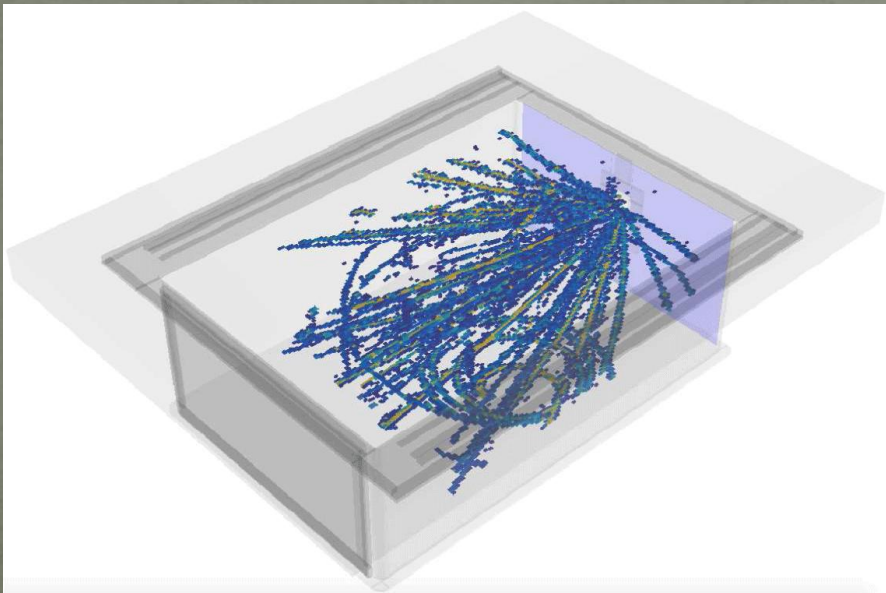


Trigger Detectors and Their Electronics for $S\pi$ RIT



Tetsuya MURAKAMI
Department of Physics
Kyoto University

For B01 sub-group
($S\pi$ RIT Collaboration)

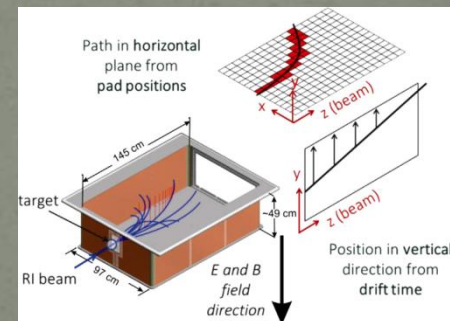
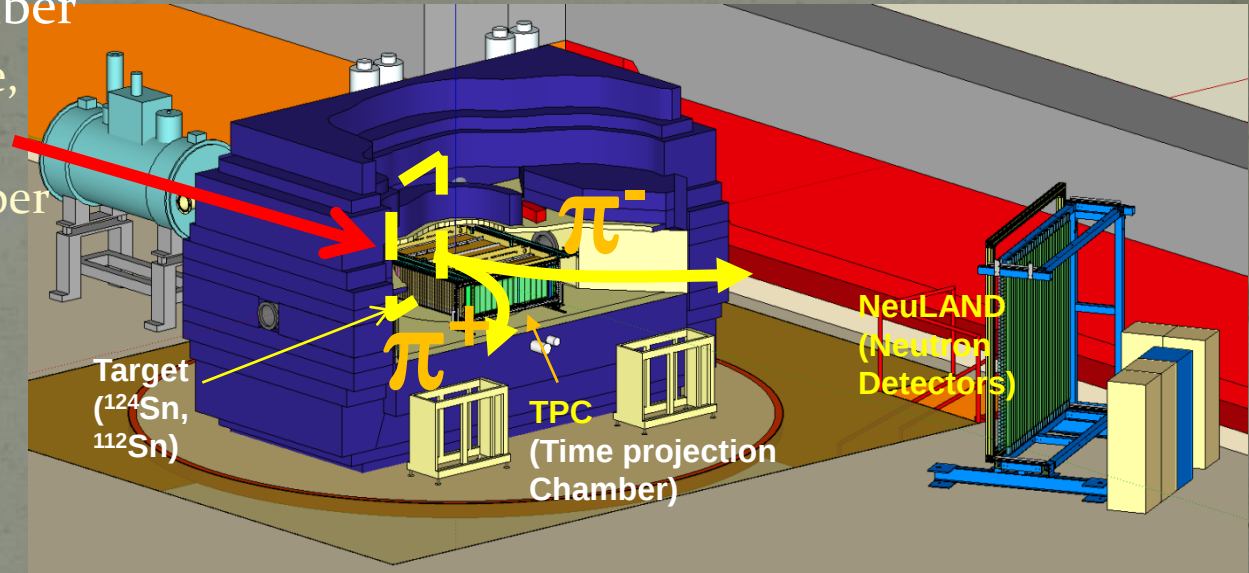
SpRIT experimental setup

