NATIONAL SCIENCE CENTRE
POLAND

KATANA Data Analysis

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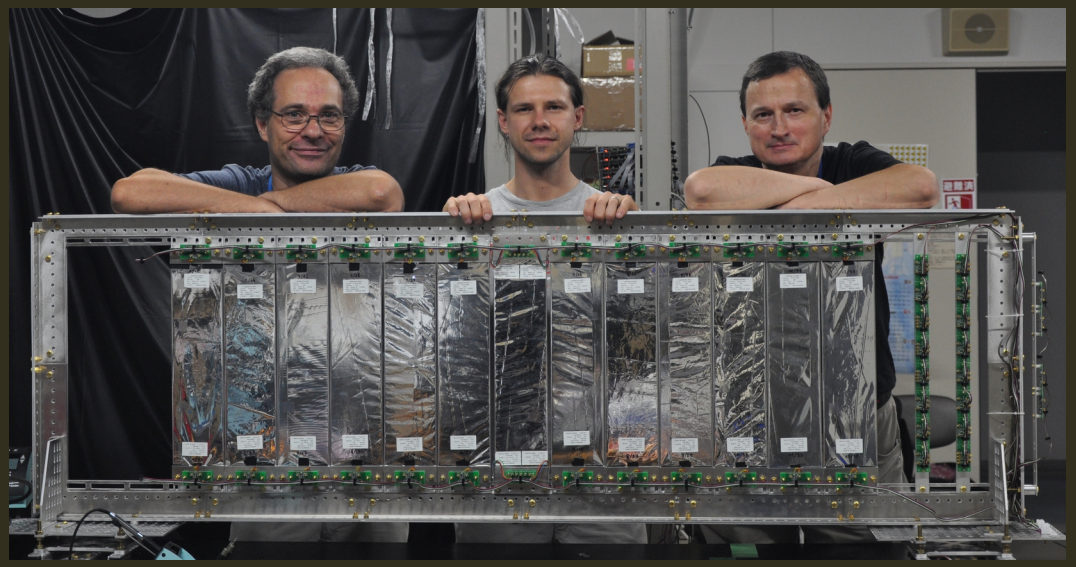
KATANA – **K**raków **A**rray for **T**riggering with **A**mplitude discrimi**NA**tion



SpiRIT Collaboration Meeting, FRIB MSU, 8-10.08.2016

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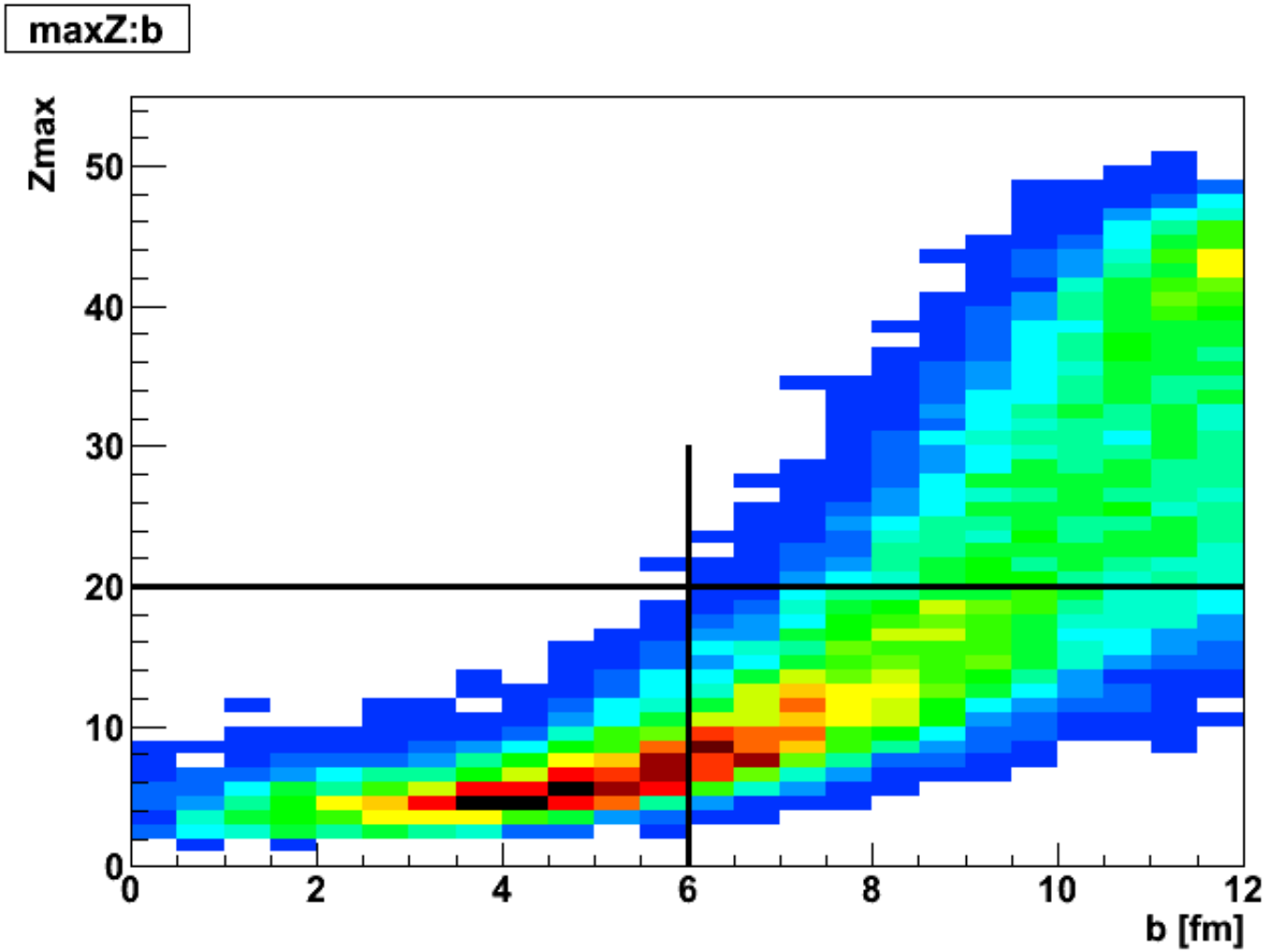
- A bit of history
- Charge calibration and resolution
- Stability and correlations

KATANA main requirements

(more than just a trigger...)

High trigger efficiency for central and semi-central collisions	GEANT4 + UrQMD simulations to test various options and setups
Fast VETO signal for fragments with Z>20 to close the Gating Grid	Fast plastics (BC404) Fast preamps Trigger Box with FPGA logic
Insensitivity to magnetic field	MPPCs (HAMAMATSU)
Possibly low position dependence of the signal amplitudes	Wave Length Shifters (BCF-92) for VETO paddles
Stability and beam time respect	Remote control of discriminator thresholds, bias voltages and temperatures
Provide data, handle Active Collimator signals	Include trigger detector in DAQ

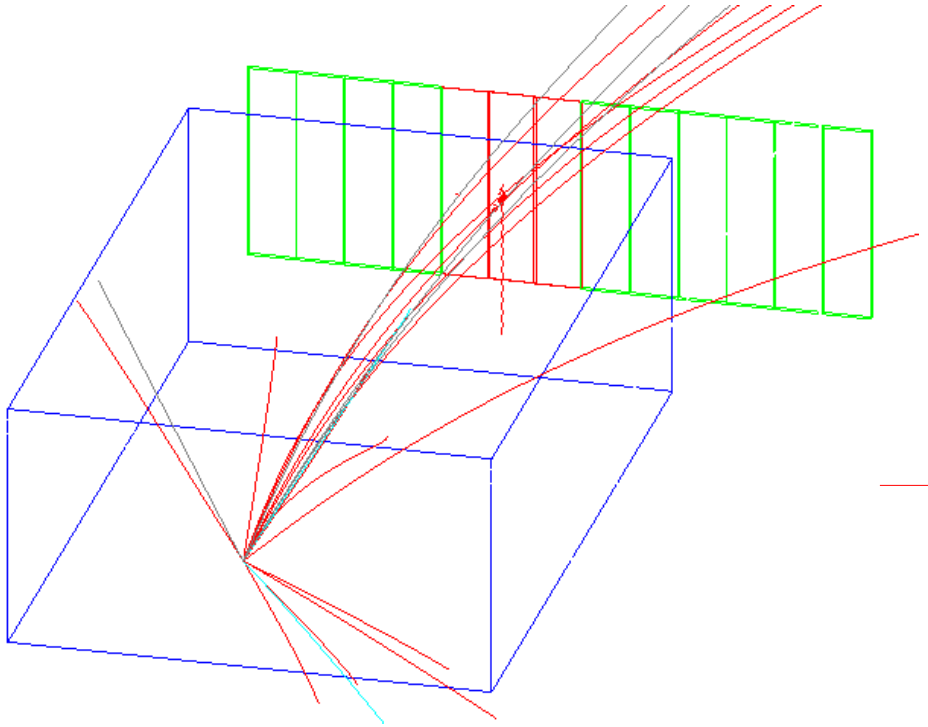
UrQMD: maximum forward charge vs impact parameter



