

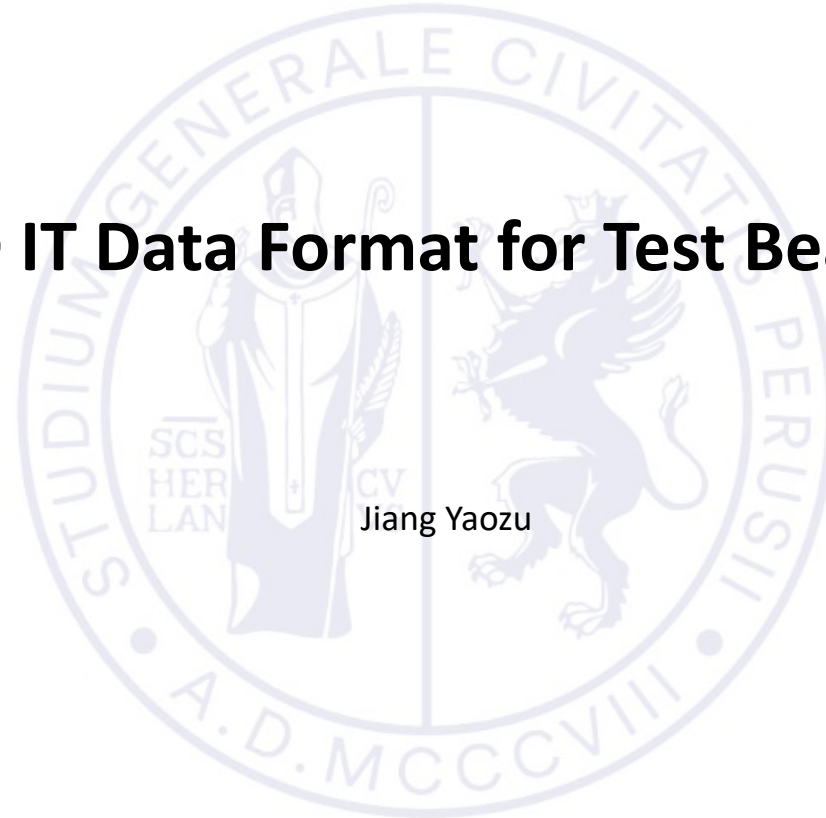


DIPARTIMENTO
DI FISICA E GEOLOGIA



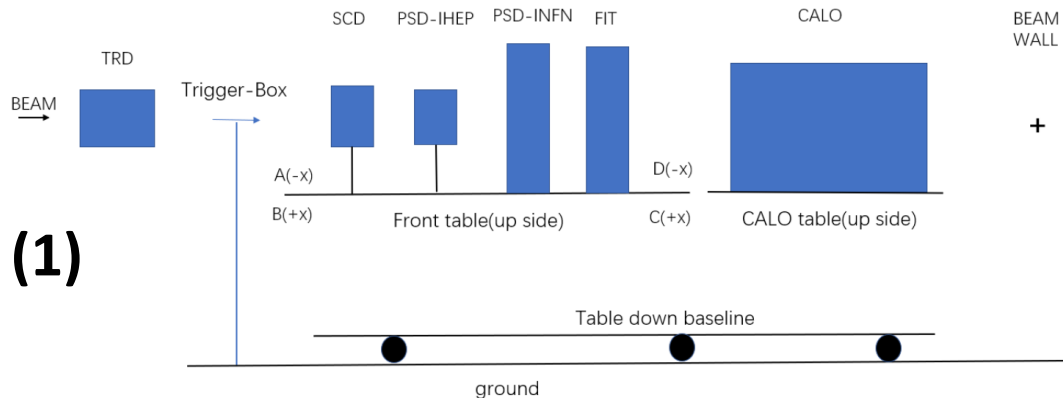
Istituto Nazionale di Fisica Nucleare
Sezione di Perugia

SCD IT Data Format for Test Beam 2023



Jiang Yaozu

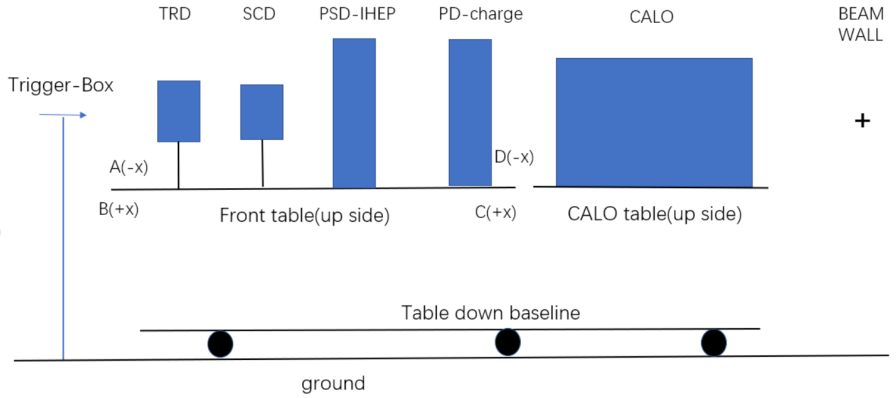
PS 06/09/2023



(1)

TRD->TB	TB_width	TB->SCD	SCD_width	SCD->PSD(IHEP)	PSD(IHEP)_width	PSD(IHEP)->PSD(INFN)	PSD(INFN)_width	PSD(INFN)->FIT	FIT_width	FIT->CALO
2.0189m	0.3625m	0.343m	0.12m	0.365m	0.02m	0.2247m	0.09m	0.3040m	0.2710m	0.4016(0.4027)m

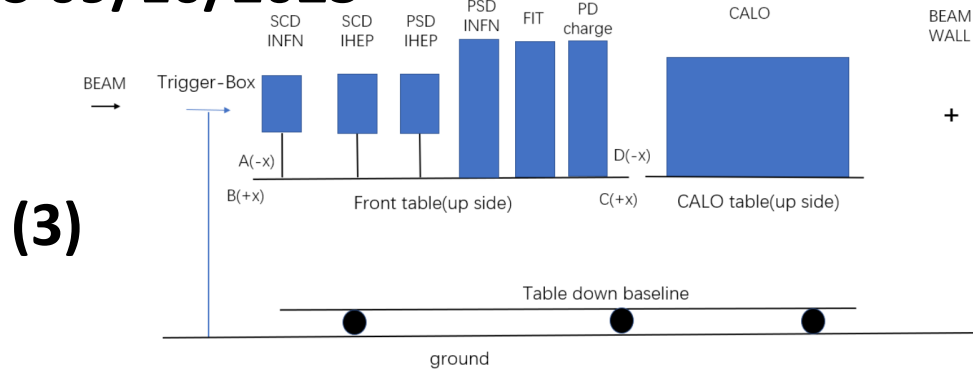
SPS 14/09/2023



(2)

TB_width	TB(edge)->TRD	TRD_width	TRD->SCD	SCD_width	SCD->PSD(IHEP)	PSD(IHEP)_width	PSD(IHEP)->CALO	PD(charge)_width	PD(charge)->CALO	SCD->CALO
0.3625m	0.535m	0.23m	0.80m	0.12m	0.253m(inaccurate)	0.02m	0.442m(inaccurate)	0.034m	0.166m	0.7193m(accurate)

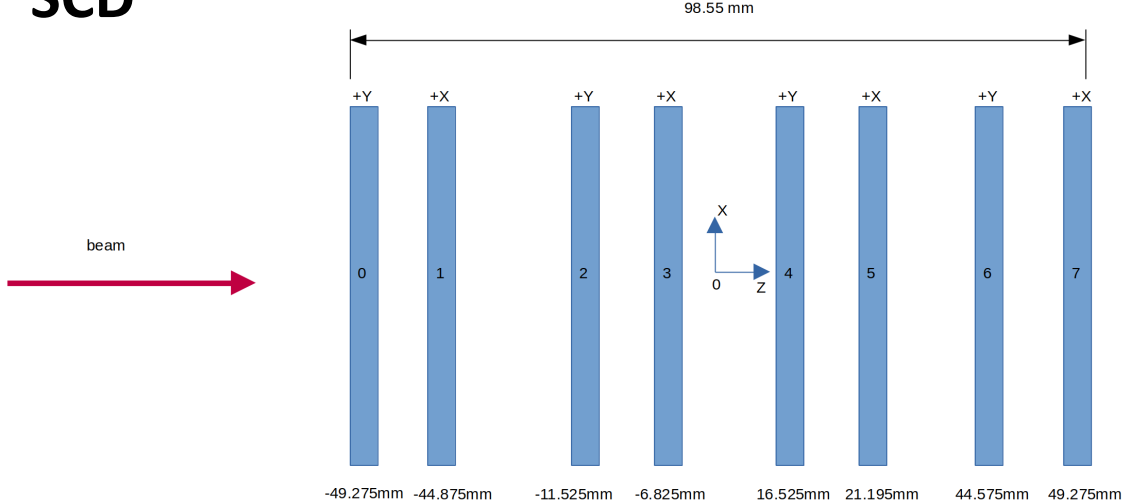
SPS 09/10/2023



(3)

