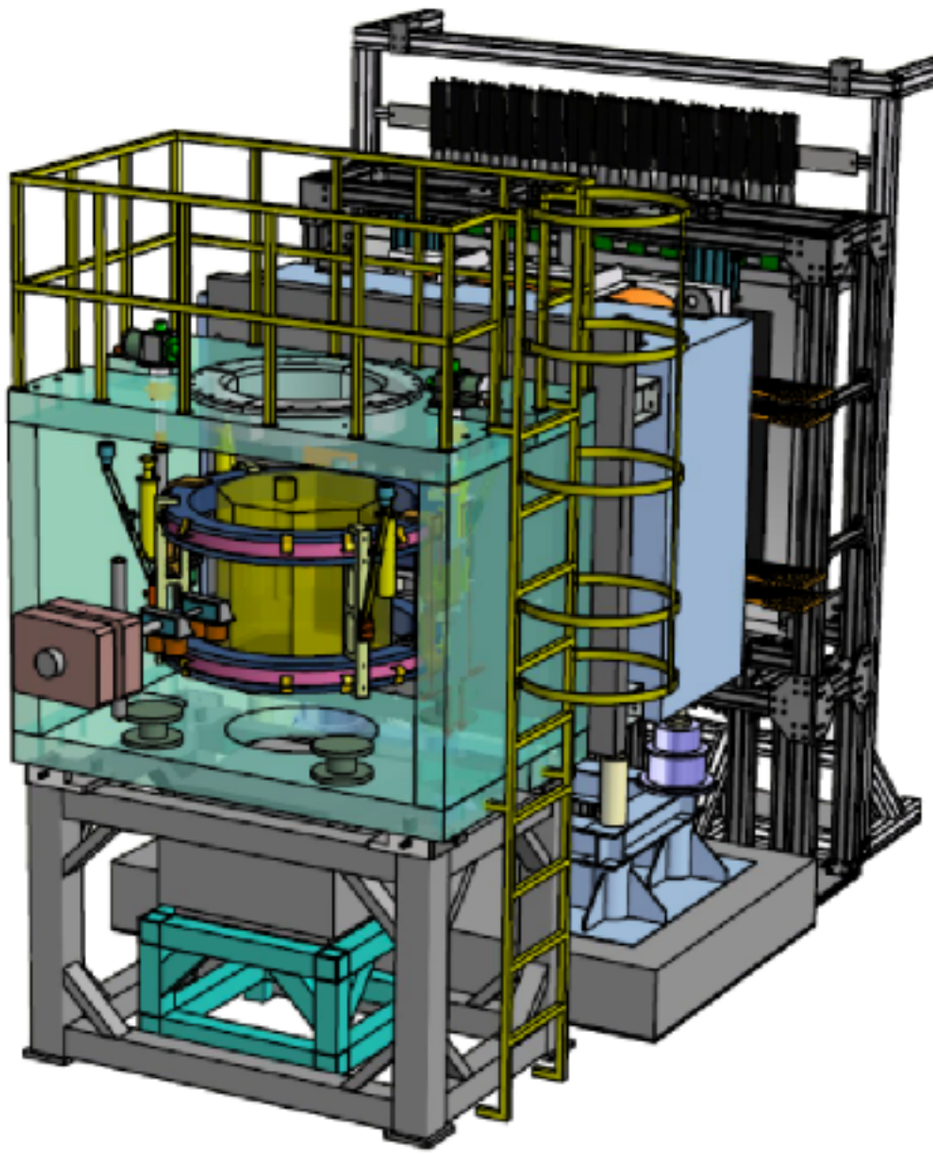
2016 KPS FALL MEETING

J-PARC E42/E45 하드론 실험을 위한 TPC Trigger Hodoscope 개발



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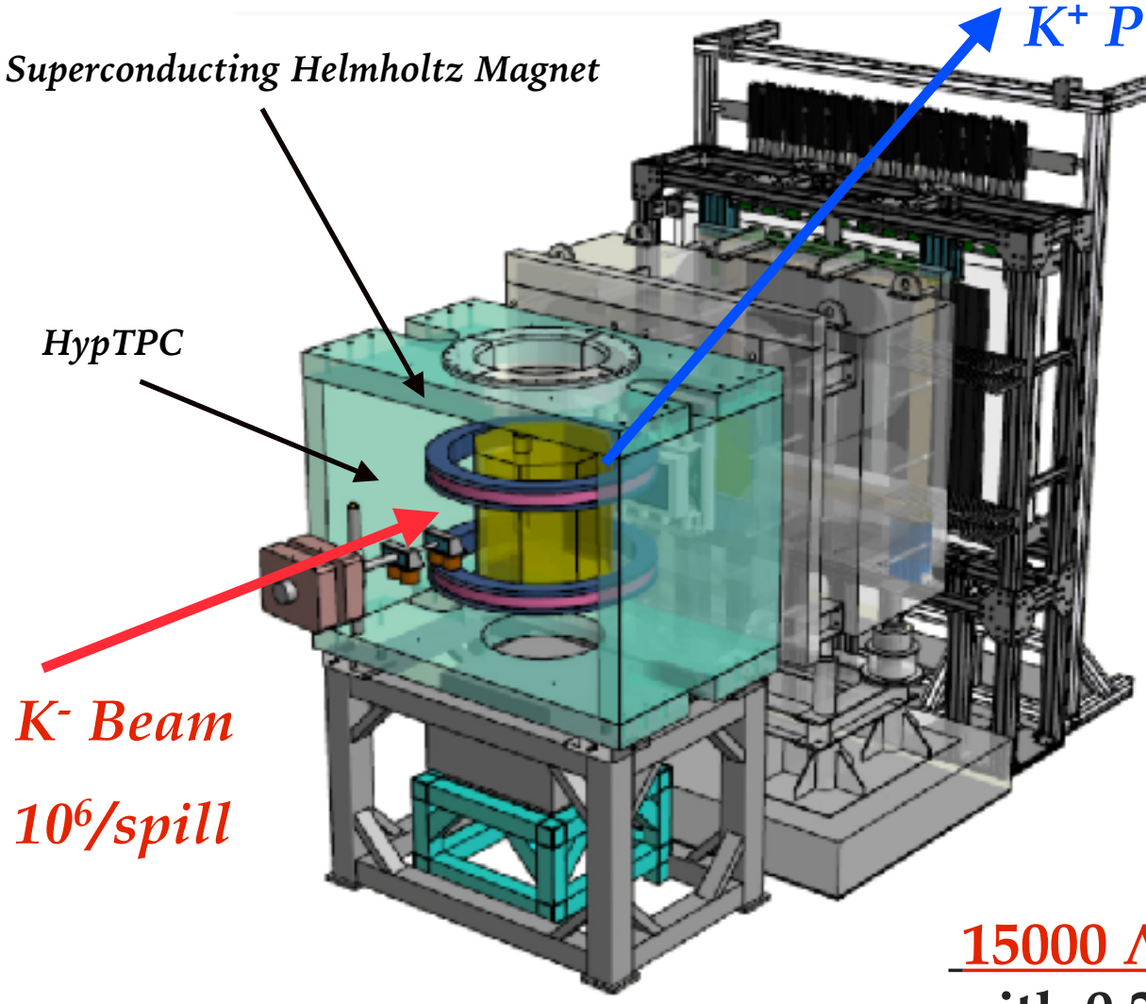
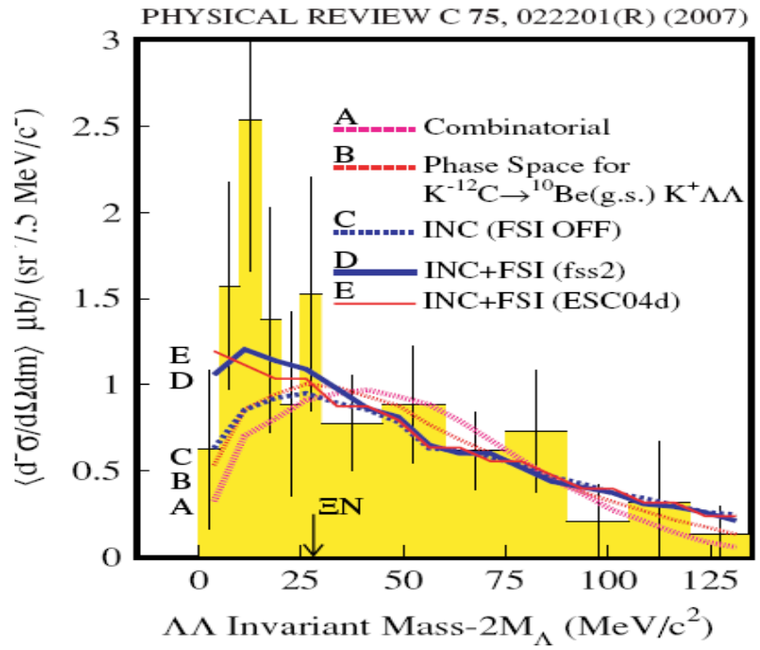
CONTENTS