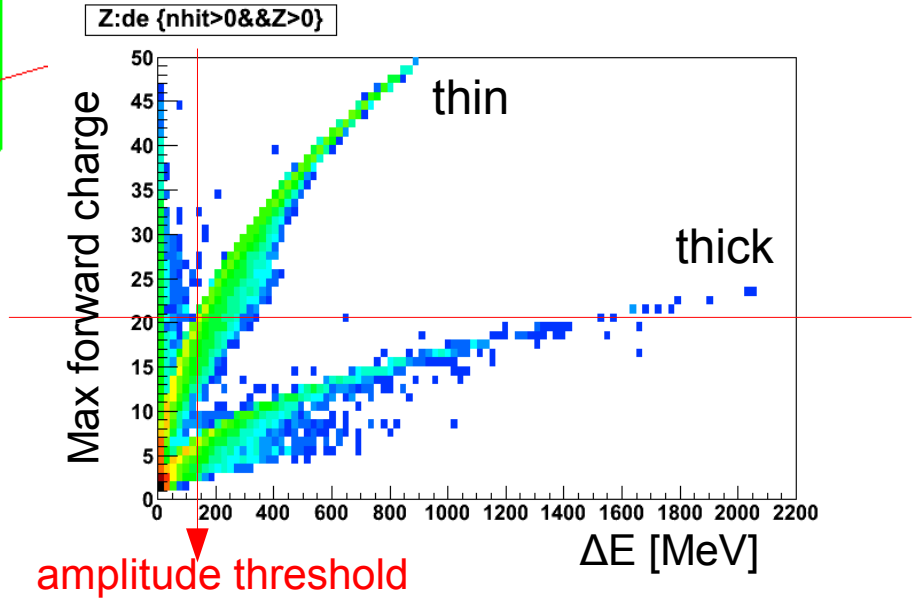
S4URQMD

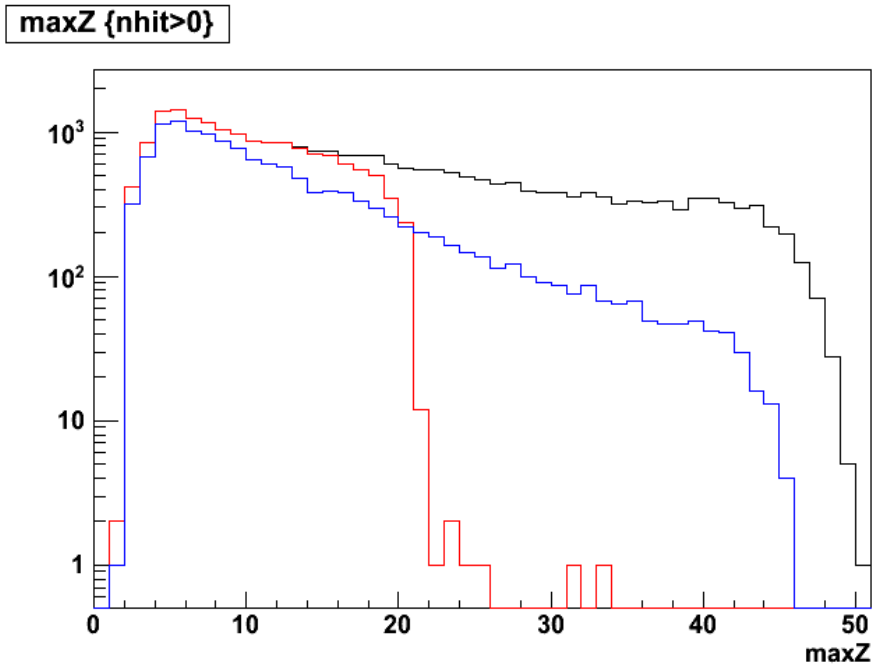
In order to make TPC blind for Z>20 heavily ionizing fragments
we should device a trigger with 0-efficiency for b>6 fm

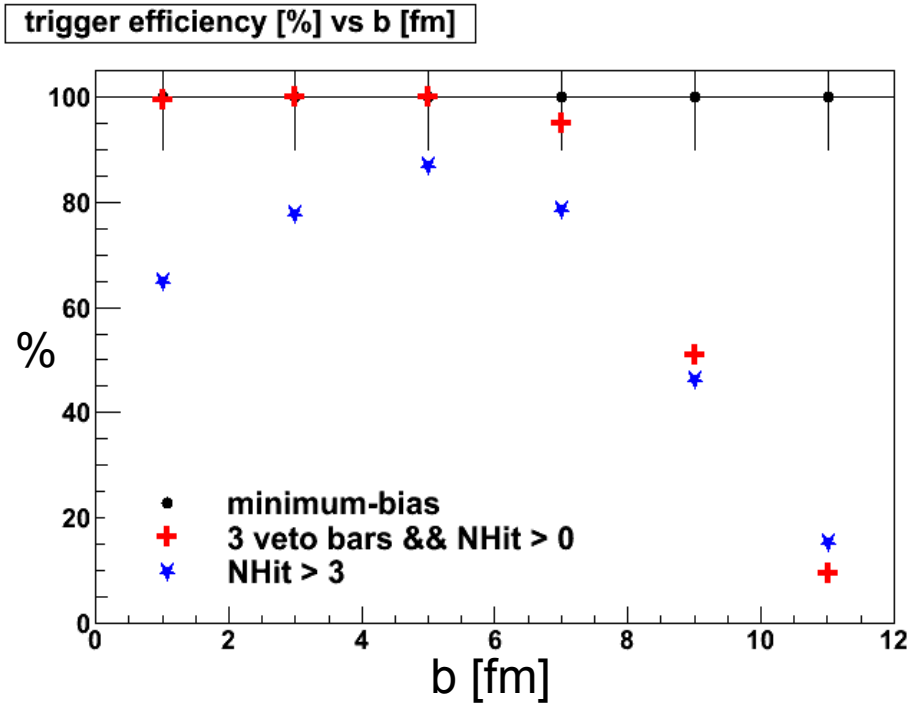
S87310URQMD



3 veto bars 10x40x0.1 cm3 with 5mm overlap +
10 multiplicity bars 10x40x1 cm3
veto bars read out from both sides
multiplicity bars read out from one side →16 channels