PAN->Trigger_box	Beam_tube->Trigger_box	Trigger_box edge outside width	Trigger_box->SCD_INFN	SCD_INFN width	SCD_INFN->SCD_IHEP	SCD_IHEP width	SCD_IHEP->PSD_IHEP	SCD_IHEP->PSD_INFN
3.507m	0.264m	0.005m	0.534m	0.117m	0.2848m	0.13m	0.177m	0.365m
SCD_INFN->FIT(side_B)	SCD_INFN->FIT(side_C)	FIT->CALO	PD_charge->CALO	PD_charge width				
0.2784m	1.5458m	0.35m	0.187m	0.034m				

SCD



PS 06/09/2023

Runs worked/Total runs:
118/131

Runs unworked:
68,88,92,95,119,121,124,128,
134,140,143,150,151,159,160,
165,180,185,218,219,220,221,
222

SPS 14/09/2023

Runs worked/Total runs:
76/149

Runs unworked:
173-300

SPS 09/10/2023

Runs worked/Total runs:
96/130

Runs unworked:
479,490,494,495,501,502,507,
509,510,541,542,543,549,561,
562,566,567,568,578,584,585,
592,593,597,617

Data Format

```
root [5] SCDIT_2023->Show(999)
=====> EVENT:999
event          = 1595
trigger        = 1208
trck_nhit      = 8
trck_ax        = -9.08027
trck_bx        = 8.72467e-05
trck_ay        = 5.70937
trck_by        = 0.00221576
trck_chi2      = 2.61736
trck_trunc_q   = 22.4972
trck_trunc_q_rms = 0.514914
clus_nstrip    = 18,
                21, 13, 16, 12, 15, 16, 14
clus_add       = 357,
                259, 357, 263, 358, 260, 359, 258
clus_seed      = 1374.81,
                1361.66, 2896.61, 2879.66, 2952.91, 3006.18,
                2913.76, 2803
clus_eta       = 0.498026,
                0.499217, 0.498825, 0.500704, 0.50171, 0.488291,
                0.463693, 0.542384
clus_sig       = 16924.3,
                17683.9, 9411.62, 9521.86, 9889.21, 9683.89,
                9383.7, 8913.48
clus_q         = 21.5918,
                21.9741, 22.8958, 22.9835, 23.0227, 23.0682,
                22.7194, 22.2934
```

Reduced Data Format:

Int_t event	DAQ Event Number
UInt_t trigger	I2C Trigger Number
Int_t trck_nhit	Number of points in the track
Float_t trck_ax	Term a of the track projection in XZ plane, $X = a + bZ$
Float_t trck_bx	Term b of the track projection in XZ plane, $X = a + bZ$
Float_t trck_ay	Term a of the track projection in YZ plane, $Y = a + bZ$
Float_t trck_by	Term b of the track projection in YZ plane, $Y = a + bZ$
Float_t trck_chi2	Global track fit normalized chi2
Int_t clus_nstrip[8]	Number of strips in each cluster
Int_t clus_add[8]	Seed address of each cluster
Float_t clus_seed[8]	Seed signal of each cluster
Float_t clus_eta[8]	Cluster position estimation in interstrip units
Float_t clus_sig[8]	Cluster total signal
Float_t clus_q[8]	Cluster estimated charge
Float_t trck_trunc_q	Global track charge evaluation (trunc. mean, removed the maximum value of 8 sensors)
Float_t trck_trunc_q_rms	Global track charge evaluation RMS

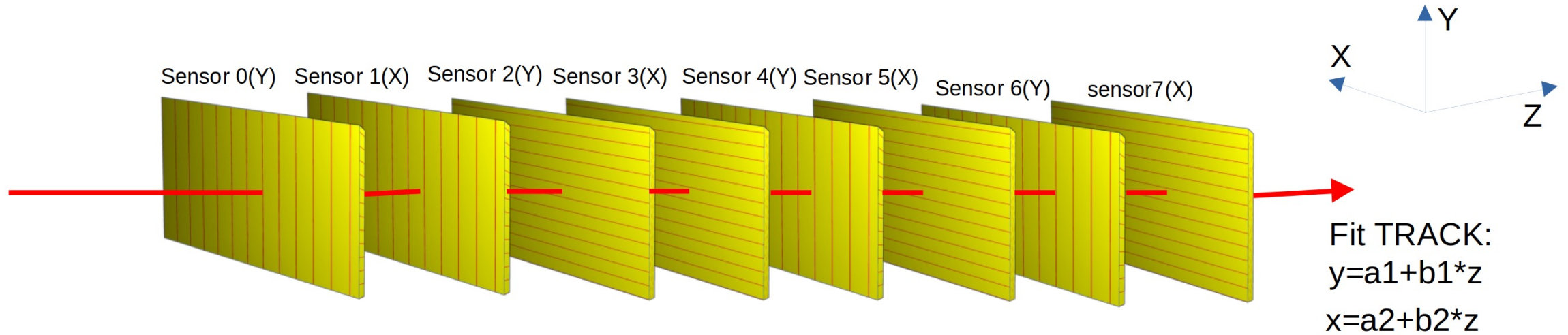
Data Format

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root [5] SCDIT_2023->Show(999)
=====> EVENT:999
event          = 1595
trigger        = 1208
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trck_ax        = -9.08027
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Float_t trck_trunc_q	Global track charge evaluation (trunc. mean, removed the maximum value of 8 sensors)
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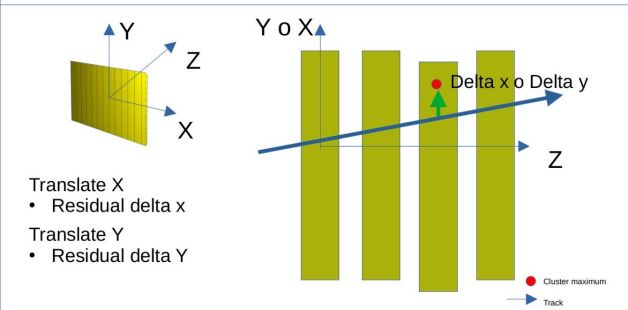
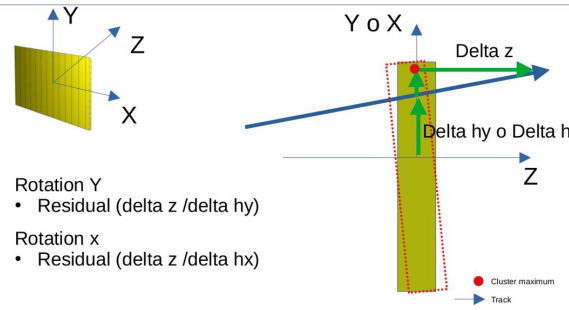
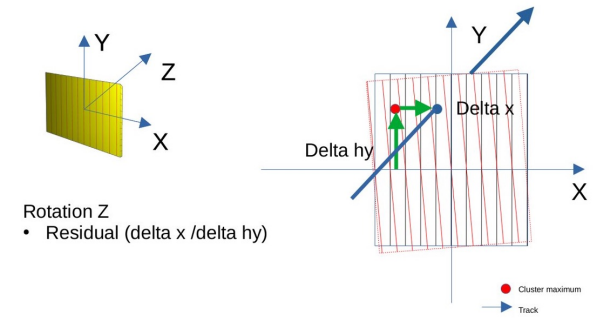
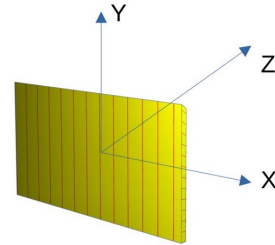
Track



