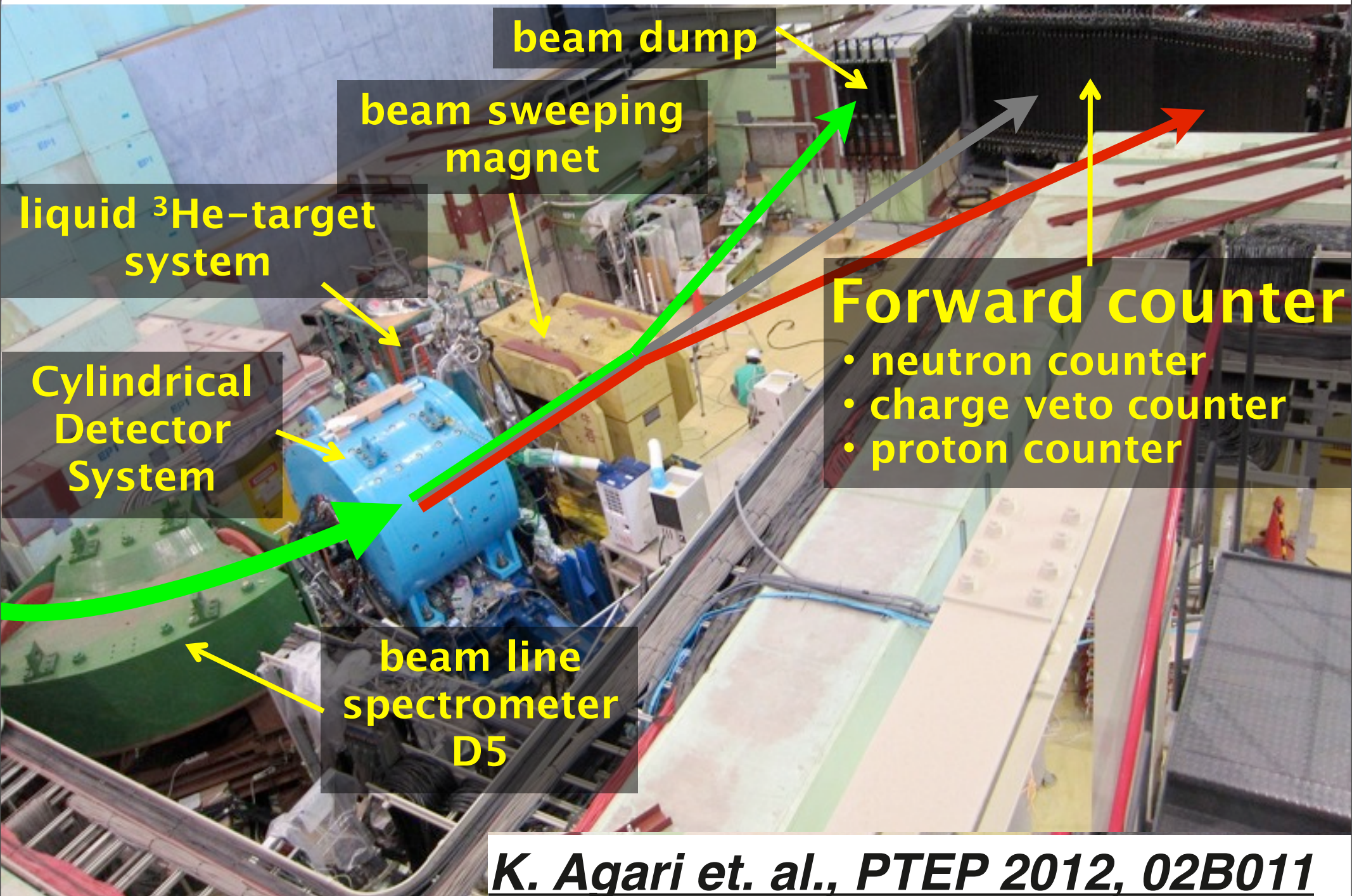
production target: Au 50% loss, spill length: ~2s, spill duty factor: ~45%

- We will present in this continuation

- E15 setup & $^3\text{He}(\text{K}^-, \text{p})$ (this talk)
- $^3\text{He}(\text{K}^-, \text{n})$ semi-inclusive (Hashimoto)
- $^3\text{He}(\text{K}^-, \Lambda\text{p}/\Lambda\text{pn})$ (Sada)
- hyperon production (Enomoto)
- $^3\text{He}(\text{K}^-, \text{d})$ (Inoue)