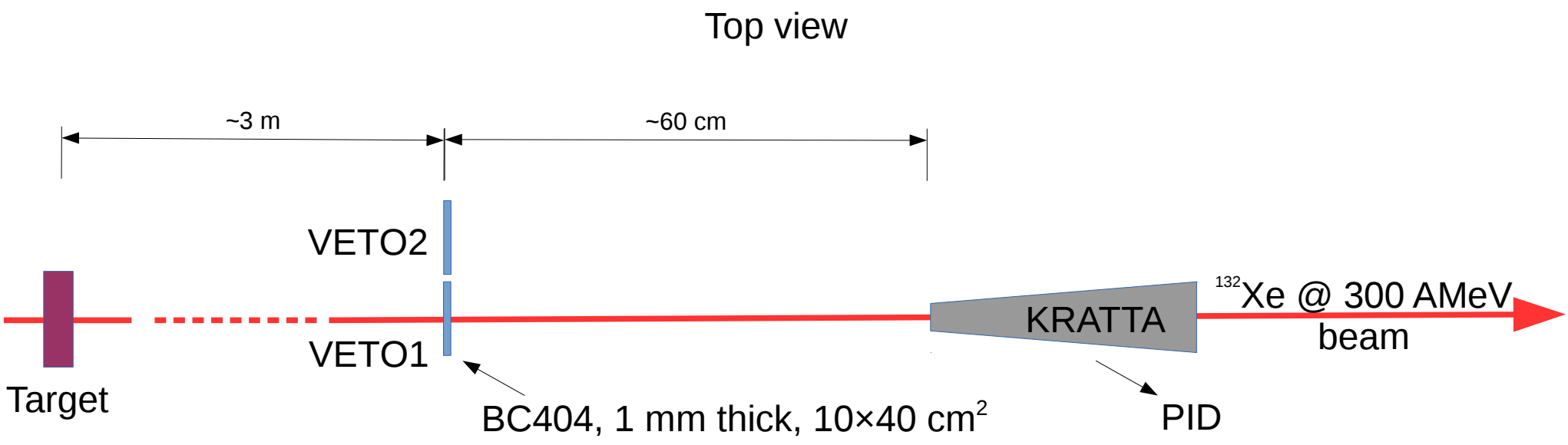






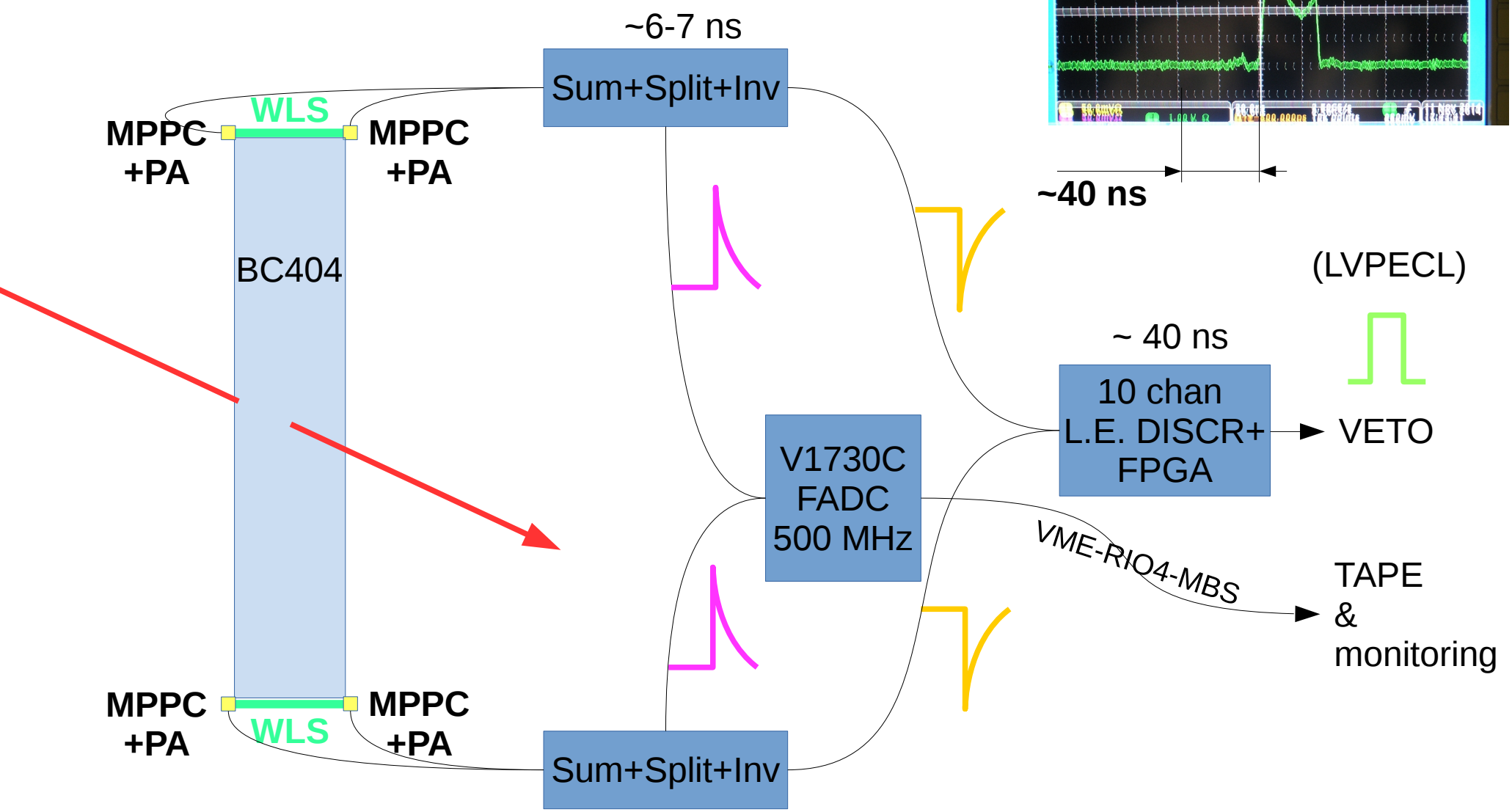
HIMAC beam-test

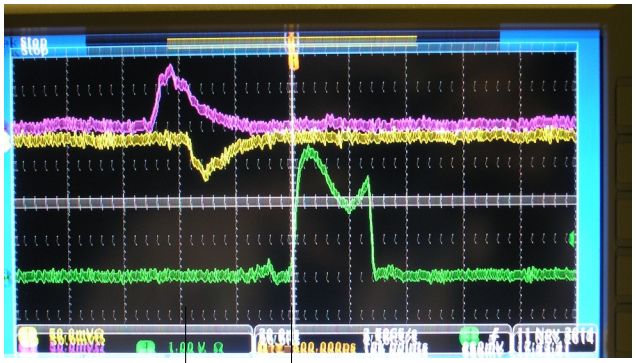
Heavy Ion Medical Accelerator in Chiba



VETO prototype

MPPC: HAMAMATSU, 1×1 mm^2, 10000 pixels
WLS: BCF92
PA: current preamplifier, τ<2 ns (P. Lasko)



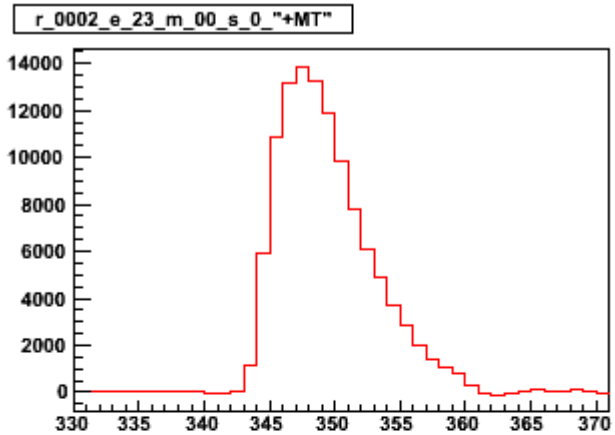


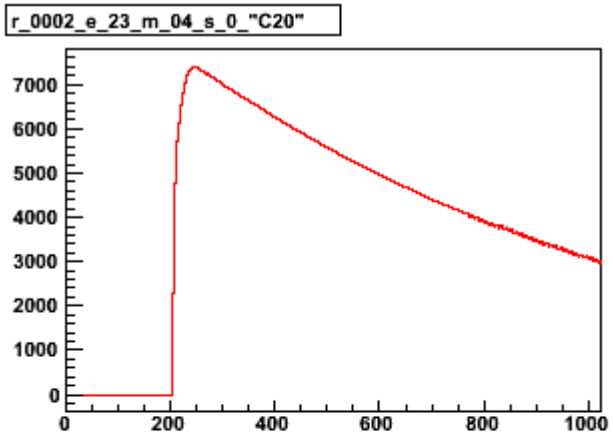
KRATTA (triggering) and VETO1 in coincidence: Xe pulses