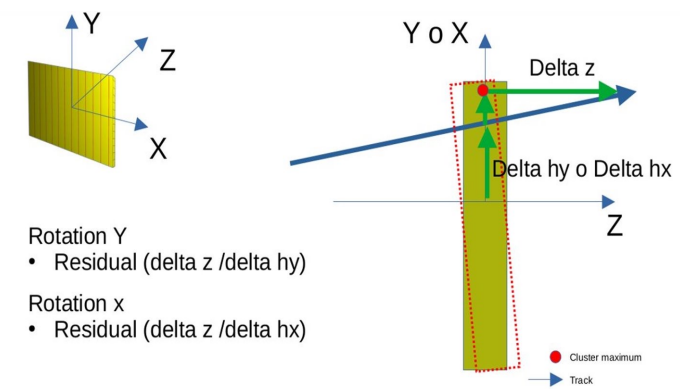
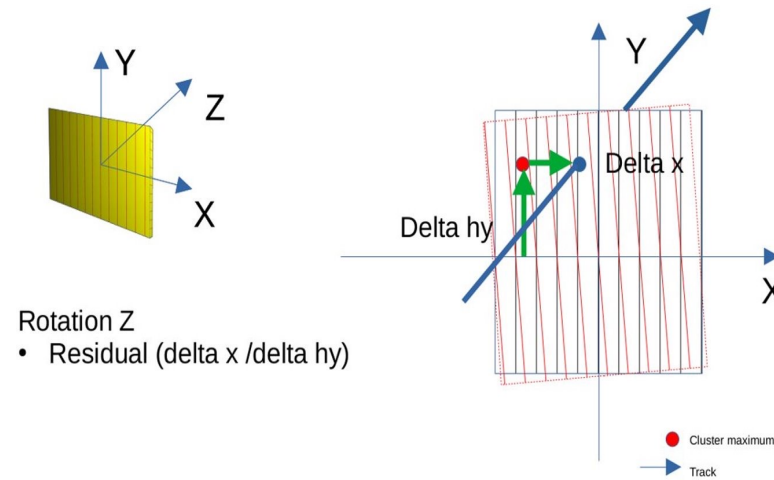
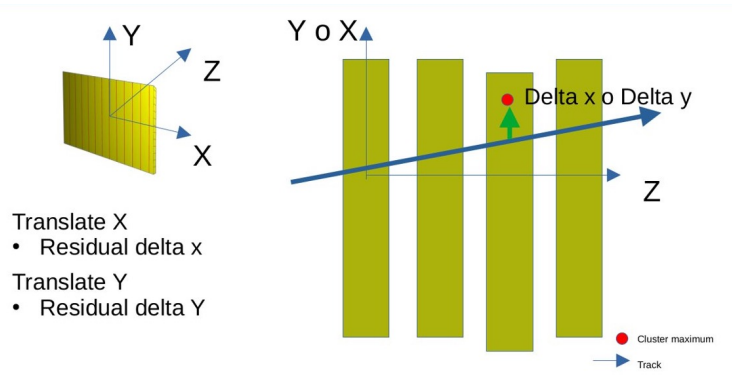
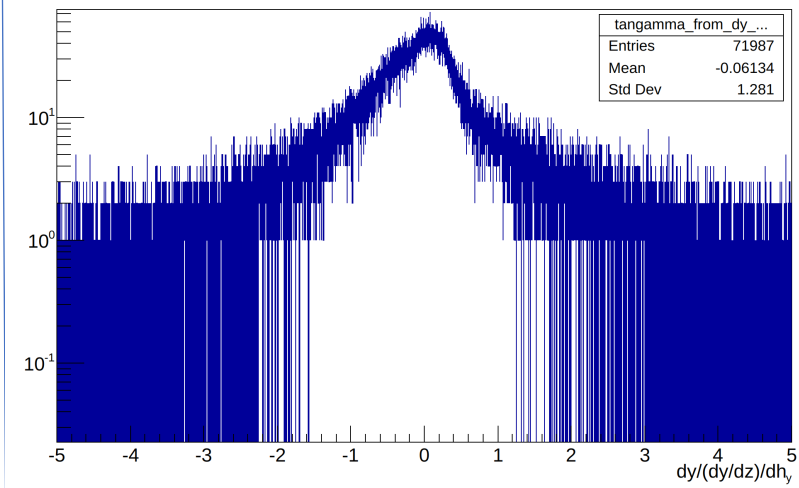
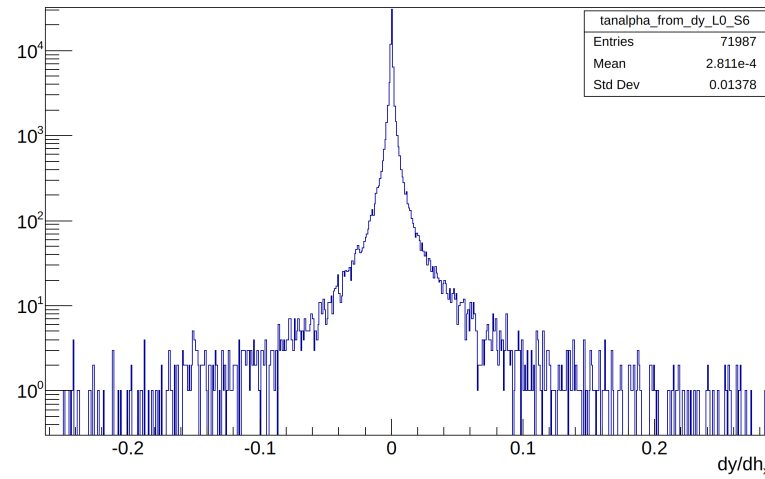
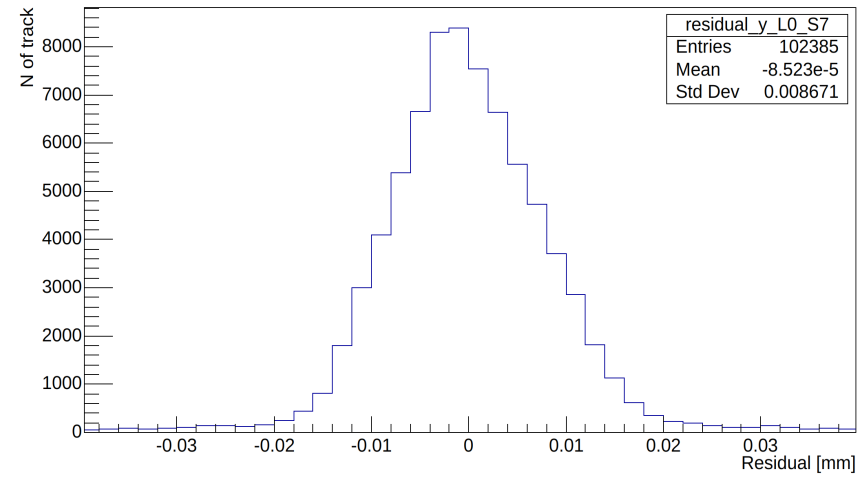
- 8 sensors enable independent estimation of positions along the X and Y axes, with 4 sensors dedicated to each axis.
- Reorder clusters from highest-to-lowest signal, and do all-points combinations of all hits in the two views (X-Z and Y-Z), keep only tracks with reasonable chi-square
- The list of track-views is then combined in 3D tracks based on similar average signal on the two views

ALIGNMENT

- Degree of freedom
- Translate x
 - Translate y
 - Translate z (not sensitive)
 - Rotation z
 - Rotation x
 - Rotation y