E42 @ J-PARC

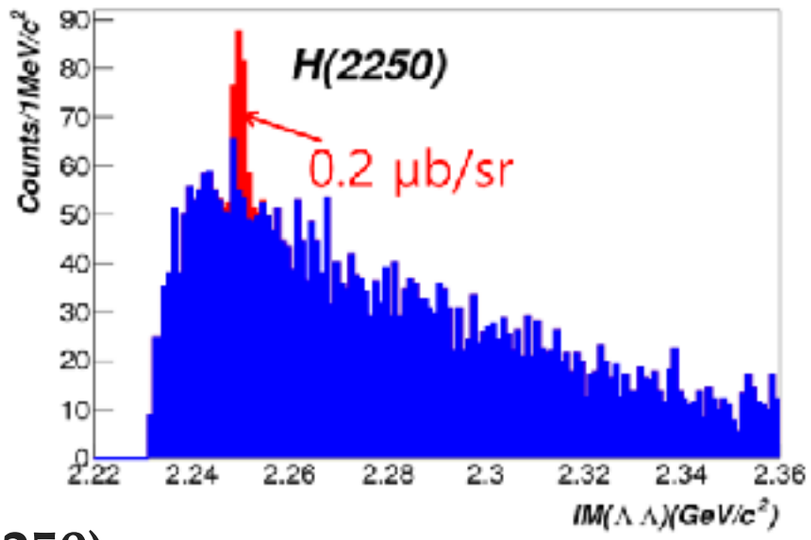
Searching for the six-quark H-dibaryon state in the mass region near ΛΛ threshold via (K , K+) reactions at J-PARC



E522 @ KEK



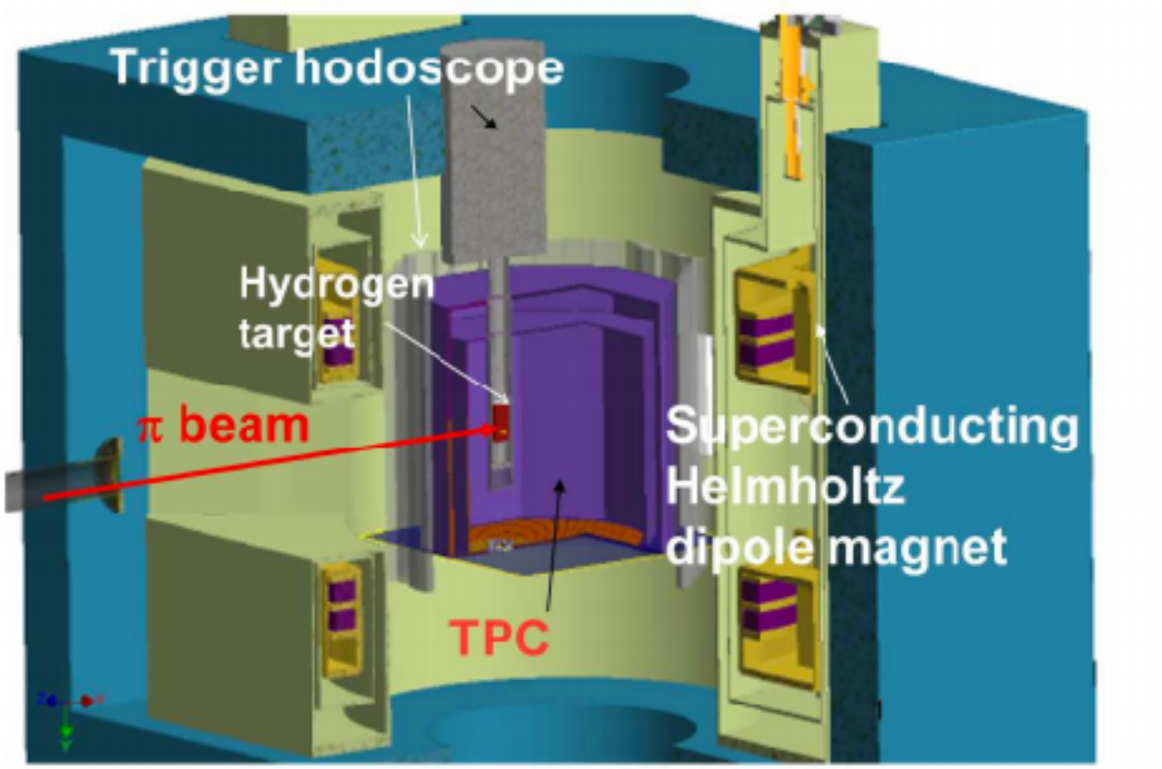
Simulation of E42 (ΛΛ invariant mass)

