J-PARC K1.8BR で用いる 前方中性子検出器の性能評価

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2012.9.11

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- J-PARC E15 experiments
  - Sweeping Magnet
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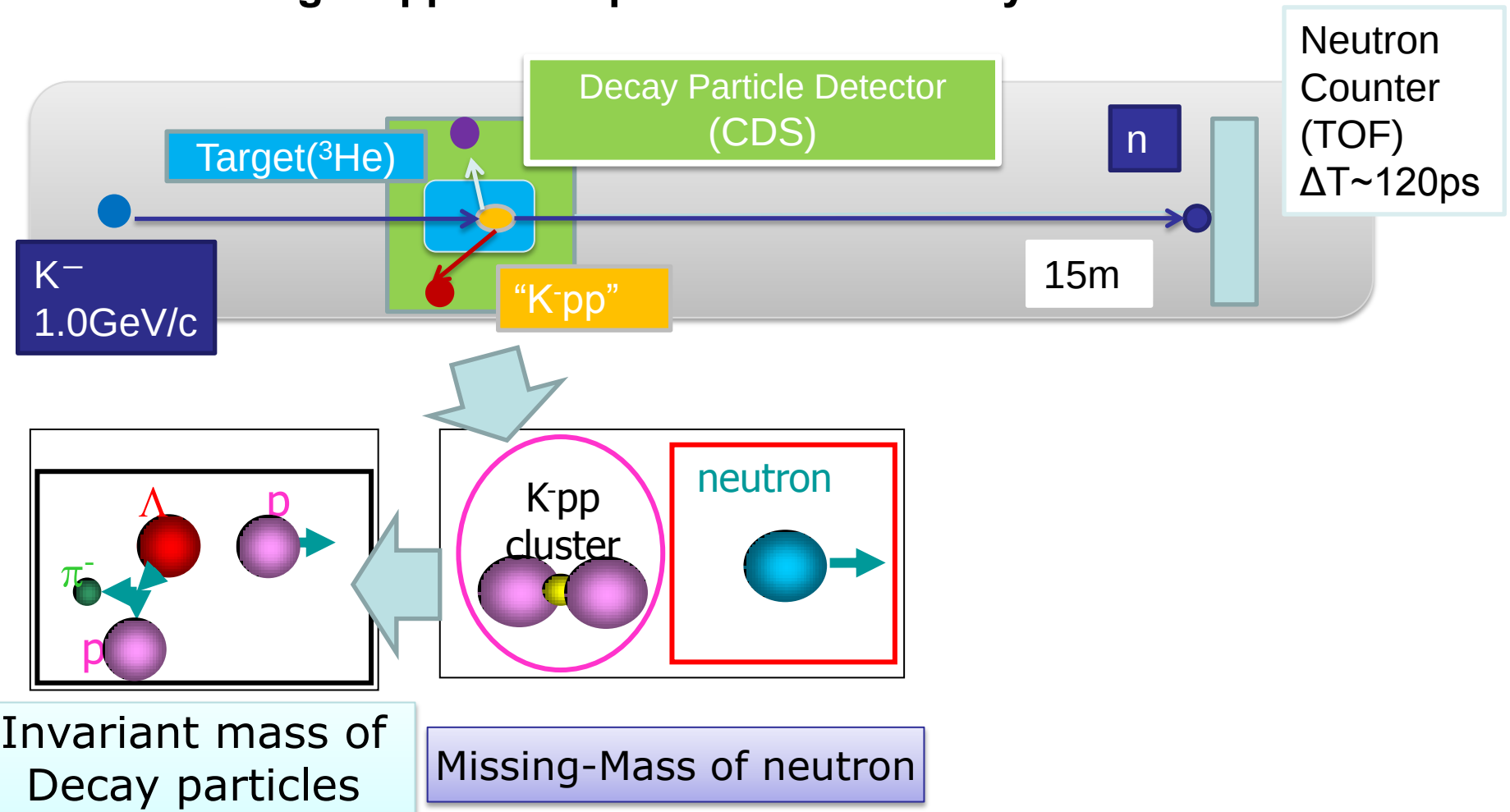
- Engineering run (Jun. 2012)
- Summary

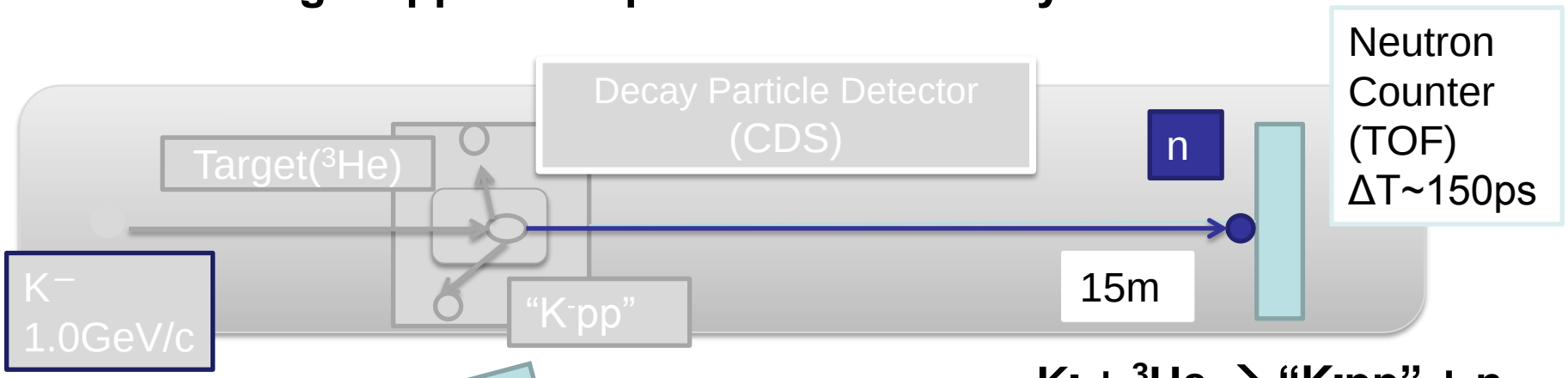
J-PARC E15 Experiment

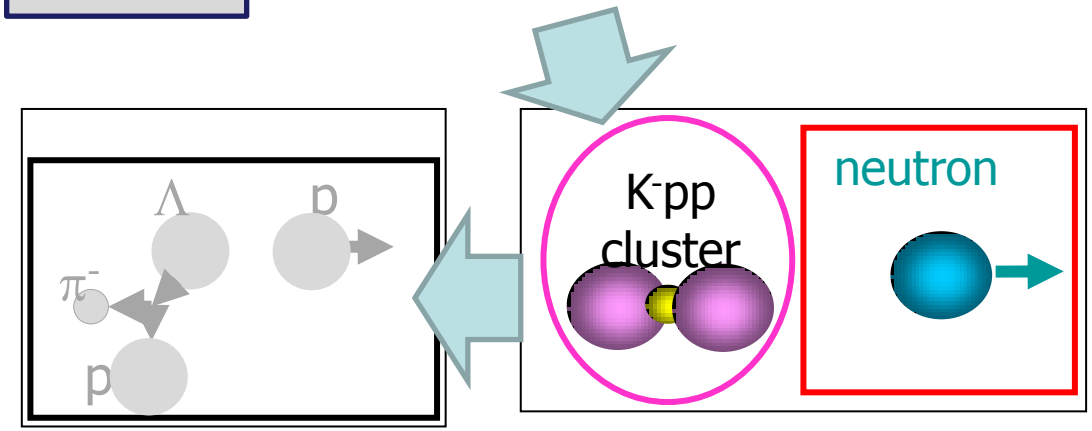
- **Search for K^-pp bound state by using In-flight $^3He(K^-,n)$ Reaction**
- **Measuring "K^-pp" from production to decay .**



J-PARC E15 Experiment

- **Search for K^-pp bound state by using In-flight $^3He(K^-,n)$ Reaction**
- **Measuring "K^-pp" from production to decay .**

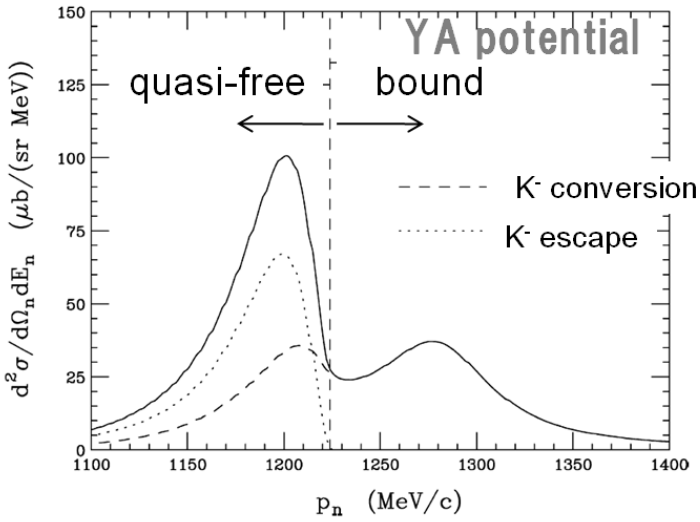




Invariant mass of Decay particles (Λ+p)