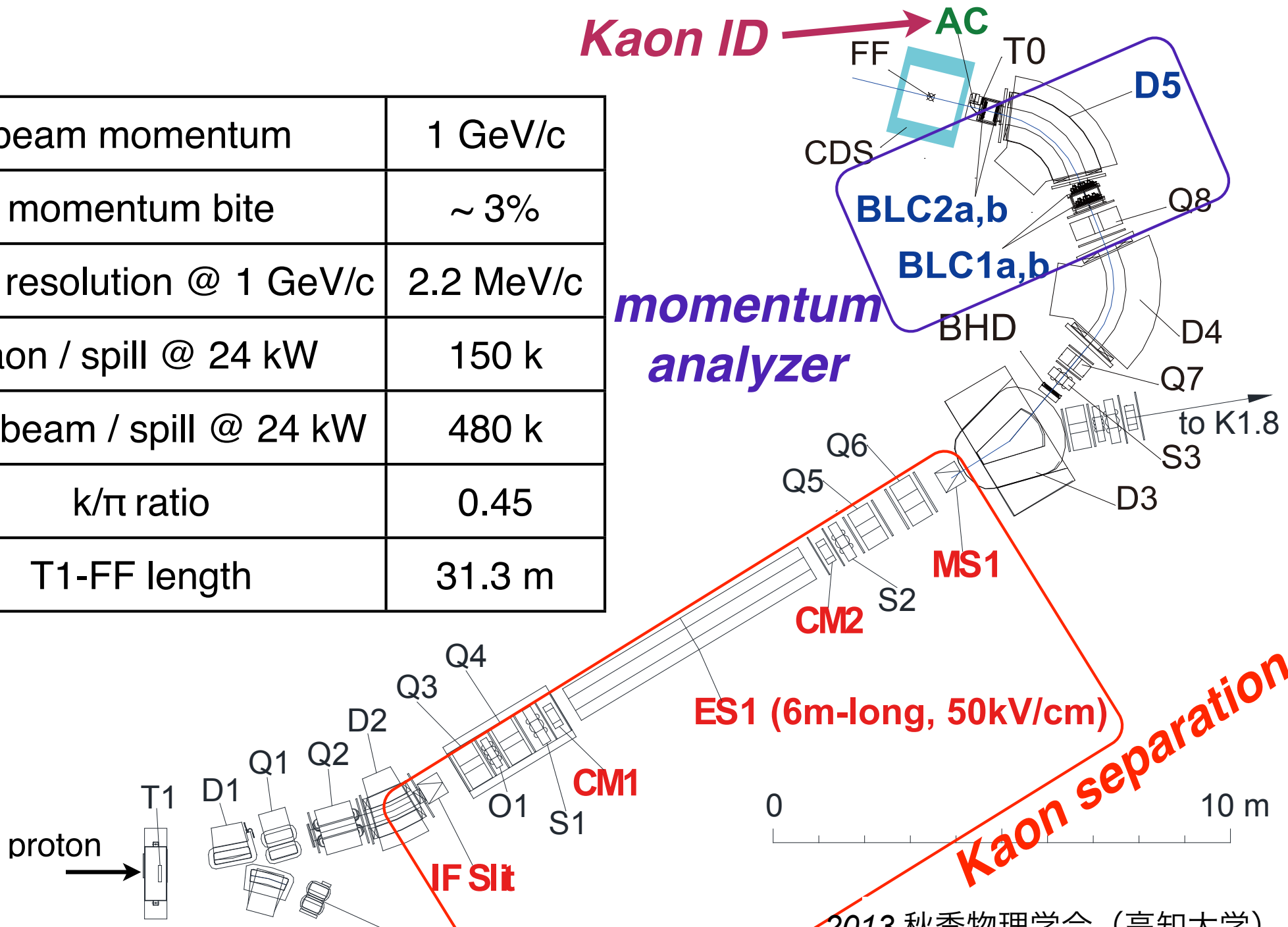


the J-PARC K1.8BR spectrometer



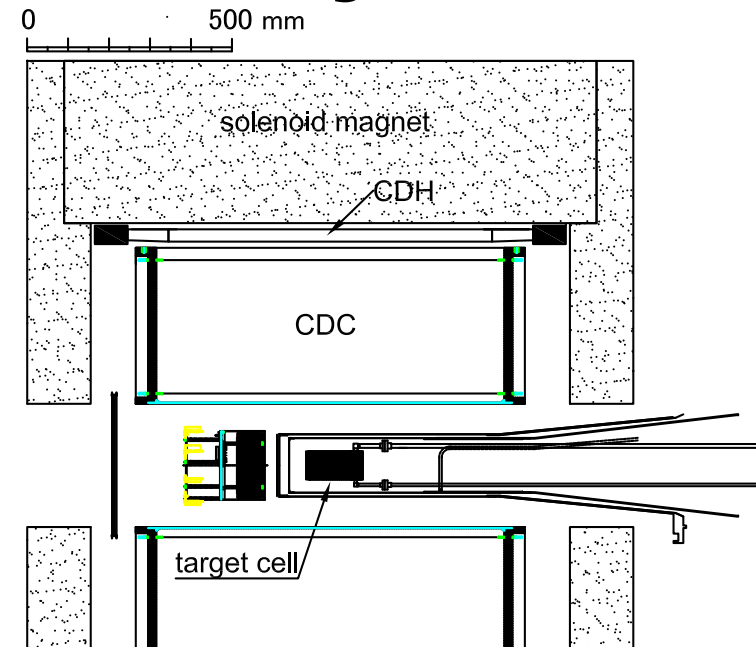
Kaon beam quality at J-PARC K1.8BR

beam momentum	1 GeV/c
momentum bite	$\sim 3\%$
mom resolution @ 1 GeV/c	2.2 MeV/c
kaon / spill @ 24 kW	150 k
total beam / spill @ 24 kW	480 k
k/ π ratio	0.45
T1-FF length	31.3 m



Cylindrical Detector System

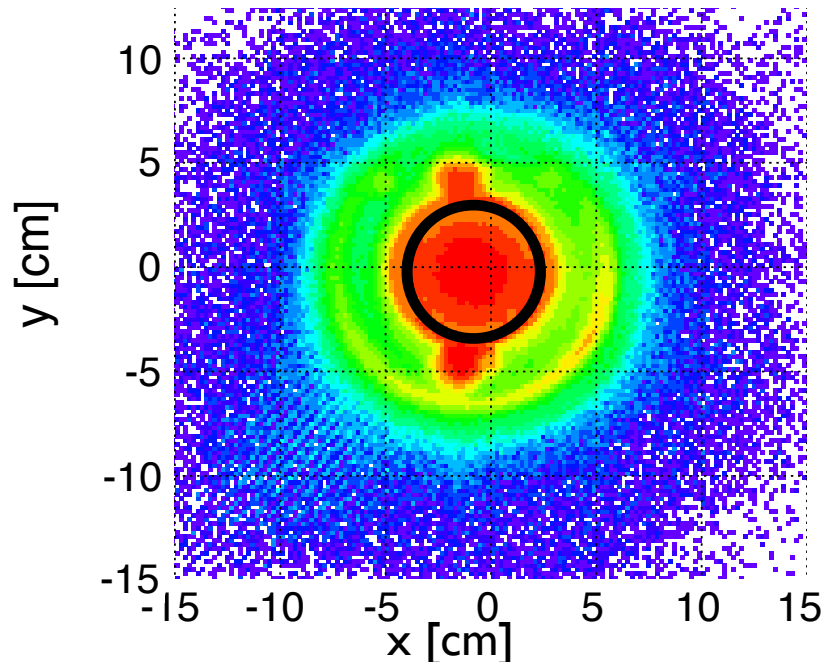
- **CDC (15 layers 1816 ch)**
- **CDH (36 seg)**
 - **cover 60% of the solid angle.**