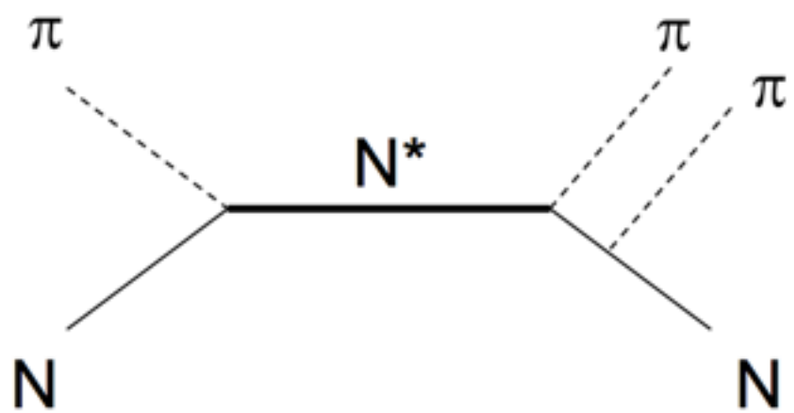


15000 ΛΛ events and 46 H(2250) with 0.2 ub/sr in 100 shifts of beam time

E45 @ J-PARC

Study of baryon excited states in (π, 2π) reactions at J-PARC





$\pi^- p \rightarrow \pi^+\pi^- n$, $\pi^0\pi^- p$

$\pi^+ p \rightarrow \pi^0\pi^+ p$, $\pi^+\pi^+ n$

2 charged particles + 1 neutral particle
→ missing mass technique

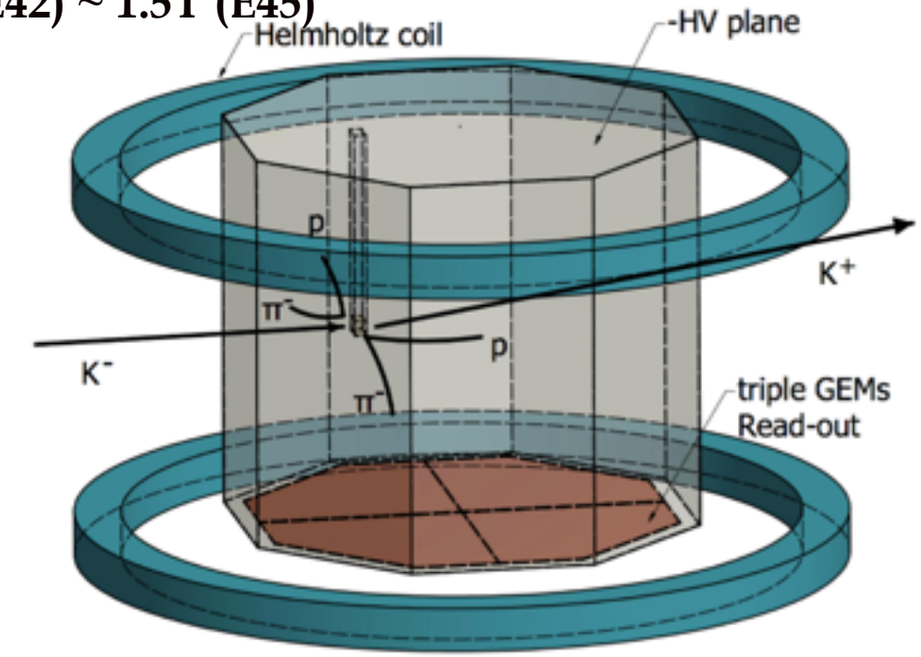
<u>Increase world's ππN data (240K) by a factor of 130</u>

HYPERON SPECTROMETER

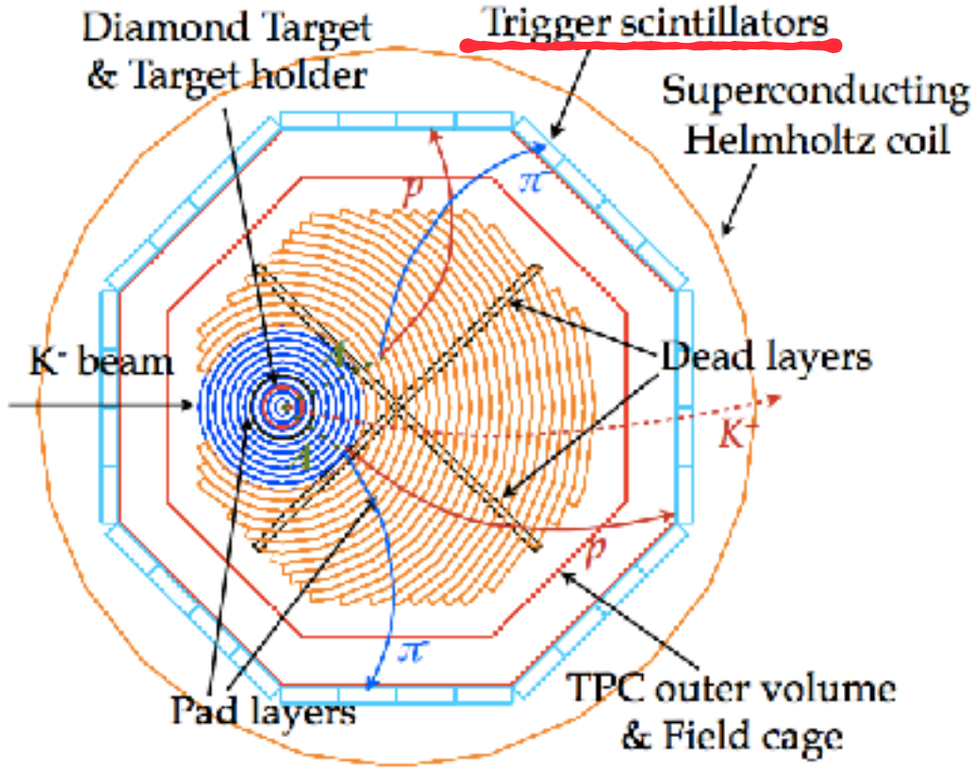
HypTPC is located in a superconducting Helmholtz magnet