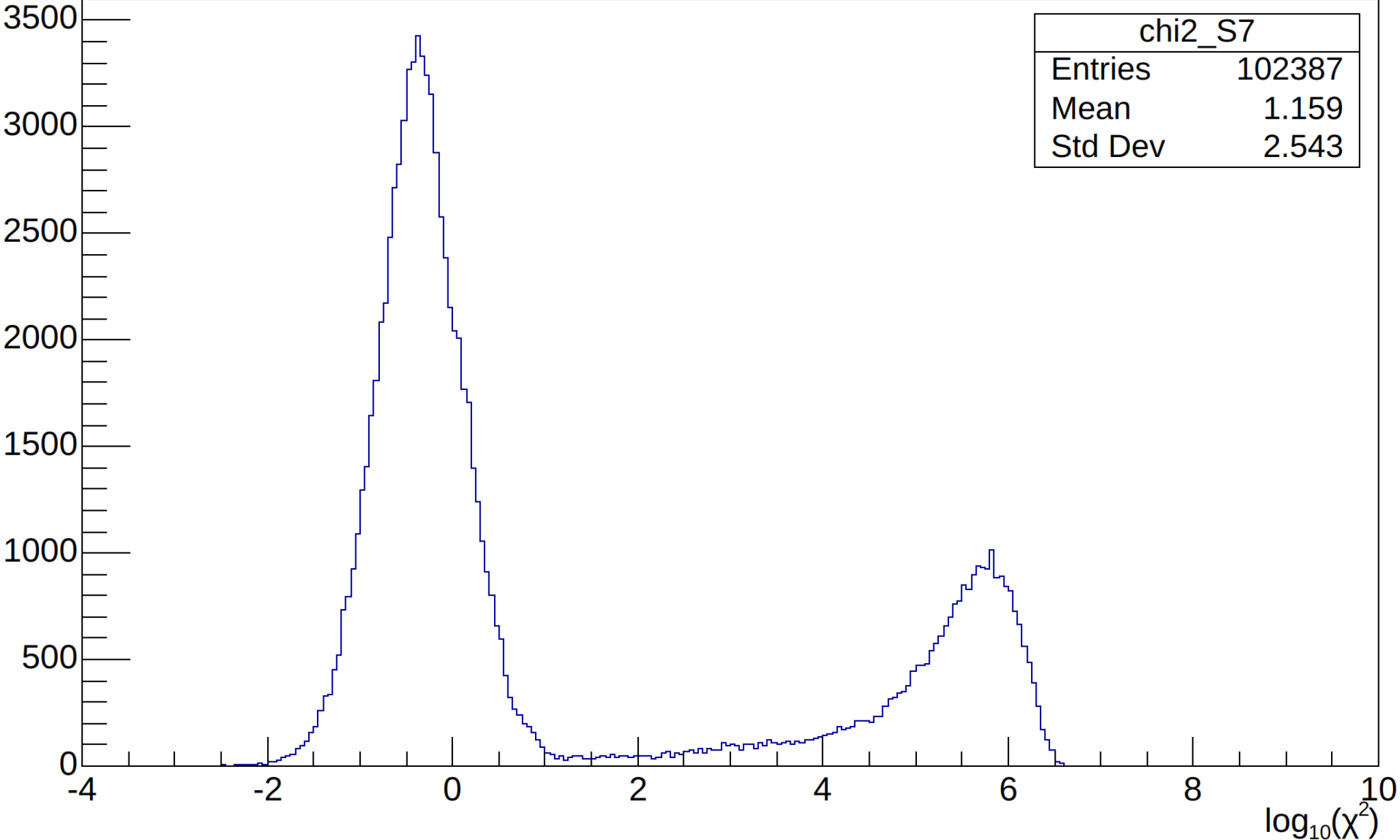


Alignment

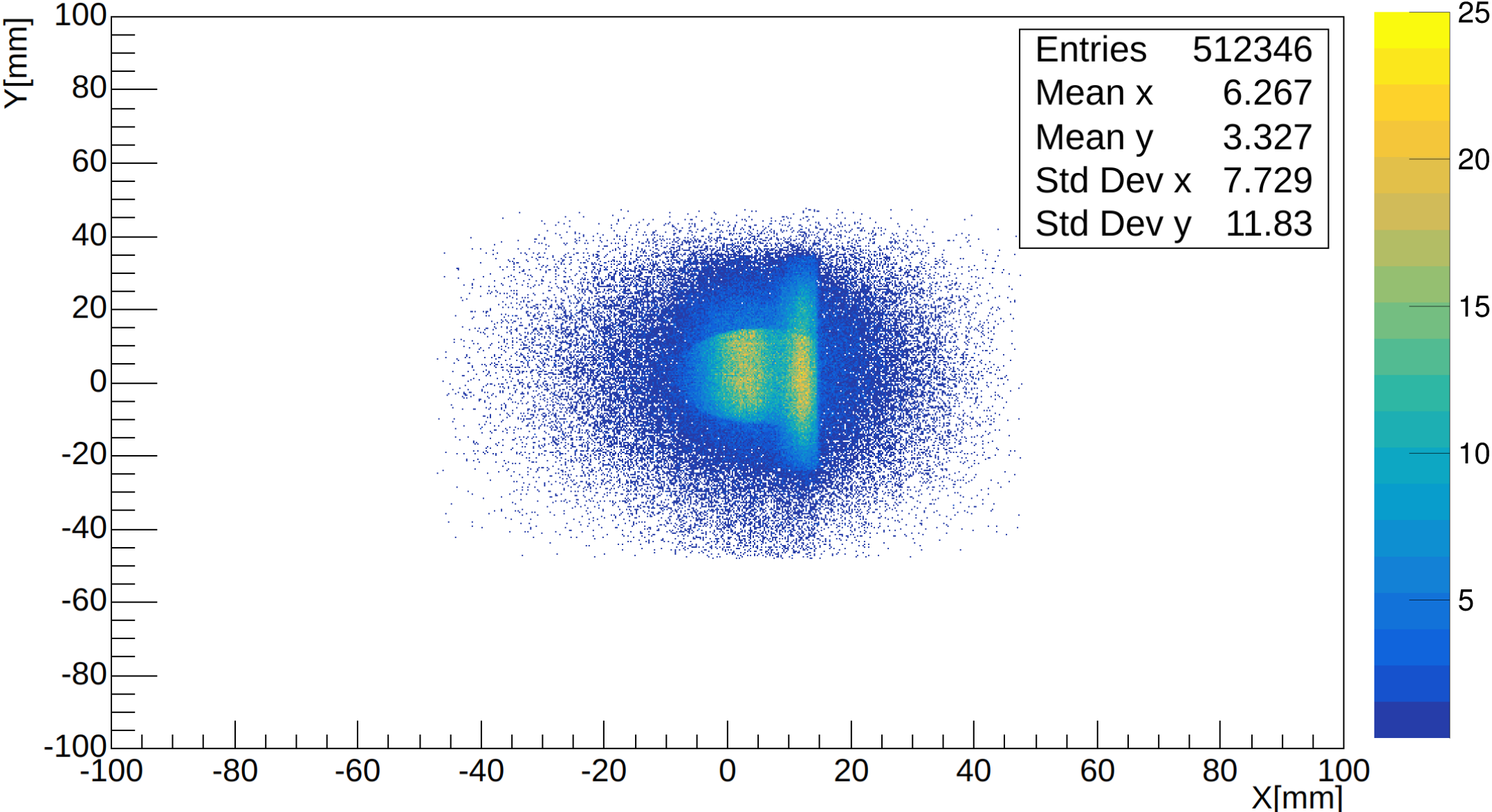


Note: Beam Test 2023 HERD, run448, sensor 0

Global track fit normalized chi^2

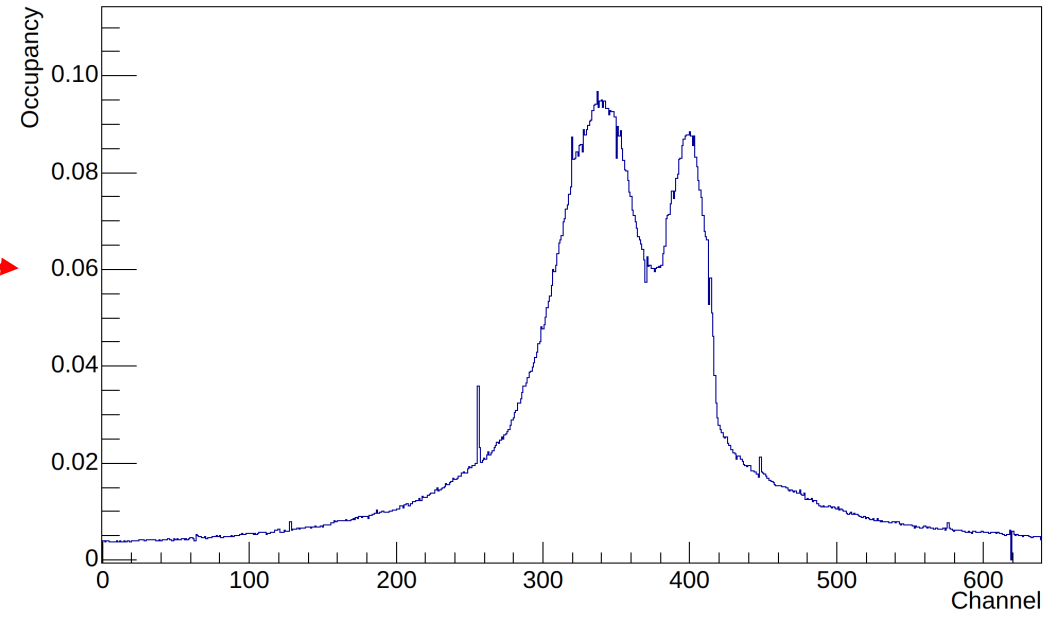
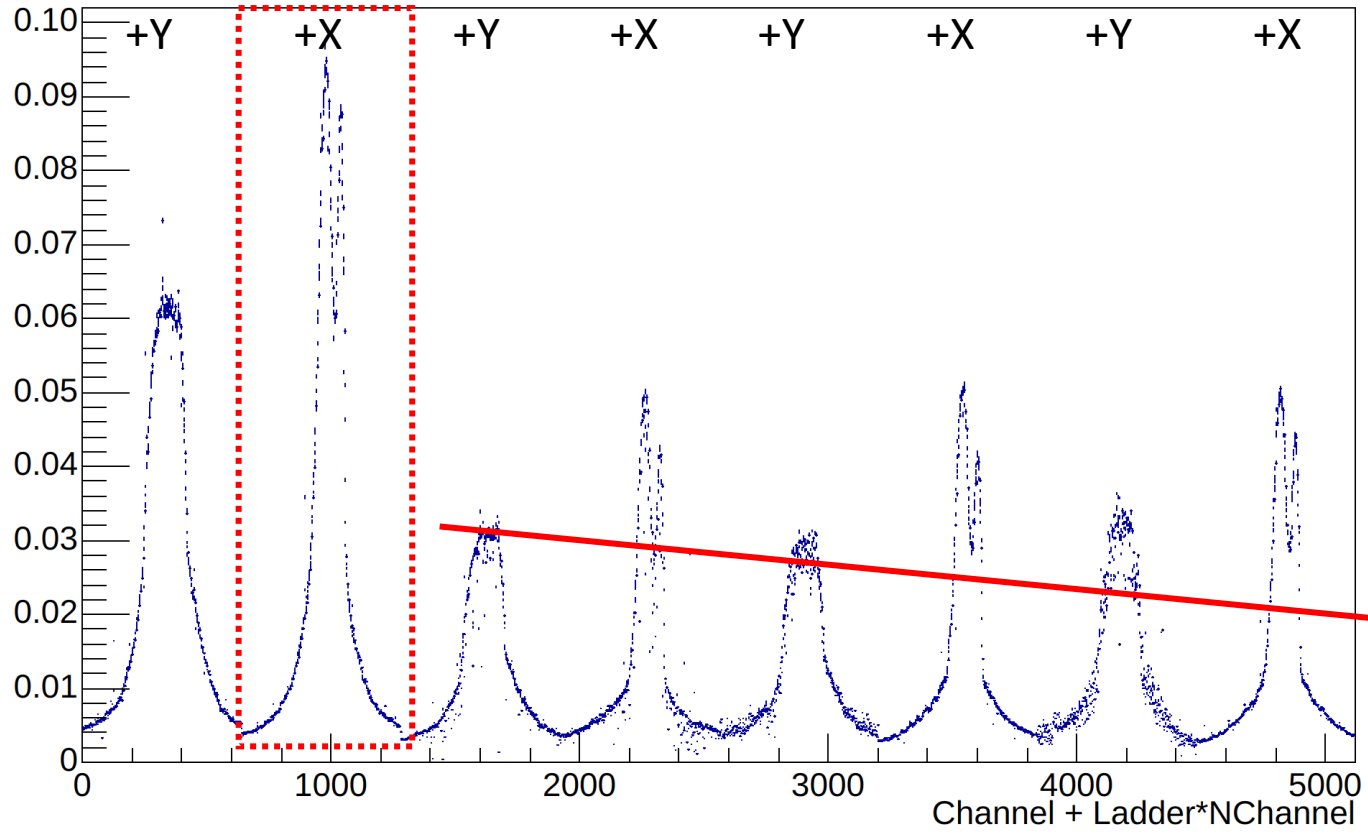