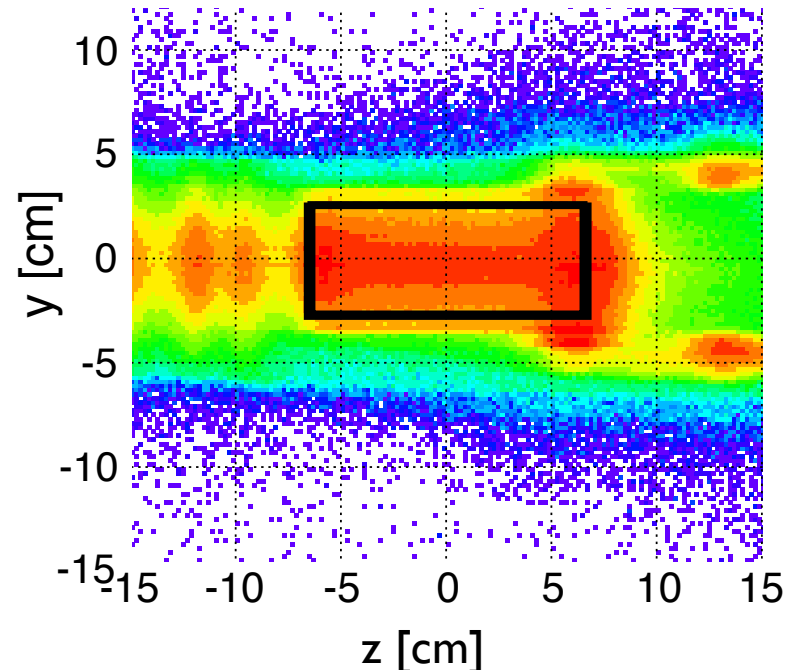
Target selection

vertex distribution between incoming K & a charged particle in CDS

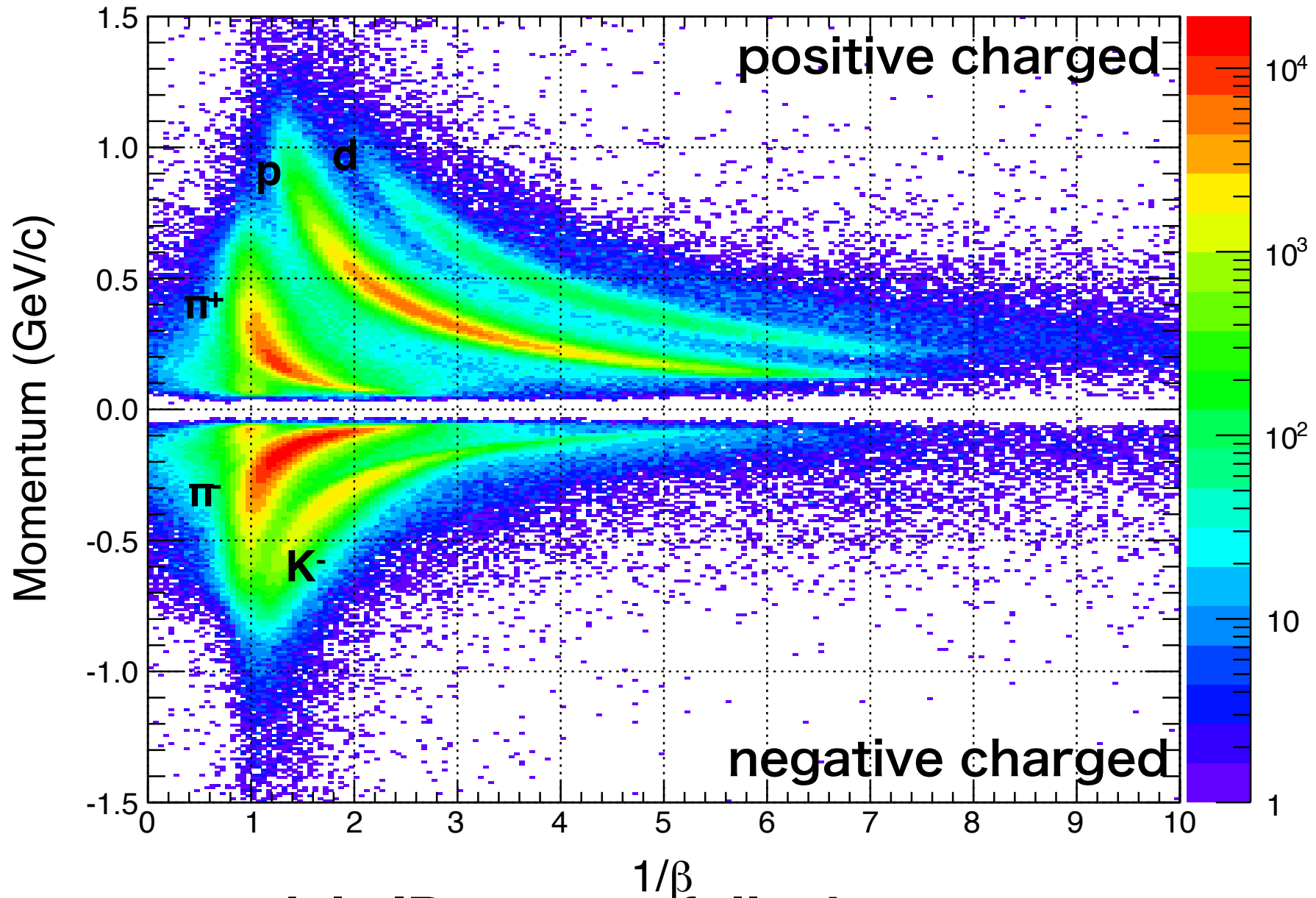
viewed from upstream



side view