Plastic, 500 Ms/s FADC

KRATTA, 100 Ms/s FADC

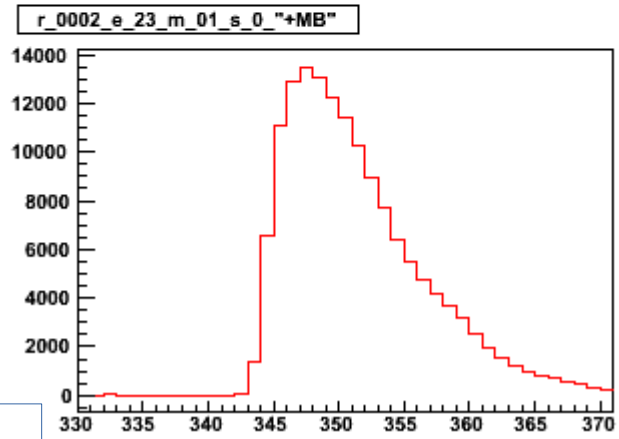
TOP

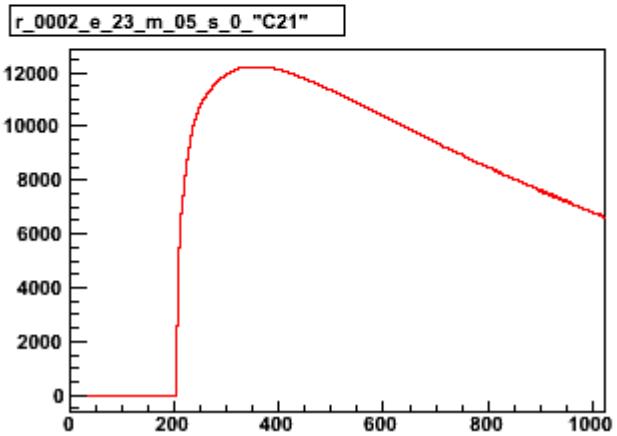




PD0

BOTTOM





PD1

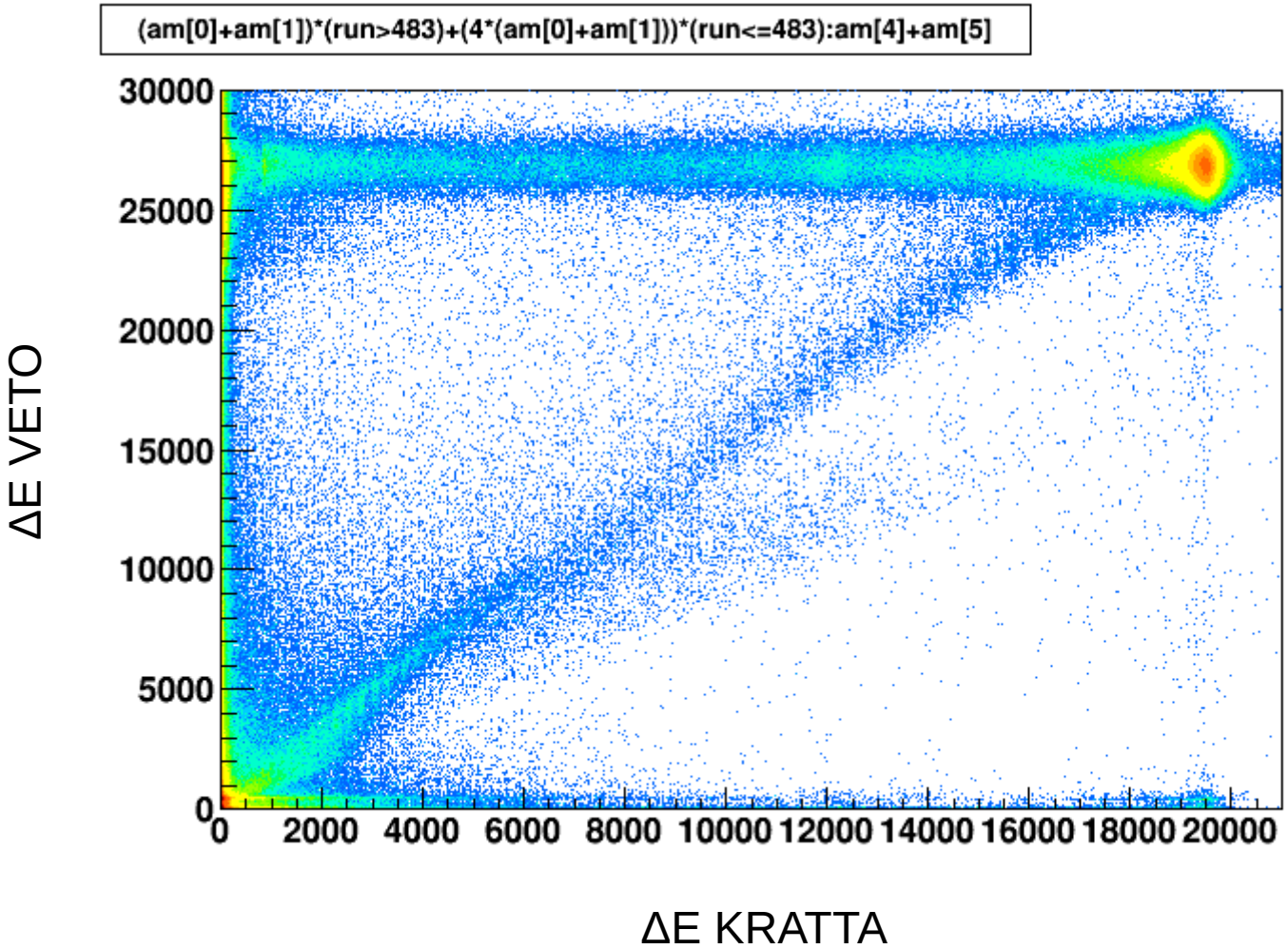
Plastic:
~6-7 ns rise time
8-11 ns FWHM

Time [2 ns/channel]

Time [10 ns/channel]

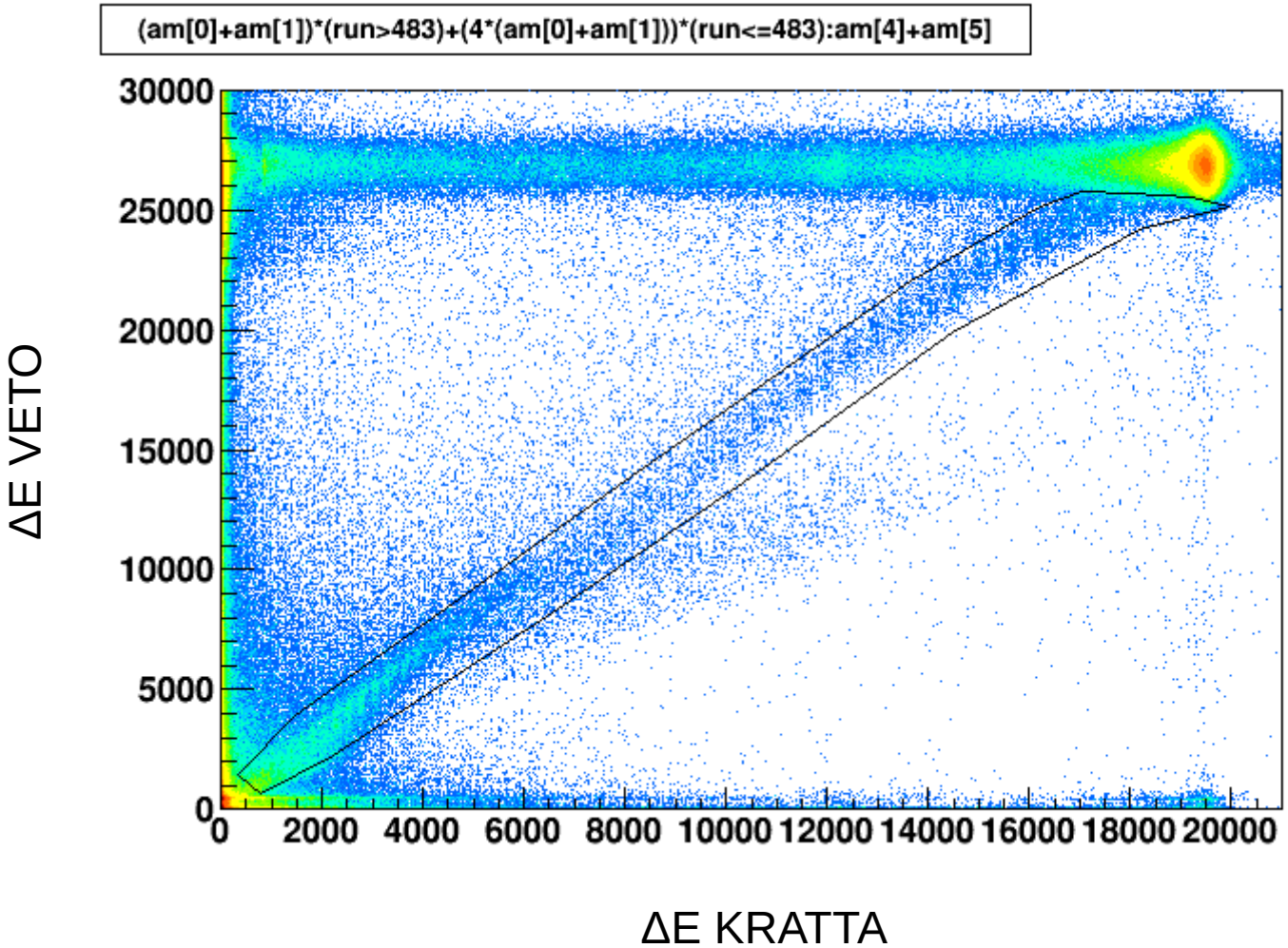
VETO vs KRATTA

(projectile fragmentation)