Tracks projected to the Z position of SCD

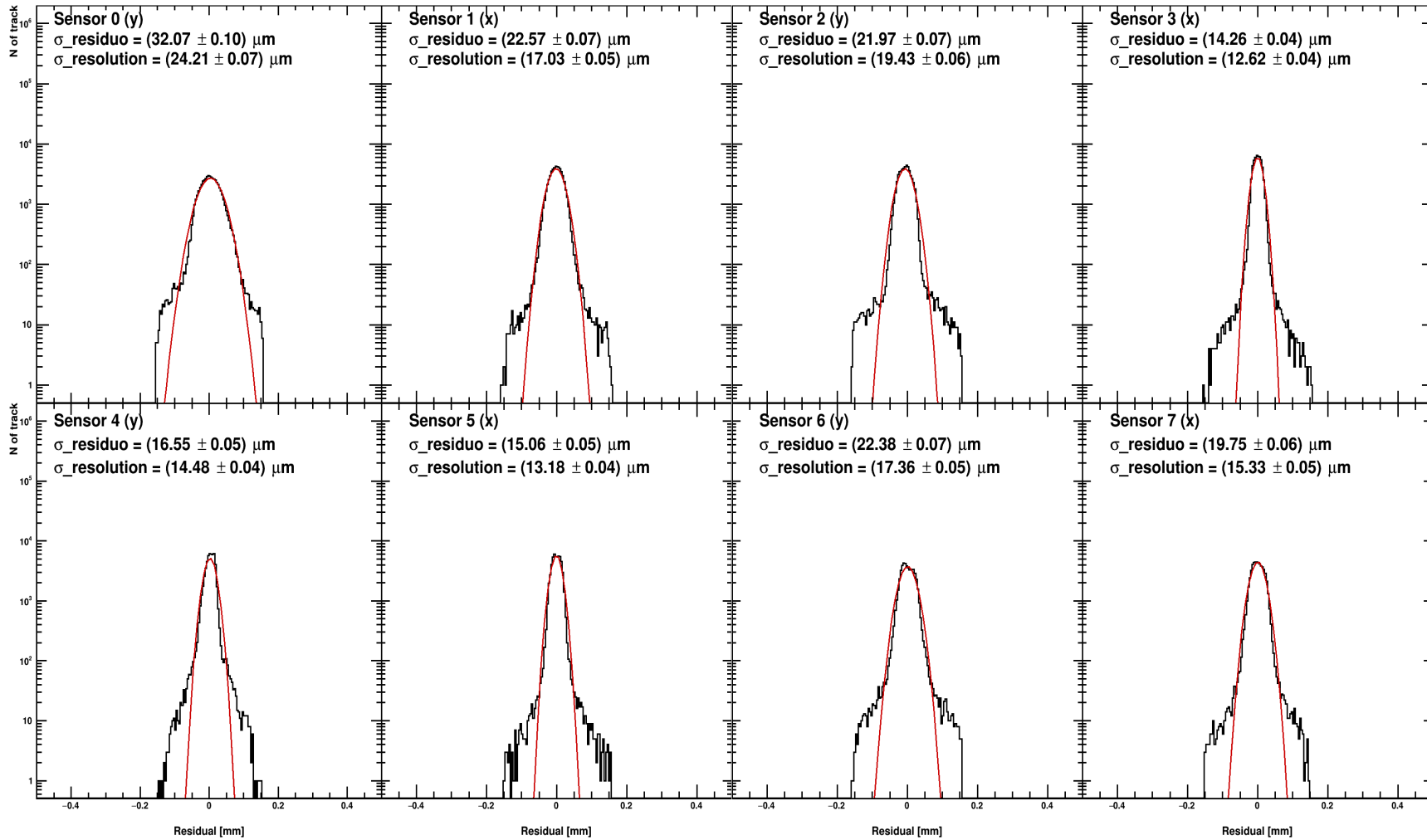


Note: Beam Test 2023 OCT HERD run_448

Occupancy



THE SPATIAL RESOLUTION

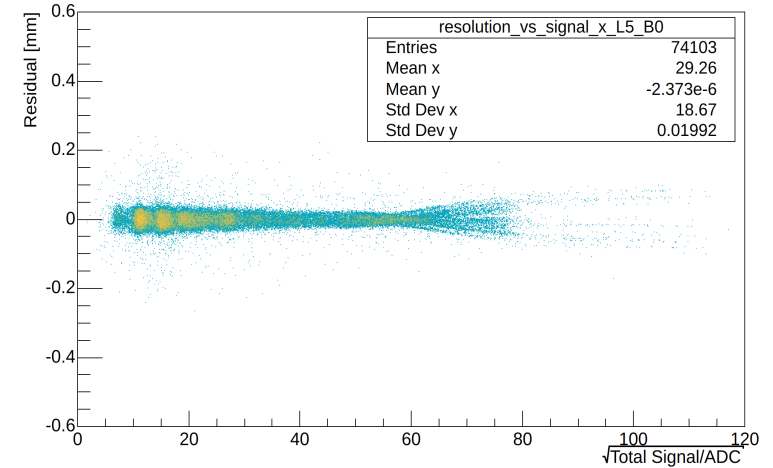


- The width (sigma) of the residual distribution can be expressed as the sum of two contributions, the intrinsic resolution of the sensor and the error in the fit prediction.

$$\sigma_{RES,i} = \sqrt{\sigma_{fit,i}^2 + \sigma_{resolu,i}^2}$$

- By knowing the value of the error in the fit prediction for each sensor, it is possible to obtain an estimate of the intrinsic resolution of the sensors.

$$\sigma_{fit,i} \approx \sqrt{\frac{1}{D} \left[\sum_{j=1}^4 \frac{z_j^2}{\sigma_j^2} - 2z_i \sum_{j=1}^4 \frac{z_j^2}{\sigma_j^2} + z_i^2 \sum_{j=1}^4 \frac{1}{\sigma_j^2} \right]}$$