Missing-Mass of neutron

$K^- + {}^3He \rightarrow$ "K^-pp" + n
@ P_K=1GeV/c, θ=0°



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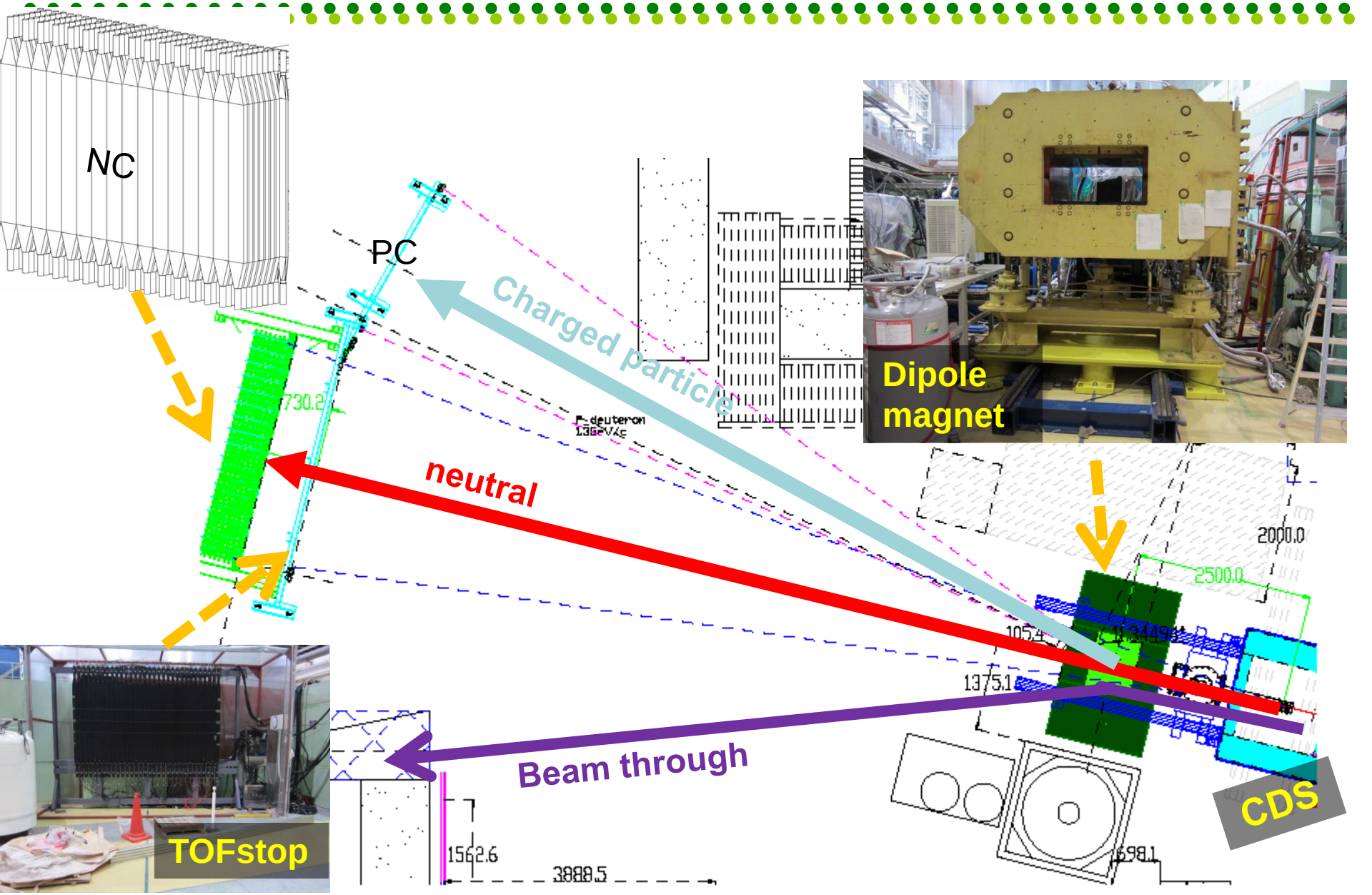
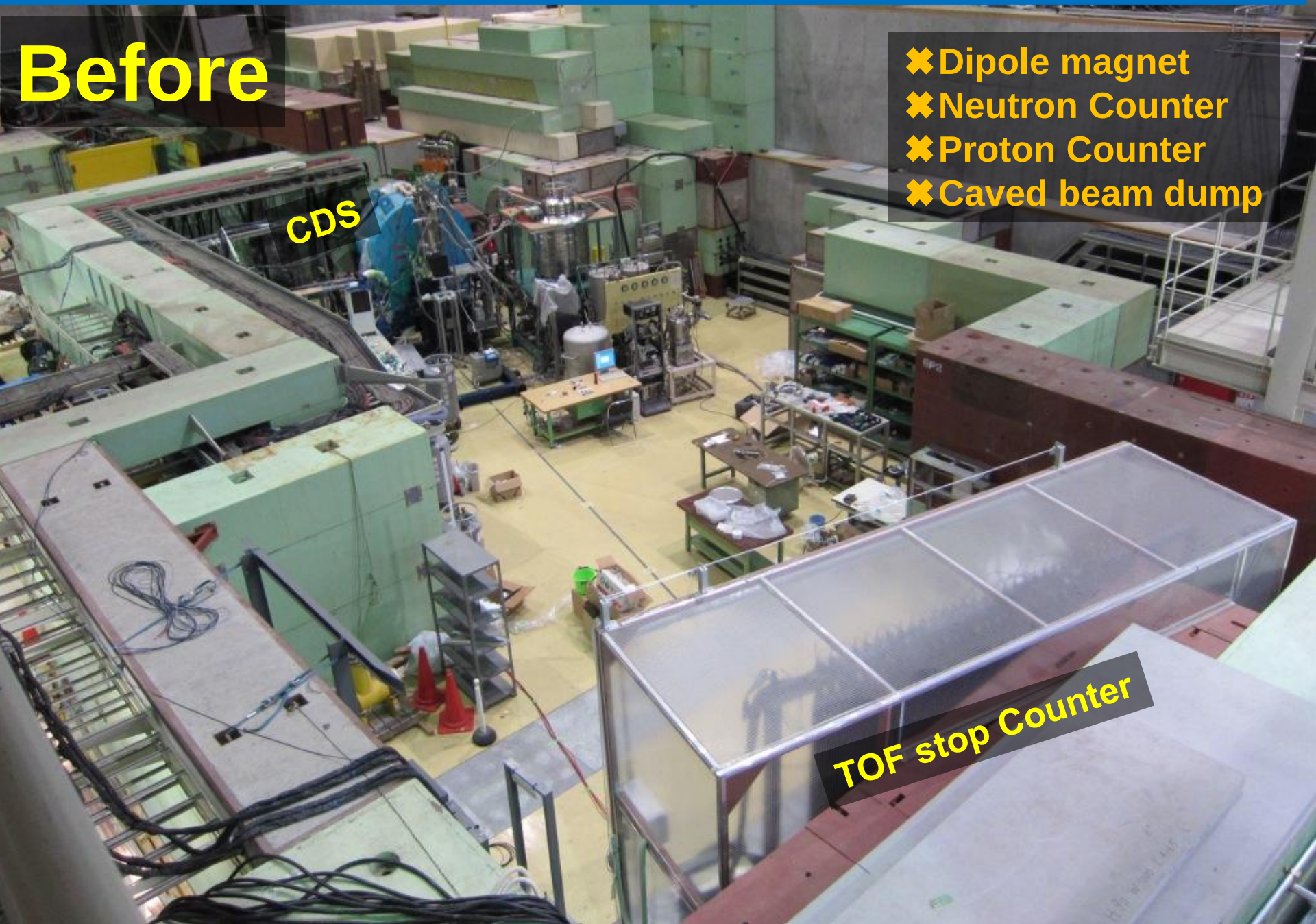
J-PARC K1.8BR


NC
PC
Charged particle
neutral
Beam through
Dipole magnet
TOFstop
CDS
730.2
2000.0
2500.0
105.4
1375.1
1562.6
3888.5

J-PARC K1.8BR beam line [Feb. 2012]



Reassembling Neutron Counter (KEK-PS➜J-PARC)

Cosmic ray test

- Using signal cables and circuits are same as production run.
- Time resolution
  - NC(BC408) **89.8±9.7**[ps]
  - NC(BC412) **93.3±9.6**[ps]
  - PC 74.8±6.4[ps]

Sweeping Magnet & Forward Counter

USHIWAKA magnet

- ✓Aperture:82cm(H)*40cm(V)
- ✓Pole length:70cm
- ✓1.0T operation
- ➜ beam sweeping