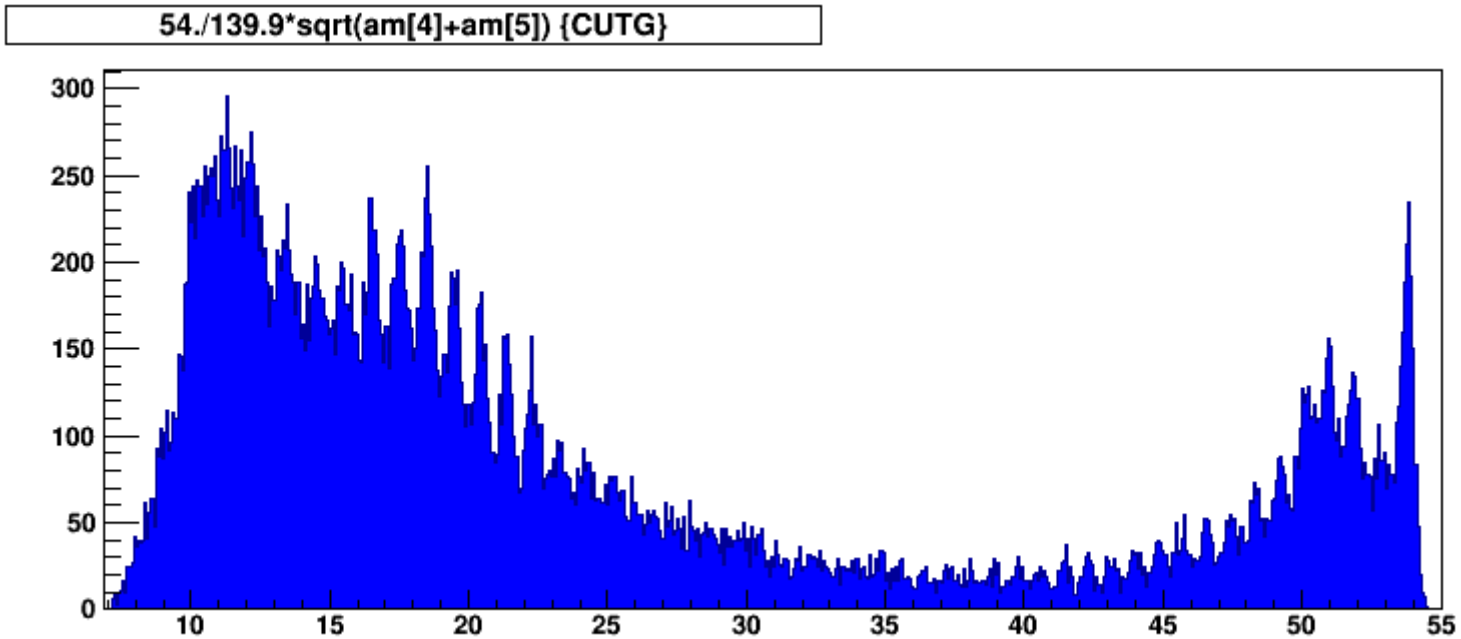


VETO vs KRATTA

(projectile fragmentation → $\Delta E \sim AZ^2/E$)



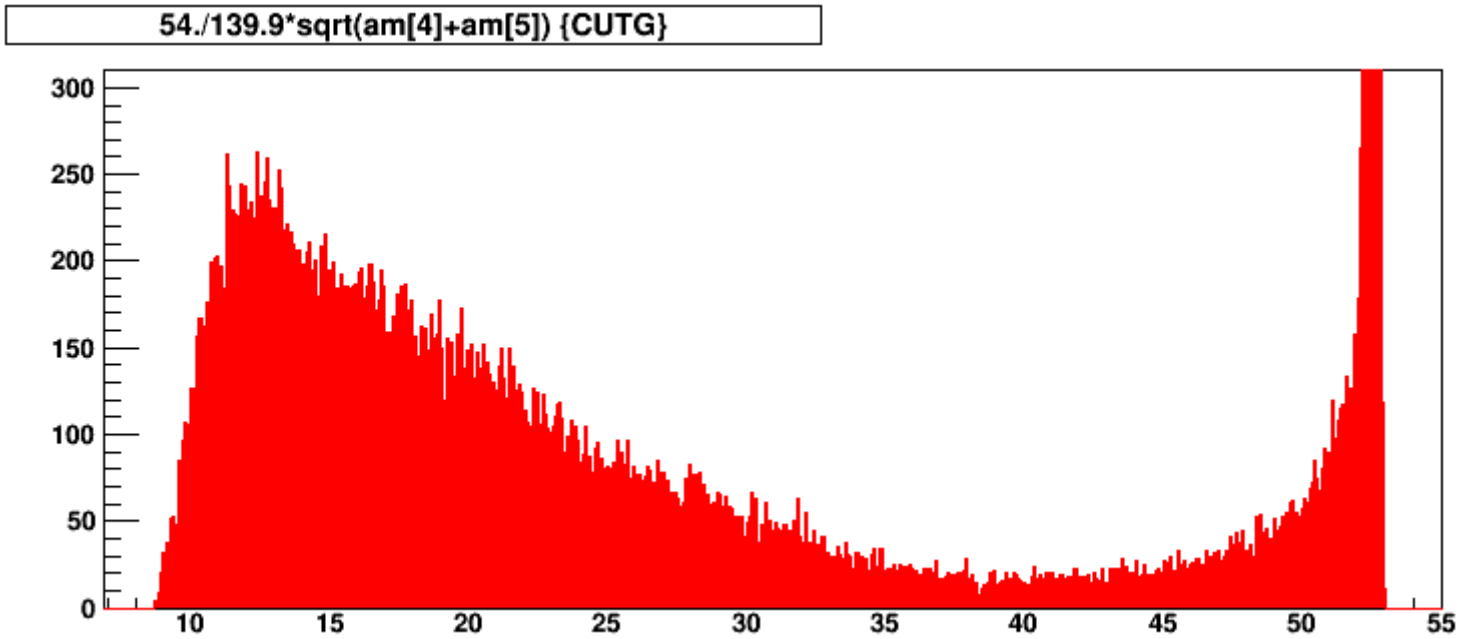
KRATTA Z-resolution (1 mm Si+CsI)



Z ~ √(amplitude)

charge resolution at Z=54: FWHM=0.6

Prototype VETO Z-resolution (1 mm BC404)



Z ~ √(amplitude)