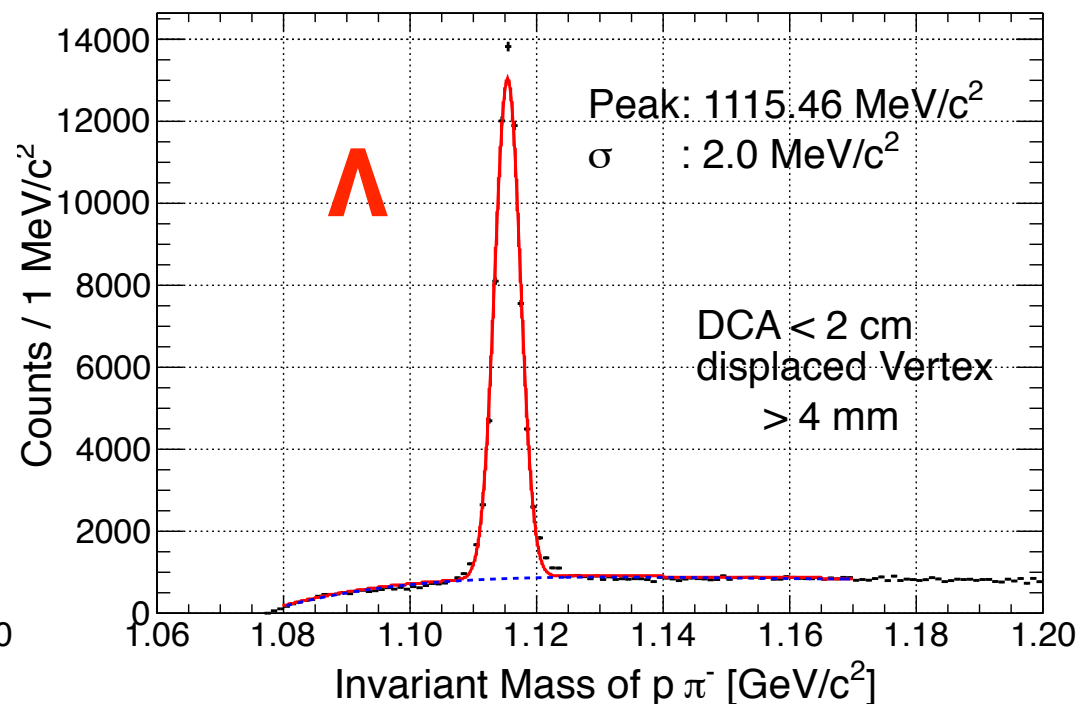
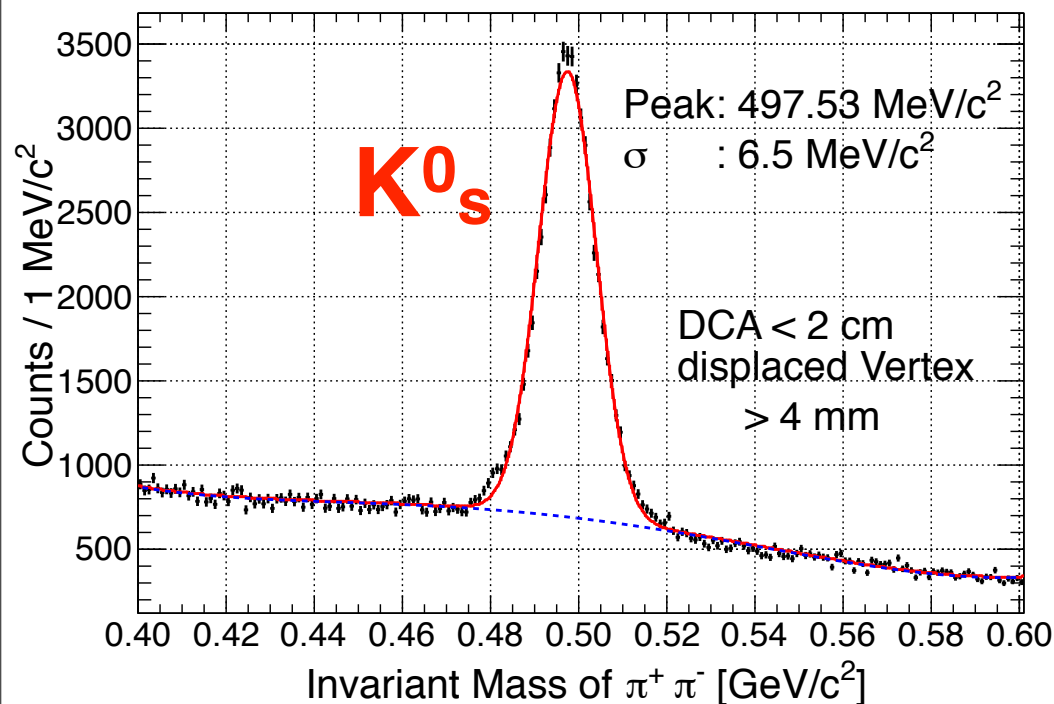


Cylindrical Detector System



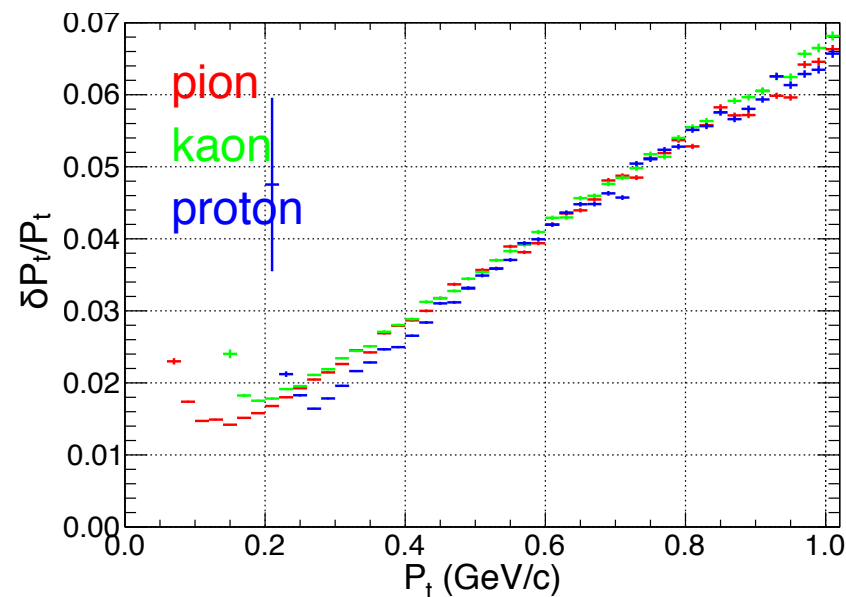
- **particle ID successfully done.**
 - **Kaon elastic event, deuterons are seen.**