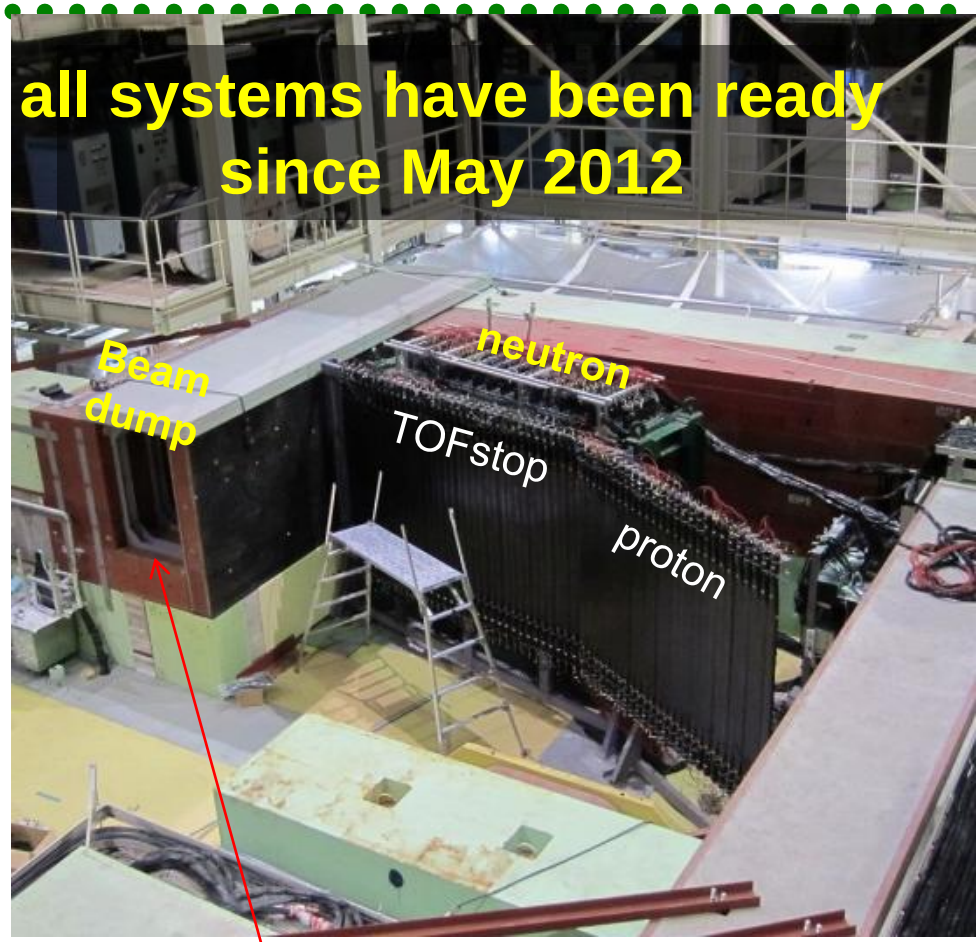
Neutron counter

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

TOFstop / proton counter

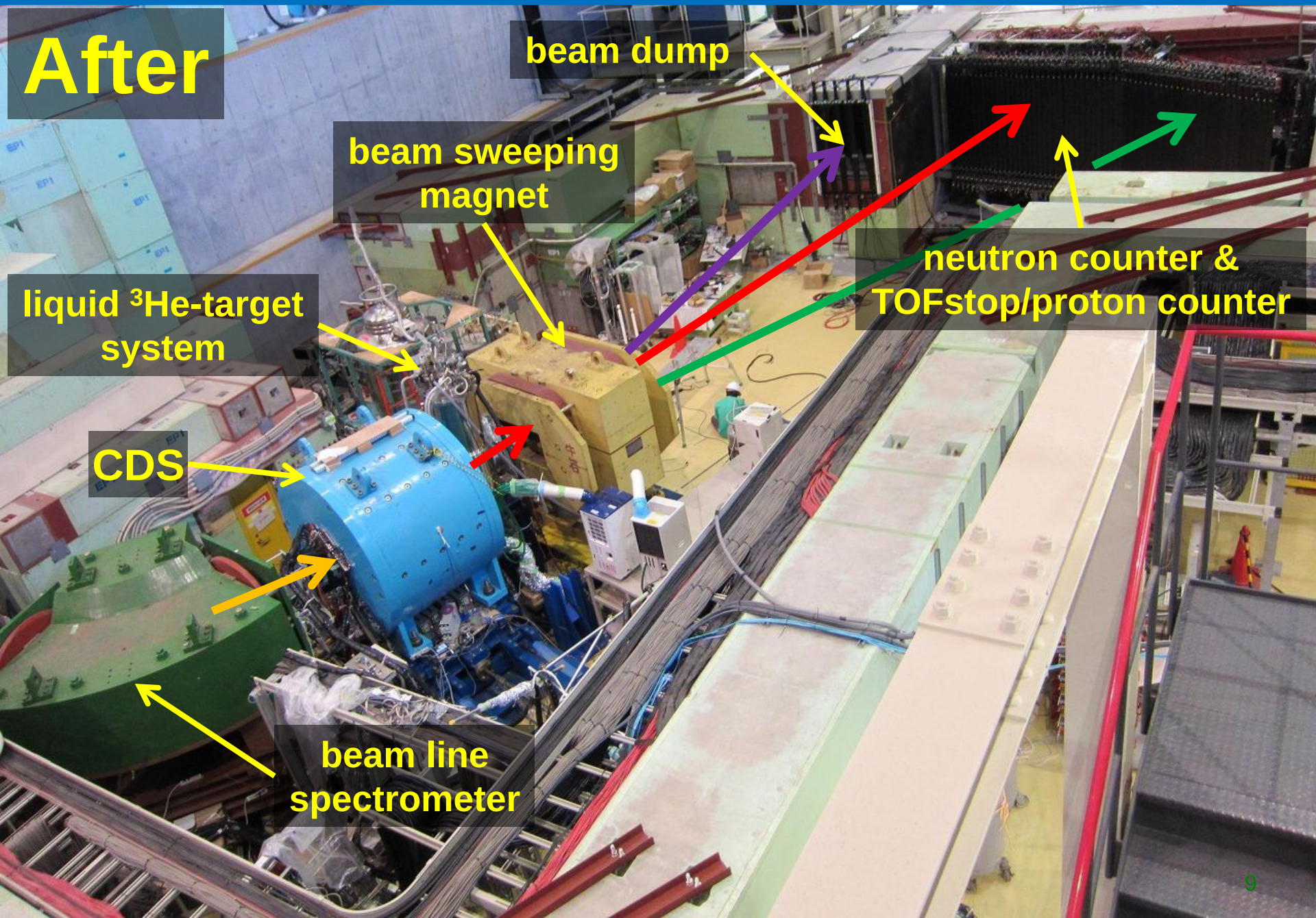
- ✓plastic scintillators
- ✓32+27 segments
- ➜ veto Charged particle.
- ➜ by production

$^{3}He(K^{-},p)$, $^{3}He(K^{-},d)$ reaction.



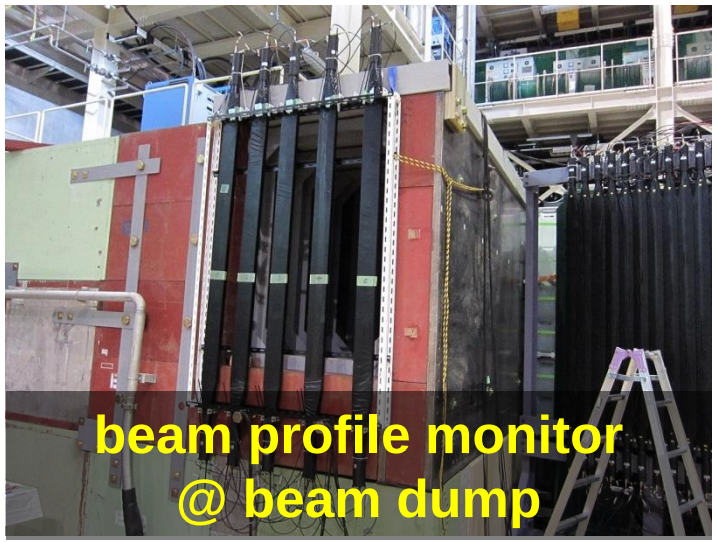
Accidental neutron Background suppression!

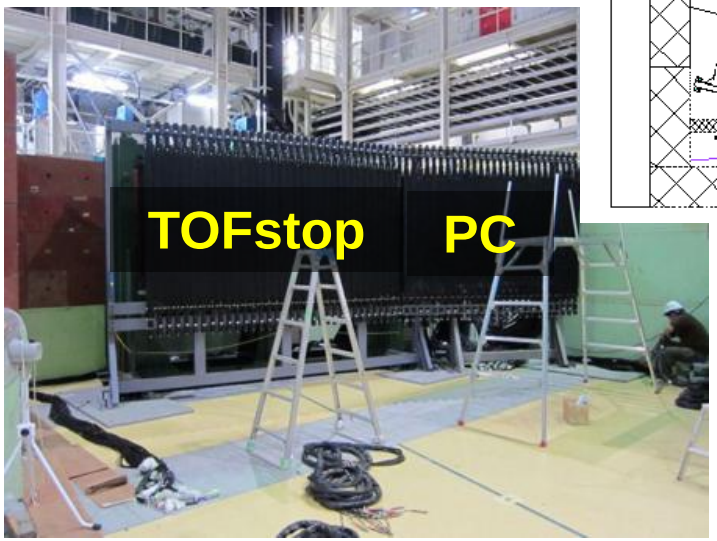
J-PARC K1.8BR beam line[Jun. 2012]

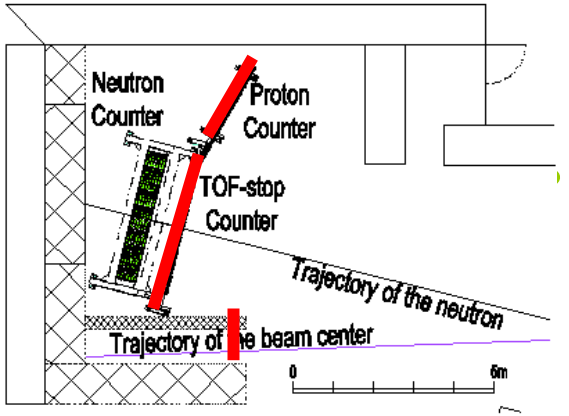


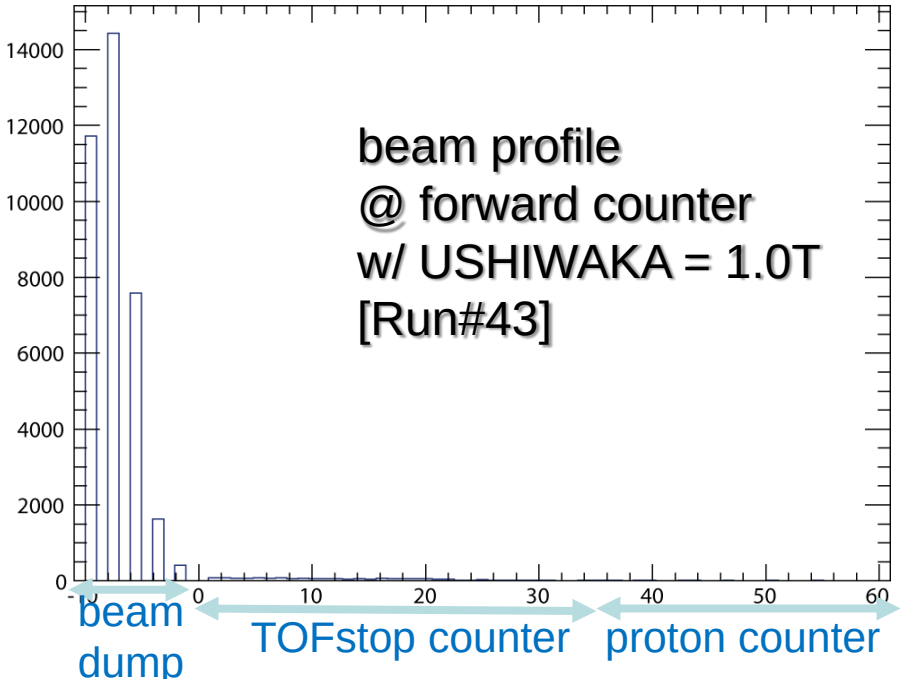
Engineering run (Jun, 2012)