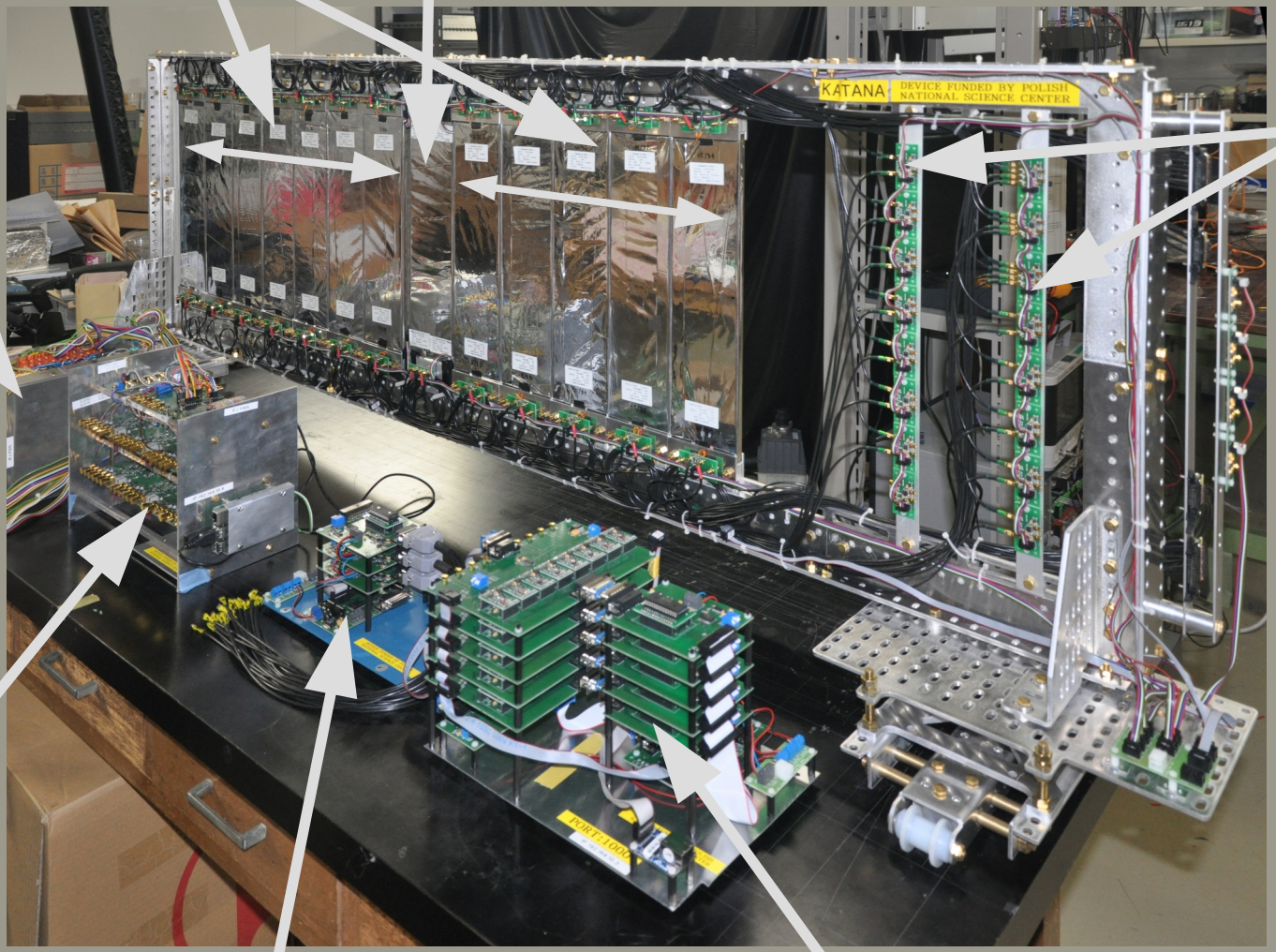
charge resolution at Z=54: FWHM=1.3

KATANA 1.0

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

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

Power supply and 110/230V transformer for Trigger Box



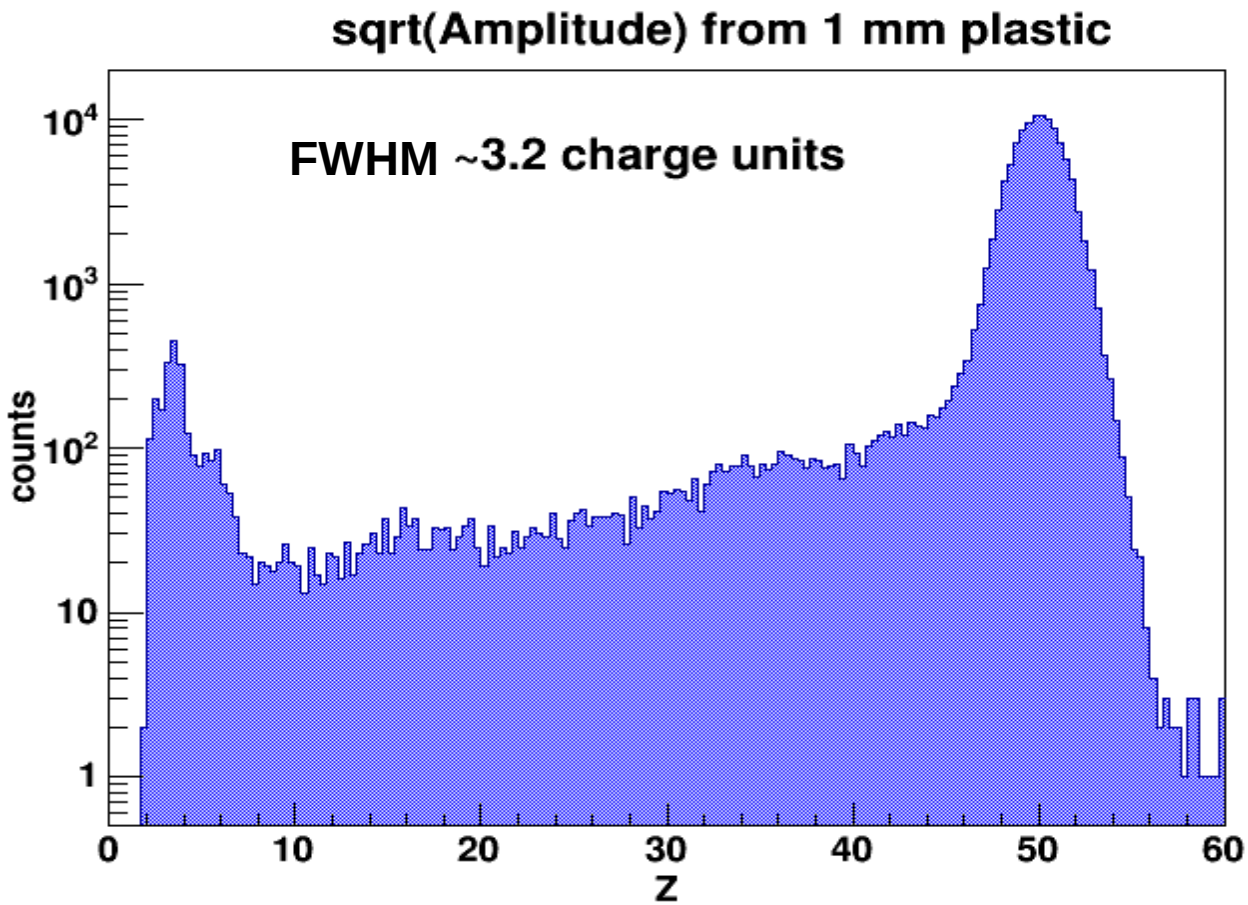
Analogue adders, splitters and inverters

Trigger Box with 20 discriminator channels and FPGA logic

24 DAC channels for remote control of the discriminator thresholds

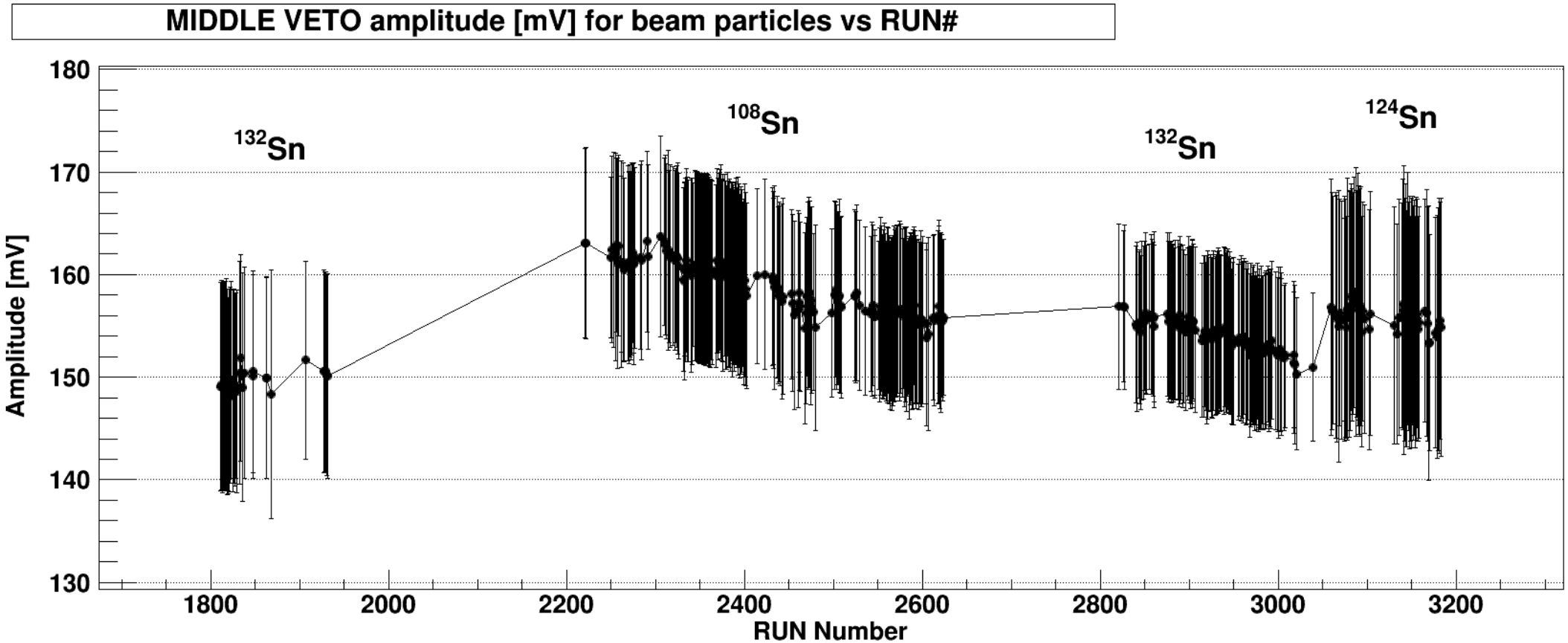
40-channel power supply (50-75 V with 10 mV precision) and 40 DAC channels for remote control of the MPPC bias