Cylindrical Detector System



Design performance was achieved

- Peak positions are consistent with PDG value
- Vertex resolution: ~ 2mm in x & y, ~ 5mm in z
- ~ 10 MeV/c² resolution for Λp invariant mass

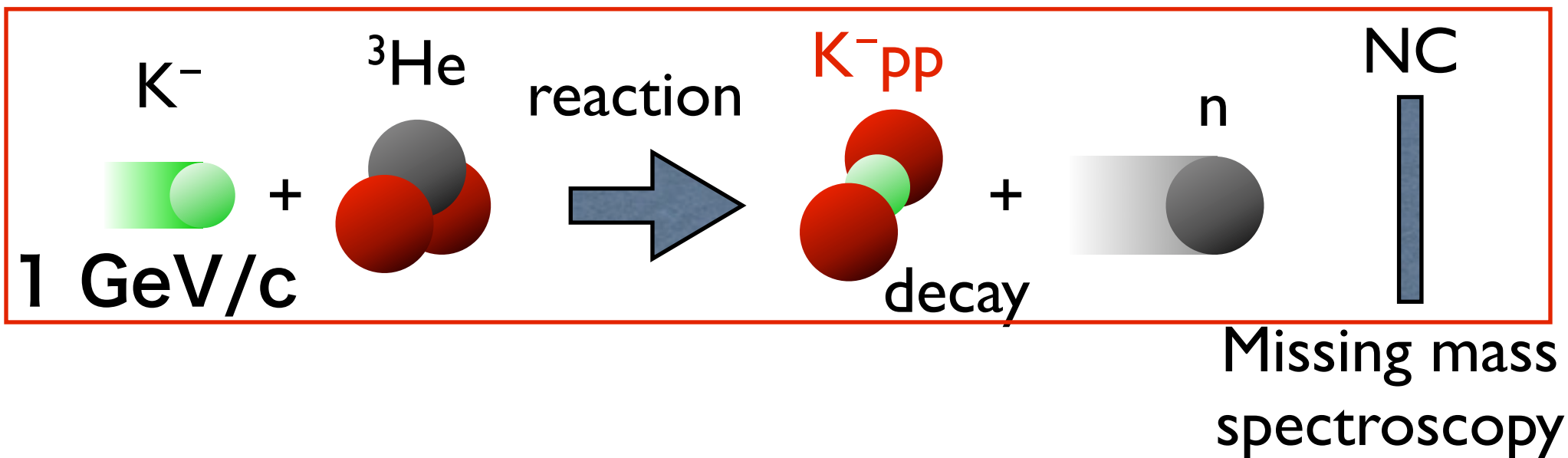


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Forward charged particle

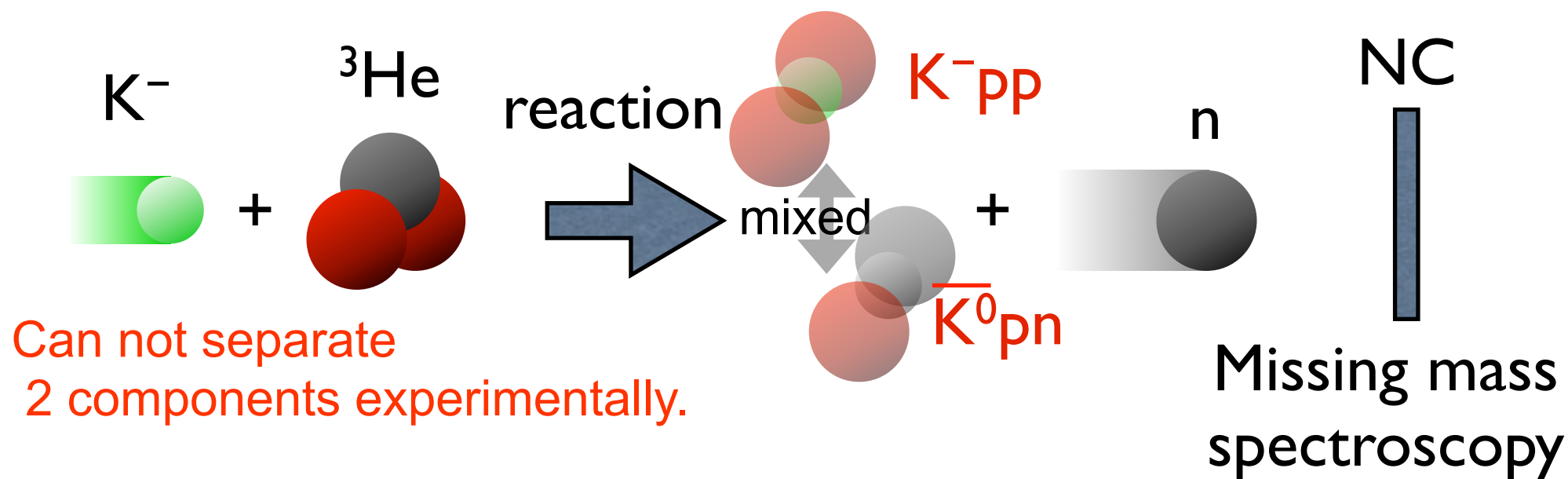
J-PARC E15 experiment

A search for the simplest kaonic nucleus K^-pp