- TPC

- Time Projection Chamber

- π^+ , π^- , p, d, t, ^3He , ^4He , IMF's
 - The SAMURAI chamber is at air

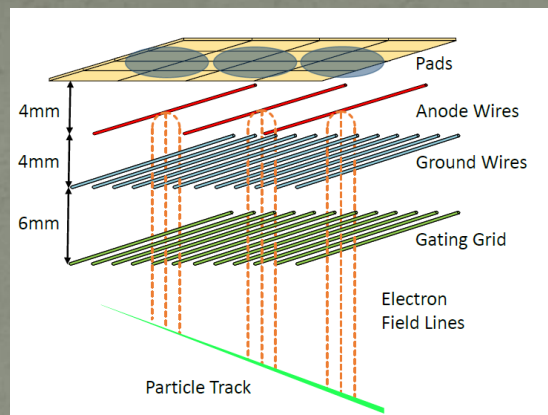
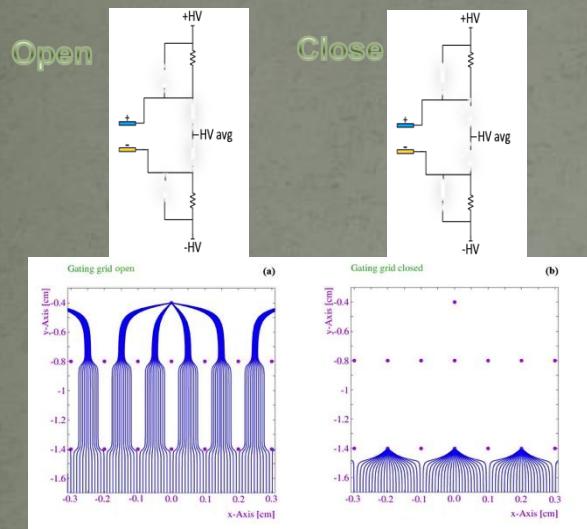
SAMURAI TPC Parameters	Values
Pad plane area	1.34m x 086 m
Number of pads	12096 (108 x 112)
Pad size	12 mm x 8 mm
Drift distance	53 cm
Pressure	1 atmosphere
dE/dx range	Z=1-3 (STAR El.), 1-8 (GET El.)
Two track resolution	2.5 cm
Multiplicity limit	200 (may impact absolute pion eff. in large systems.)