Middle VETO charge resolution



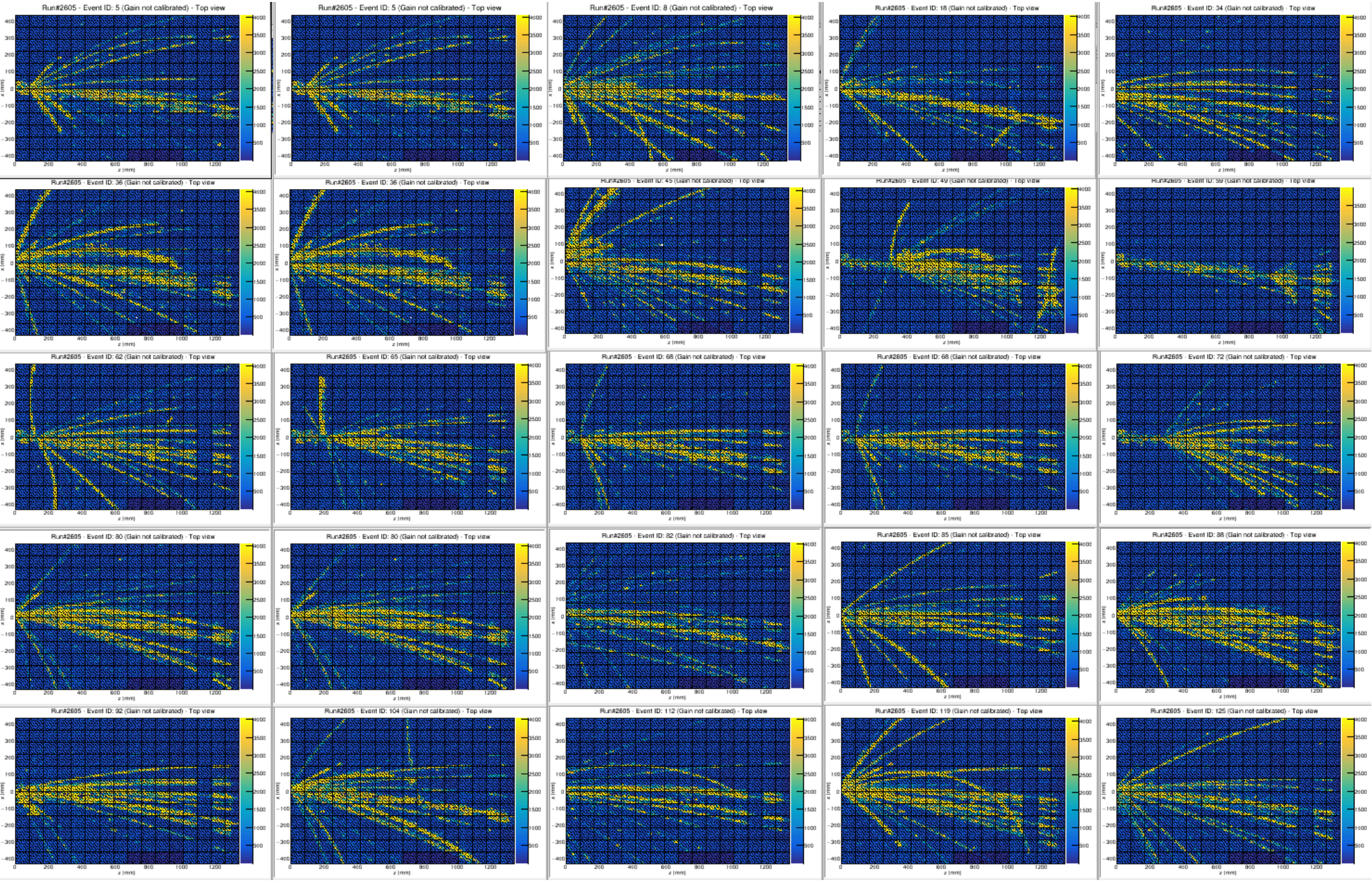
Run 2350: charge resolution ~ ± 1.6 charge units
30 mV threshold corresponds to Z≈22

