Status Report of E15

M.Iwasaki

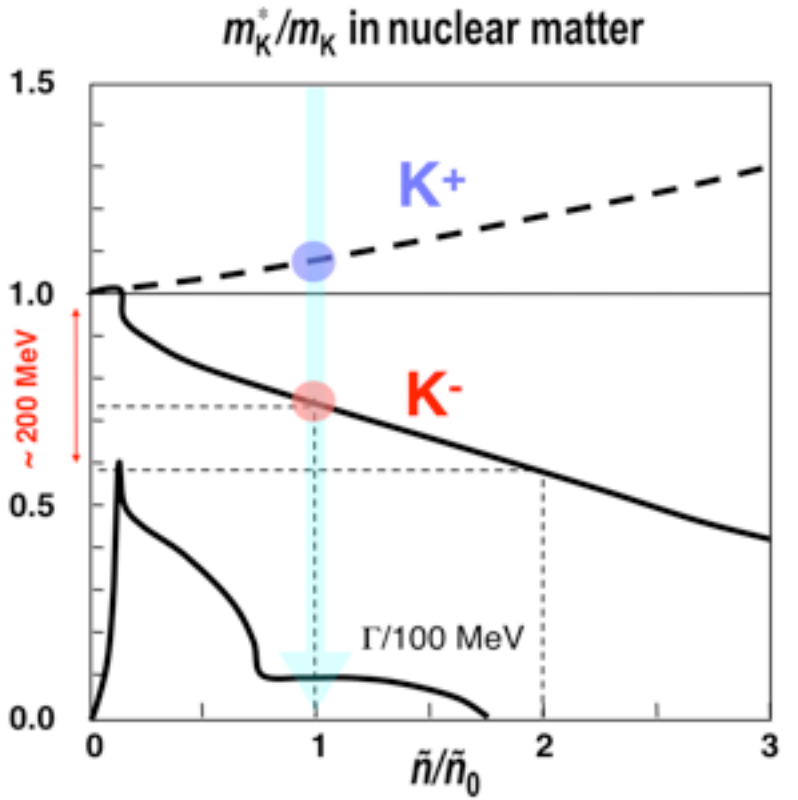
for J-PARC E15 Collaboration

- Introduction
- E15 experiment
- Status of E15
- Results of Run#40 and Run#43
- Beam time request & expected results
- Conclusion

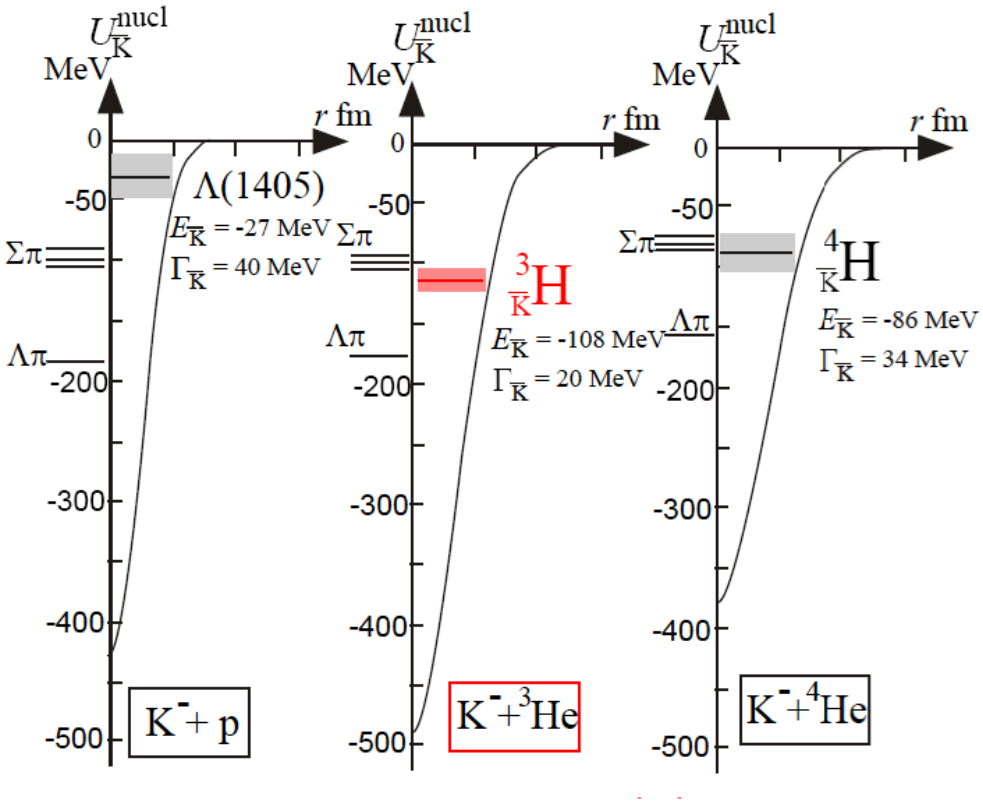
Embedding K^- in nucleus

Motivation of J-PARC E15

~ J-PARC E27

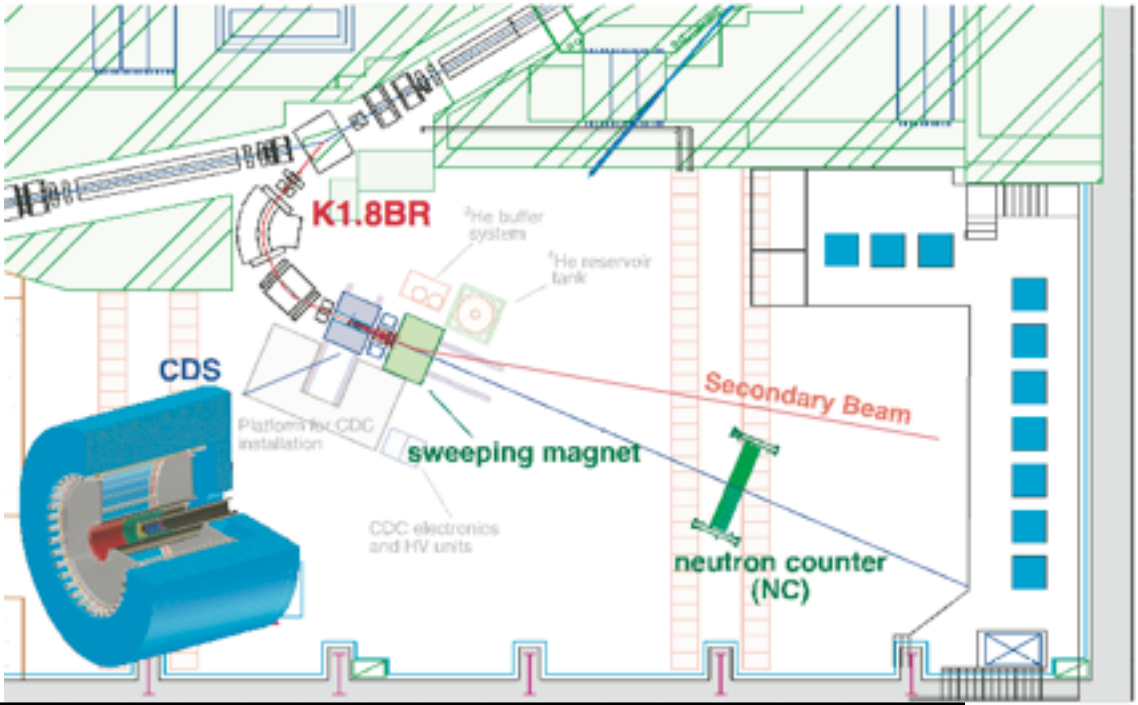


T. Waas, N. Kaiser & W. Weise, Phys. Lett. B379 (1996) 34.



Y. Akaishi & T. Yamazaki : PRC 65 (2002) 044005

E15: $\bar{K}N$ interaction study by nuclear bound state



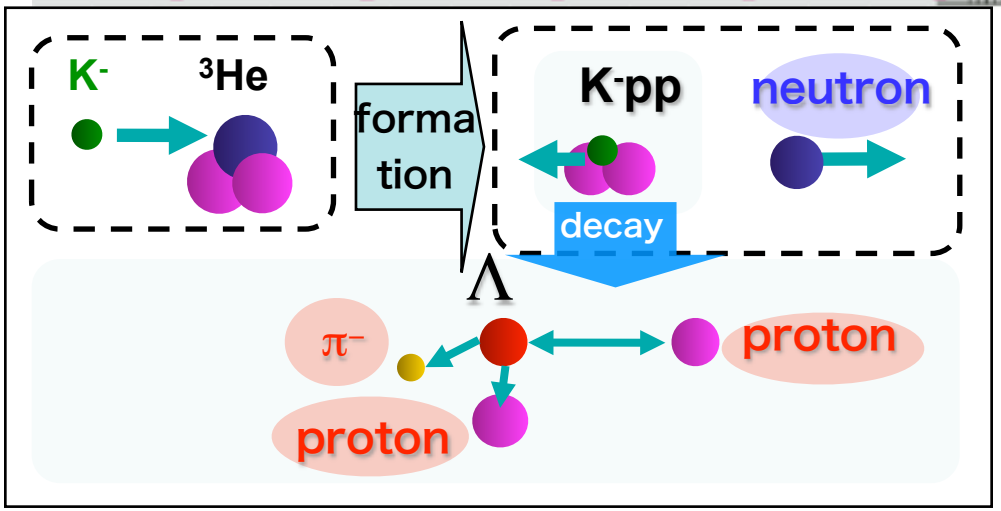
$K^- + {}^3He \rightarrow$ " pp K^- " + n

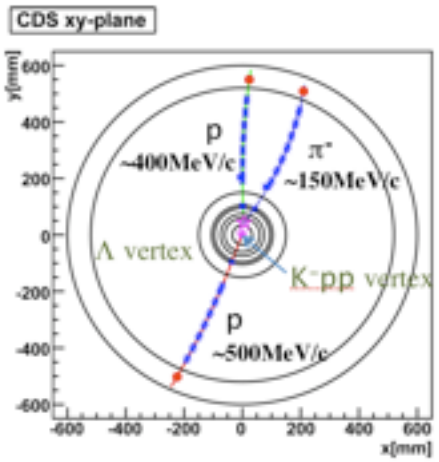
at 1 GeV/c

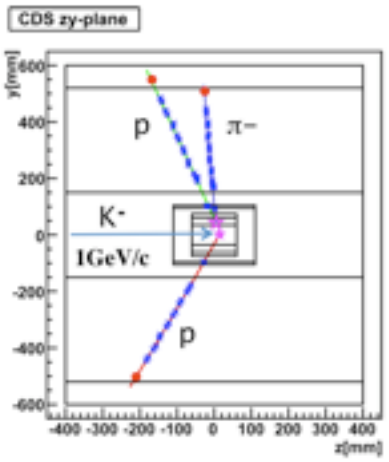
by both

missing & invariant mass

detect everything!