R. Shane et al.

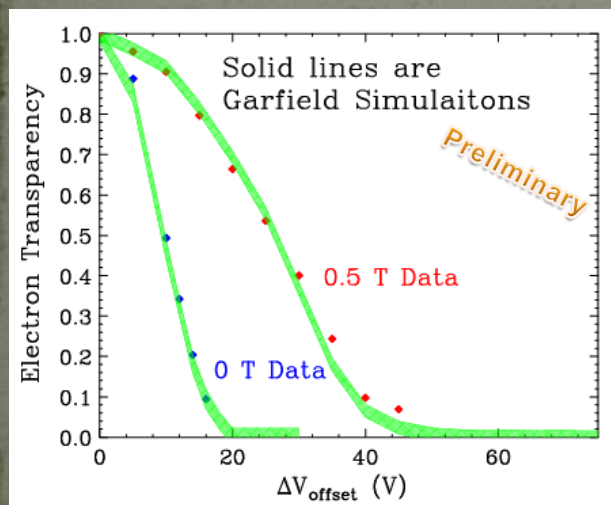
Nucl. Instr. Meth. A 784 (2015) 513-517

Gating Grid



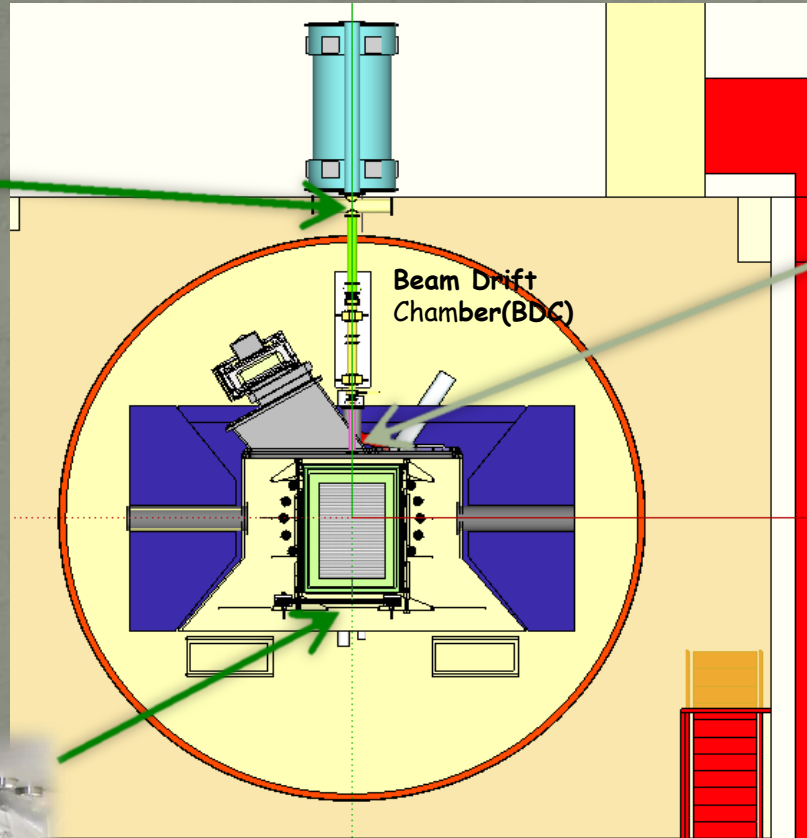
- Gating grid wires
 - 不用なイベントの信号をブロック&アノードワイヤーの経年劣化防止
- 早いトリガー信号でGGの電位をClose→Openする
- 隣接ワイヤー間の電位差と電子の透過率が磁場中Garfieldのシミュレーション結果と一致。

S. Tangwancharoen et al., NIM A753 (2017) 44-52

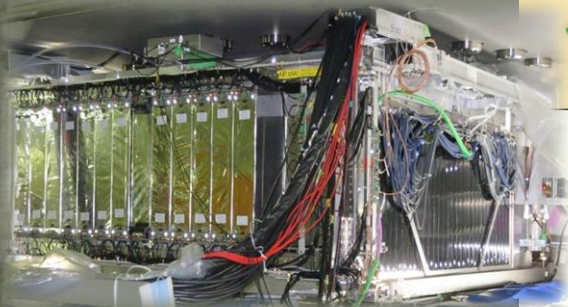
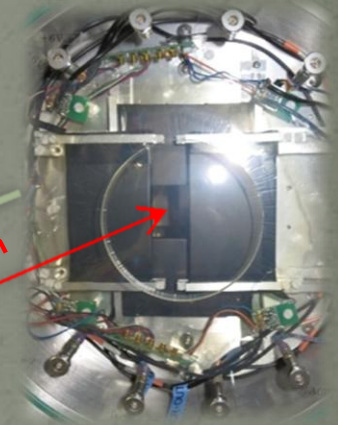


Trigger detectors

SBT:Start Counter (hitting)