B field strength

1 T (E42) ~ 1.5T (E45)



High resolution
($\Delta M \approx 1 MeV/c^2$, $\Delta p/p \approx 3\%$)

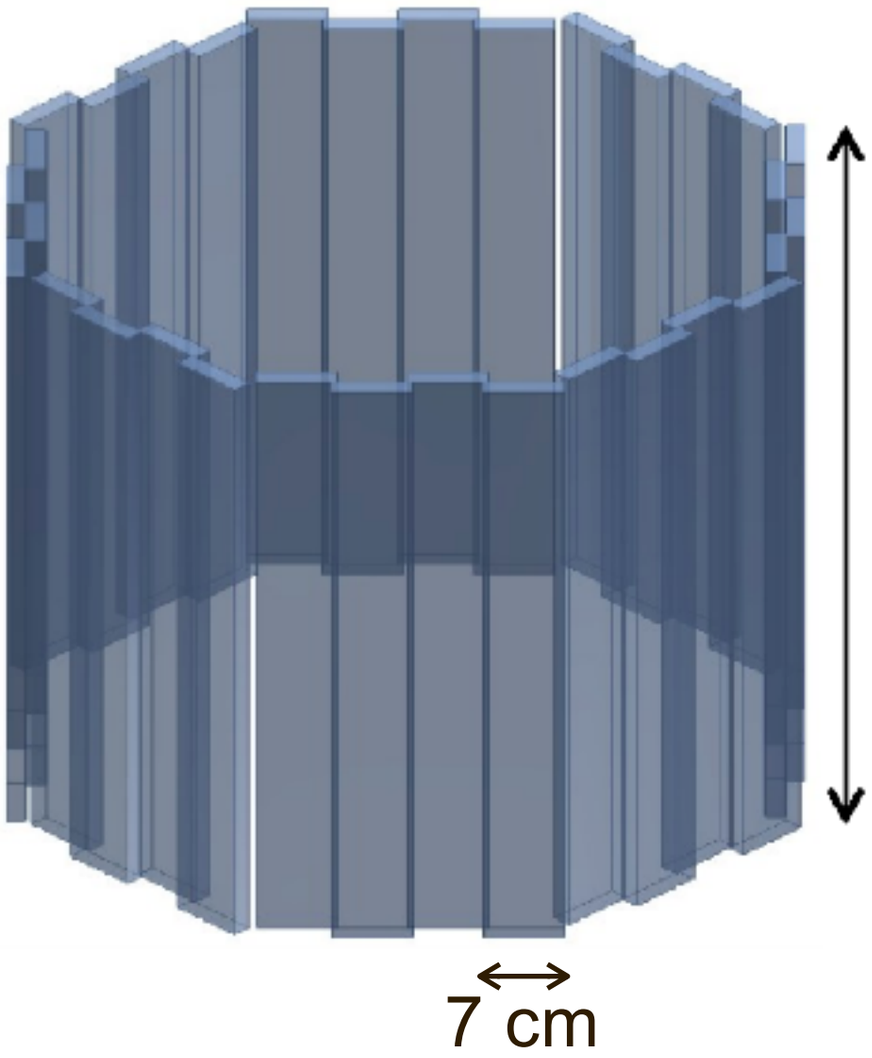


Strong magnetic field strength
&
Small available space

⇒MPPC

TPC TRIGGER HODOSCOPE

Scintillators surrounding TPC for triggering and timing purpose

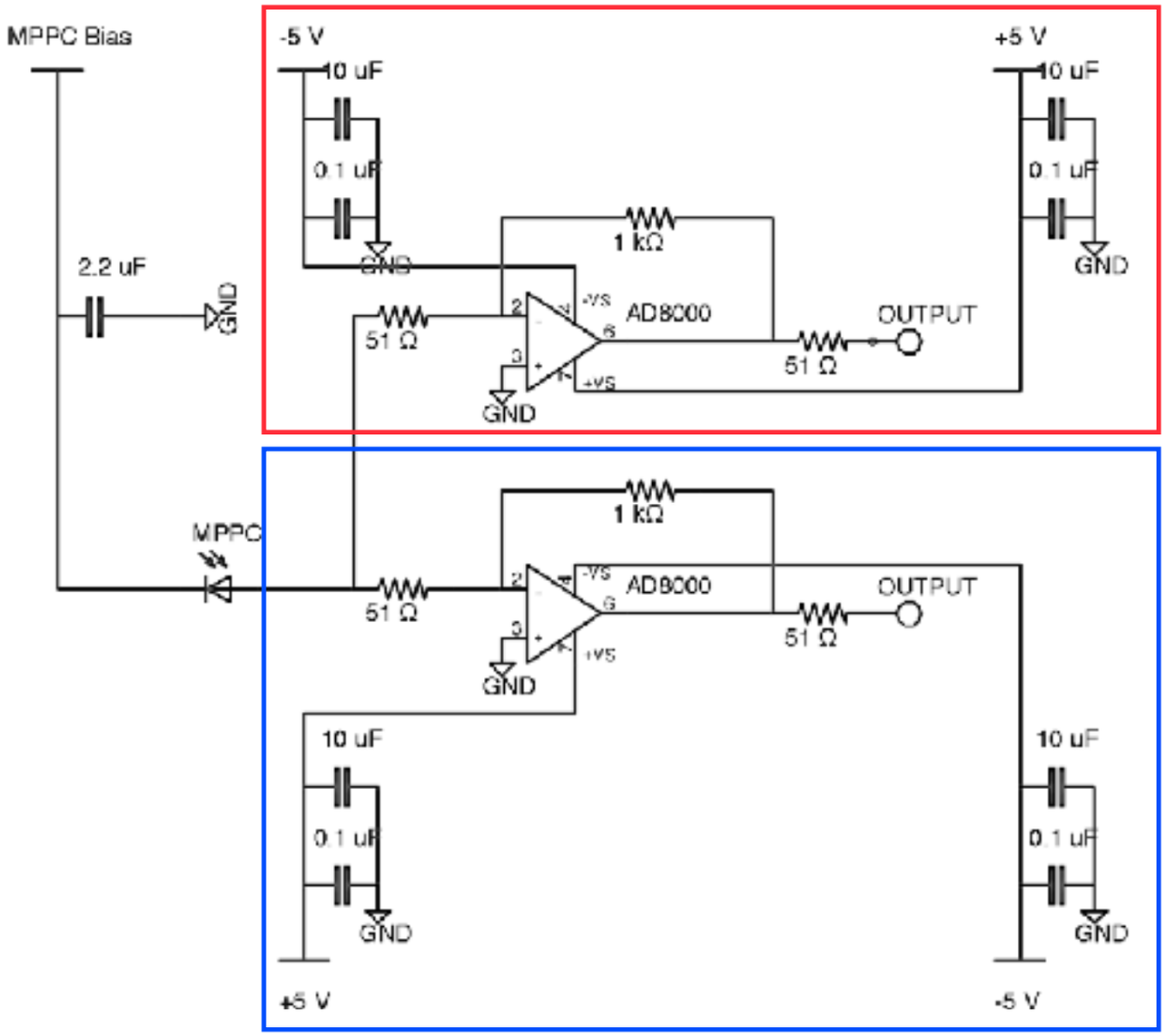