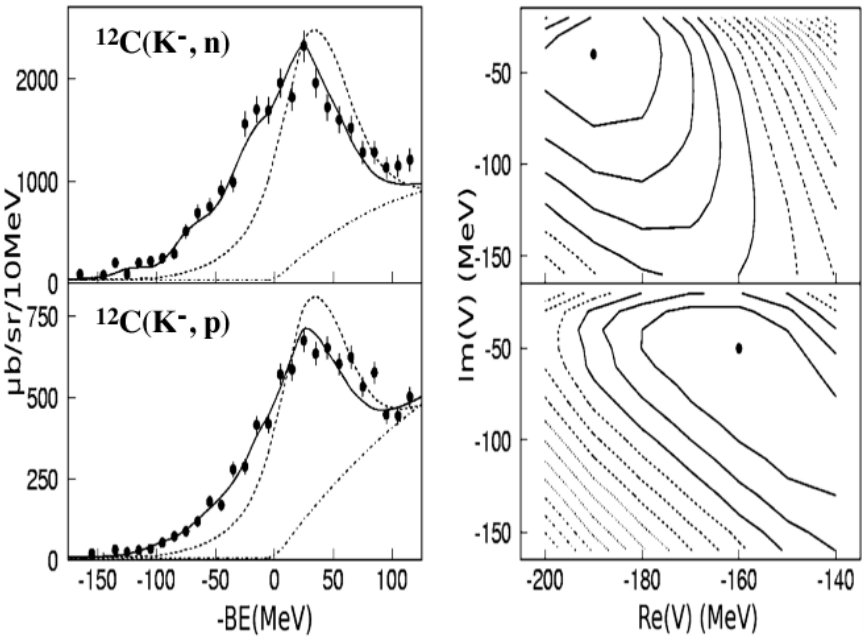






New data

in-flight (K^-, n) reaction @ 1 GeV/c



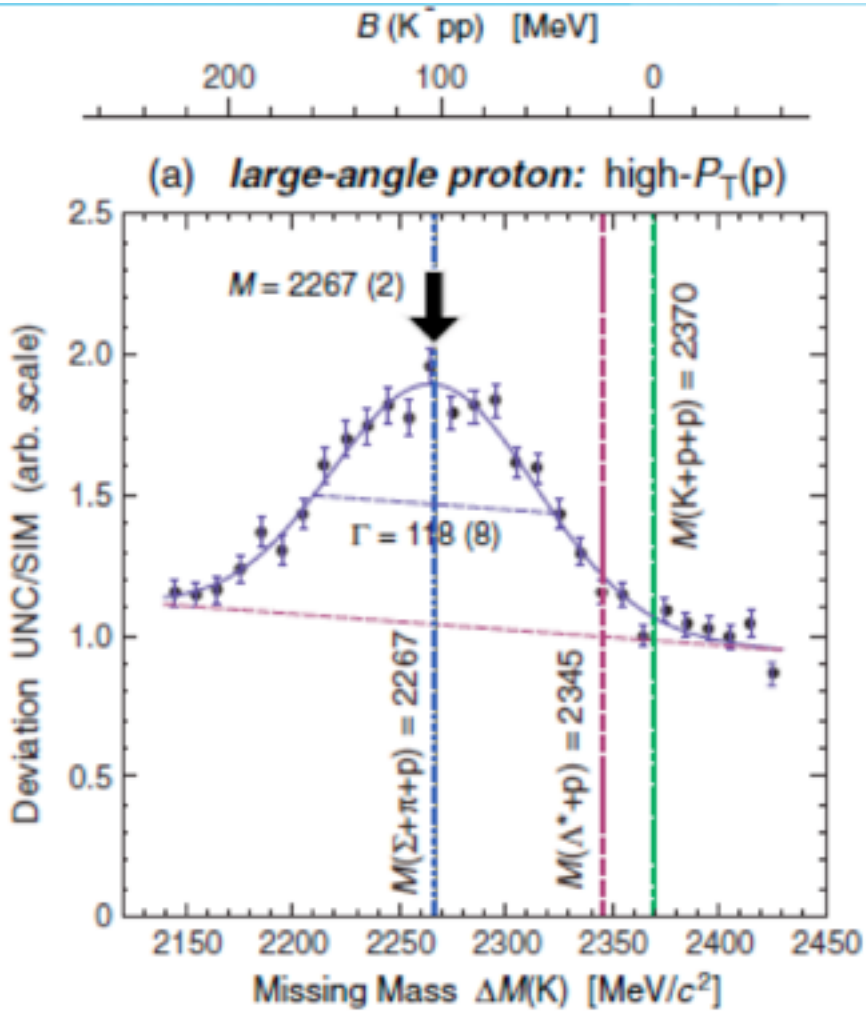
fit = Green's function

T. Kishimoto et al., Prog. Theor. Phys. 118 (2007) 18

indicating very deep potential

- deep & wide KN pot.
  - Re(V) ~ 180 MeV
  - Im(V) ~ 50 MeV
- lower background
  - in-flight ensures ...
  - 2N process suppressed

p (p, K^+) X @ T = 2.85 GeV



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

Kpp state? at

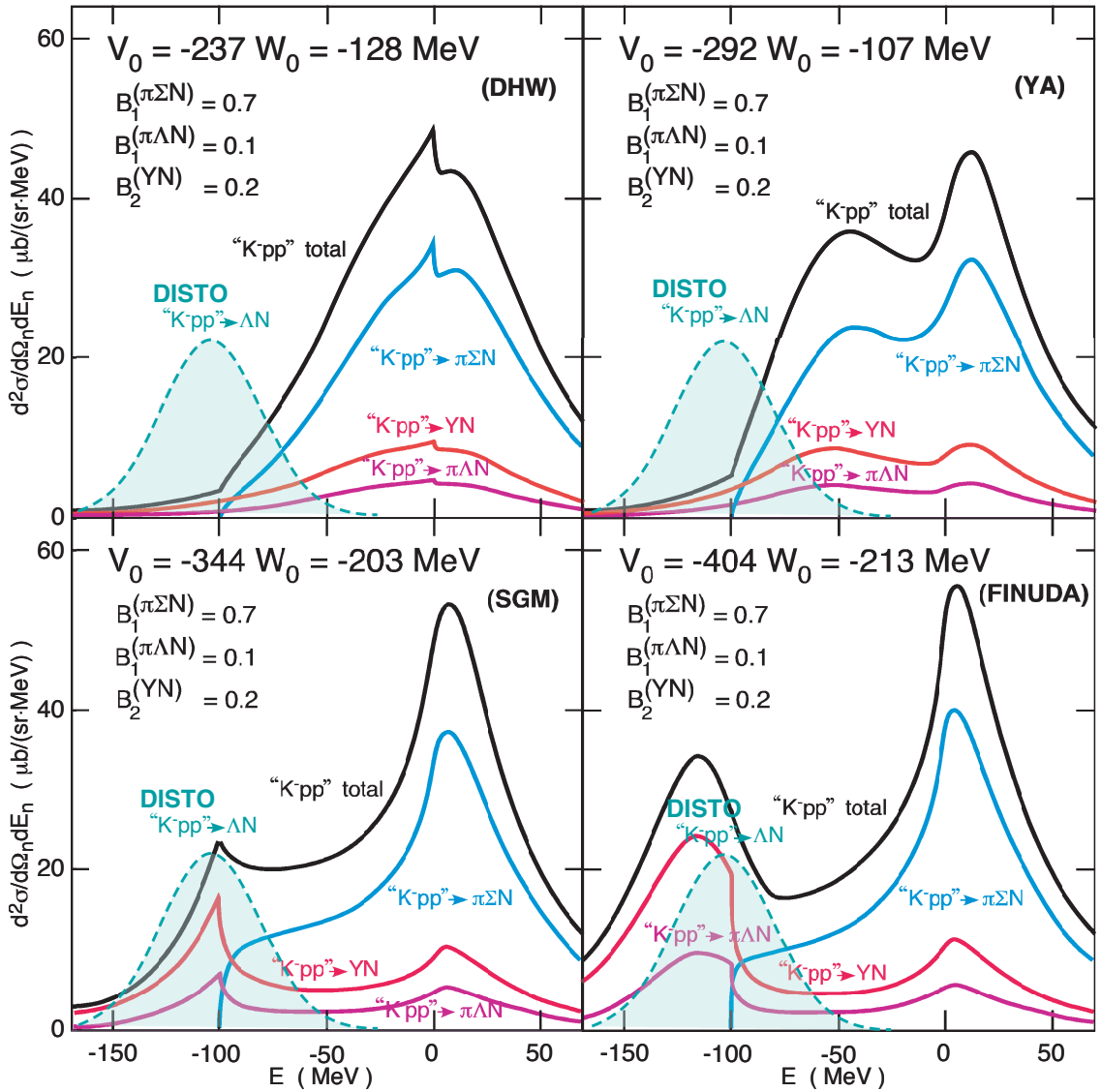
M_x=2267±3±5 MeV !

Γ_x=118±8±10 MeV !

Koike-Harada vs DISTO

DISTO

B_K~100MeV and Γ_K~100MeV



DHW: A. Dote, T. Hyodo, and W. Weise,
Nucl. Phys. A804, 197 (2008);
Phys. Rev. C79, 014003 (2009).

YA: T. Yamazaki and Y. Akaishi,
Phys. Lett. B535, 70 (2002);
Proc. Jpn. Academy, Series B 83, 144 (2007)

SGM: N.V. Shevchenko, A. Gal, and J. Mares,
Phys. Rev. Lett. 98, 082301 (2007);
N.V. Shevchenko, A. Gal, J. Mares, and J. Revai,
Phys. Rev. C76, 044004 (2007).

FINUDA: M. Agnello et al.,
Phys. Rev. Lett. 94, 212303 (2005).