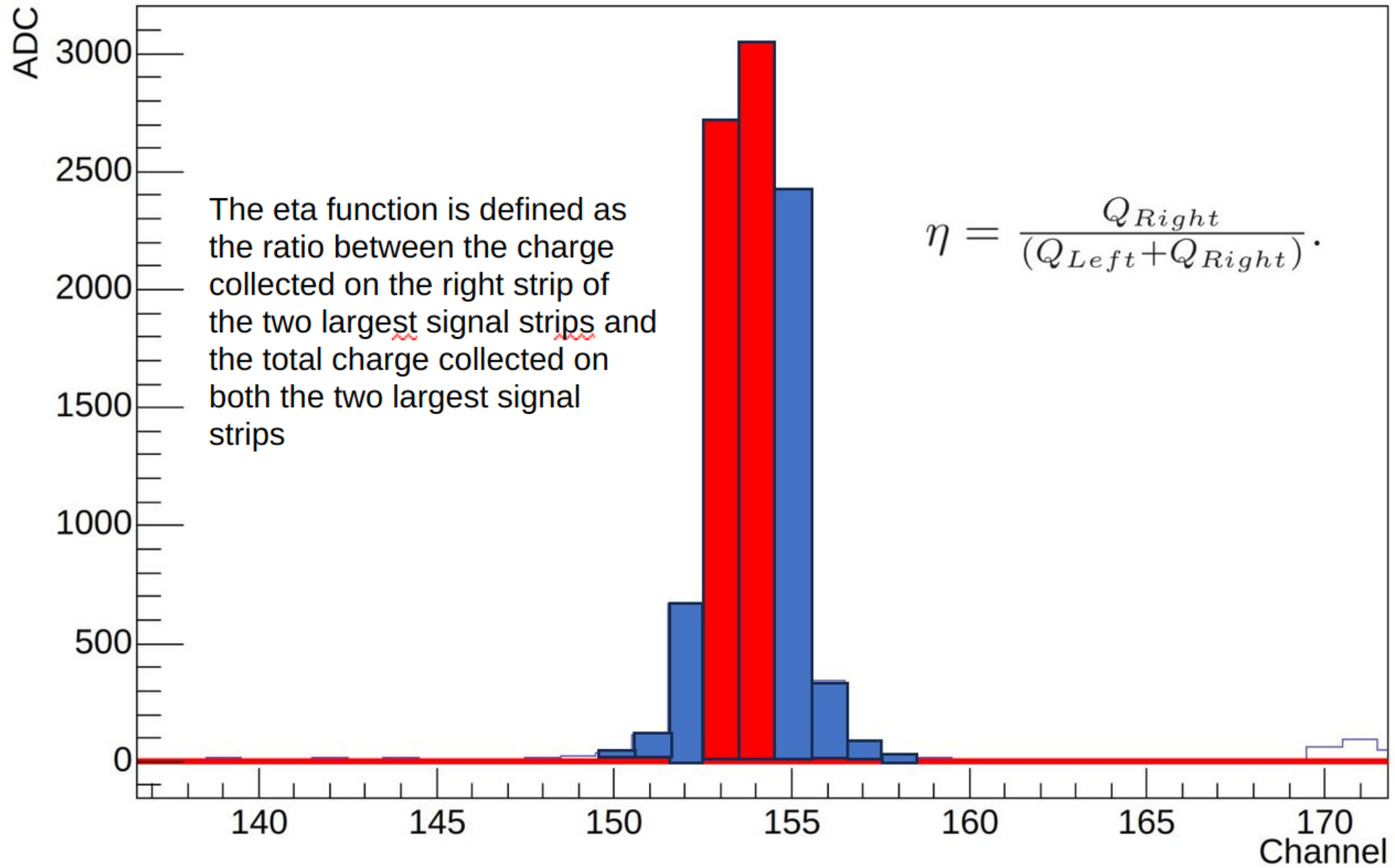
Data Format

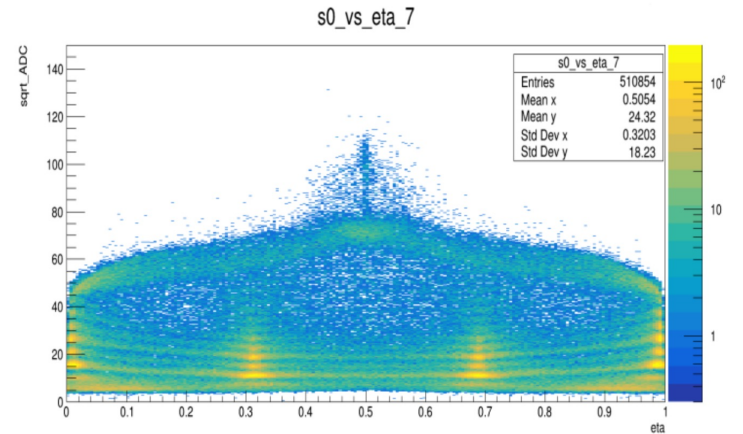
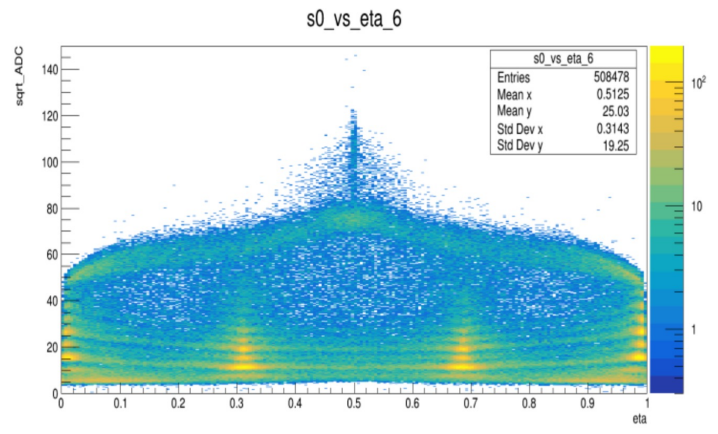
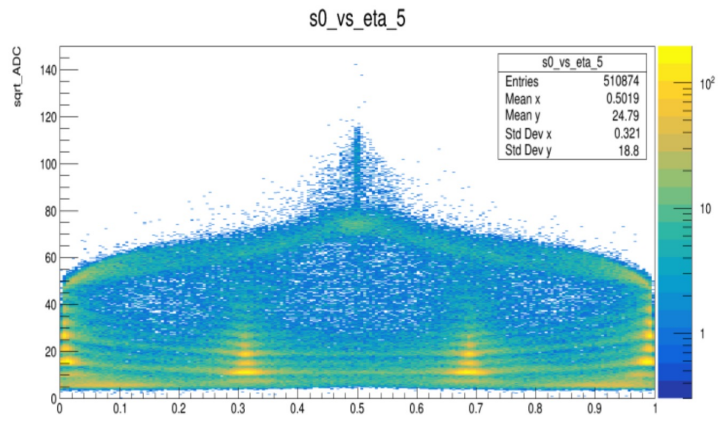
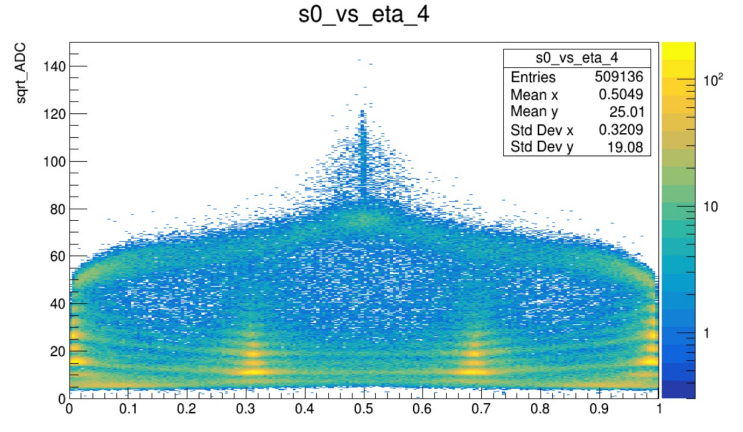
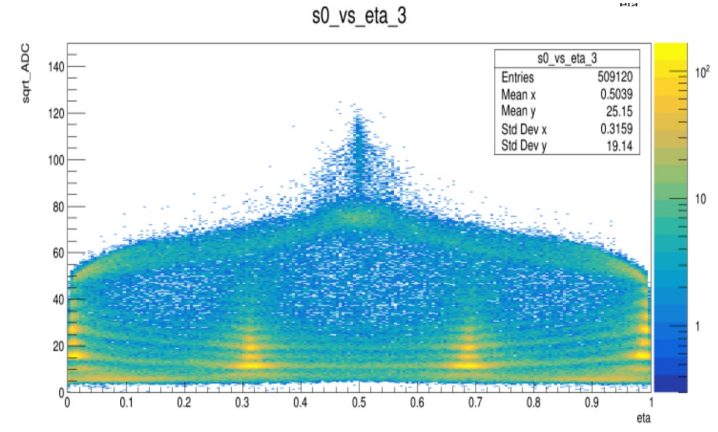
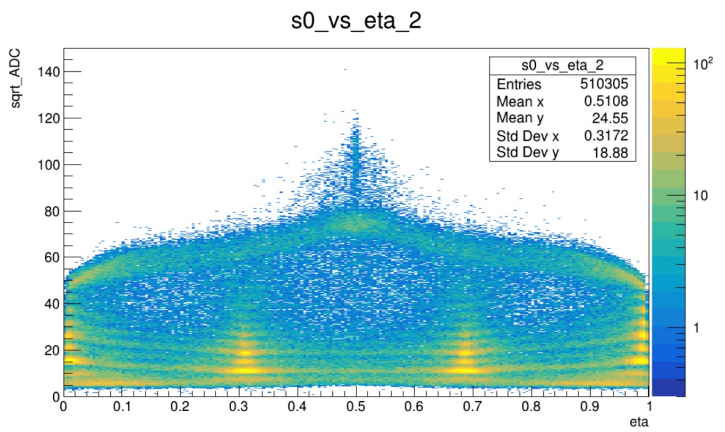
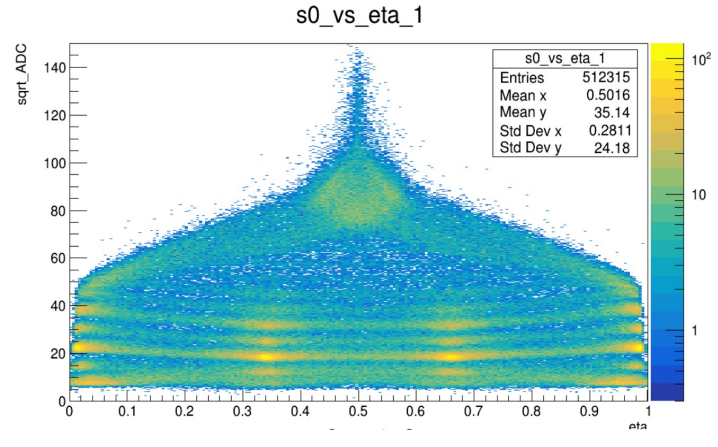
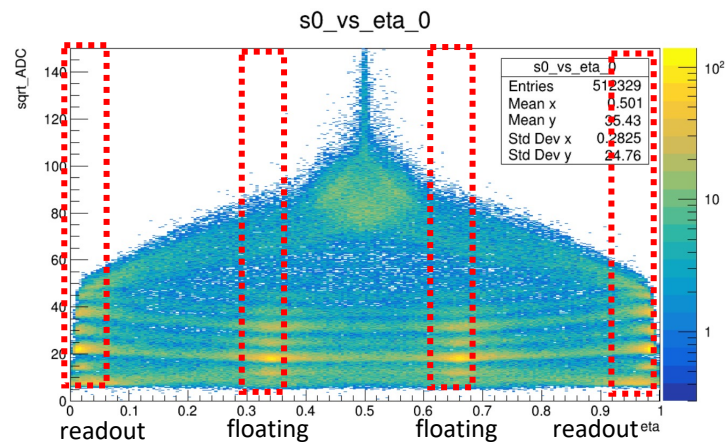
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clus_q         = 21.5918,
                21.9741, 22.8958, 22.9835, 23.0227, 23.0682,
                22.7194, 22.2934
```