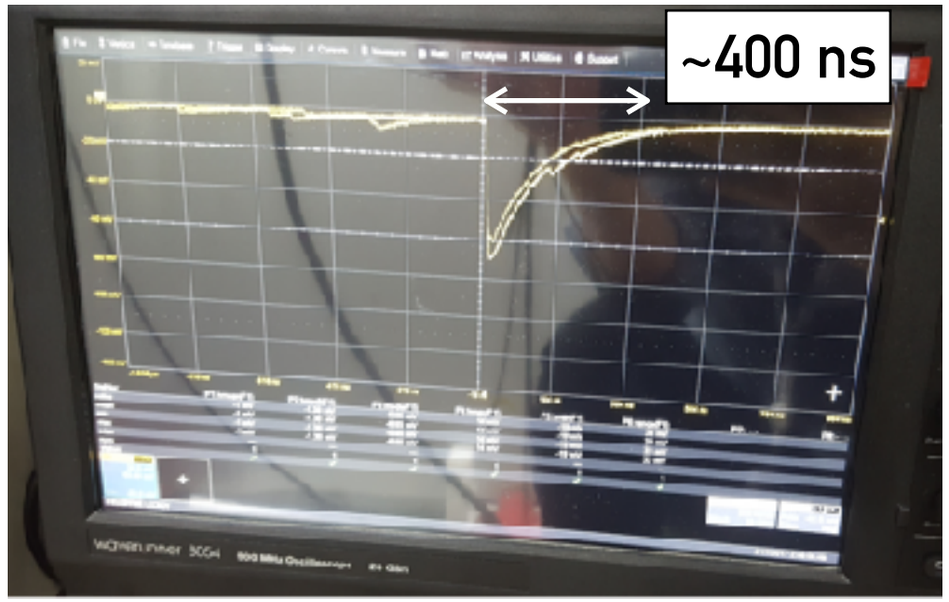
Multiplicity Trigger

32 scintillators with both-ends mppc readout

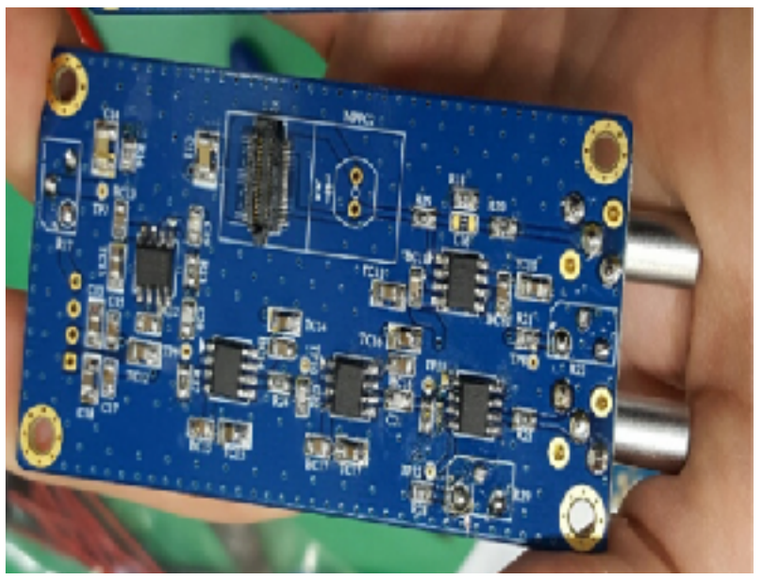
HODOSCOPE PROTOTYPE

mppc signal readout circuit





LED signal

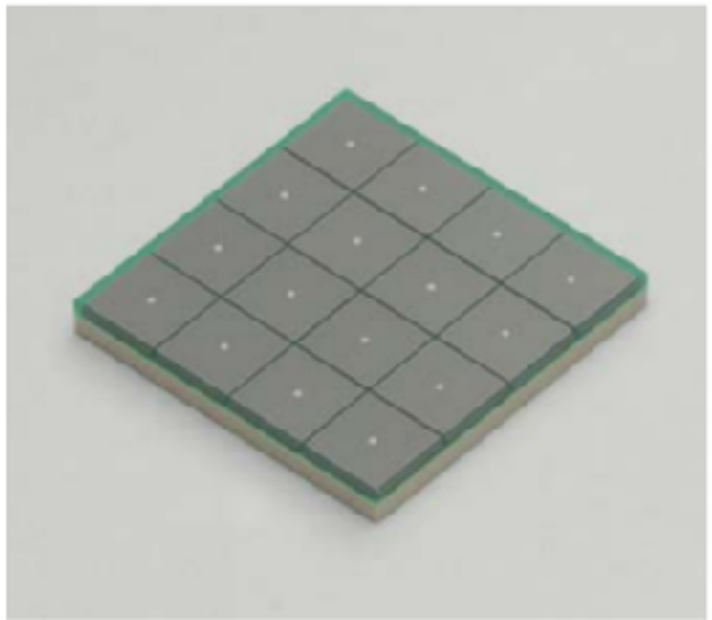


mppc current divided into two lines (for ADC and TDC) with fixed gain (~20)