Beam Sweeping



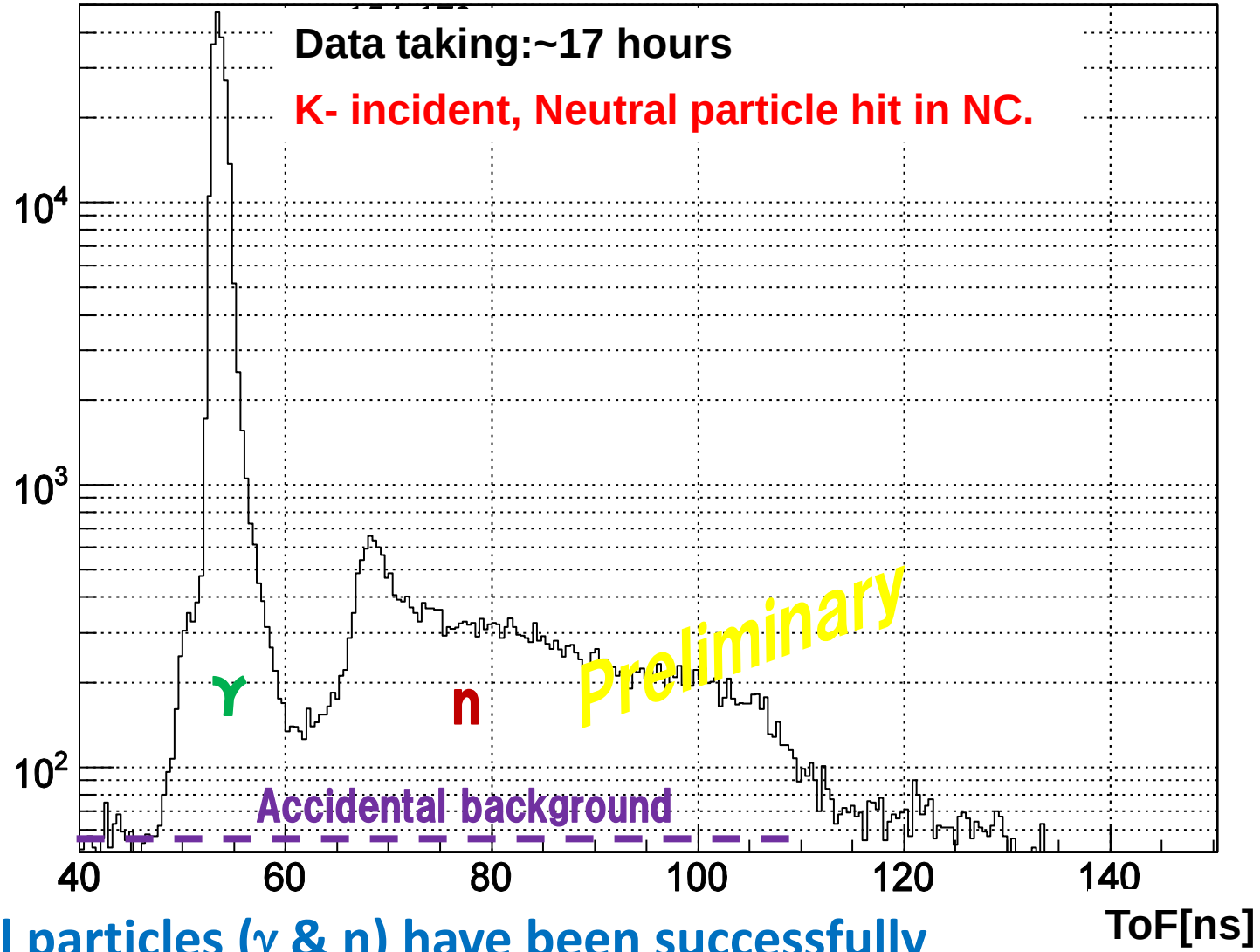






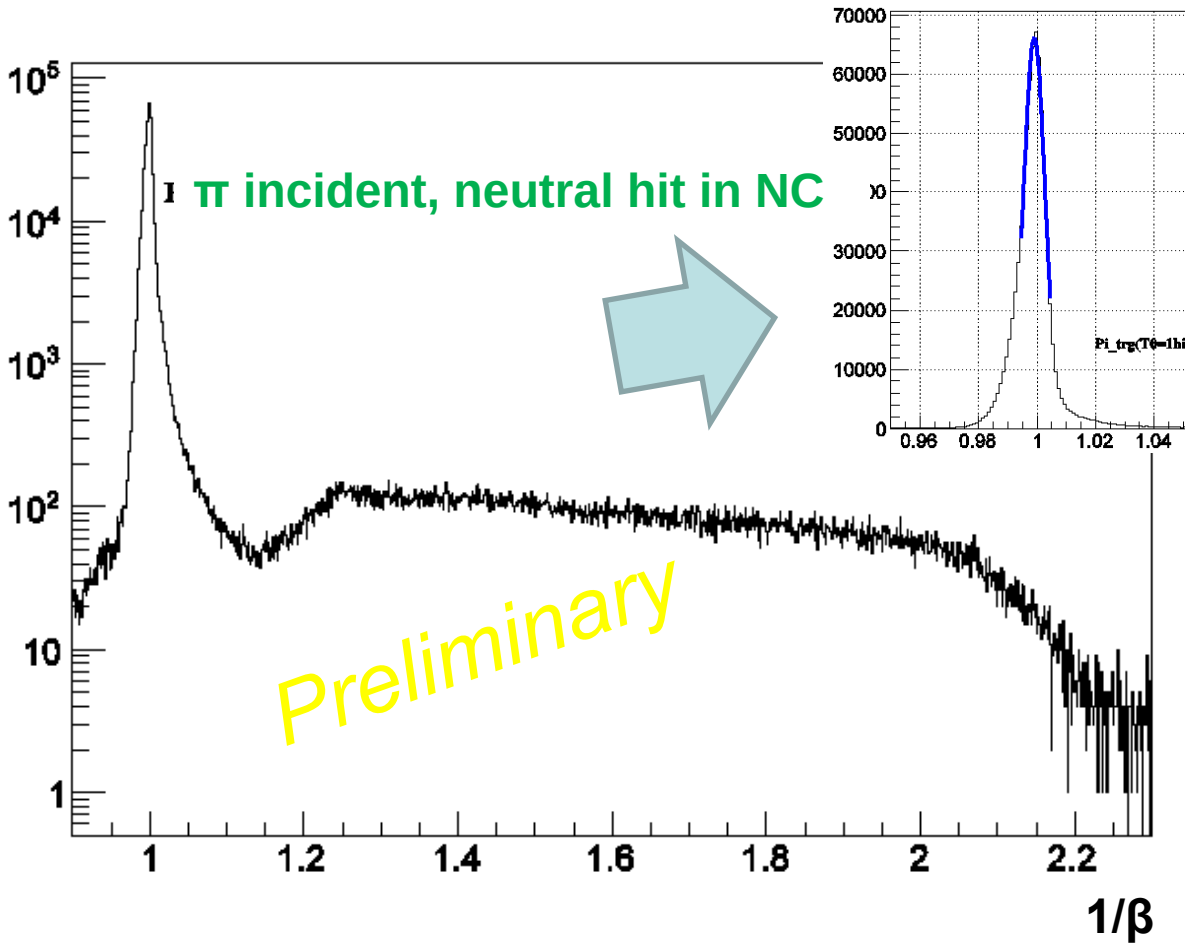
- ✔1.0GeV/c beam is swept out to the beam dump.
- ✔Small background in the forward counters

TOF measurement [T0−NC]



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

1/β Time response of NC



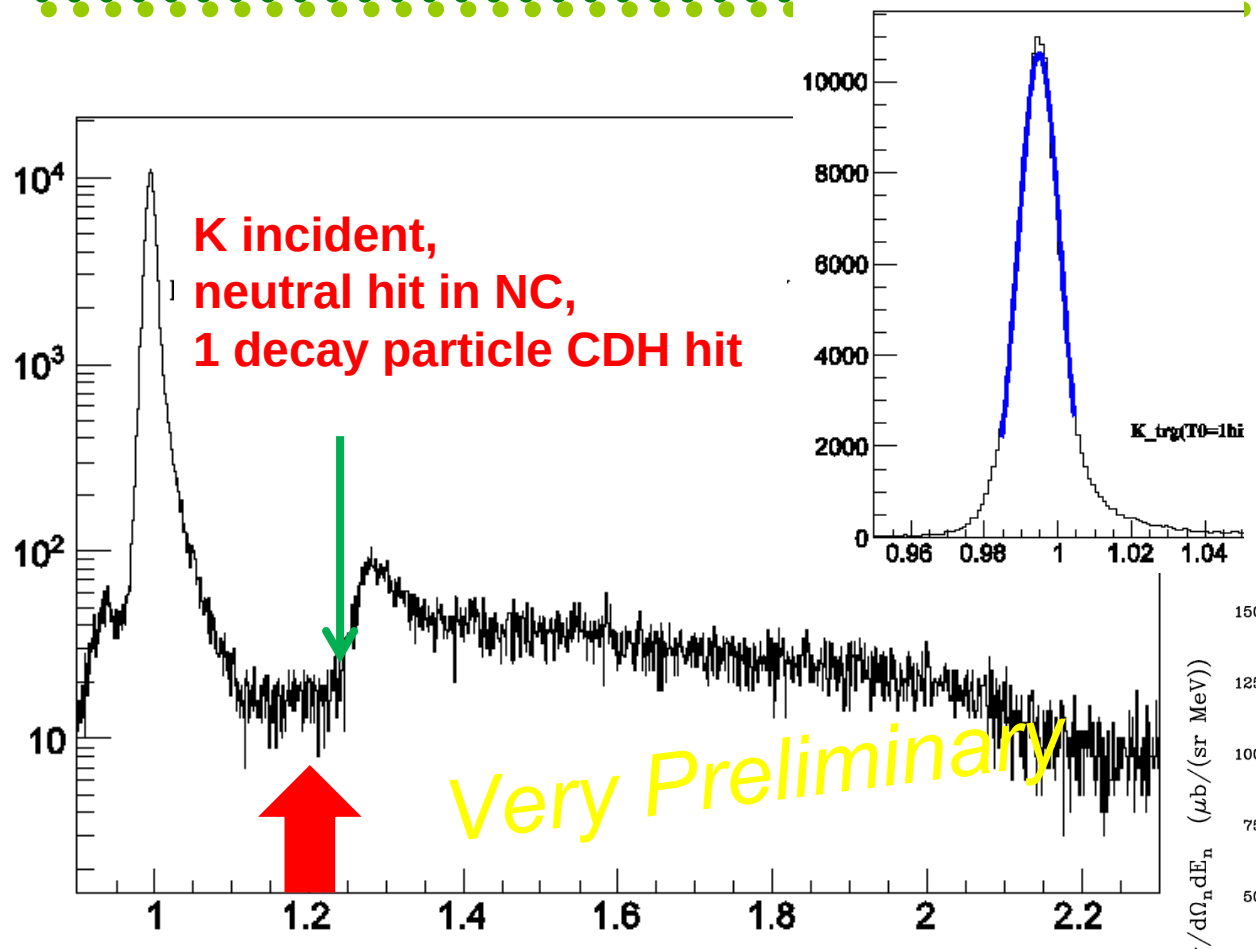
γ- peak

σ(1/β) =0.0036

Flight path ~15[m]

Time resolution ~180[ps]

1/ β spectrum of scattered neutral particles (K^- beam)