Reduced Data Format:

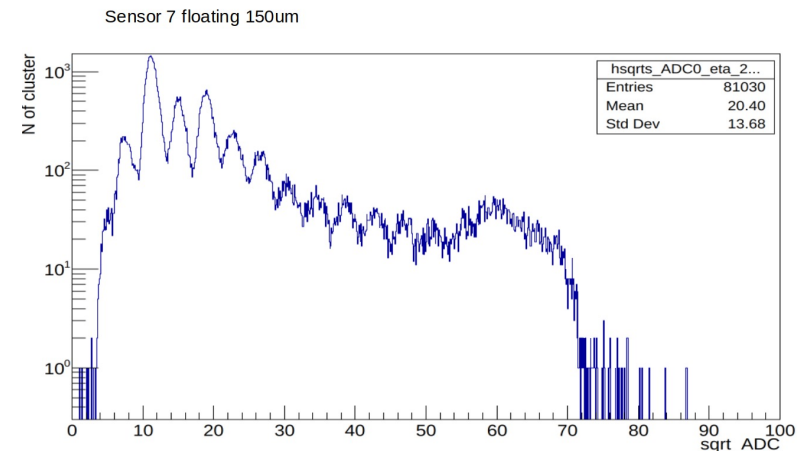
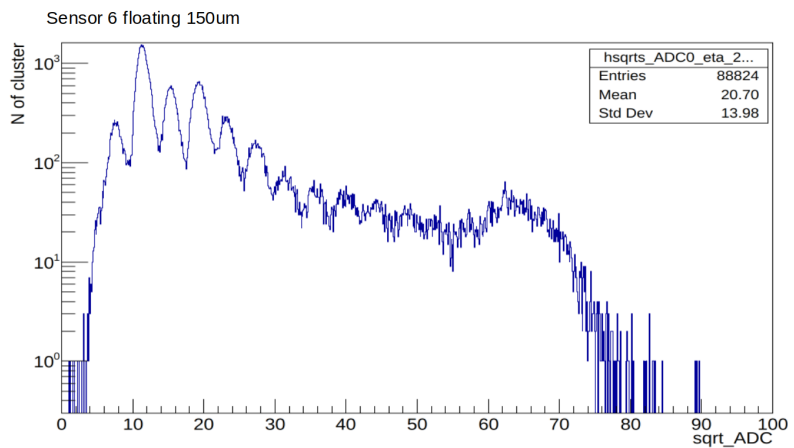
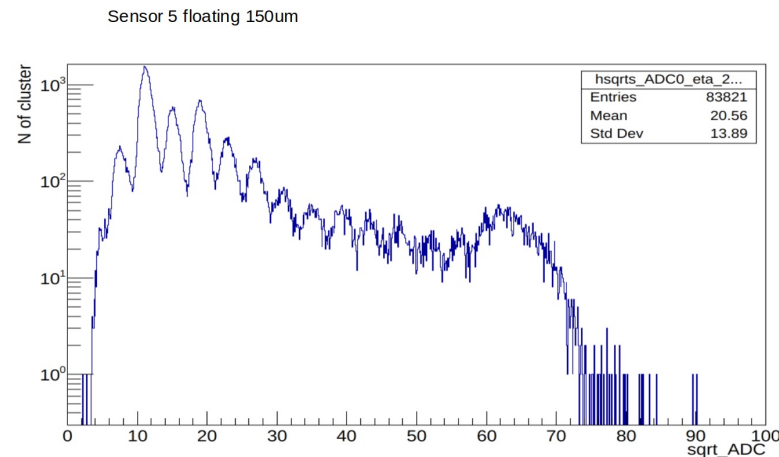
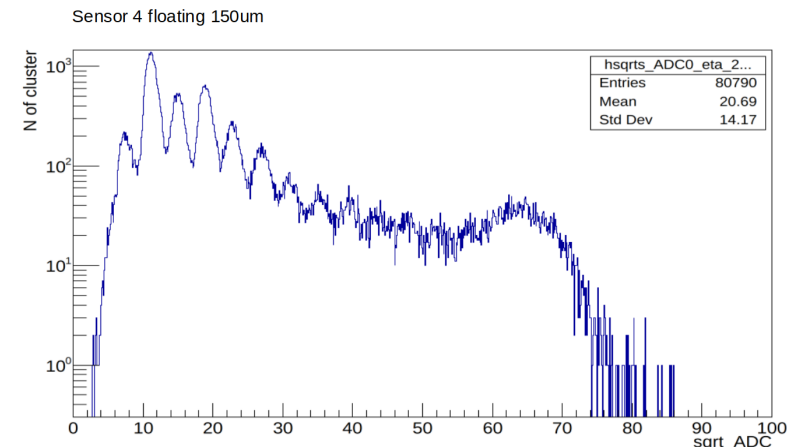
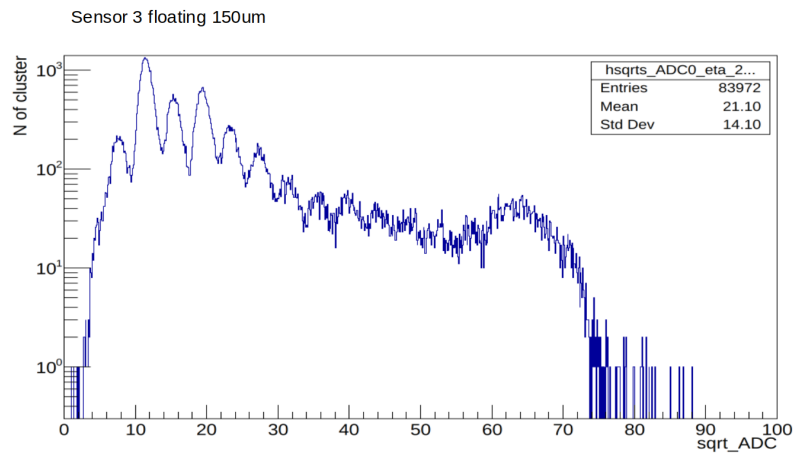
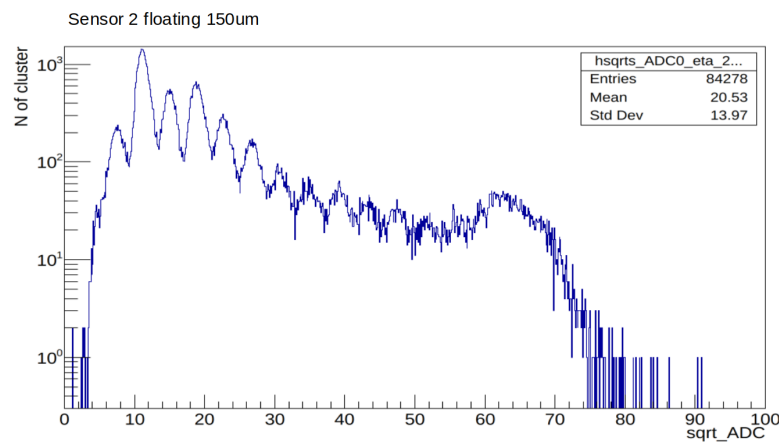
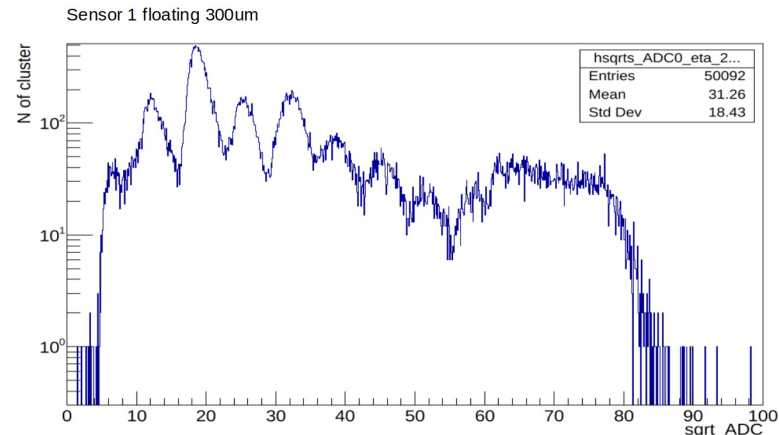
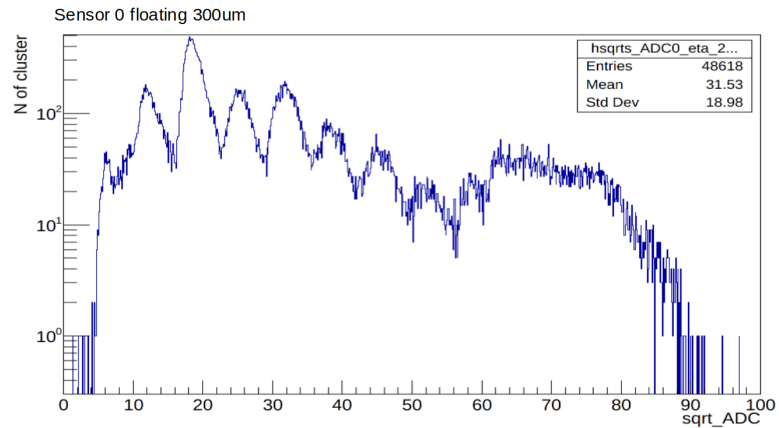
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UInt_t trigger	I2C Trigger Number
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Float_t trck_trunc_q_rms	Global track charge evaluation RMS

Eta

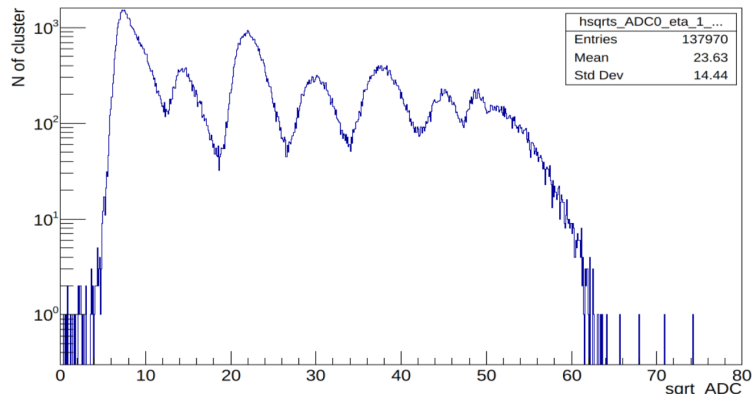