DISTO

B_K~100MeV and Γ_K~100MeV

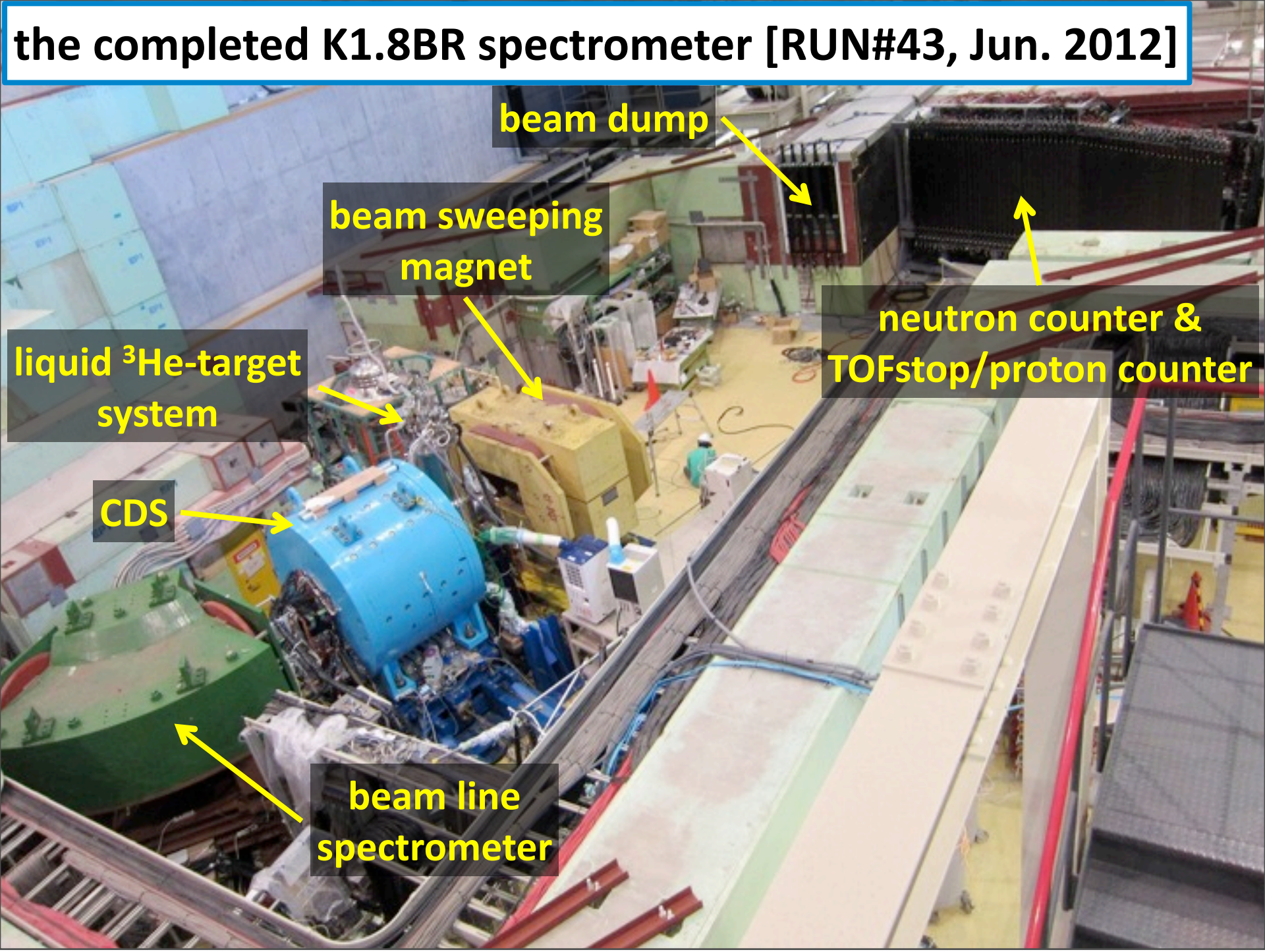
- only for Λp decay ch.

private communication

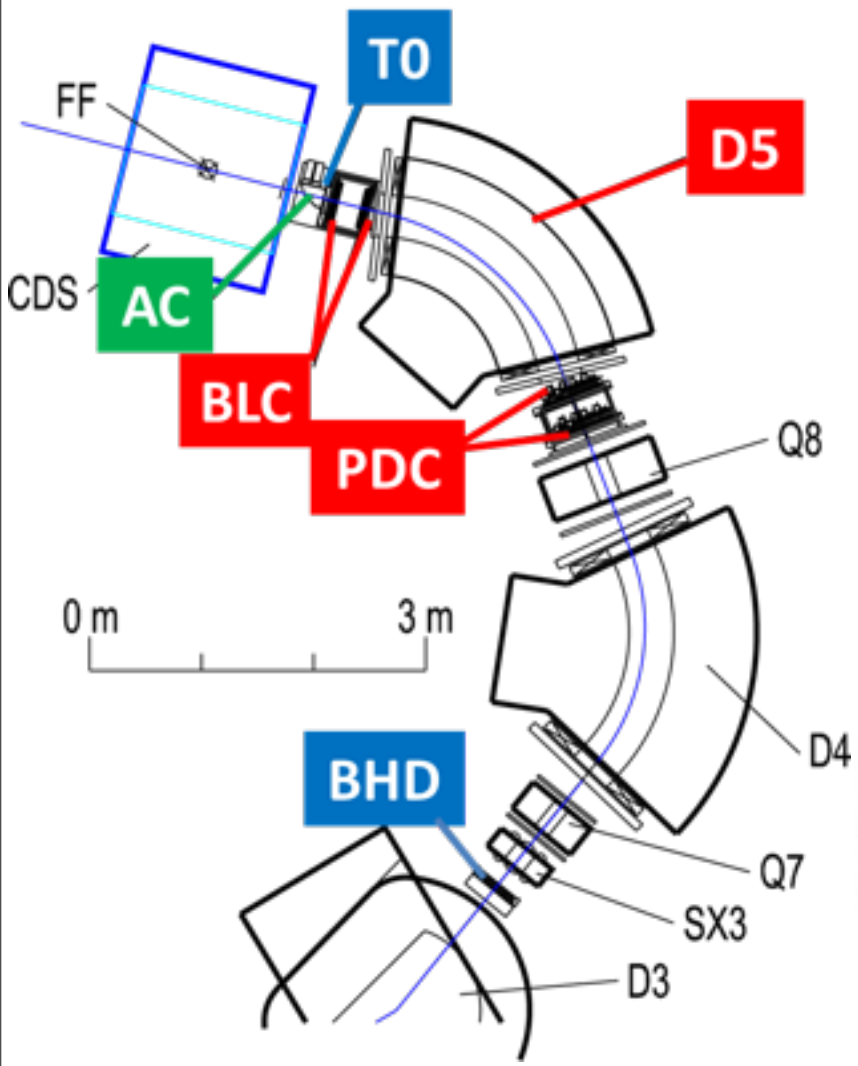
- does not fit in KH scheme

easy to observe,
if dσ/dΩ ≳1mb/sr

the completed K1.8BR spectrometer [RUN#43, Jun. 2012]



Beam Line Spectrometer



beam trigger: BHD & T0

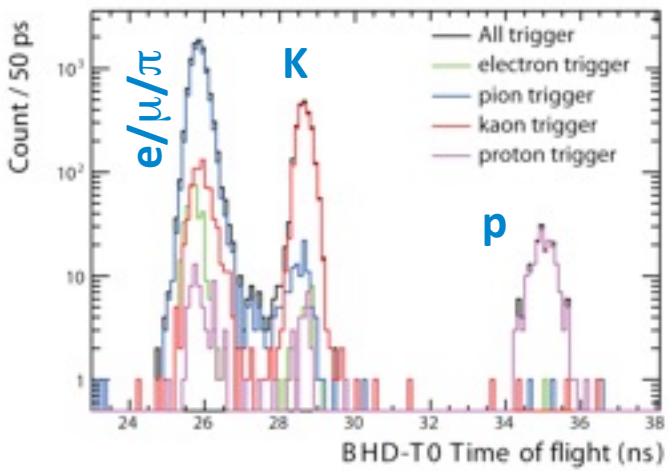
- ✓ plastic scintillator arrays
- ✓ TOF length (BHD-TO) = 7.7m
- ✓ $\sigma(TOF_{BHD\text{-}T0})$ = 160ps

kaon identification at trigger level: AC

- ✓ mirror reflection type aerogel Cherenkov counter (index = 1.05)
- ✓ π detection eff. = 96% (th=5p.e.)

beam momentum: D5 & PDC & BLC

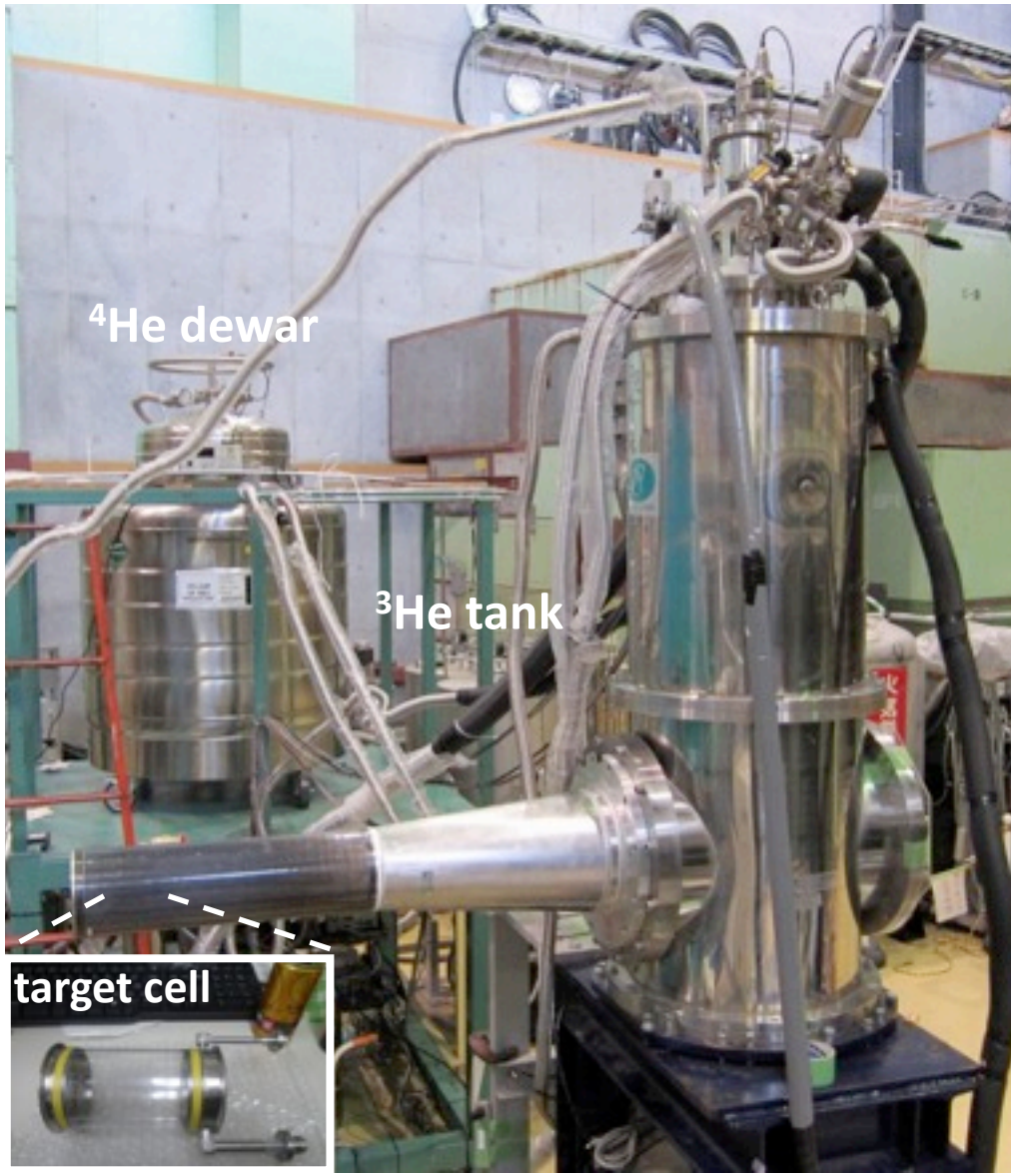
- ✓ dipole and wire drift chambers
- ✓ expected momentum resolution = 0.1%