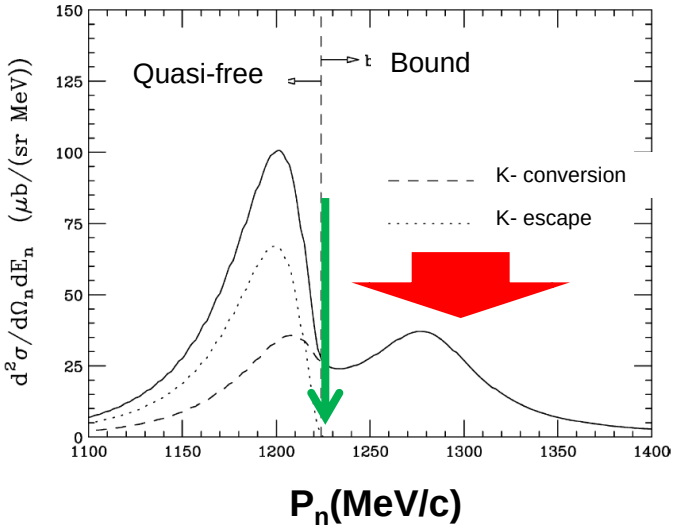


γ- peak

σ(1/β) =0.0057

Vertex point is assumed target center.
Resolution must be improved

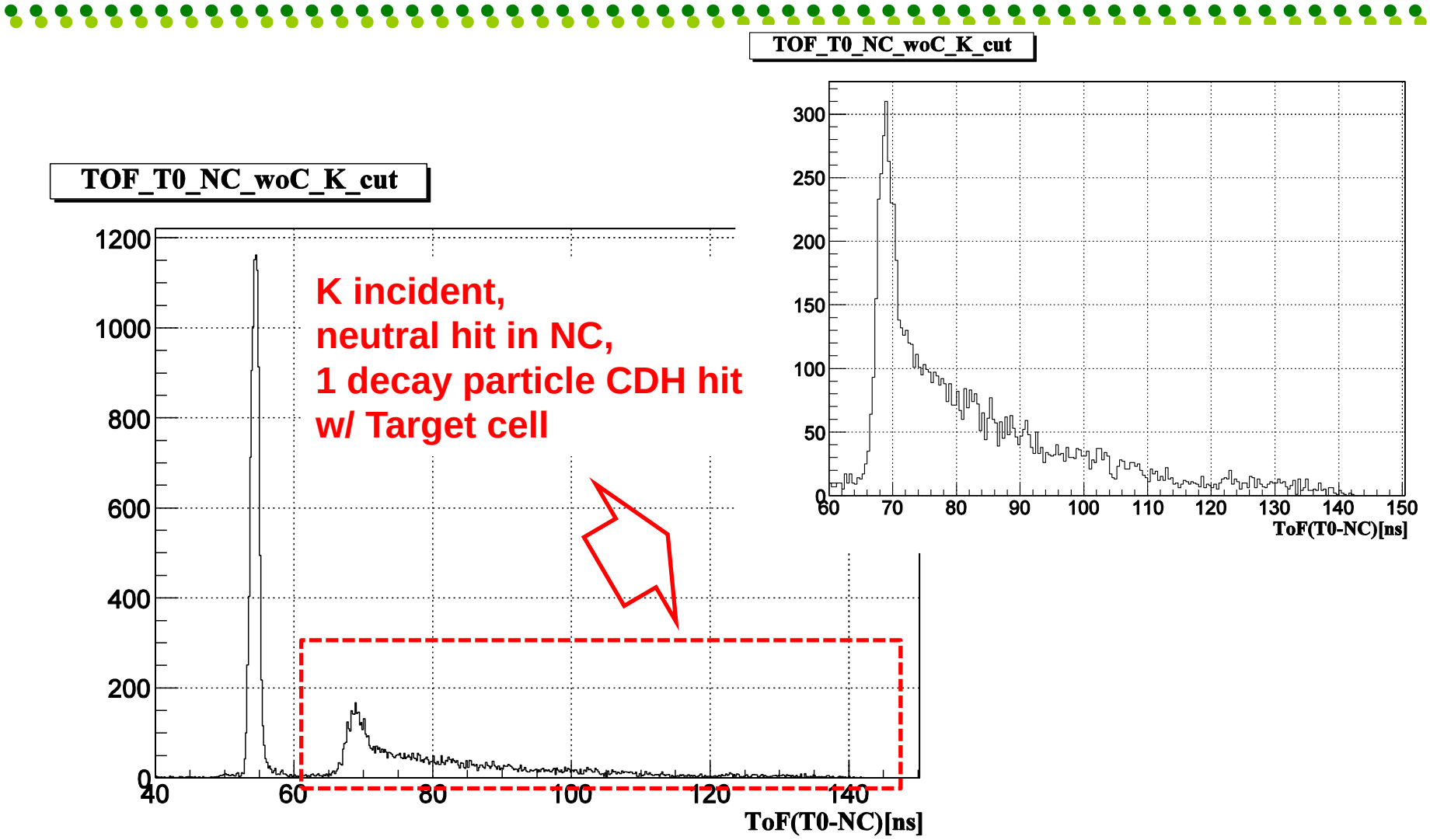
Bound state event?
Analyzing now.



Summary

- 2012年5月に中性子検出器および前方検出器群をJ-PARC K1.8BRに設置した。
- 2012年6月に実際にビームを照射し、動作していることを確認した。
  - BG rateが少ない。
  - γ/nがはっきりと識別できる。
- 本実験に向けて準備万端である。
  - **2013年早春**にphysics run予定している。

➜現在より詳細な解析を行っており、
興味深い結果が期待できる。


TOF_T0_NC_woC_K_cut
TOF_T0_NC_woC_K_cut
K incident,
neutral hit in NC,
1 decay particle CDH hit
w/ Target cell
ToF(T0-NC)[ns]
ToF(T0-NC)[ns]

The J-PARC E15 Collaboration

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

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(*) Spokesperson
($) Co-Spokesperson

J-PARC E31 Collaboration

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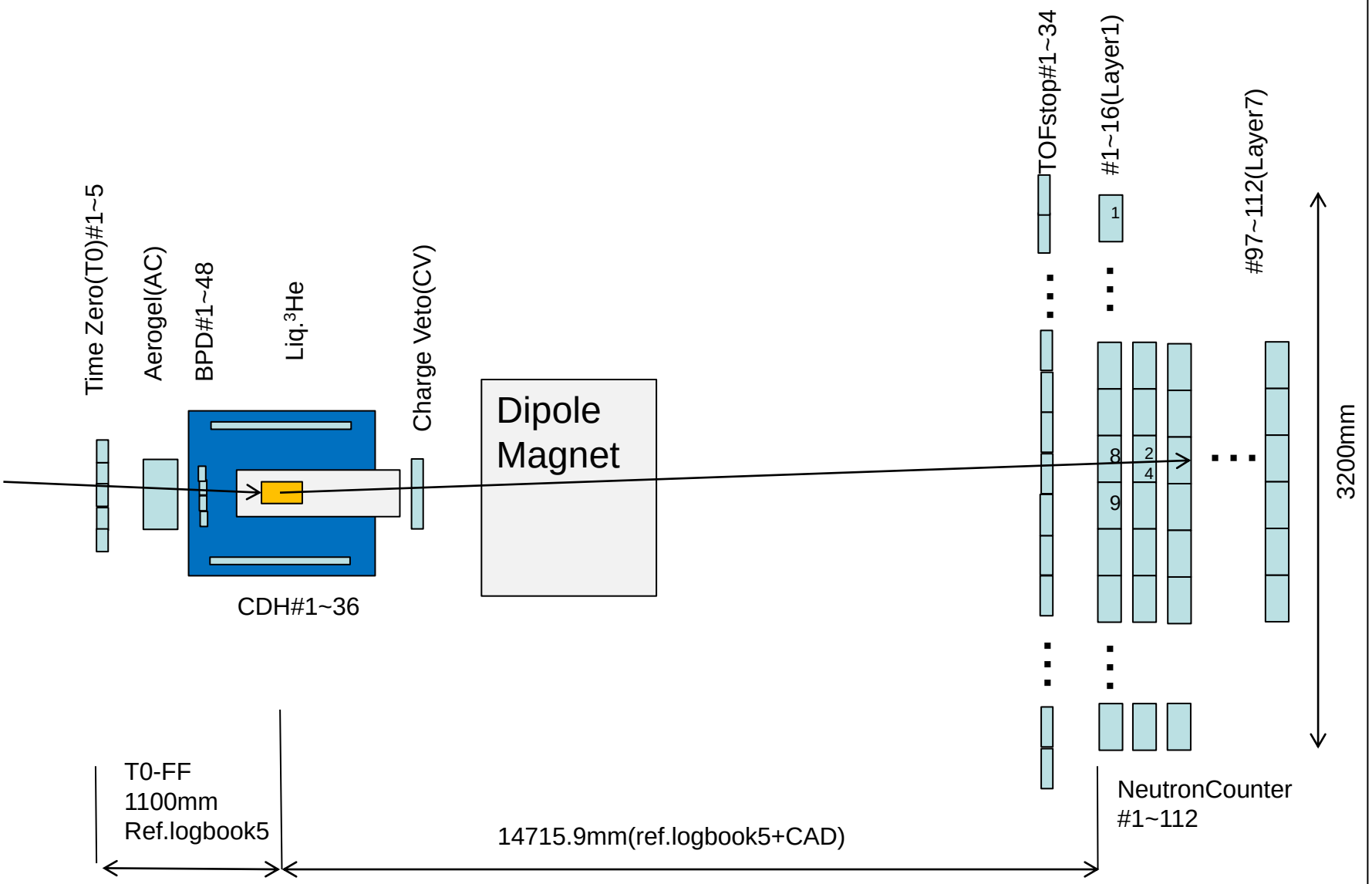
- *11. Osaka Electro-Communication University, Japan, 12. University of Tokyo, Japan*
- *13. Kyoto University, Japan, 14. High Energy Accelerator Research Organization (KEK), Japan*
- *15. Technische Universitat Munchen, Germany, 16. INAF-IFSI, Sezione di Torino, Italy*
- *17. Osaka University, Japan*