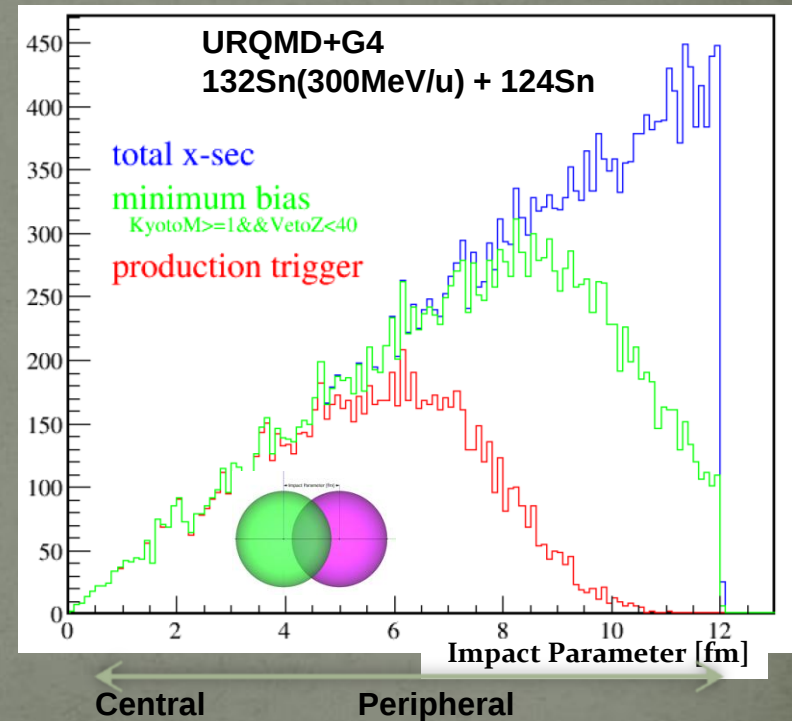
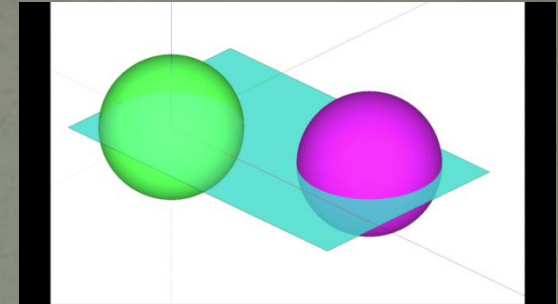
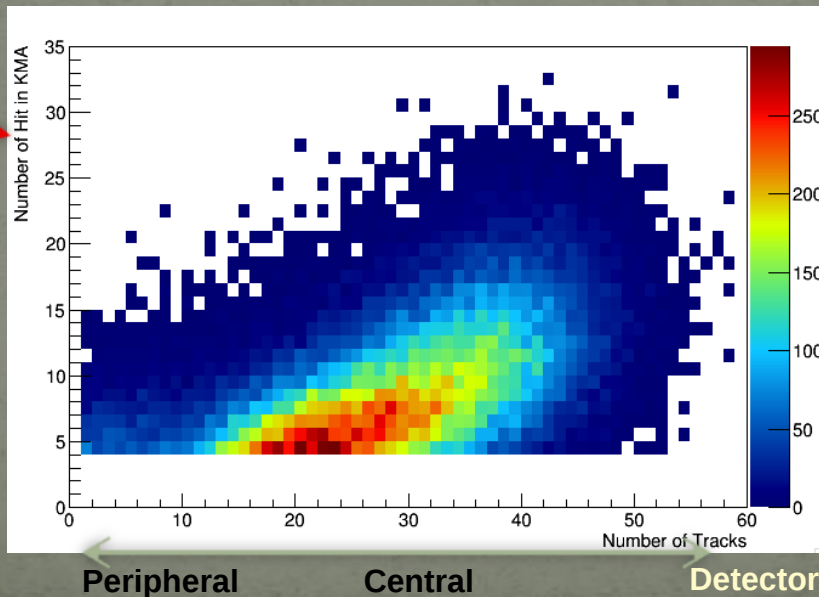
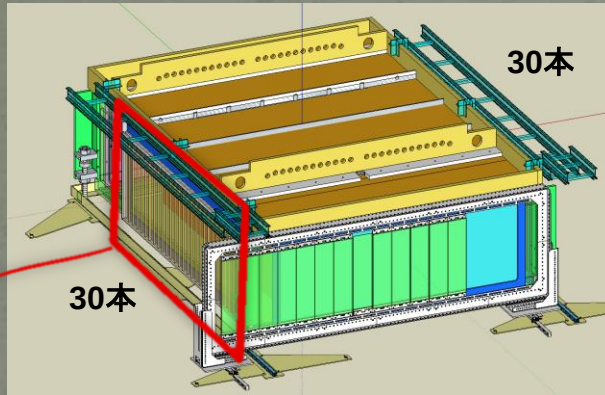
Active Collimator (no hit)