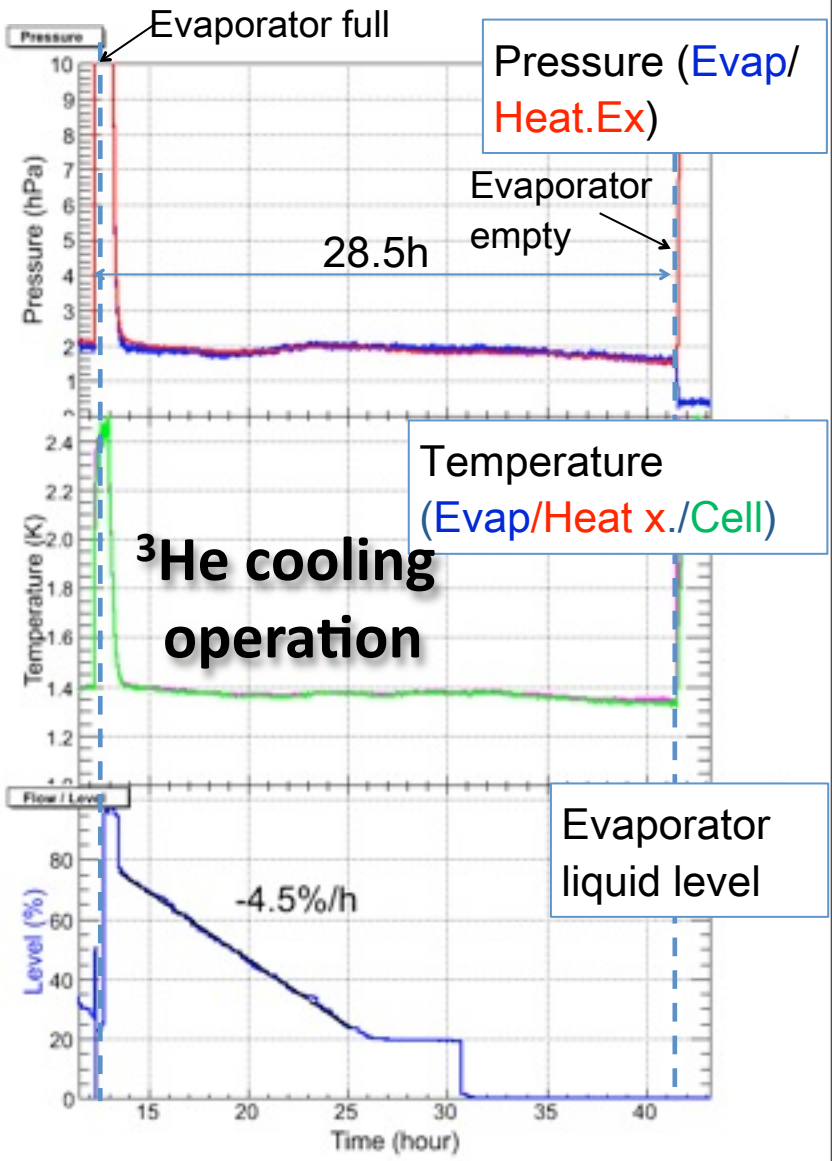


TOF(BHD-T0)

- **Run#40**
- **+1.0 GeV/*c***
- **ESS1 = +/-250kV**

Liquid ^{3}He Target System



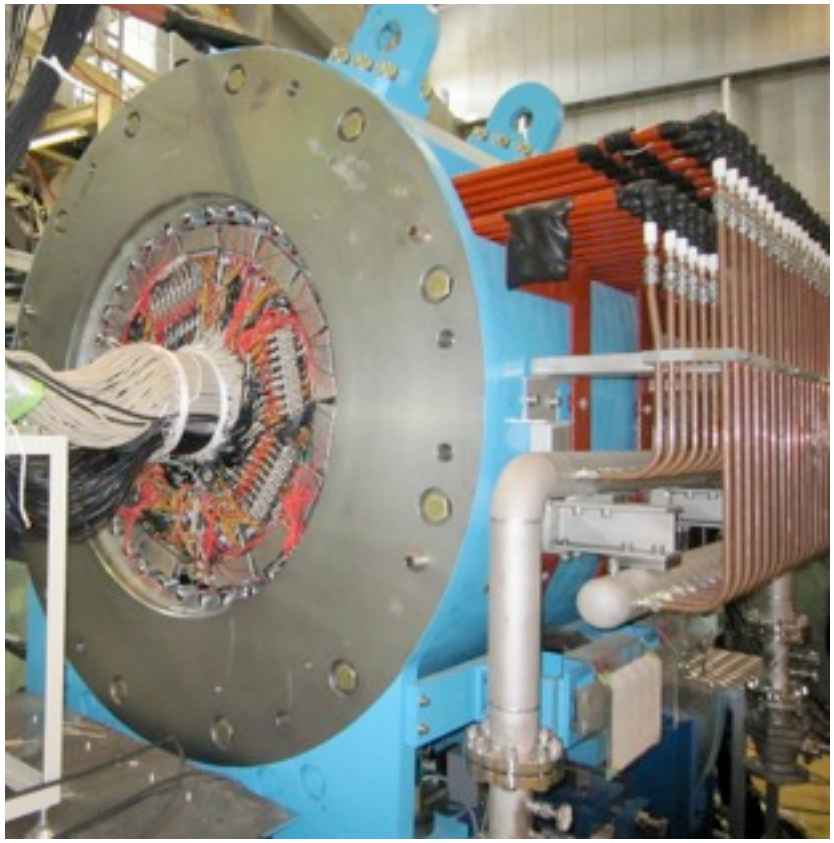


the system was successfully operated in Run#43

Cylindrical Detector System (CDS)

solenoid magnet

- ✓bore ϕ1.18m, length 1.17m
- ✓0.7T operation

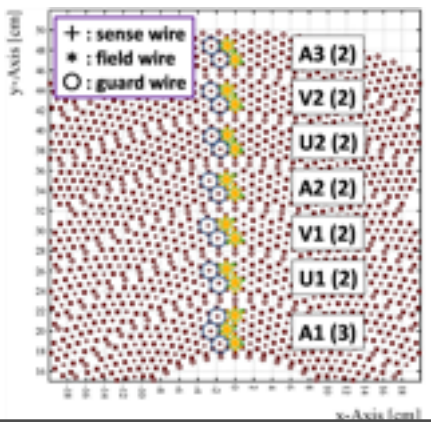


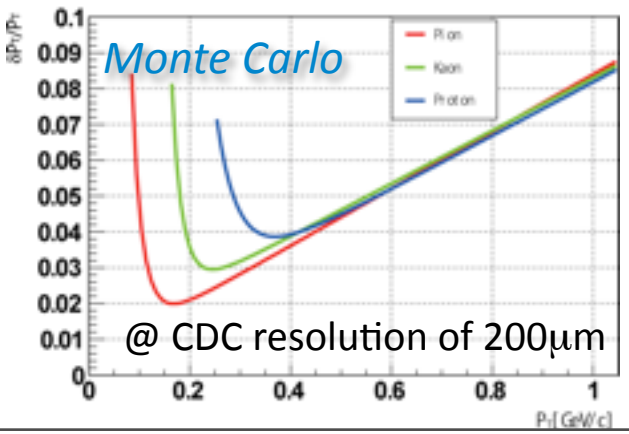
CDH (Cylindrical Detector Hodoscope)

- ✓36 plastic scintillators
- ✓FM-PMTs
- ✓$\sigma(TOF_{T0\text{-}CDH})$ = 160ps

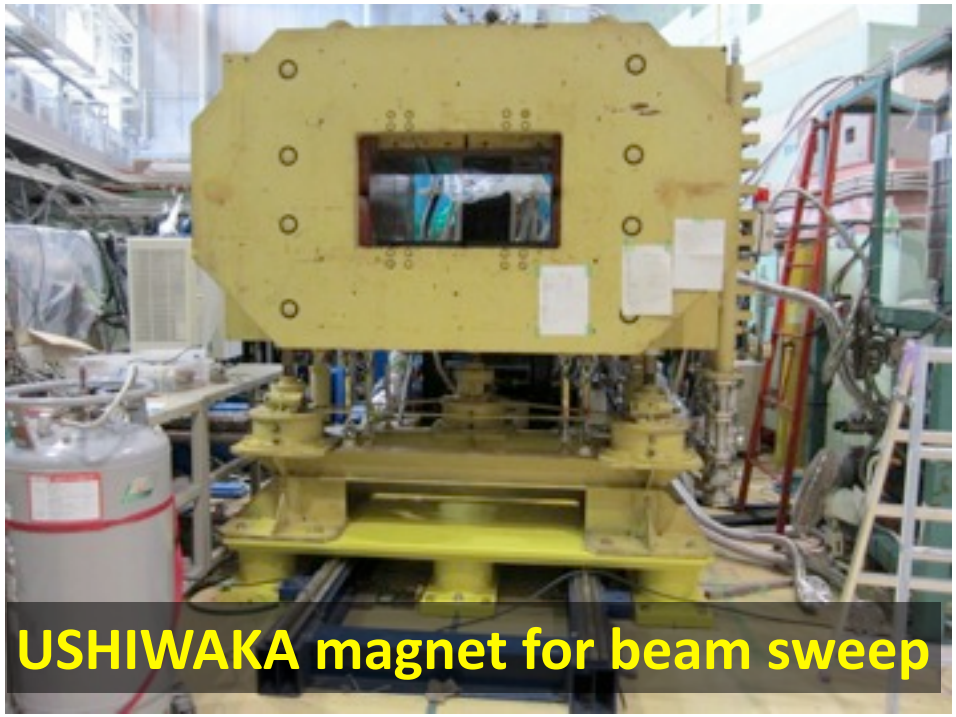
CDC (Cylindrical Drift Chamber)

- ✓wire drift chamber
- ✓15 layers, 1816ch
- ✓solid angle = 2.6π
- ✓gas = Ar:C_2H_6/50:50