Geometry K1.8BR

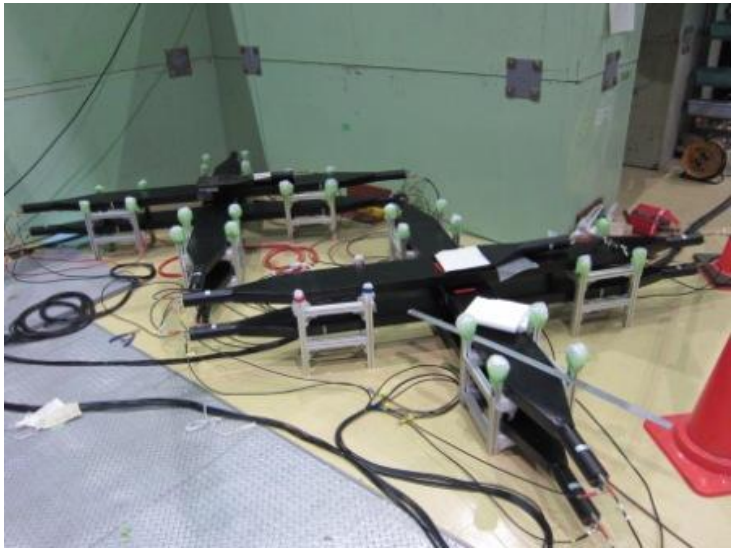


Back up

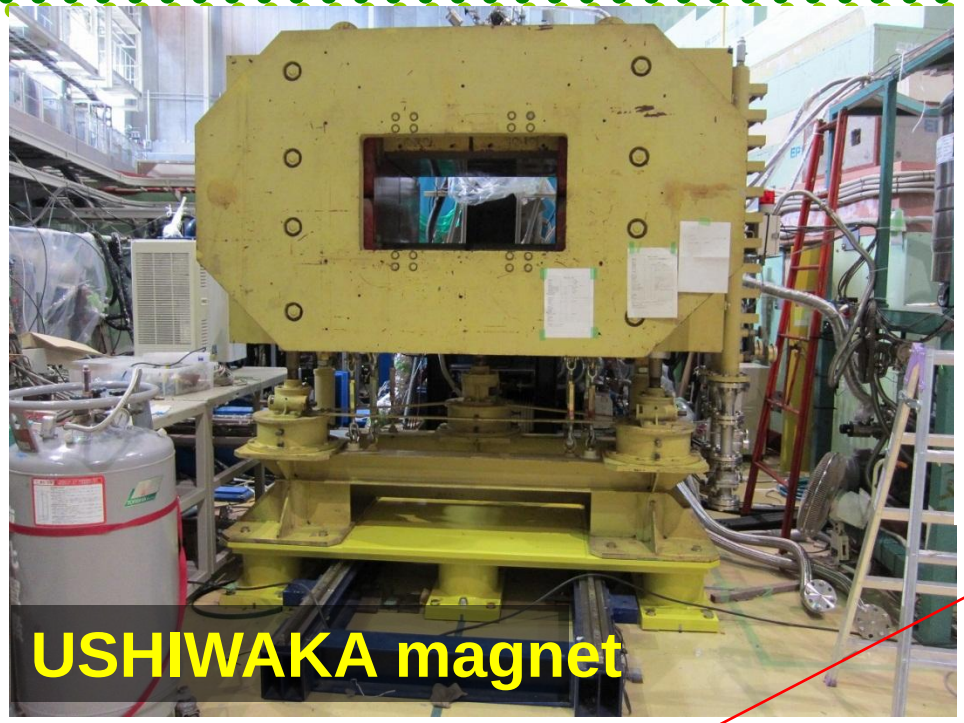
Cosmic ray test

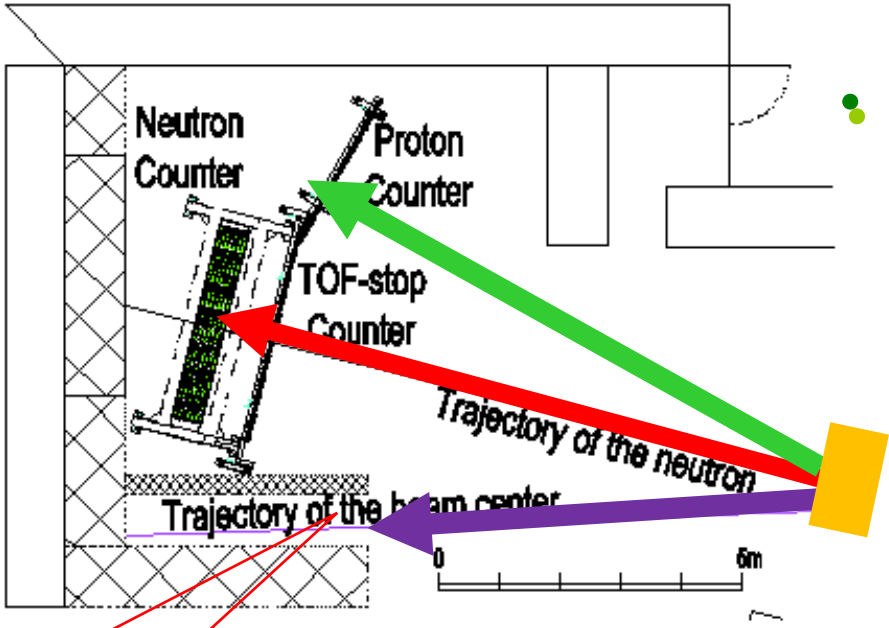
- Using signal cables and circuits are same as production run.

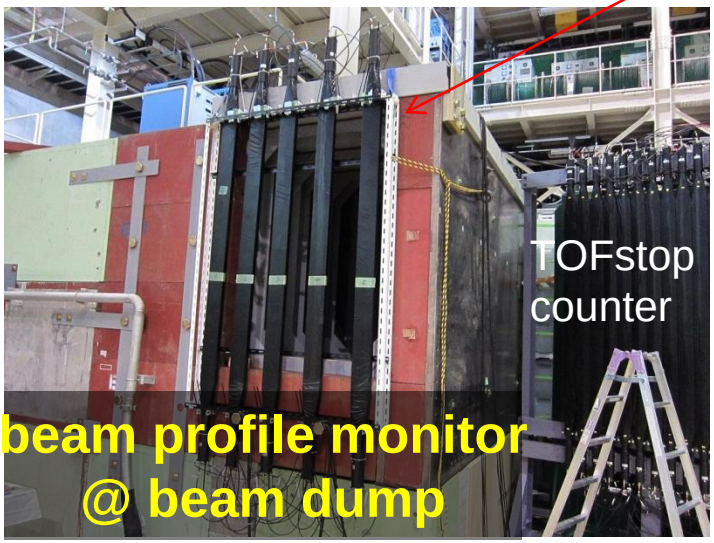
- Time resolution
  - NC(BC408) 89.8±9.7[ps]
  - NC(BC412) 93.3±9.6[ps]

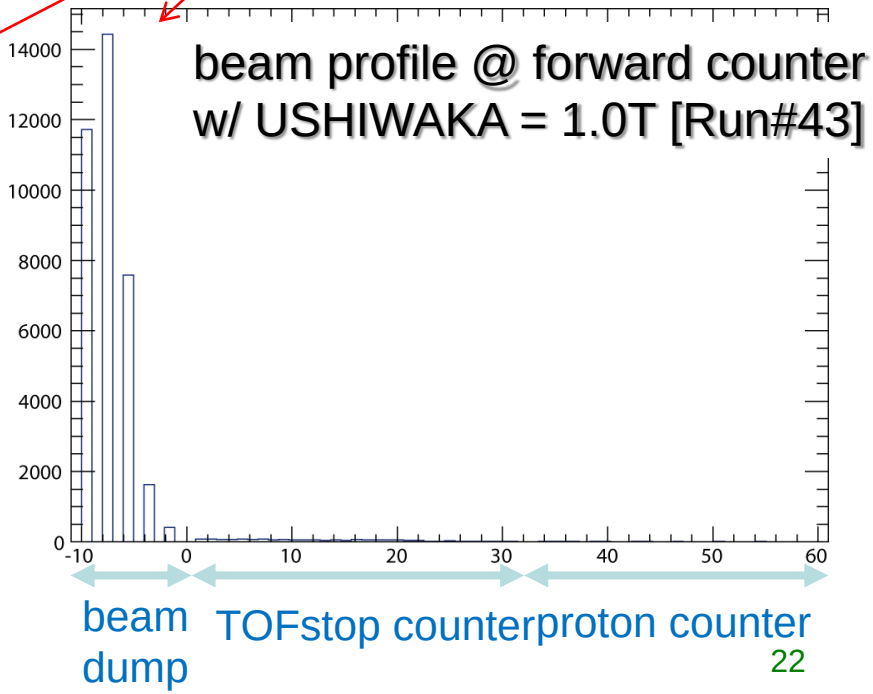


Beam Sweeping Magnet









Neutron Counter

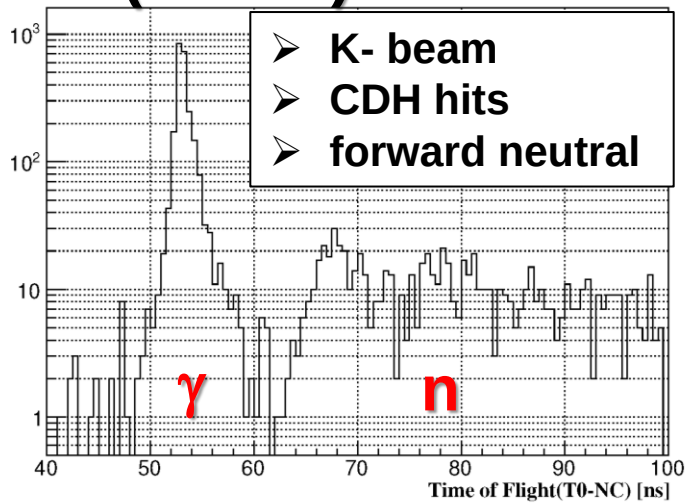
Neutron counter

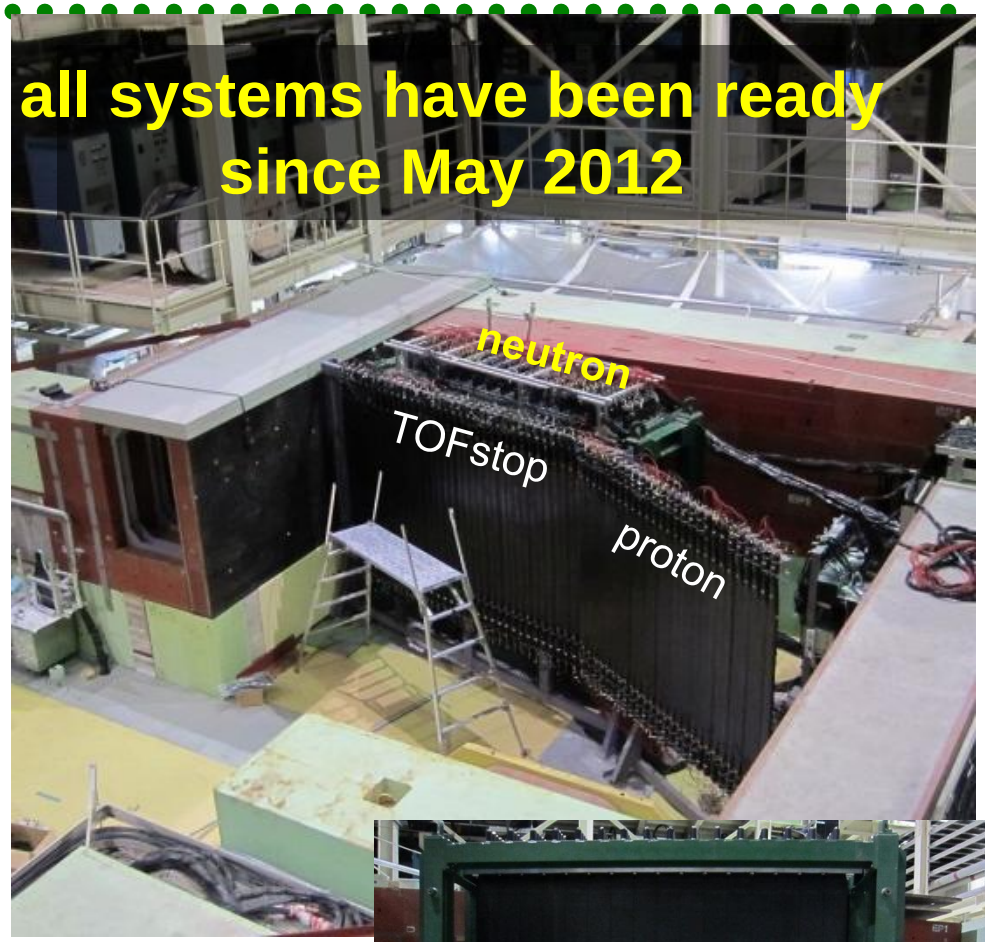
- ✓plastic scintillator array
- ✓16 segments * 7 layers
  [320(w)*150(h)*35(d)cm]