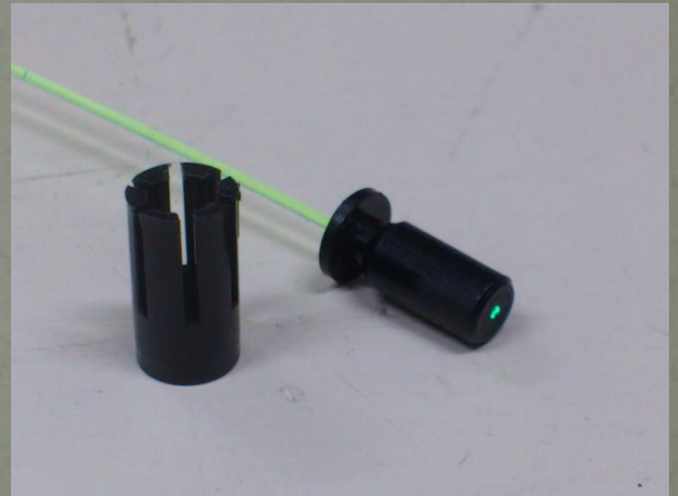
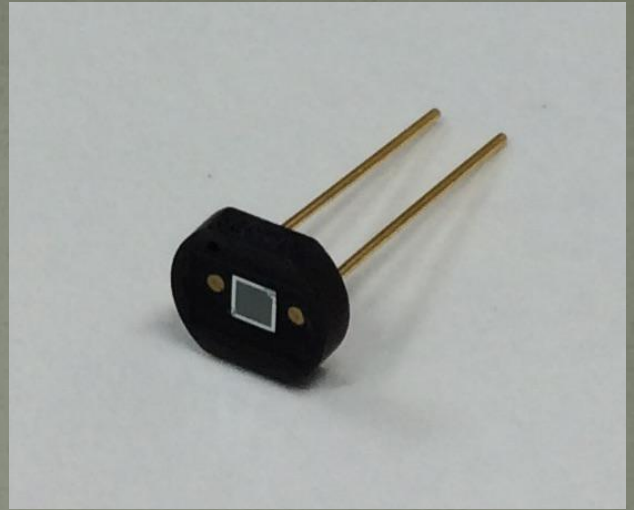
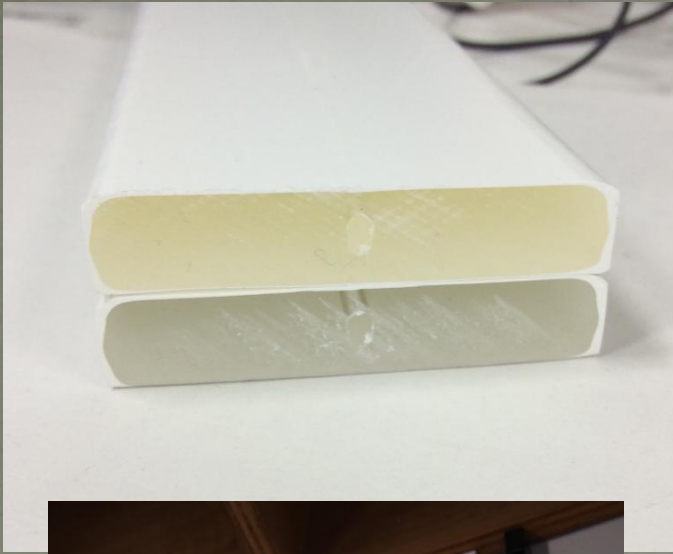