Stability

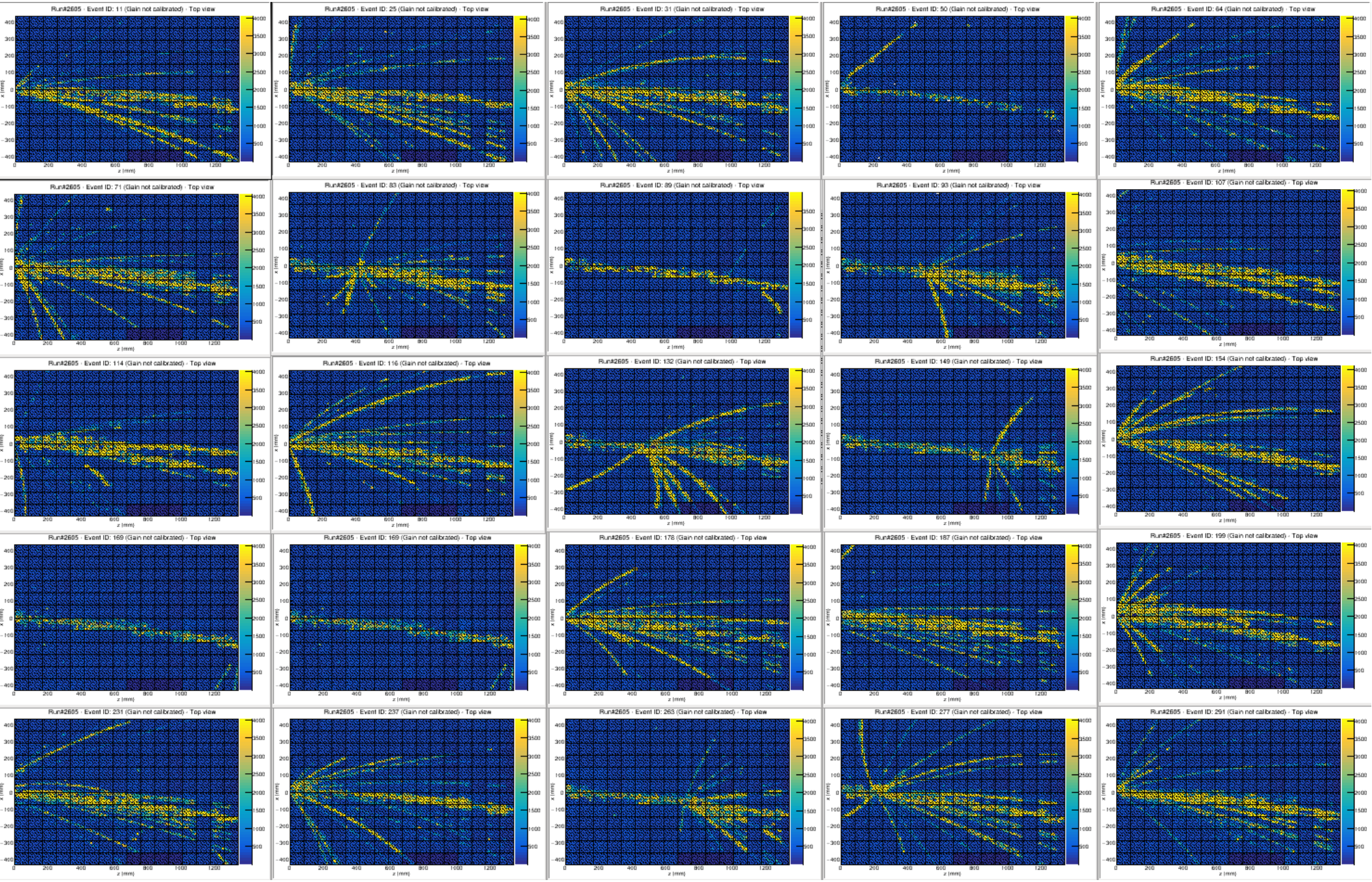


~ 1% drop / day

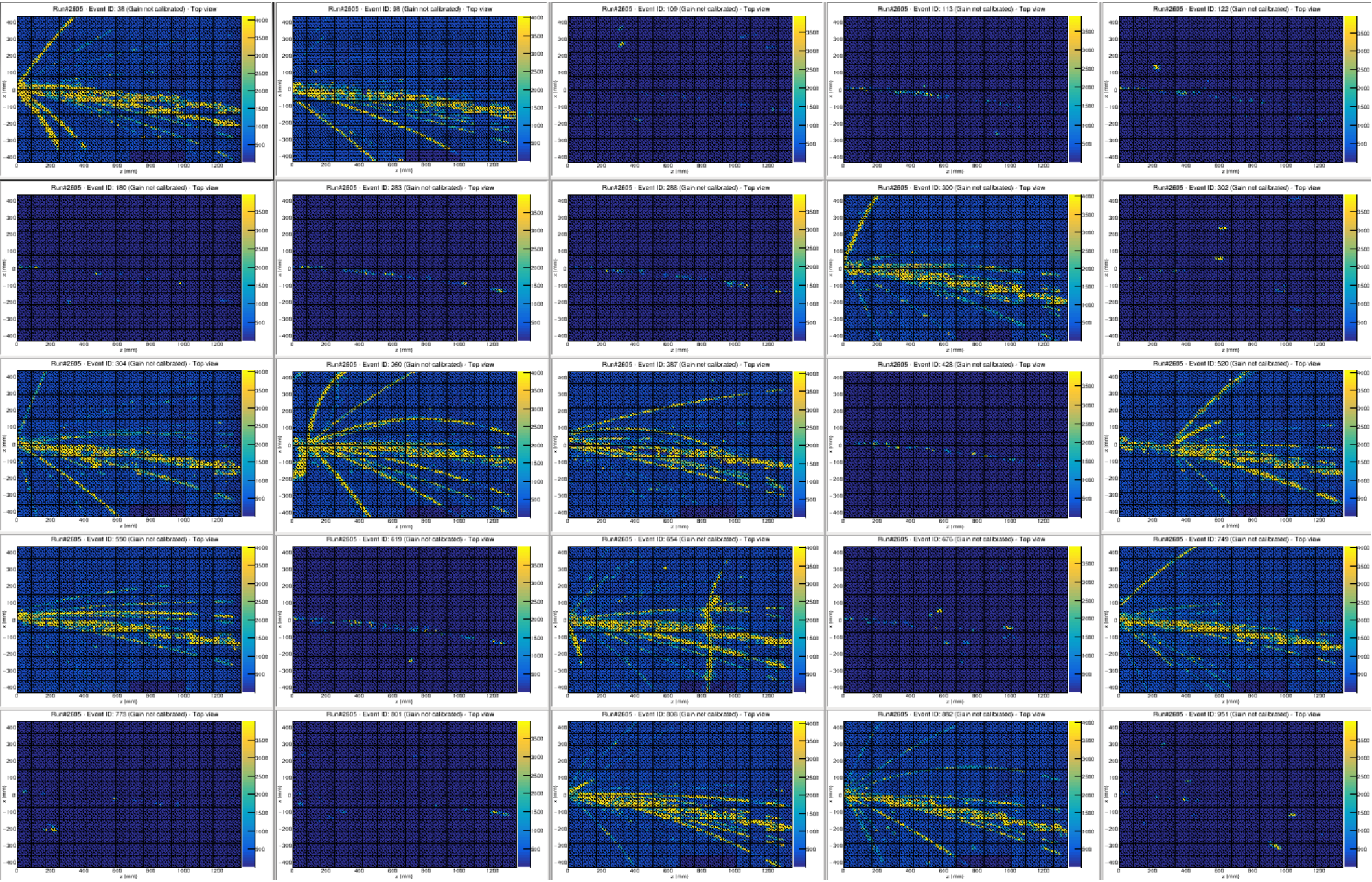
First 25 evts with 0 < VETO ampl < 5 mV



First 25 evts with 10 < VETO ampl < 15 mV



First 25 evts with 25 < VETO ampl < 30 mV



Summary

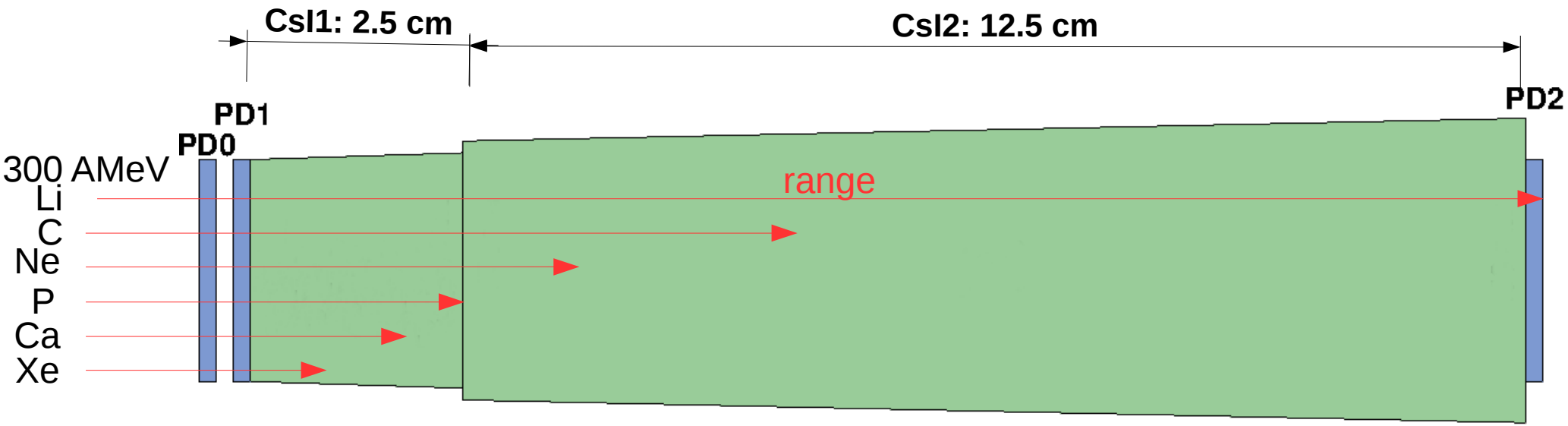
- Charge resolution of the VETO paddle: about 2.9-3.9 charge units FWHM
- Amplitude drop of the central VETO: about 1% per day of the beam time
- Visible sensitivity of the VETO amplitude to the track multiplicity and, supposedly, to the centrality

KRATTA module

active elements

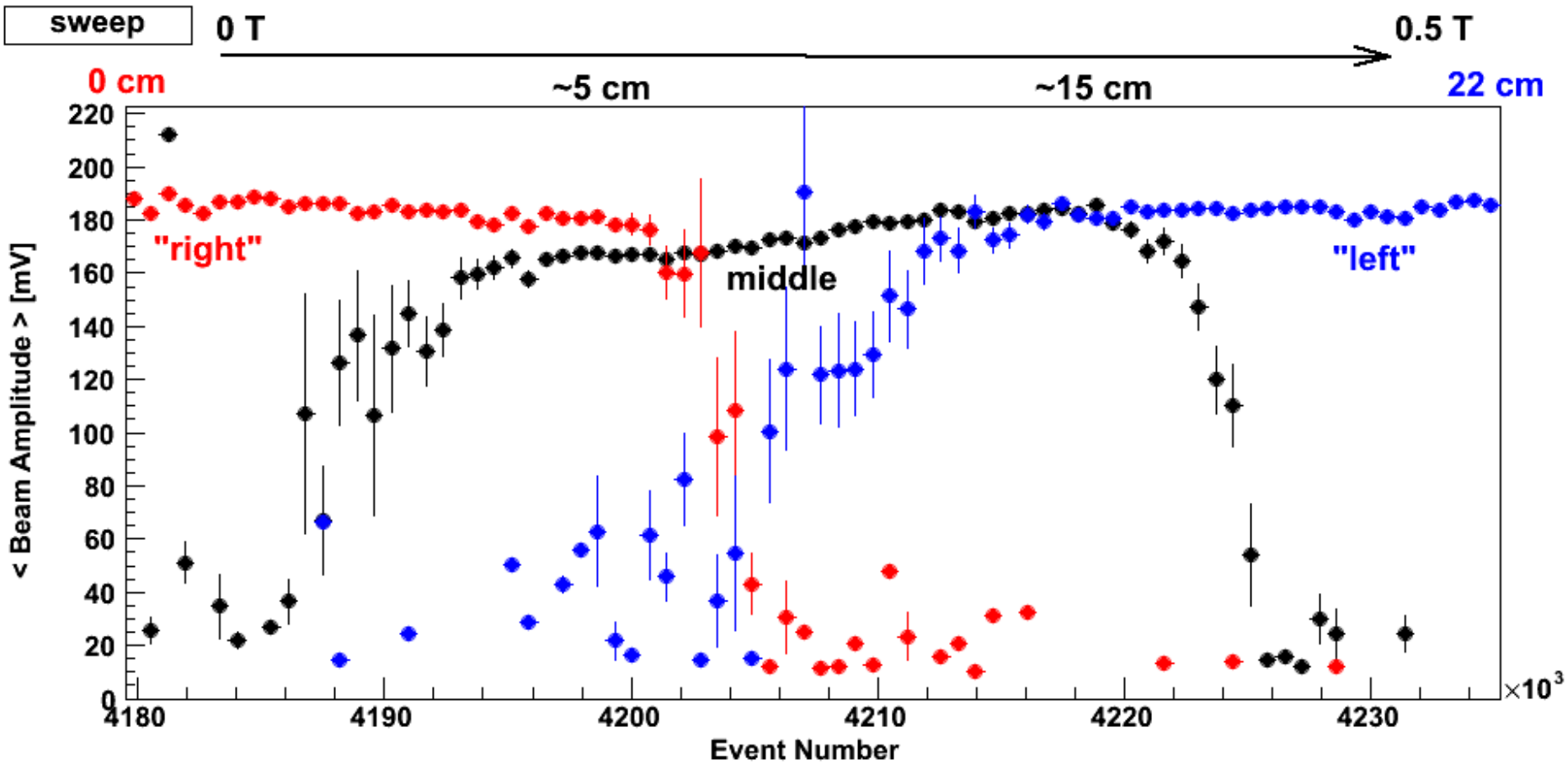
PD0, PD1, PD2 – HAMAMATSU PIN photodiodes for direct detection, 500 μm thickness

Opening: 3×3 cm^2



Ions of beam velocity and Z~<15 punch through CsI1 (2.5 cm)

Sweep runs


sweep
0 T
0.5 T
0 cm
~5 cm
~15 cm
22 cm
"right"
middle
"left"
< Beam Amplitude > [mV]
Event Number
×10³
0
20
40
60
80
100
120
140
160
180
200
220
4180
4190
4200
4210
4220
4230