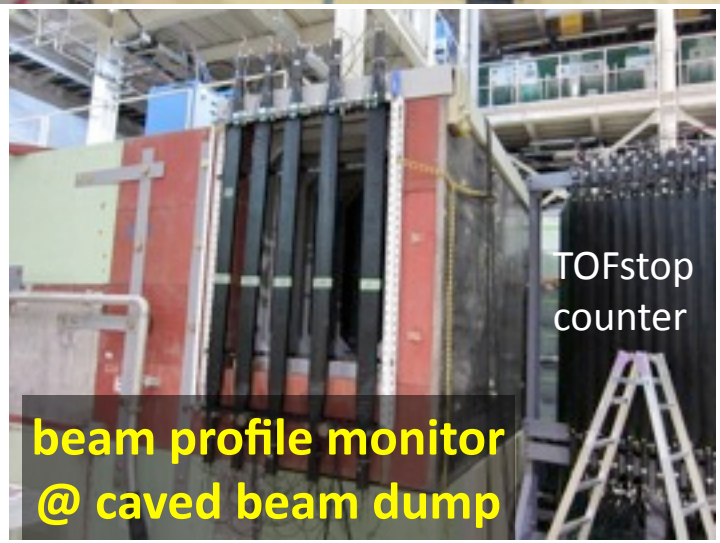


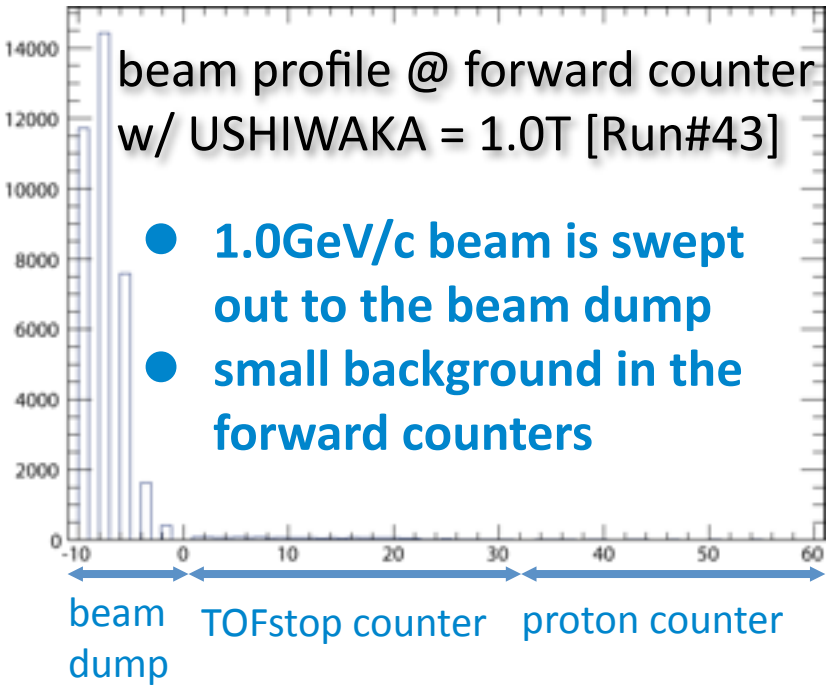
Beam Sweeping Magnet



USHIWAKA magnet

- ✓used in KEK π2 beam line
- ✓**installed in May 2012**
- ✓aperture: 82cm(H)*40cm(V)
- ✓pole length: 70cm
- ✓1.0T operation





Neutron Counter

neutron counter

- ✓plastic scintillator array
- ✓16 segments * 7 layers
  [320(w)*150(h)*35(d)cm]

TOFstop / proton counter

- ✓plastic scintillators
- ✓32+27 segments

accidental neutron background suppression!

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

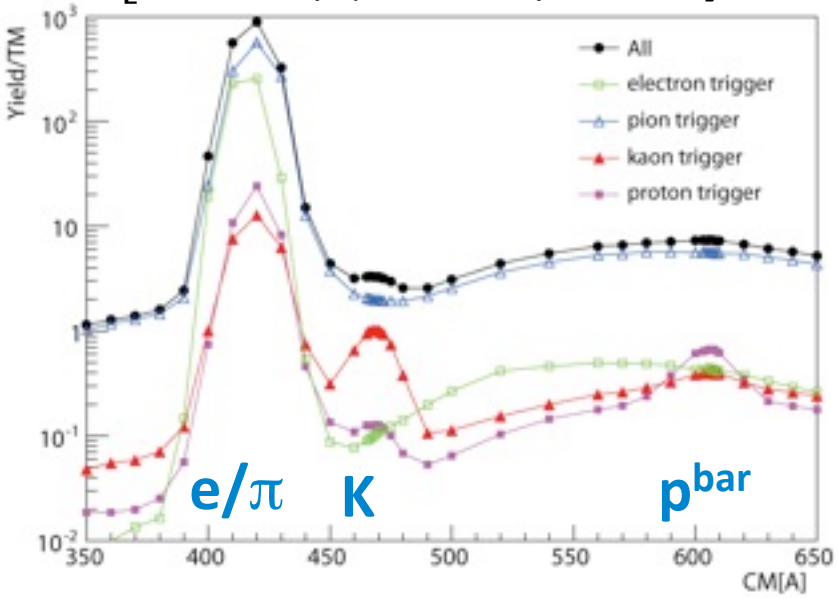
Online analysis[PLUS]

Although it is quite interesting!

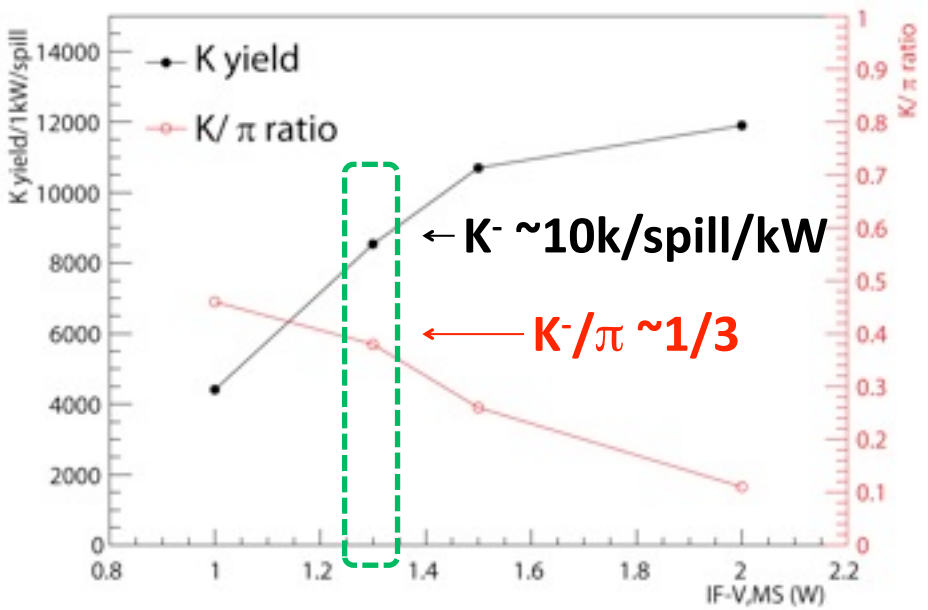
Beam Line Parameters for 1GeV/c

particle separation by ESS1

[–1.0 GeV/c, ESS1 = +/-275 kV]



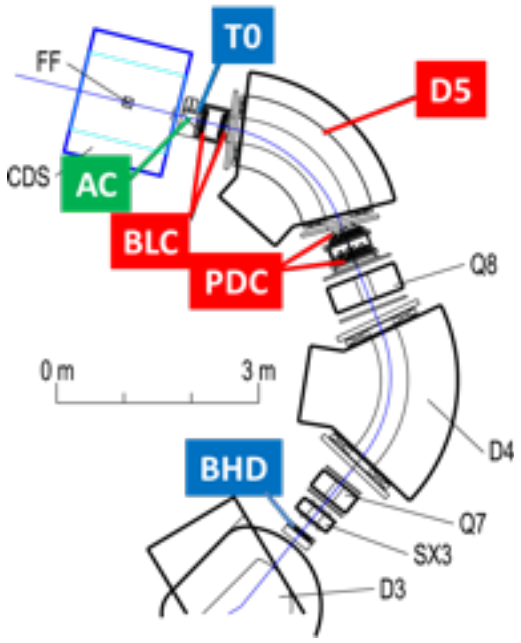
–1.0 GeV/c K-yield & K/π-ratio

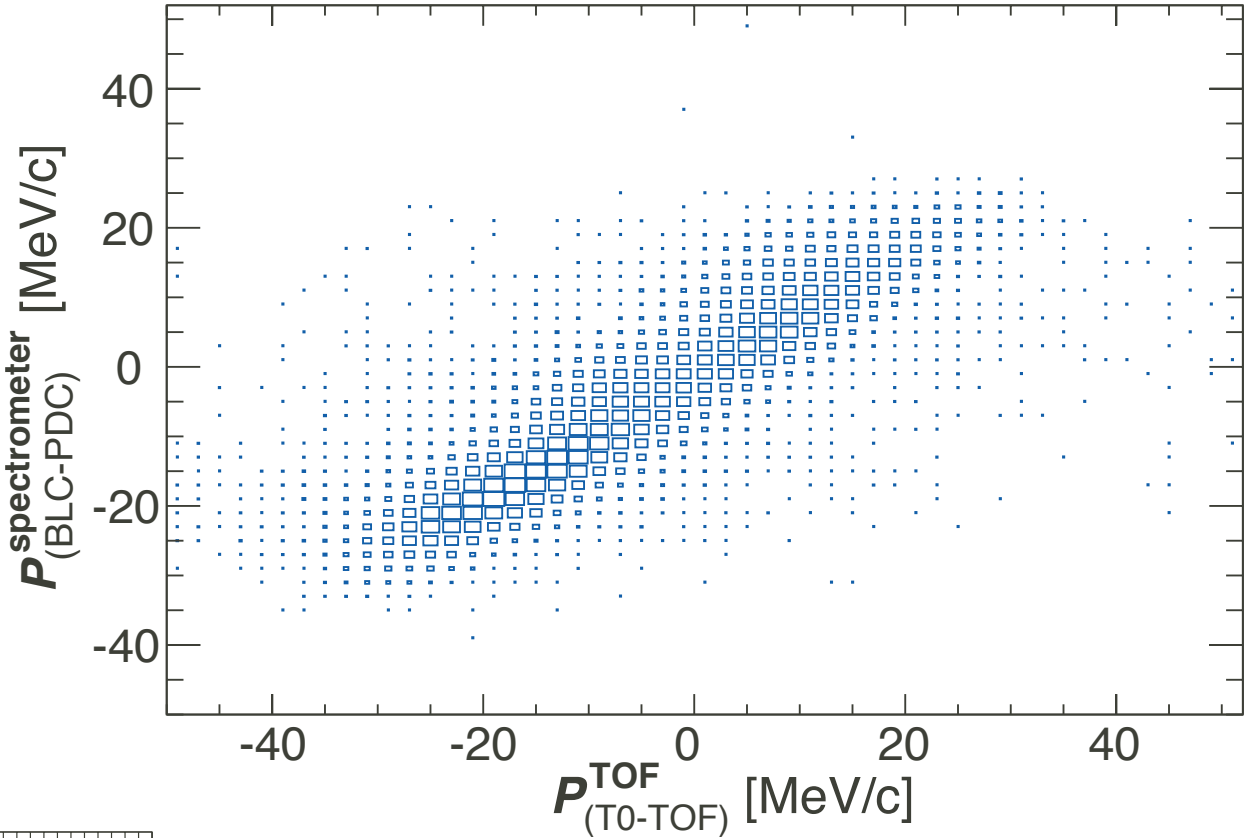


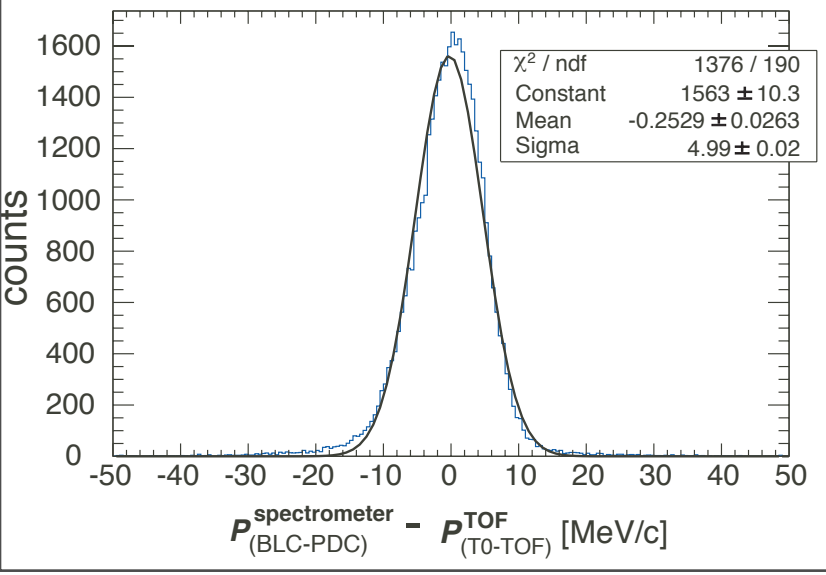
[/spill]	1kW	10kW	100kW
beam intensity	40k	400k	4M
K^- yield	10k	100k	1M
CDS trig. rate *run#40/43*	150	1.5k	15k
CDS & NC trig. rate *run#43*	**1.5**	**15**	**150**