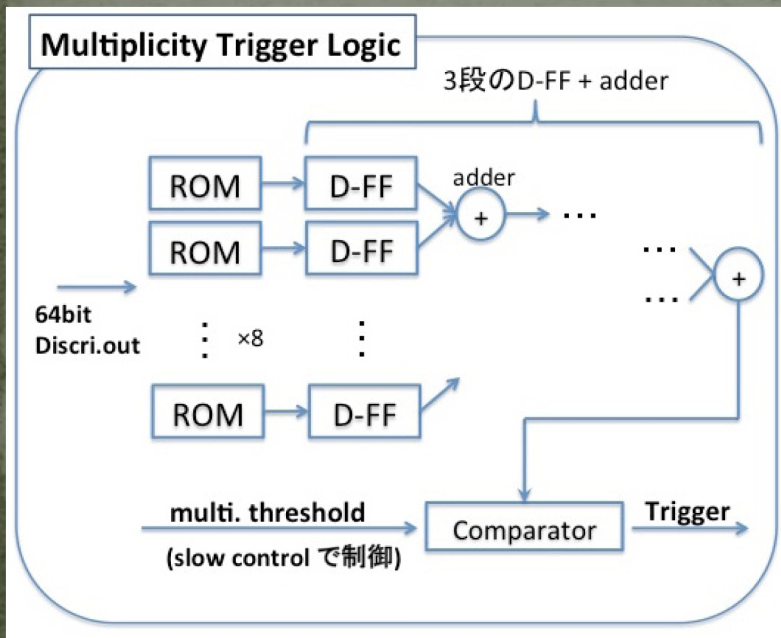
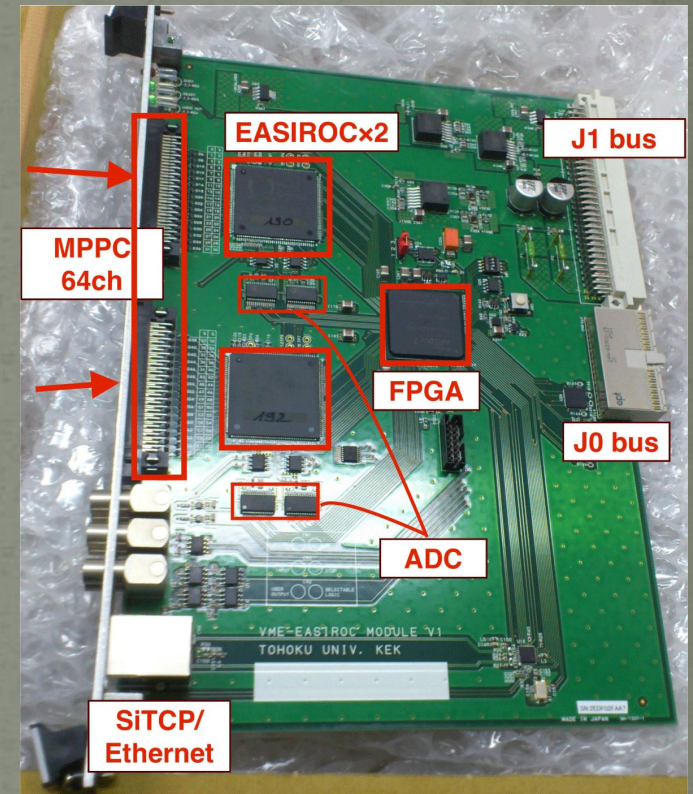
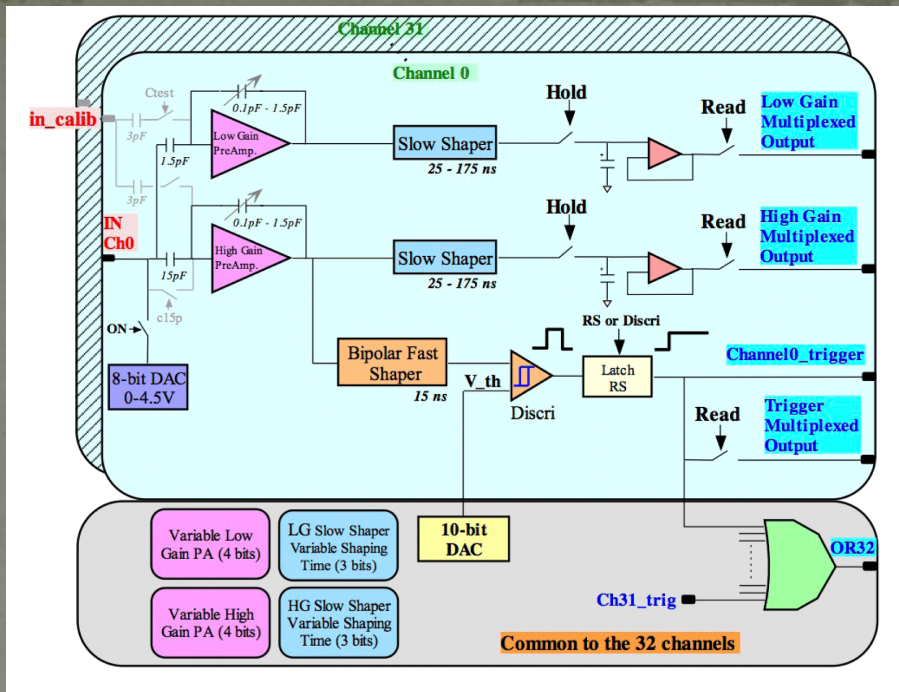
Details of Trigger detectors

Detector	Location	In trigger	Purpose
SBT: Start Counters	After STQ mag.	Hitting	Count number of beam and determine start timing
Active Collimator	In front of the target	No hit	Reject beam passing through out of the target.
KATANA-Veto	After the exit window	Pulse Height $\leq -30\text{mV}$	Reject more than Z=20 beam passing through
Kyoto Array	Left and Right side	Multiplicity ≥ 4	Trigger central collision events

Side Array – KYOTO ARRAY







Front Array -- Katana

- [arXiv:1610.06682v2 \[physics.ins-det\]](https://arxiv.org/abs/1610.06682v2)