TOFstop / proton counter

- ✓plastic scintillators
- ✓32+27 segments

TOF(NC-T0) in Jun 2012

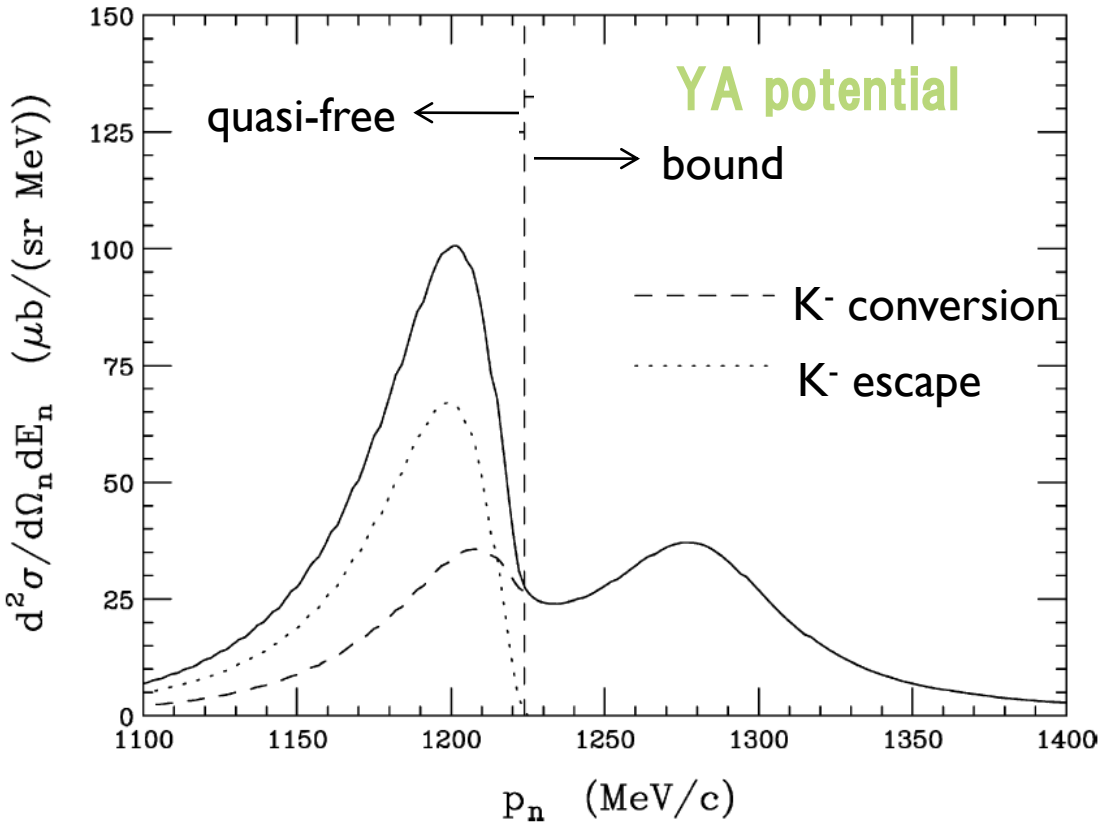




neutral particles (γ & n) have been successfully detected and identified by the NC

….Formation spectra : in-flight $^3He(K^-,n)$….

$K^- + {}^3He \rightarrow$ "K^-pp" + n @ P_K=1GeV/c, θ=0º



Integrated production cross section amounts to ~3.0 mb/sr.

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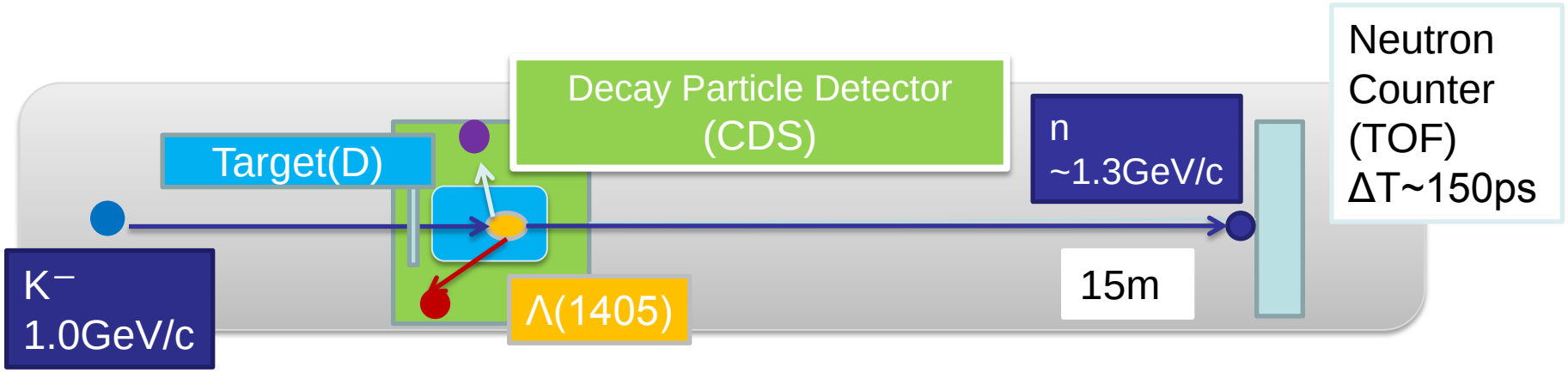
J-PARC E31 Experiments

Spectroscopic study of Hyperon Resonances below KbarN threshold via the (K^-,n) reaction on Deuteron.

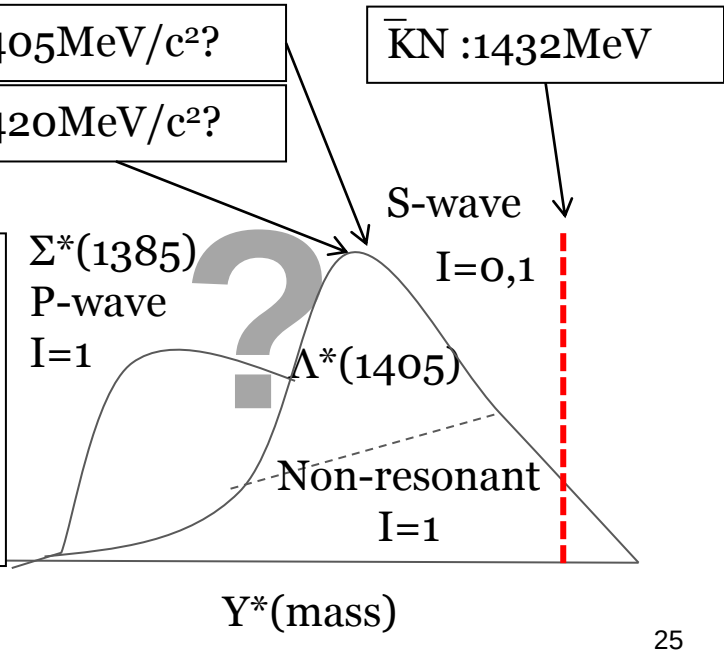


Purely I=0

Λ(1405) and BG(NR/∑*)

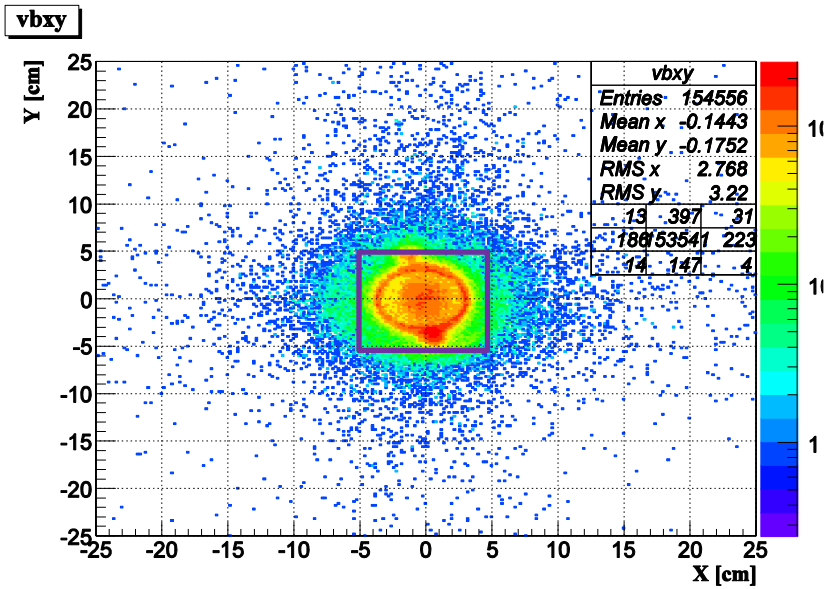
- S-wave,I=0

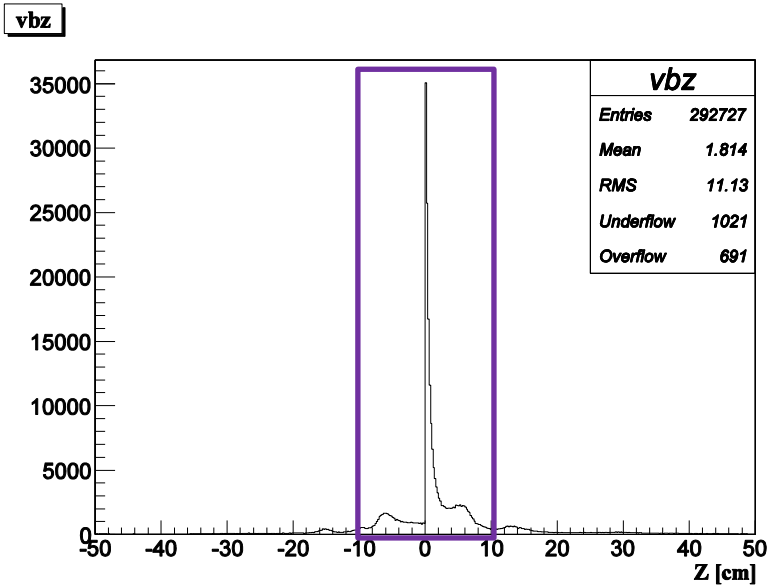
- **Possible ID of I=0 in KbarN→πΣ**
- **Possible decomposition of I=0 amplitude.**