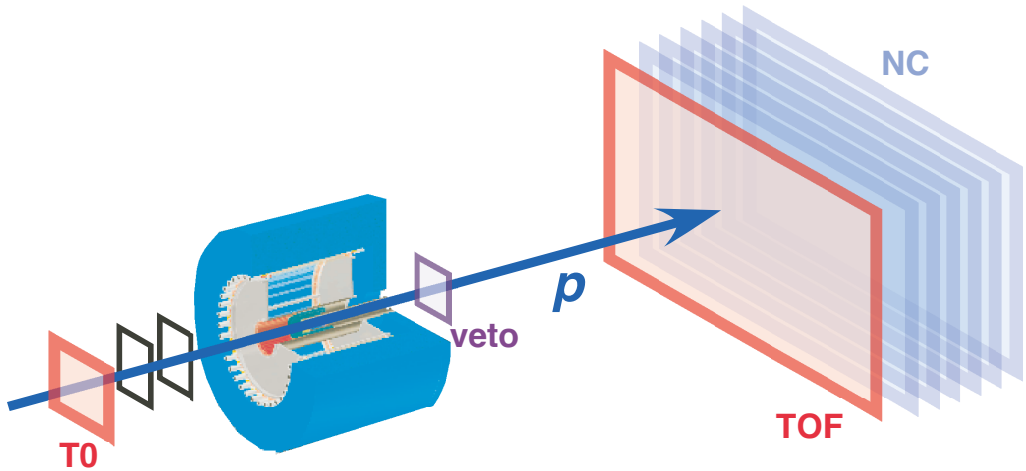
We can handle more than 10kW beam-power!!!

[CDS trig = 2-charged]









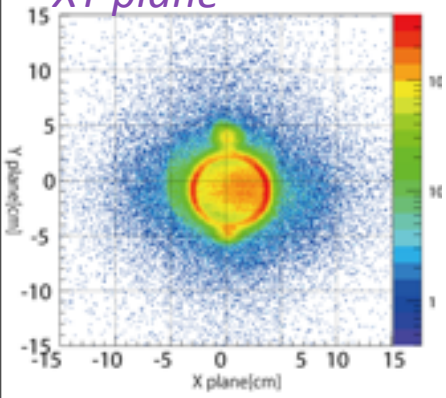
Very Preliminary Results on ^{3}He(K^{-},n)