HODOSCOPE PROTOTYPE

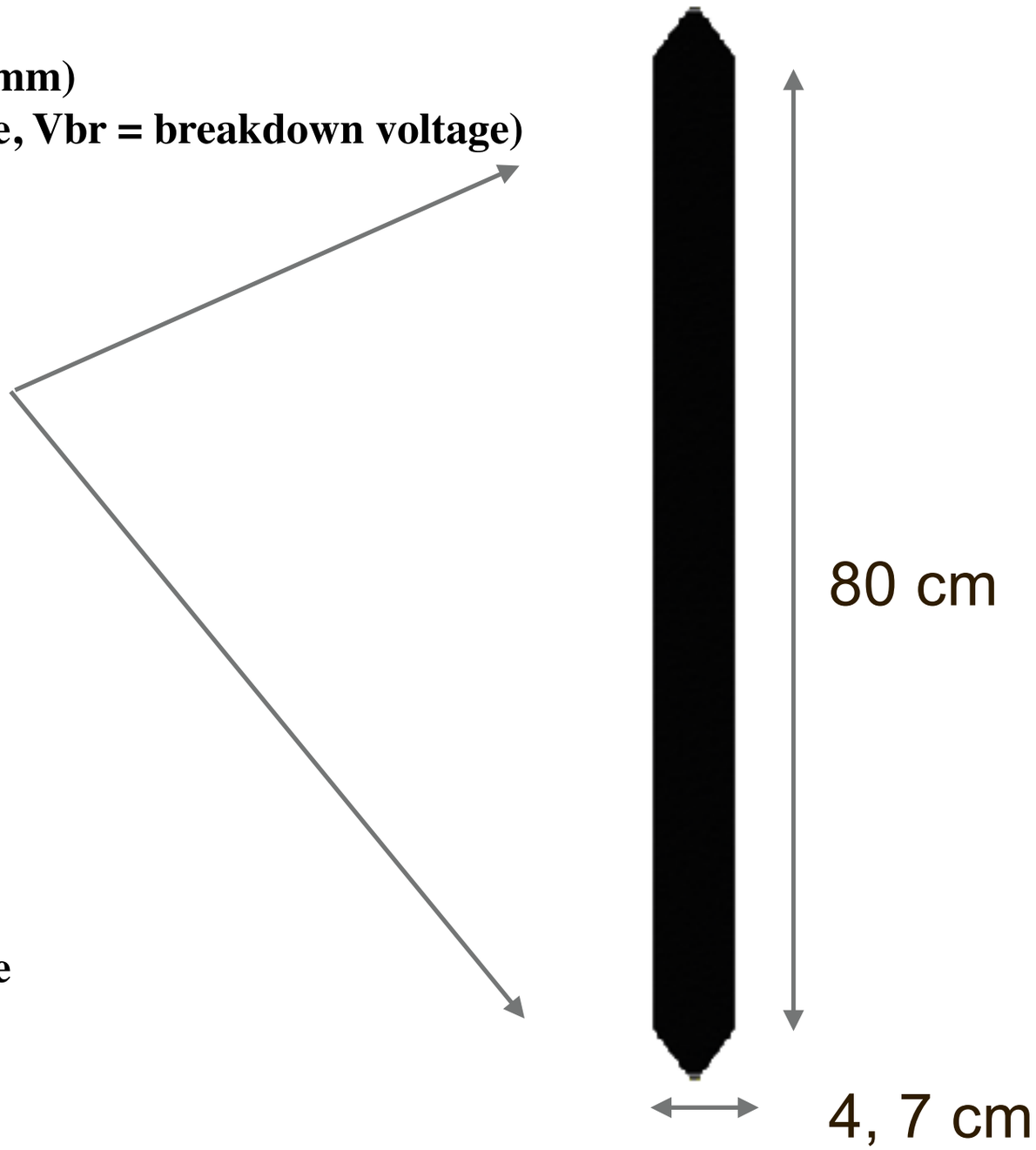
mppc

hamamatsu 12642-0404PB-50(1.2x1.2 mm)
Vop = Vbr +2.6 (Vop: operation voltage, Vbr = breakdown voltage)



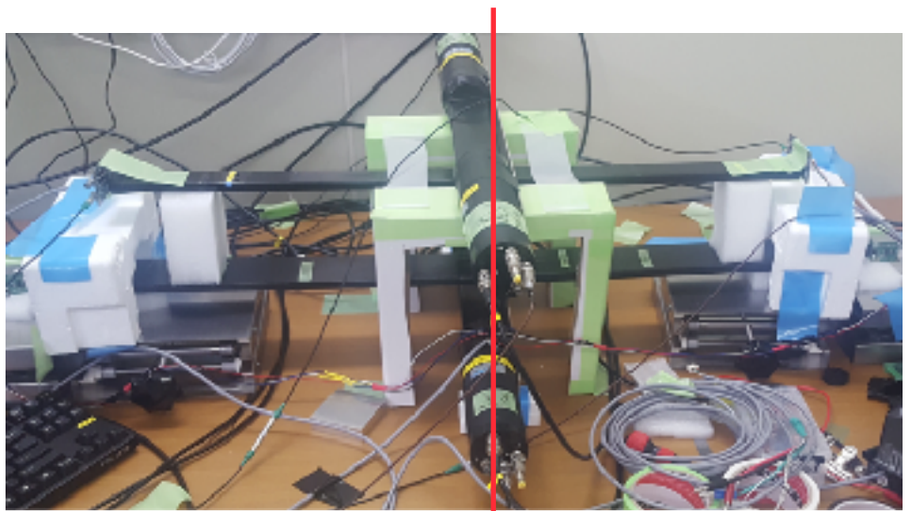
Scintillators(ej-200)

80x10x70 (mm) - proposed hodoscope
80x10x40 (mm) - candidate



HODOSCOPE PROTOTYPE

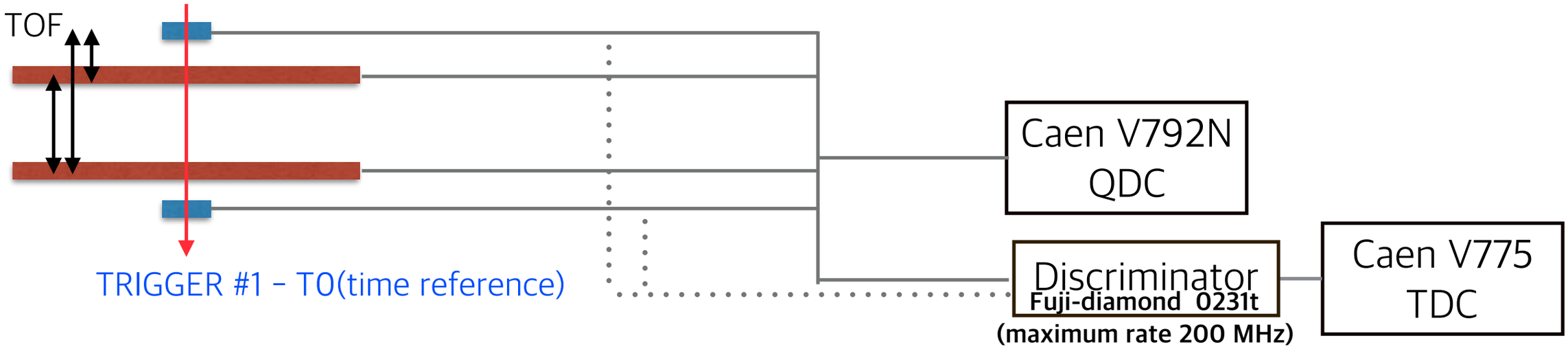
Cosmic ray test-bench



DAQ VME

V792N QDC
FSR : 400 pC, gain: 100 fC/count (12 bit)