Target image

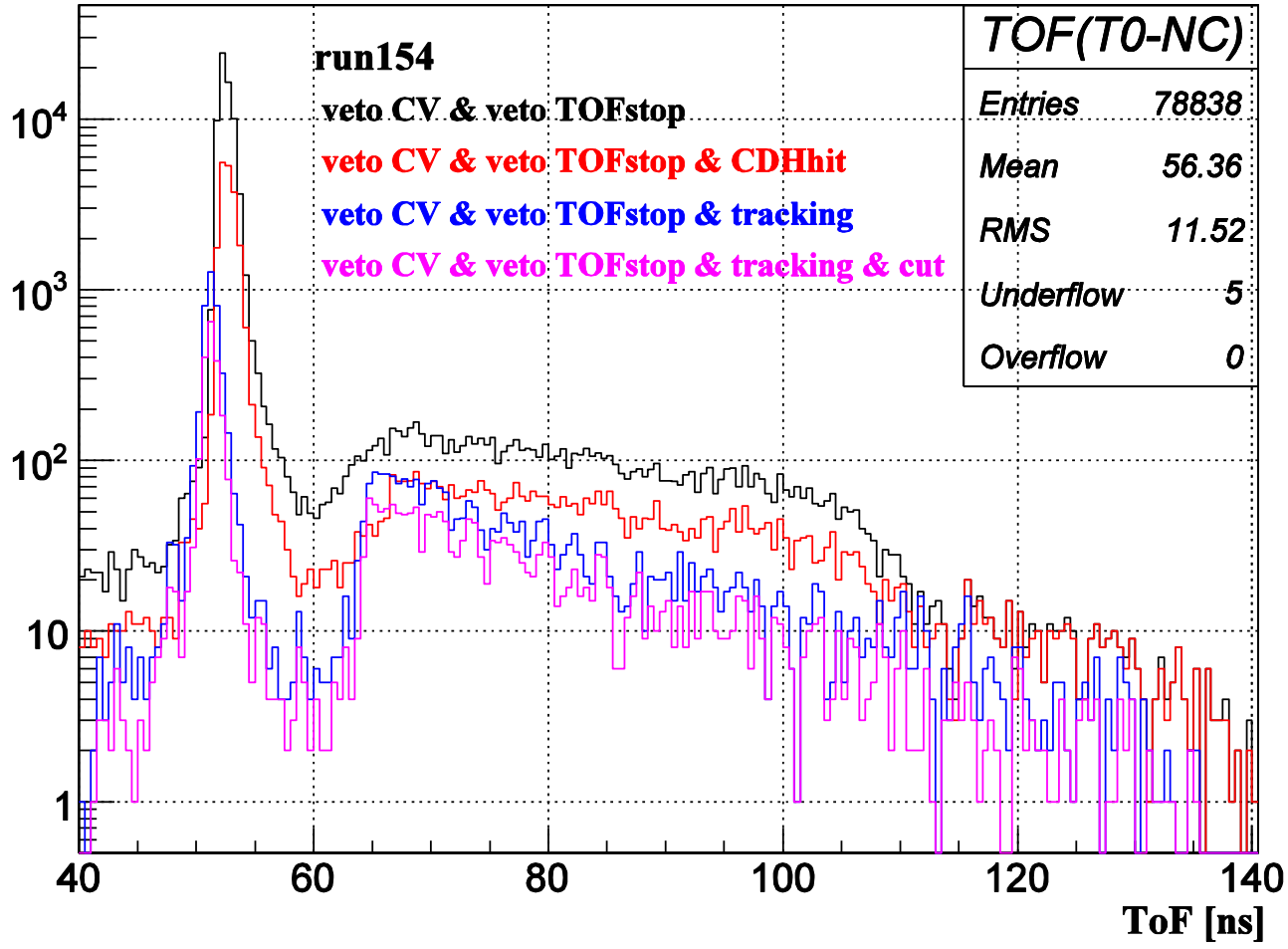
/s/e15/CDC/root/Run43/
Track_xxx.root(tree) ➜BPC-CDC tracking





- Target image
- cut x:-5~5cm y:-5~5cm z:-10~10cm

ToF [T0−NC] w/ target info.



select trigger

L:Neutral hit in NC

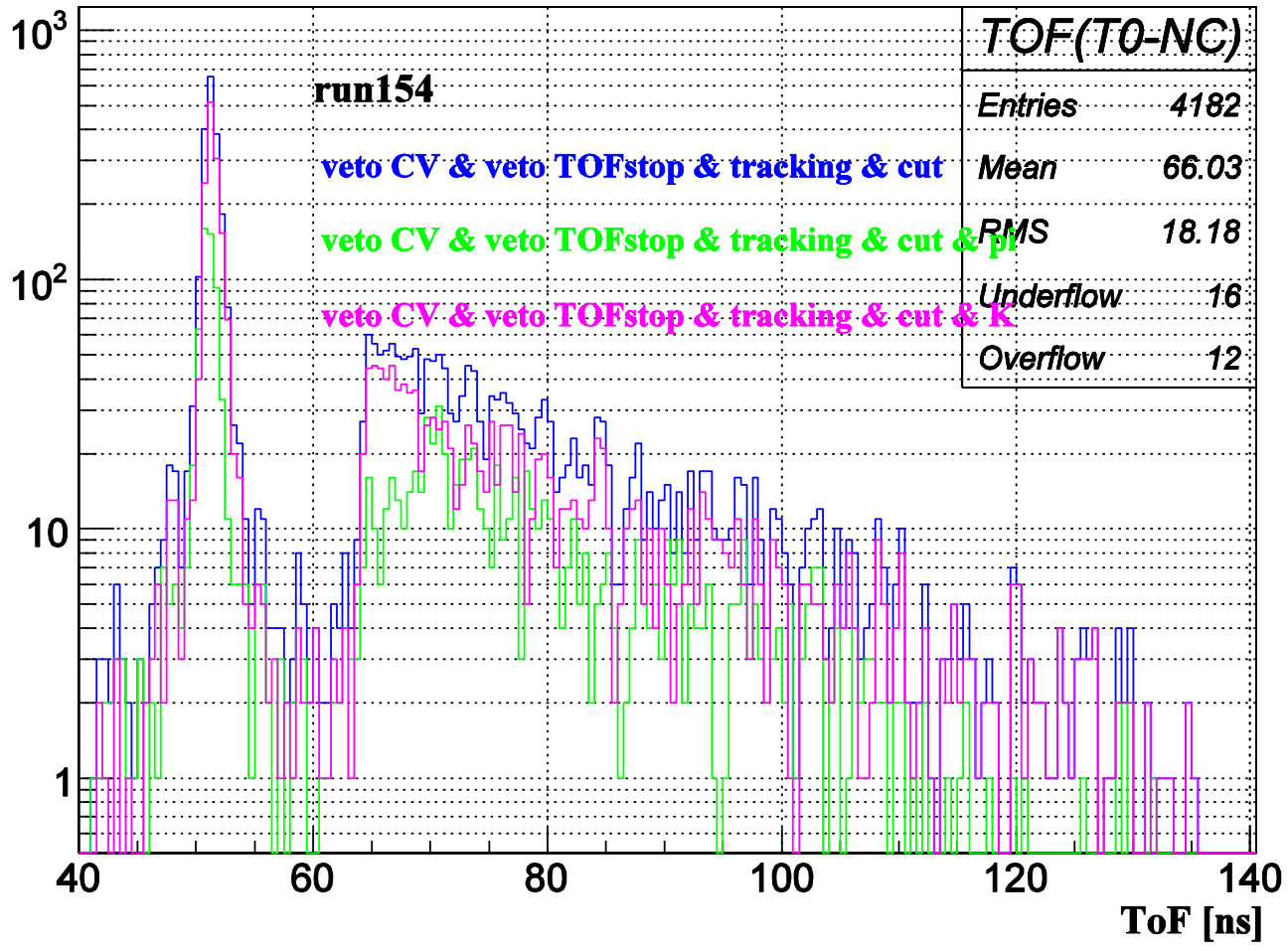
2:Neutral hit in NC
× CDH hit

3:Neutral hit in NC
× CDC tracking

4:Neutral hit in NC
× CDC tracking
× cut target cell
mage

Different 1,2 from
3,4 of parameter file.
. time offset)

ToF [T0−NC] w/ target info. Select trigger



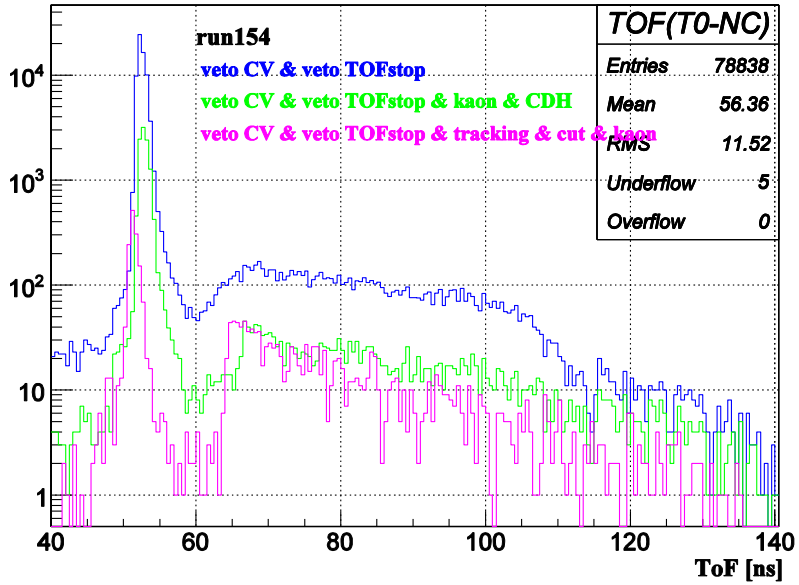
1:Neutral hit in NC ×
CDC tracking ×
Cut target cell image ×
Not select trigger

2:Neutral hit in NC ×
CDC tracking ×
Cut target cell image ×
Kaon trigger

3:Neutral hit in NC ×
CDC tracking ×
Cut target cell image ×
Pion trigger

ToF [T0−NC] w/ target info. Kaon and Pion trigger

Kaon



Pion