CDS Performances

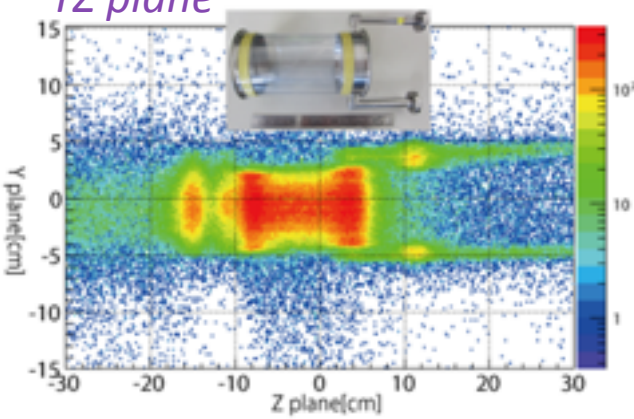
event vertex

Liquid ^{4}He(run#40)/ ^{3}He(run#43) inside

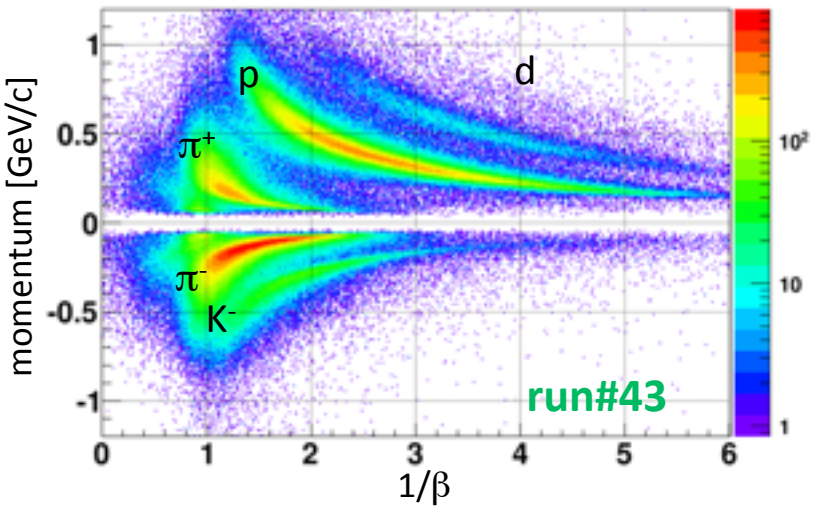
XY plane



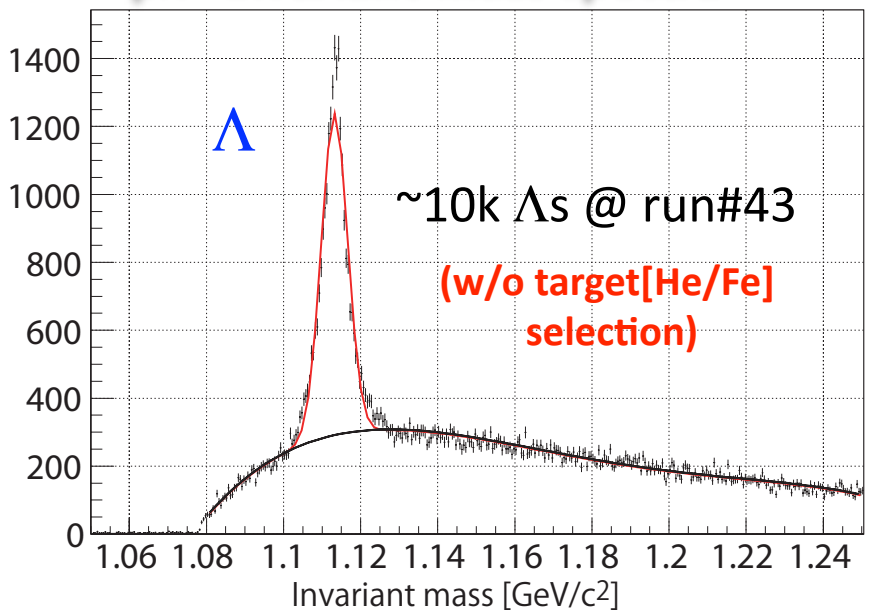
YZ plane



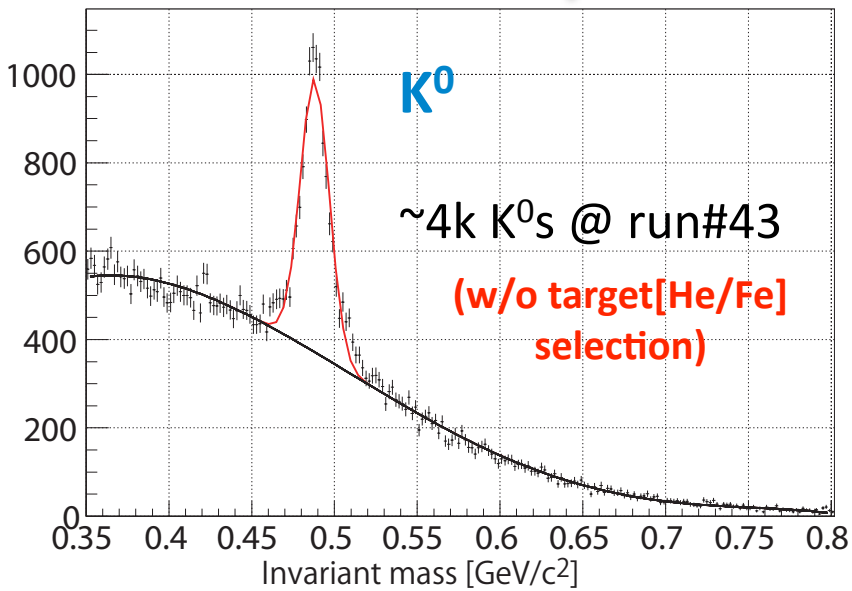
pID



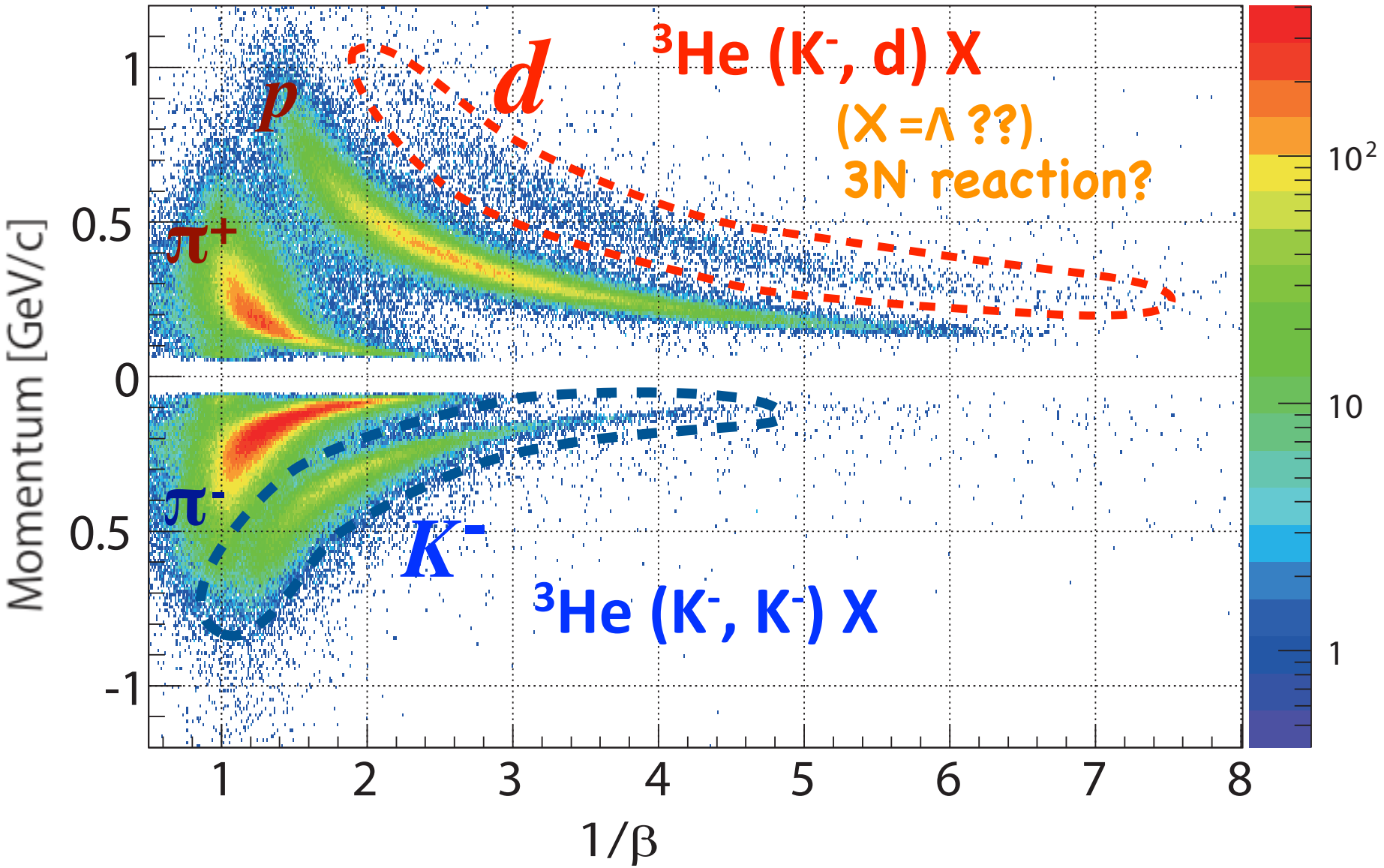
pπ- invariant-mass spectra



π+π- invariant-mass spectra

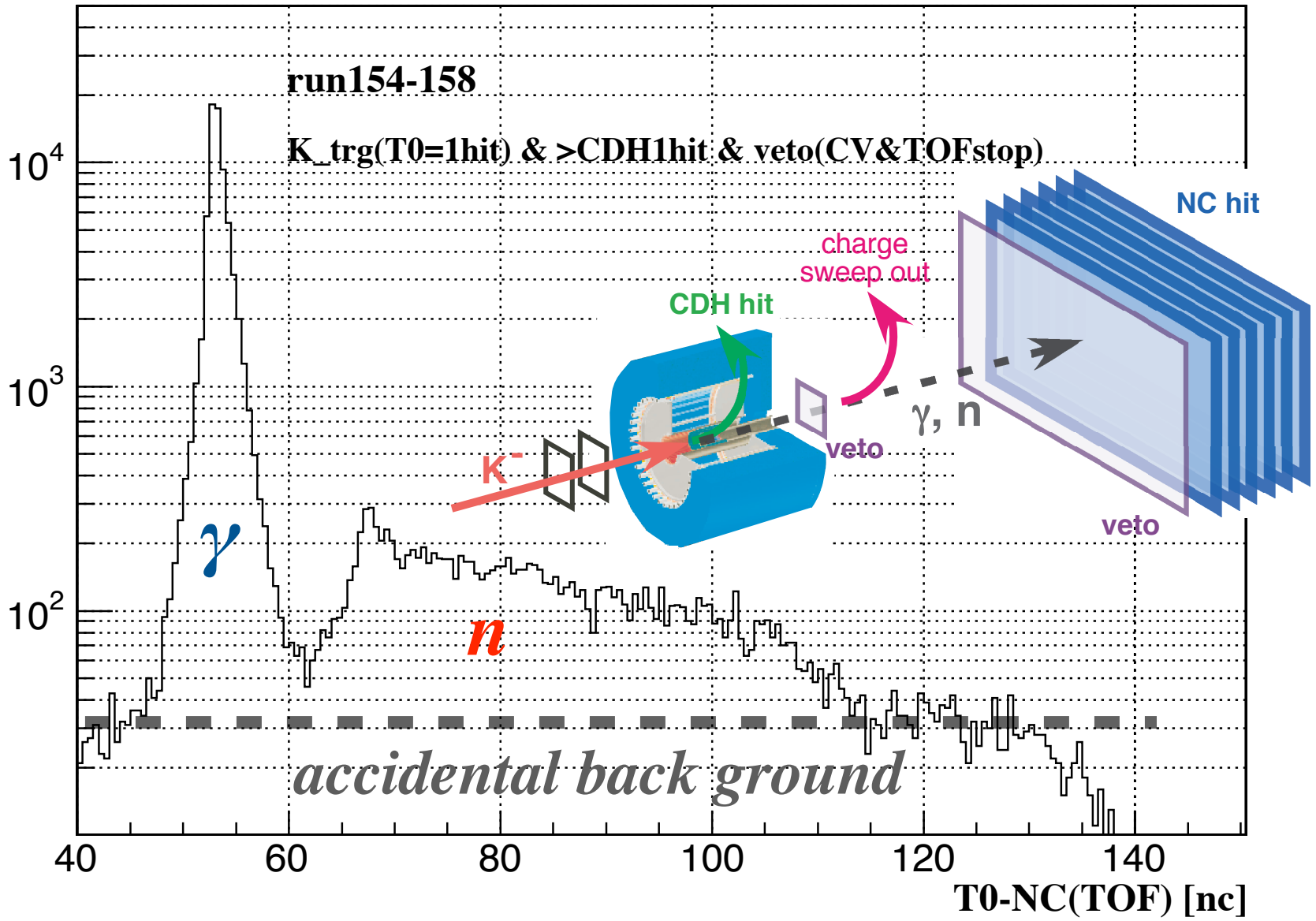


PID for CDS: Reaction vertex is in target volume



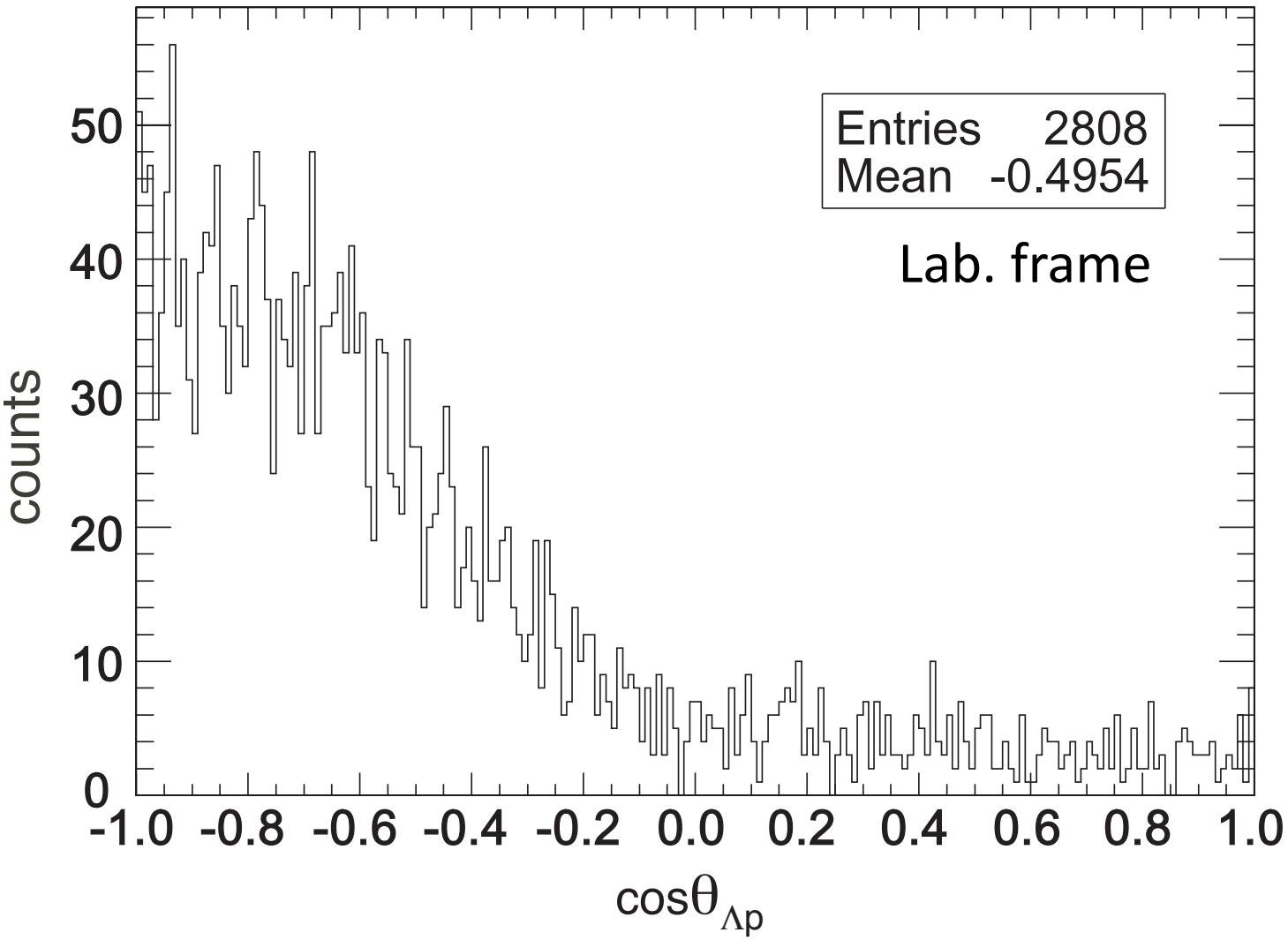
Very Preliminary Results on ^{3}He(K$^-$,n)

TOF_T0_NC_layer1 kaon & CDH2 w/o charge



Very Preliminary Results on ^{3}He(K$^-$,n)

Λp opening angle (w/o target selection [He/Fe])



Very Preliminary Results on ^{3}He(K^{-},n)

Beam Time Request

proposed and approved = 270kW*4weeks (@Ni-target)