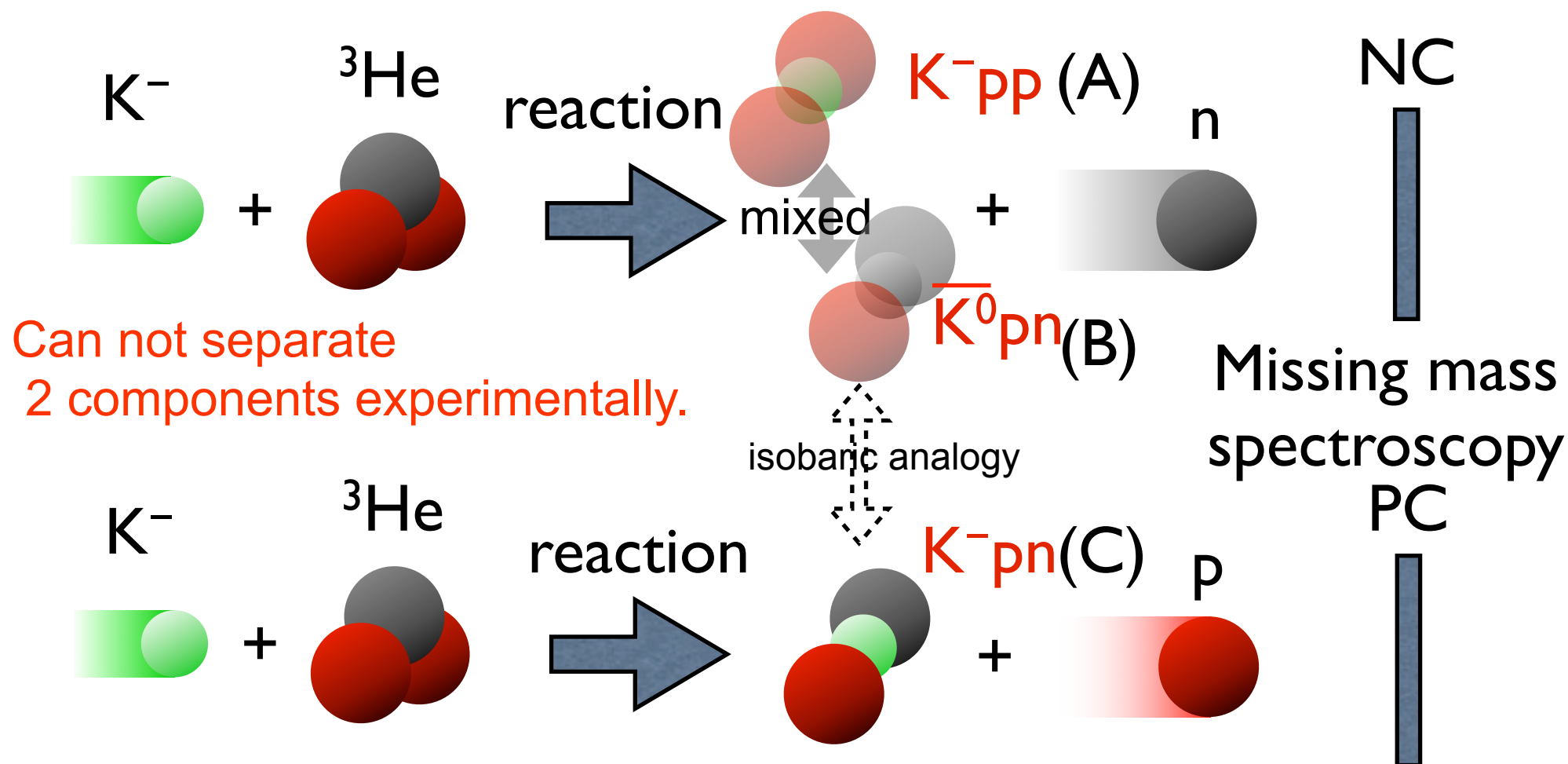
J-PARC E15 experiment

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J-PARC E15 experiment

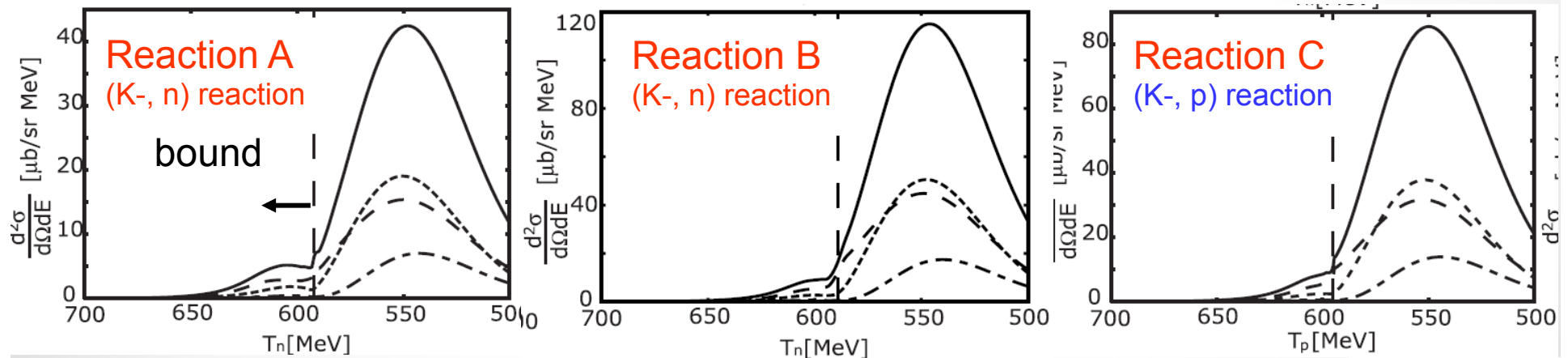
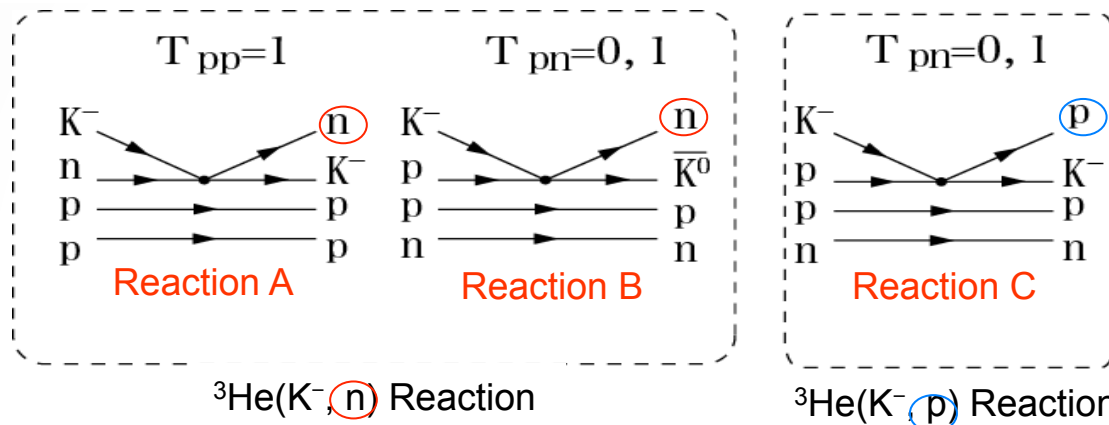
A search for the simplest kaonic nucleus K^-pp



To compare with both ${}^3\text{He}(K^-, n/p)$ reactions,
We can get the information of isospin dependence of reactions.