V775V TDC
FSR : 140 ns LSB: 35 ps (12 bit)



Result (Time resolution)

Scintillator 1 : 627.748 +/− 4.27568 ps (width 7cm)

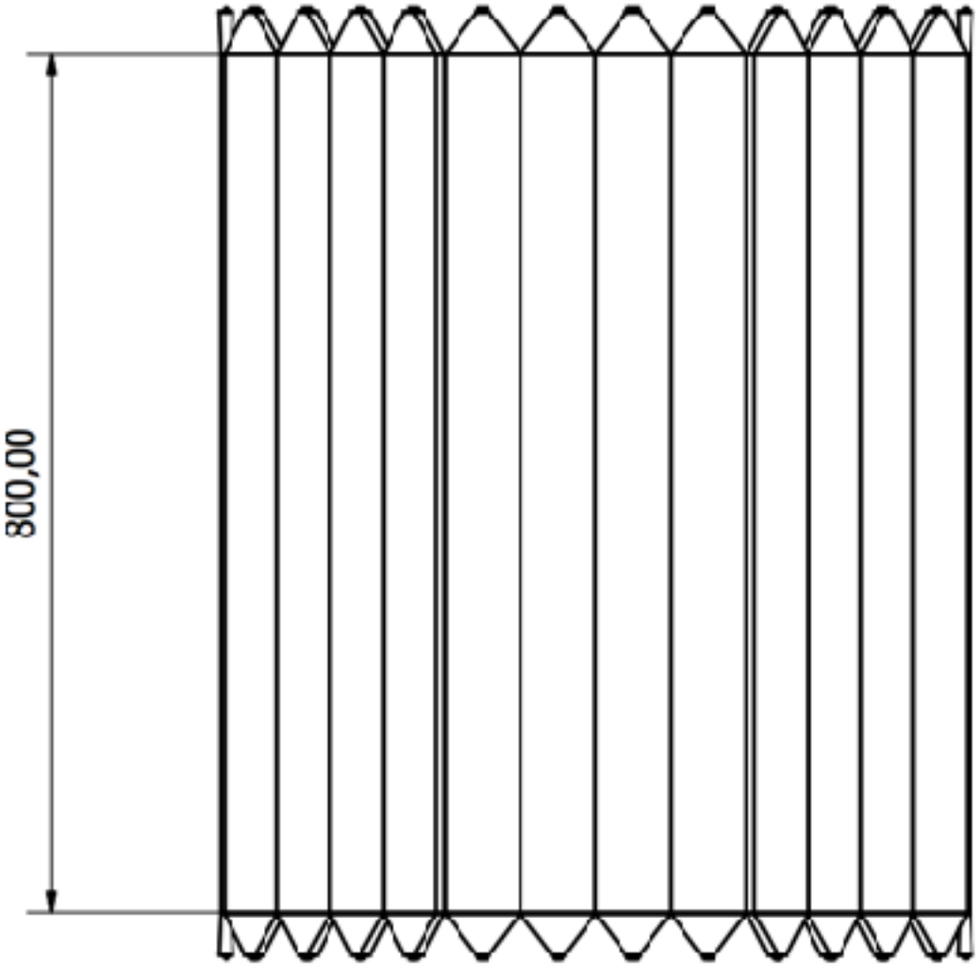
Scintillator 2 : 337.878 +/− 7.94384 ps (width 4cm) trigger : 217.204 +/− 12.3573 ps

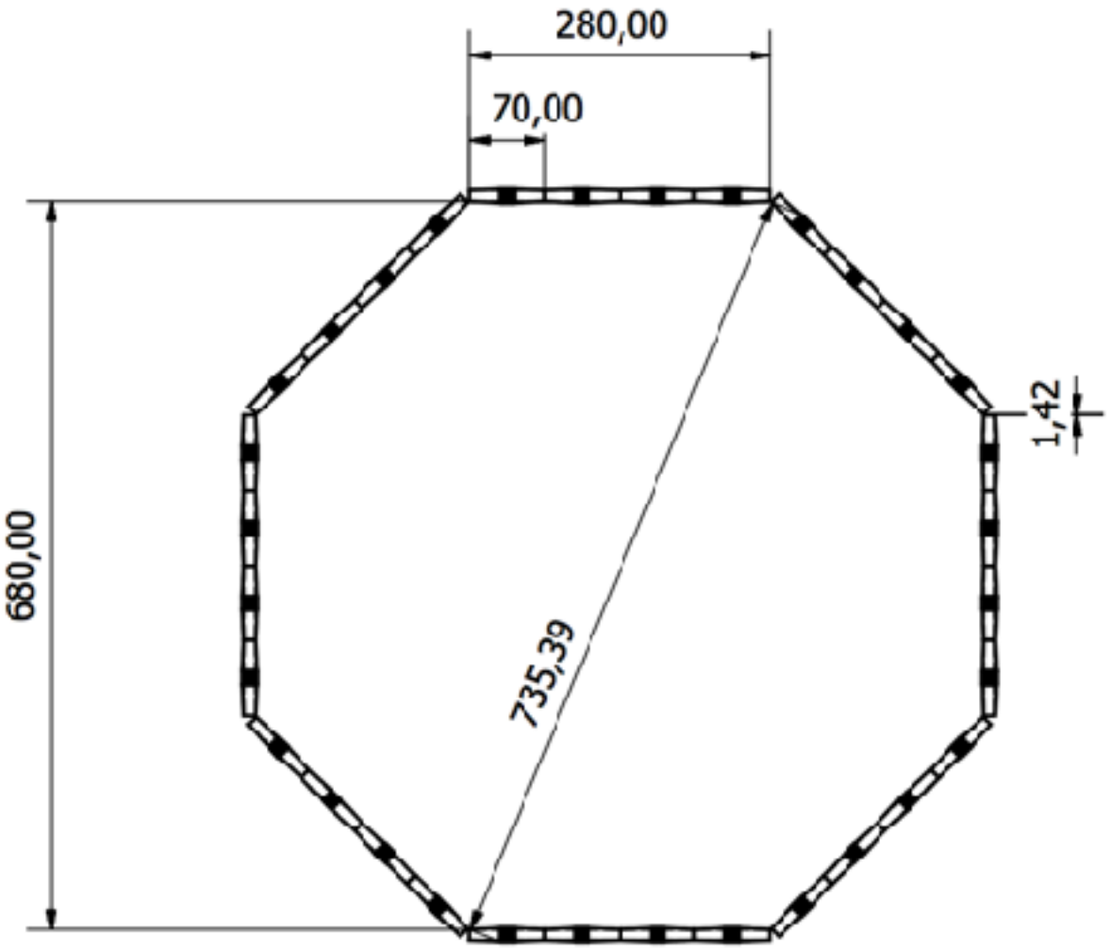
SUMMARY

- Introduction to E42,E45 hadron experiments at J - PARC
- Benefits of mppc for a trigger hodoscope in hyperon spectrometer
- Prototypes of trigger hodoscope
- Cosmic ray test result of prototypes