Not easy to realize

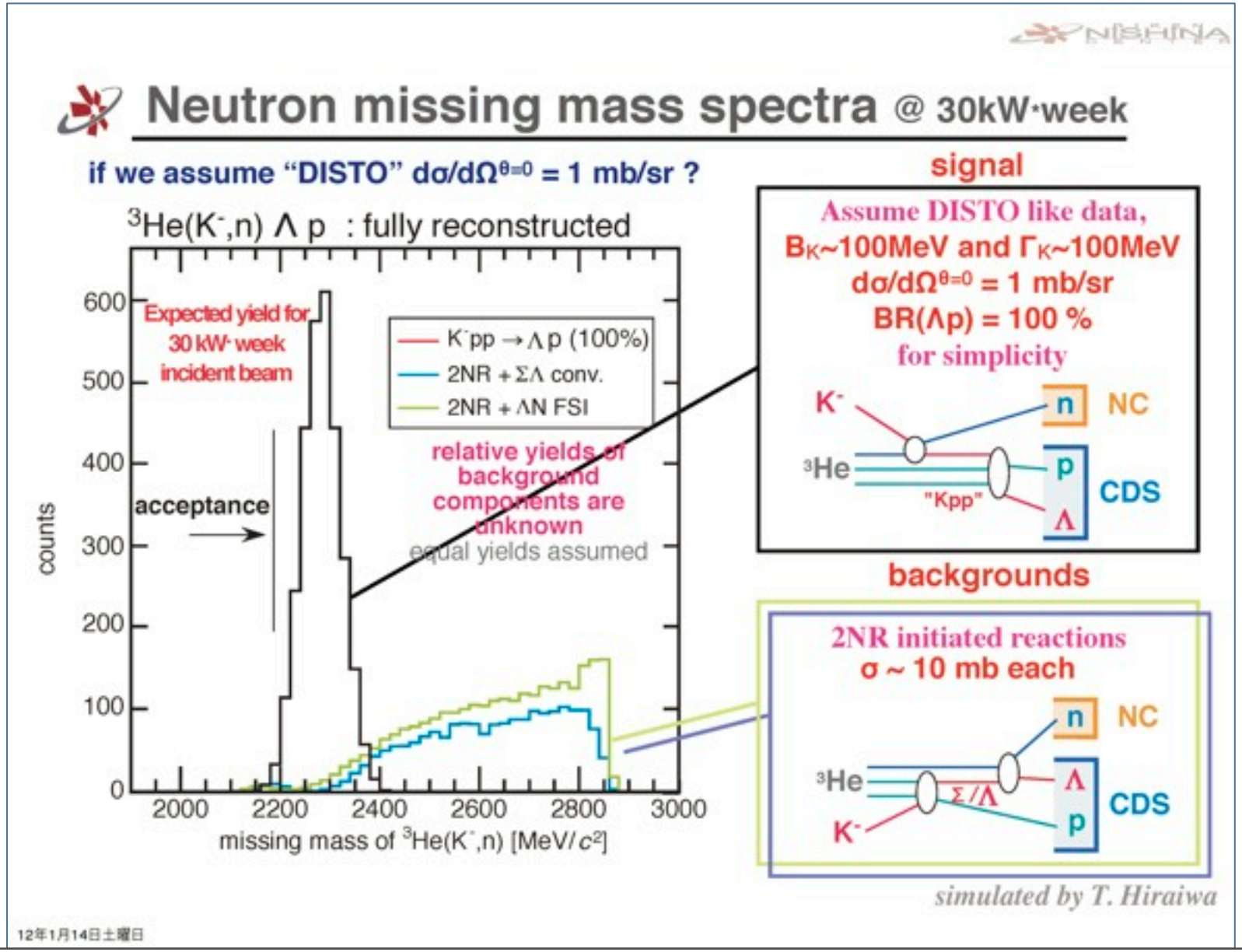
Staging strategy

E15^{1st} ~ 30kW*week before long shutdown in 2013

1. to know the background processes
2. to evaluate the realistic beam time for E15^{full}
3. to present an information of the K^{bar}N interaction
   → ^{3}He(K^{-},n) spectrum below K^{bar}N threshold
4. to hunt for a hint of signal in Λ+p+n final states

realize E15^{1st} as soon as possible

Expected Results; ^{3}He(K$^-$,n) interactions



The J-PARC E15 Collaboration

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

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(*) Spokesperson
($) Co-Spokesperson

Conclusion

E15^{1st} ~ 30kW*week before long shutdown in 2013

1. to know the background processes
2. to evaluate the realistic beam time for E15^{full}
3. to present an information of the K^{bar}N interaction
   → ^{3}He(K^{-},n) spectrum below K^{bar}N threshold
4. to hunt for a hint of signal in Λ+p+n final states

realize E15^{1st} as soon as possible

We are ready!

Data seems to be very enthusiastic!

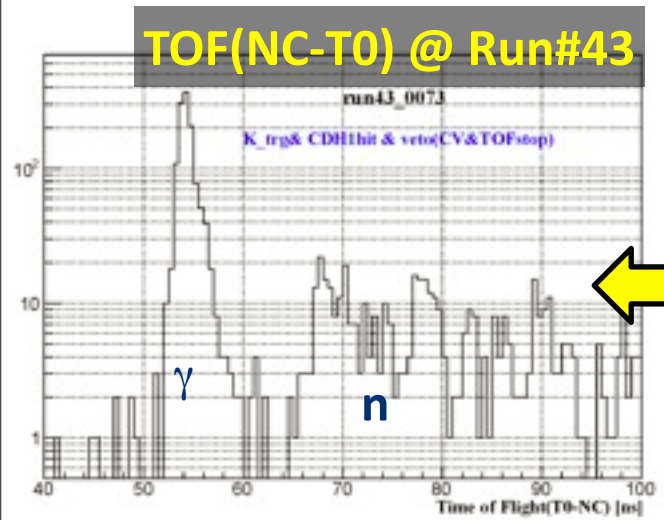
50 ~ 100 times more data only with E15^{1st}!

backup

History of E15

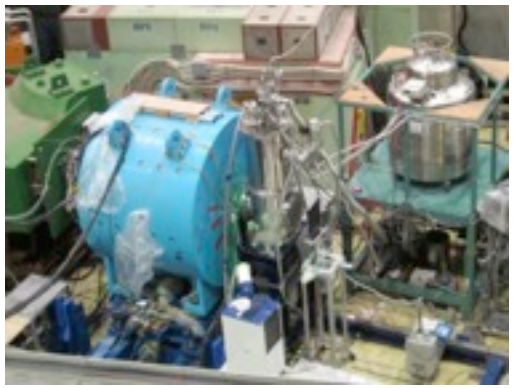
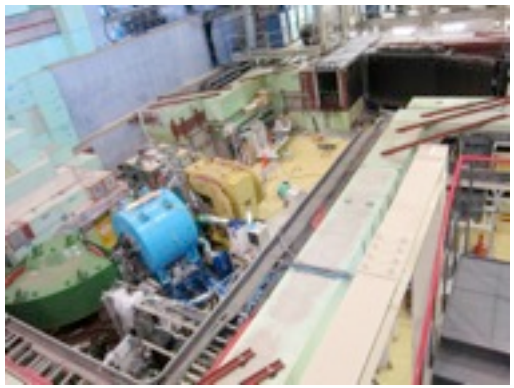
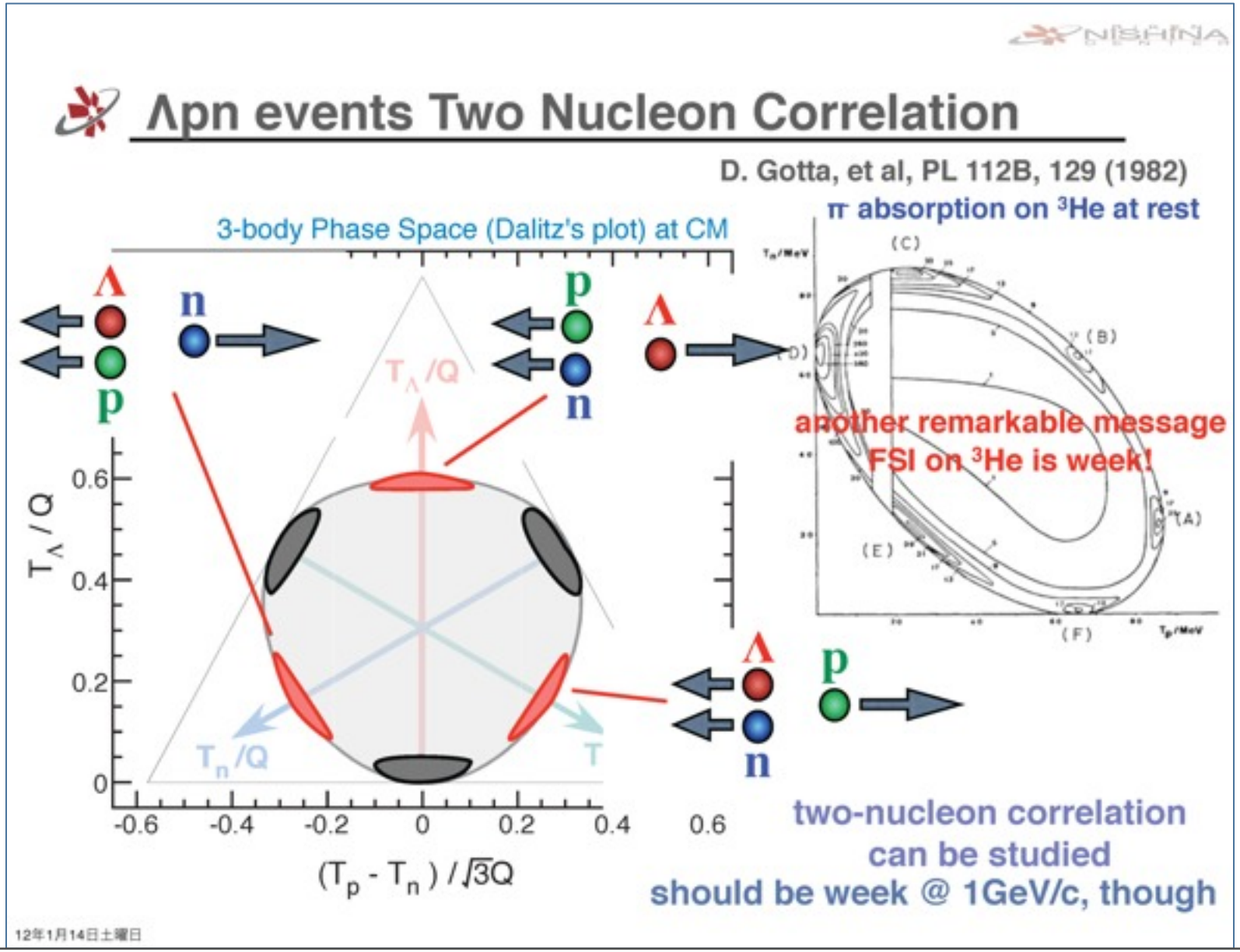
Jun.2006	1st PAC	proposed and approved as the stage-1 and the day-1 experiment
Jan. 2007	2nd PAC	approved as the stage-2 experiment
Feb. 2009	**Run#22**	**first beam transportation to K1.8BR**
Oct. 2009	Run#26	beam line commissioning (~6.5h)
Nov. 2009	Run#27	beam line commissioning (~15h)
Dec. 2009	Run#28	beam line commissioning (~20h)
Jan. 2010	Run#29	beam line commissioning (~50h)
Feb. 2010	Run#30	beam line commissioning (~55h)
Oct. 2010	Run#35	beam line and CDS commissioning (~90h)
Mar. 11 2011		**the earthquake**
Feb. 2012	Run#40	beam line commissioning for 1.0 GeV/c CDS commissioning w/ liq. ^{4}He target (~150h)
May. 2012		**completion of spectrometer construction**
Jun. 2012	**Run#43**	neutron counter commissioning **1st engineering run with full-setup (w/ liq. ^{3}He target)** (~100h)

Neutron Counter



neutral particles (γ & n) have been successfully detected and identified by the NC

Run#40 & Run#43

Run#40	Run#43
 **CDS (^{4}He-target)**	 **full setup (^{3}He-target)**
*(π or K)*CDH2 trig. & calib trig.*	*K*CDH1*(forward n or p), K*CDH2 trig. & calib trig.*
3.3kW, ~42h → ~0.8kW*week	6.0kW ~40h → ~1.4kW*week
0.67G K^- on target	1.3G K^- on target
18M events recorded	22M events recorded

Expected Results; Λpn events