KATANA – Kraków Array for Triggering with Amplitude discrimiNAtion

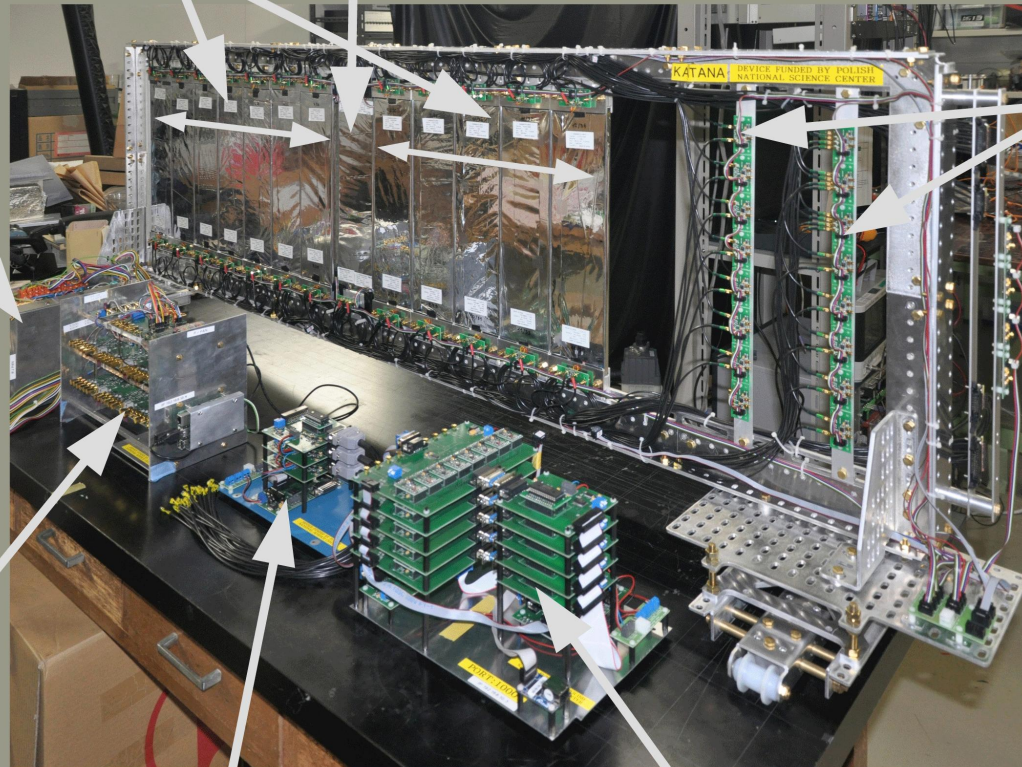


7+5 Multiplicity plastic bars
(BC408, 10x40x1 cm³)
with 2 3x3 mm² MPPCs
(S12572-025P)

3 Veto paddles (2 on the other side of the frame, BC404,
10x40x0.1 cm³) with 4 1x1 mm² MPPCs (S12571-010P)
read out by BCF-92 WLS on top and bottom sides

Power supply
and 110/230V
transformer for
Trigger Box

**Analogue
adders,
splitters
and
inverters**



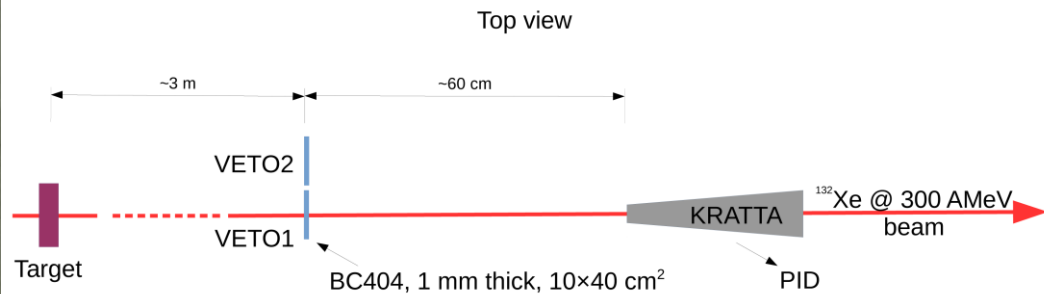
Trigger Box
with 20
discriminator
channels
and FPGA
logic

24 DAC channels
for remote control
of the
discriminator
thresholds

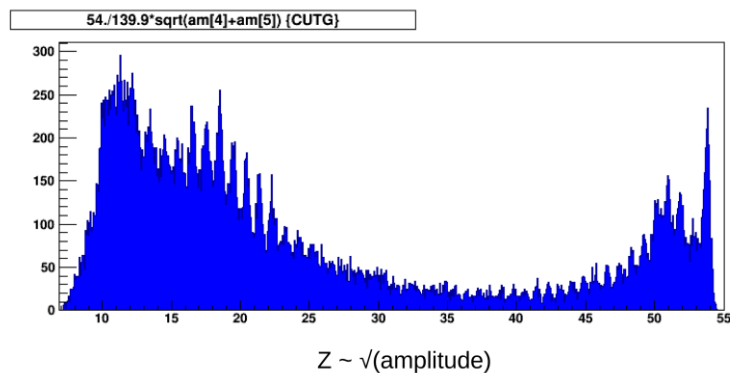
40-channel power supply
(50-75 V with 10 mV
precision) and 40 DAC
channels for remote
control of the MPPC bias