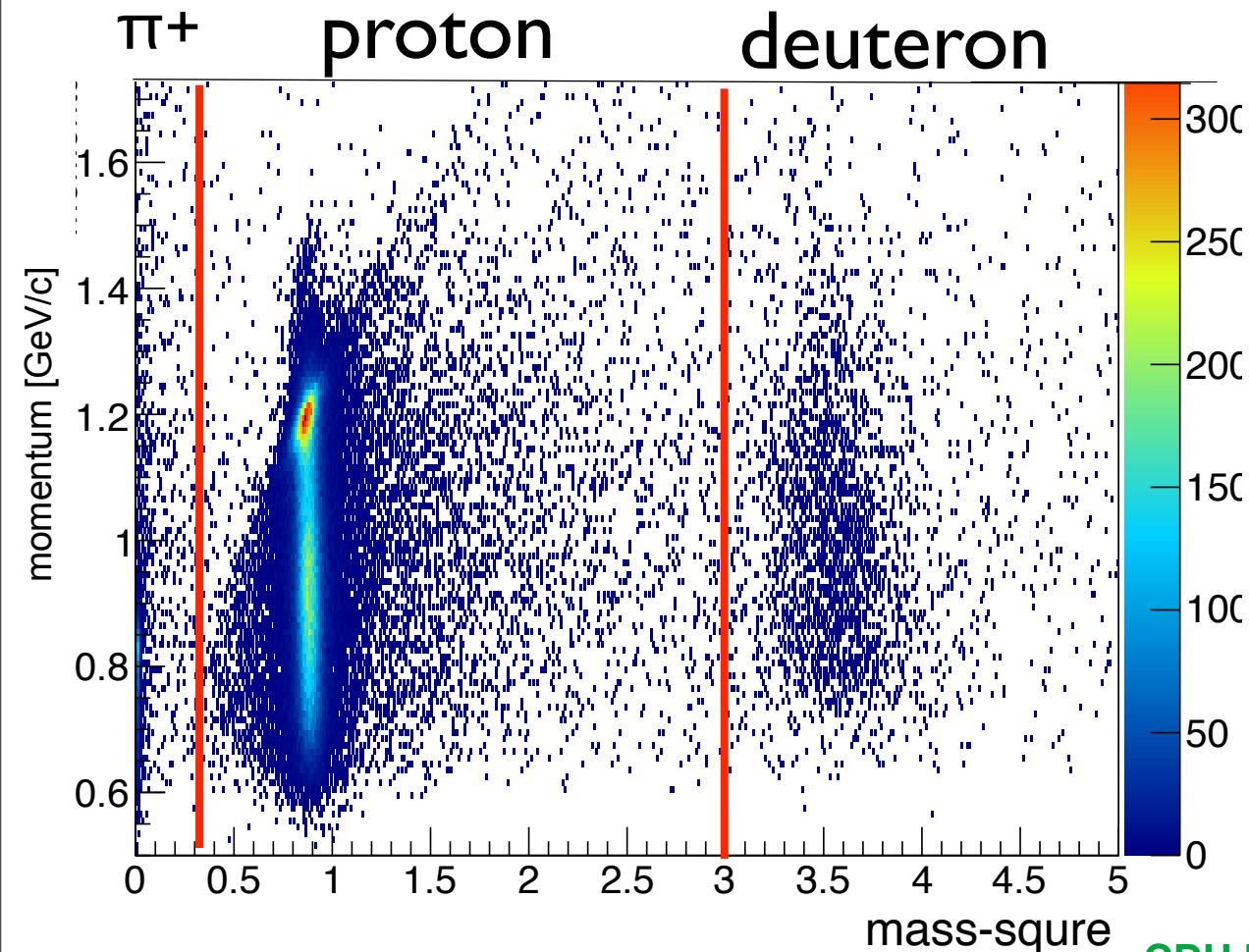
Theoretical calculation on ${}^3\text{He}(\text{K}^-, \text{p}/\text{n})$

Calculation of $(\text{K}^-, \text{n}/\text{p})\bar{\text{K}}\text{NN}$ missing mass spectrum



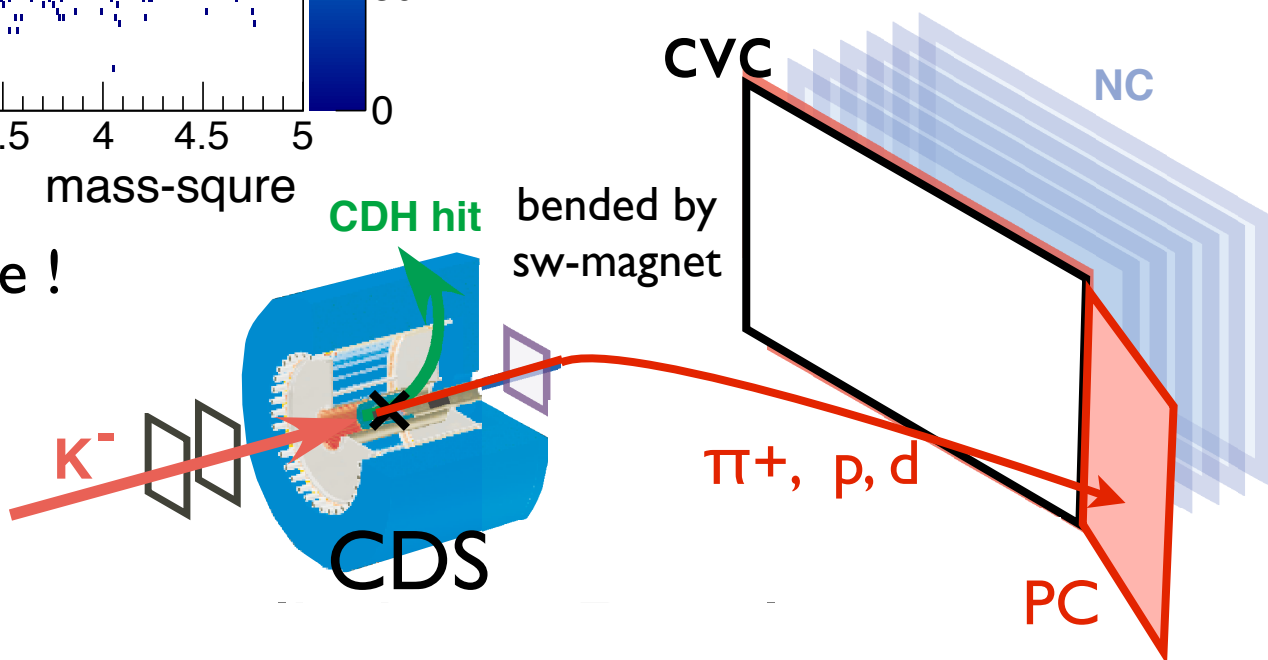
J. Yamagata-Sekihara, D. Jido, H. Nagahiro, and S. Hirenzaki.,
Phys. Rev. C80, 045204 (2009)