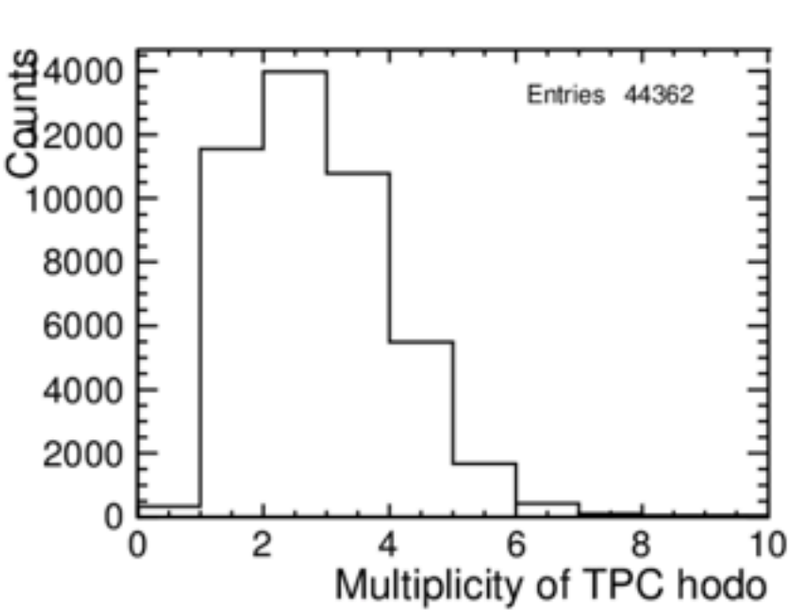
BACKUP

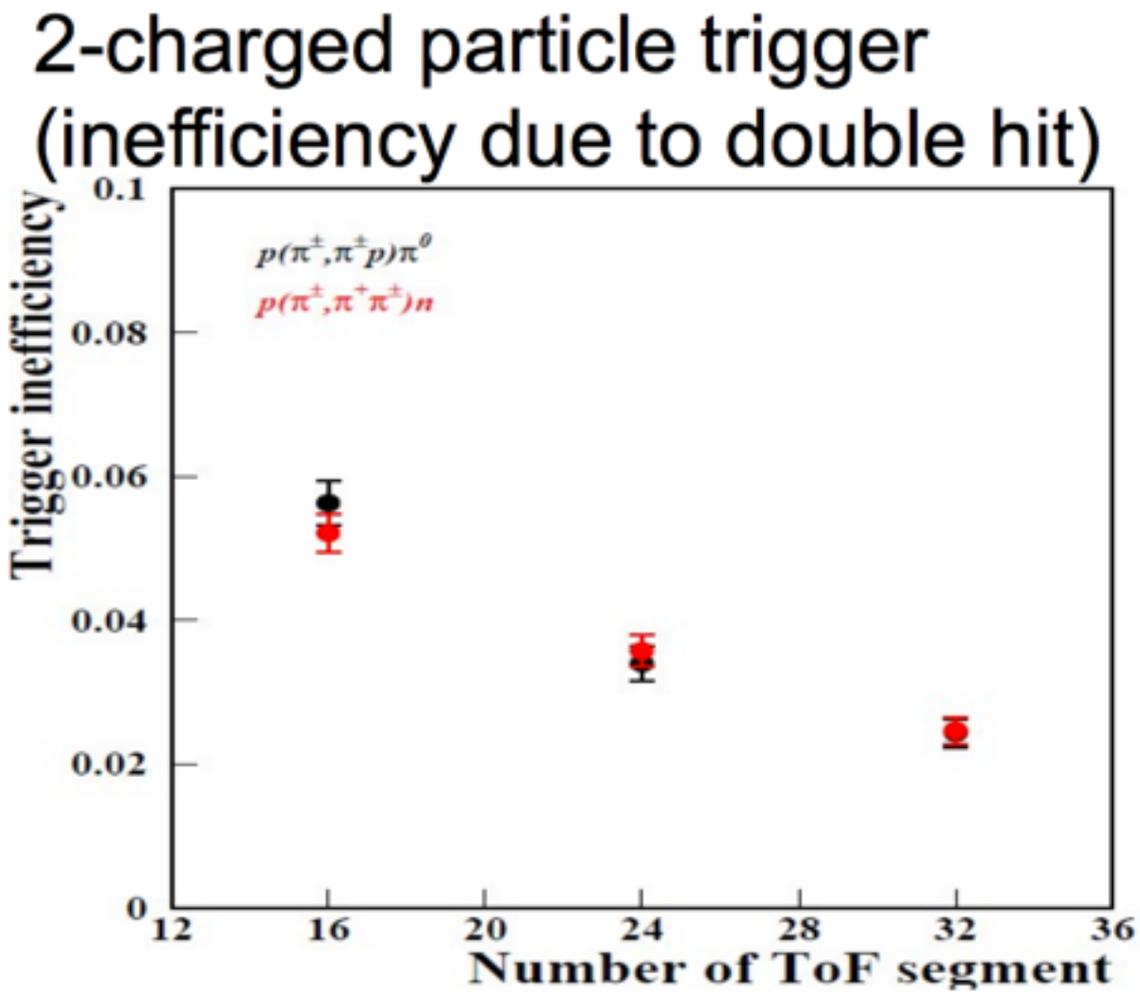
HODOSCOPE GEOMETRY





- 32 plastic scintillators will surround the TPC for triggering and timing purpose.
- Online requirement for more than two hits in the TPC hodoscope suppresses 30% of background processes.





Parameters	Diamond target
K^- beam	$10^6 K^-$ per spill (6 s)
Target length	15 mm
Number of nuclei	$2.65 \times 10^{23}/\mathrm{cm}^2$
$d\sigma/d\Omega^C_L(\Lambda\Lambda)$	7.6 μb/sr
$\Delta\Omega(K^+)$	0.11 sr
Branching ratio $(\Lambda \to p\pi^-)^2$	0.41
KURAMA efficiency for K^+	0.5
HypTPC efficiency for $\Lambda\Lambda$	0.4-0.6 (0.4 for H(2250))
Yield	0.023 event / spill

Table 1: Expected yield for $\Lambda\Lambda$ events.