HIMAC beam-test

Heavy Ion Medical Accelerator in Chiba

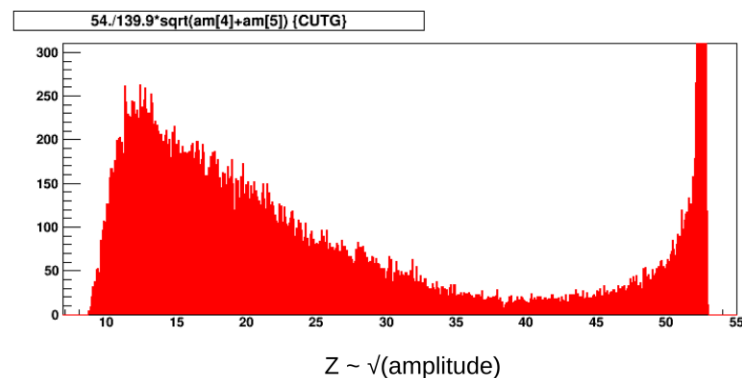


KRATTA Z-resolution (1 mm Si+CsI)



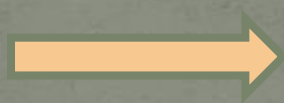
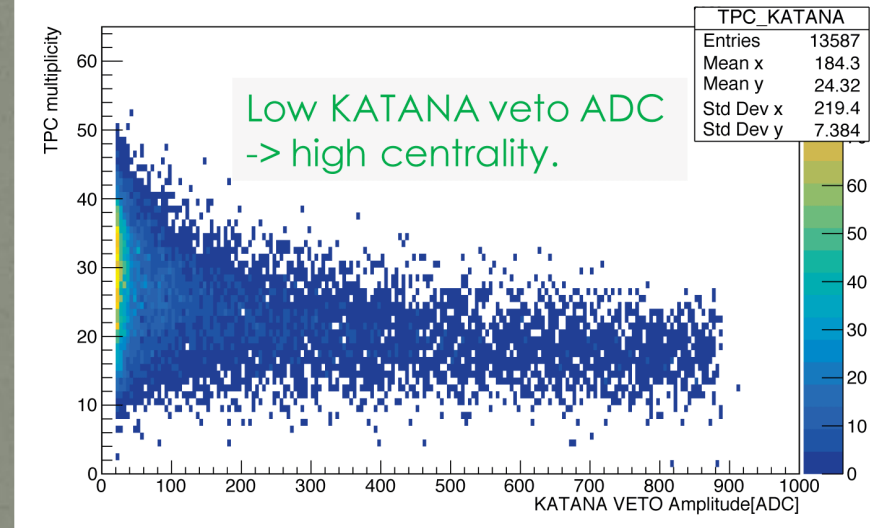
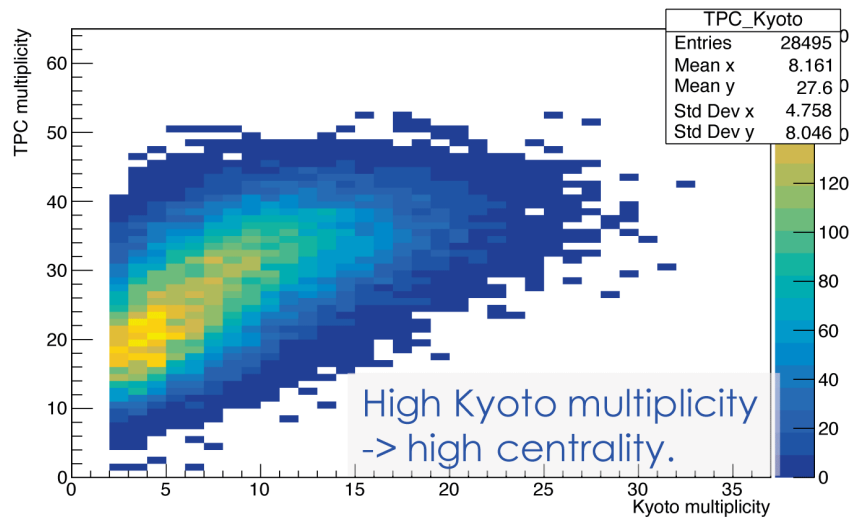
charge resolution at Z=54: FWHM=0.6

Prototype VETO Z-resolution (1 mm BC404)



charge resolution at Z=54: FWHM=1.3

Verify performance of trigger detectors



**Select Kyoto Multiplicity ≥ 4
KATANA veto cuts peripheral events**

Schematic circuit diagram of the trigger logic