Forward Charged particle



particle ID successfully done !

*require 1 charged track
to determine the vertex*



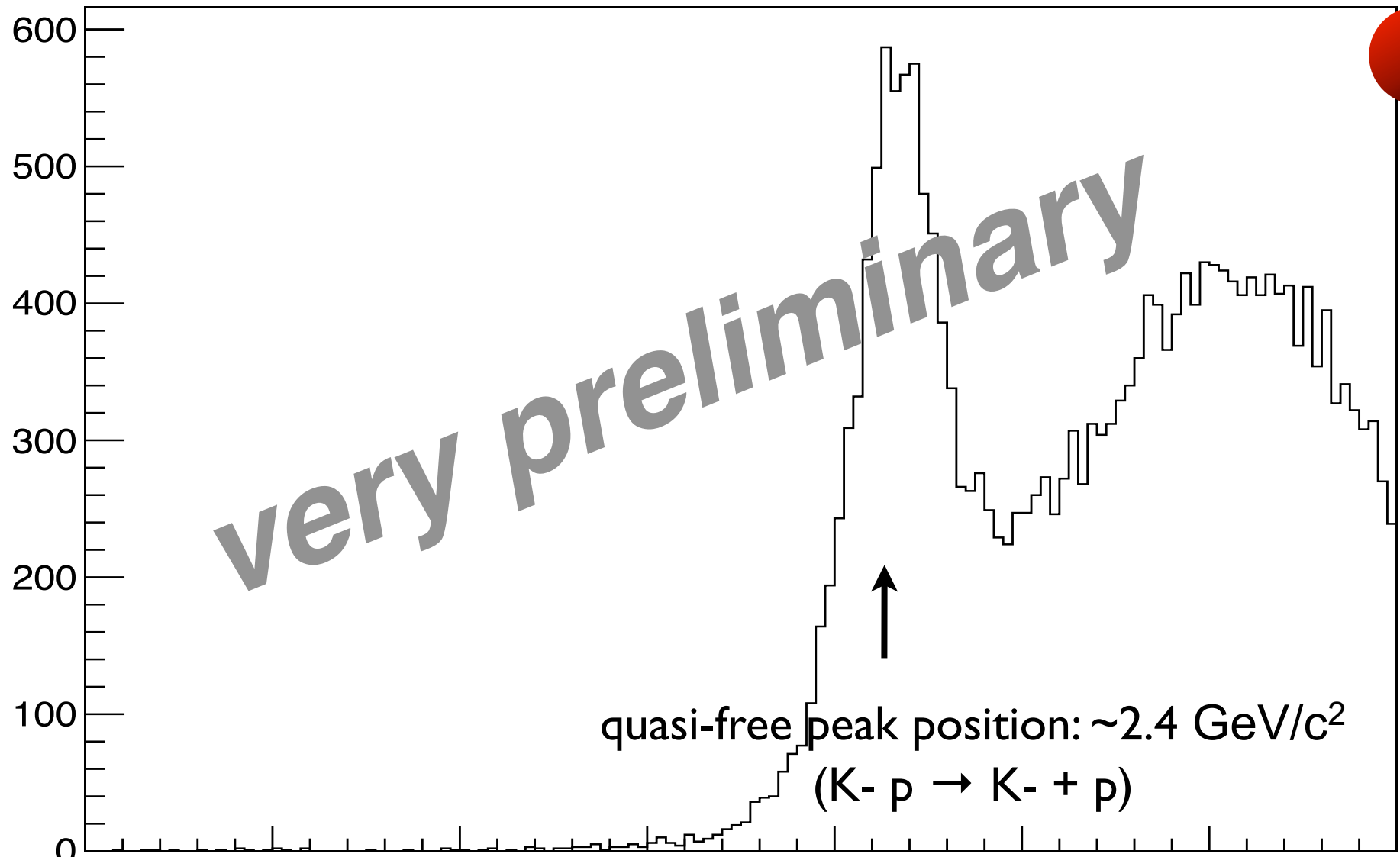
Bending Magnet

- used in KEK π^2 beam line
- aperture: 82cm(H)*40cm(V)
- pole length: 70cm
- 1.0T operation

Proton Counter

- w 2.7 m x H1.5 m
- T 3cm
- 27 seg

Inclusive proton spectrum at forward angle



Missing Mass $^3\text{He}(K^-, p)$ [work in progress]

quasi-free reaction ($K^- p \rightarrow K^- p$) has been clearly seen in the spectra

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Summary

- We have performed J-PARC E15 1st stage physics run to search for the K^-pp bound state.
- **$\sim 5 \times 10^9$ kaons on ^3He .**
- **We achieved designed resolution of CDS**
- Forward charged particle
 - **$^3\text{He}(K^-,p)X$ missing mass spectrum is presented**
 - **Single nucleon elastic reaction on ^3He target is clearly seen**