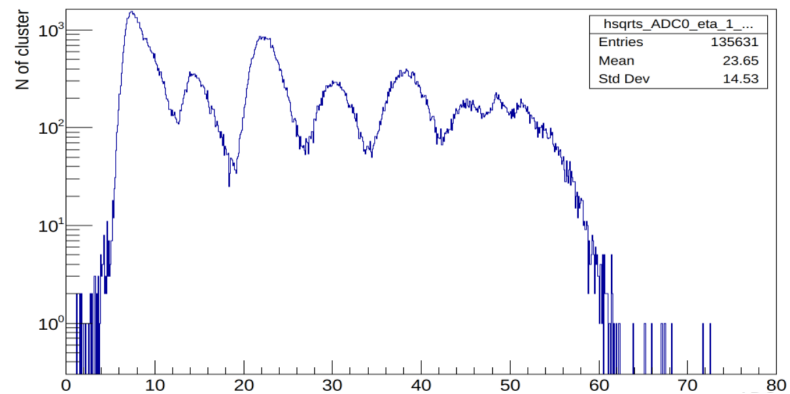
Note: Beam Test 2023 OCT HERD run_448



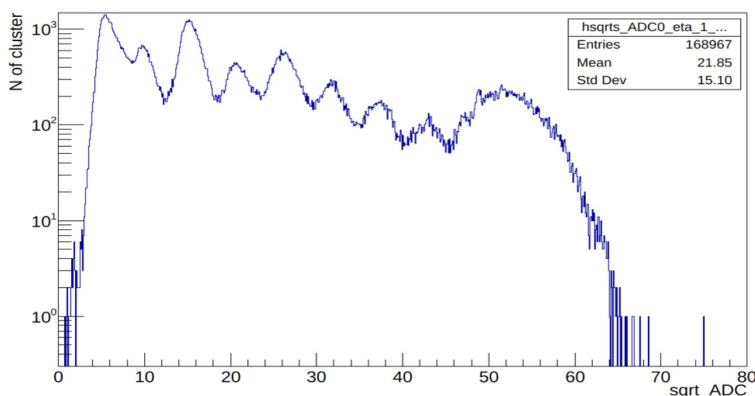
Sensor 0 readout 300um



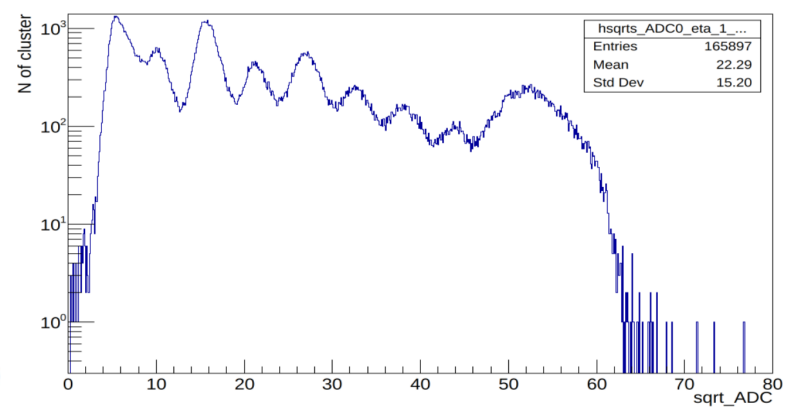
Sensor 1 readout 300um



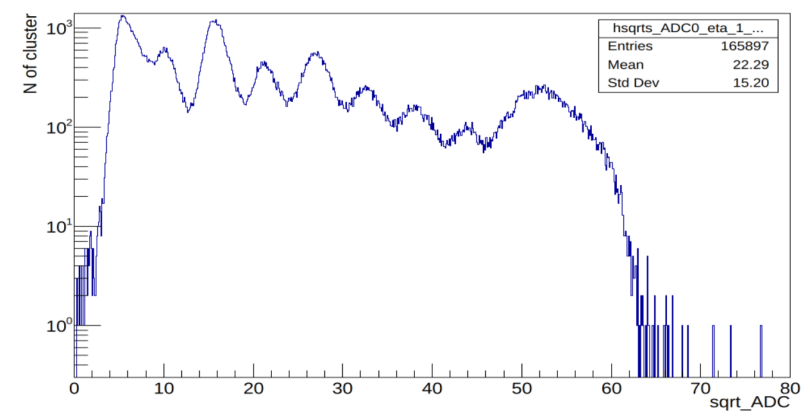
Sensor 2 readout 150um



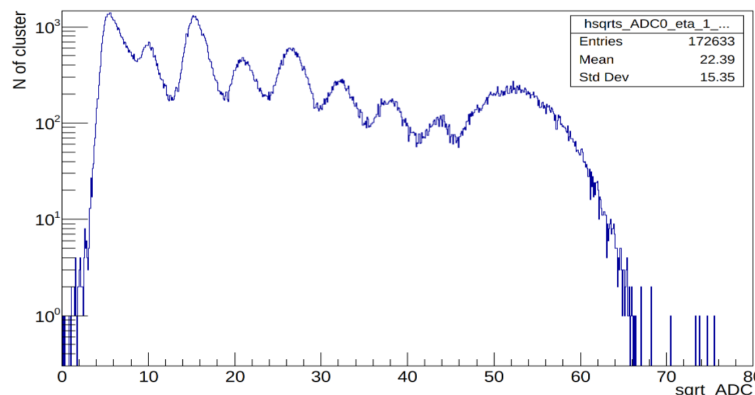
Sensor 3 readout 150um



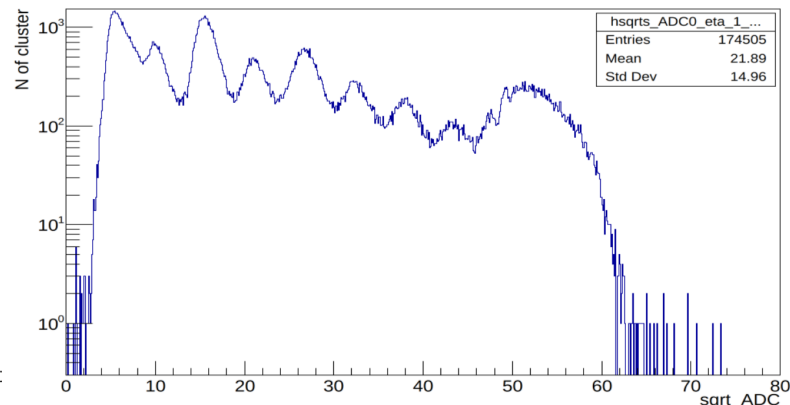
Sensor 3 readout 150um



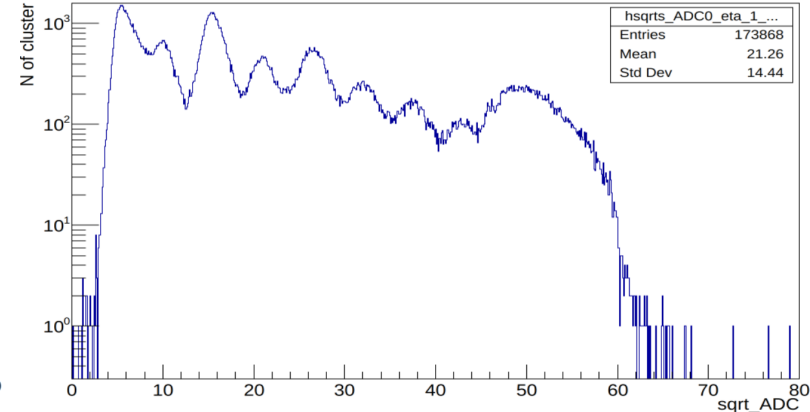
Sensor 4 readout 150um



Sensor 5 readout 150um



Sensor 7 readout 150um



Data Format

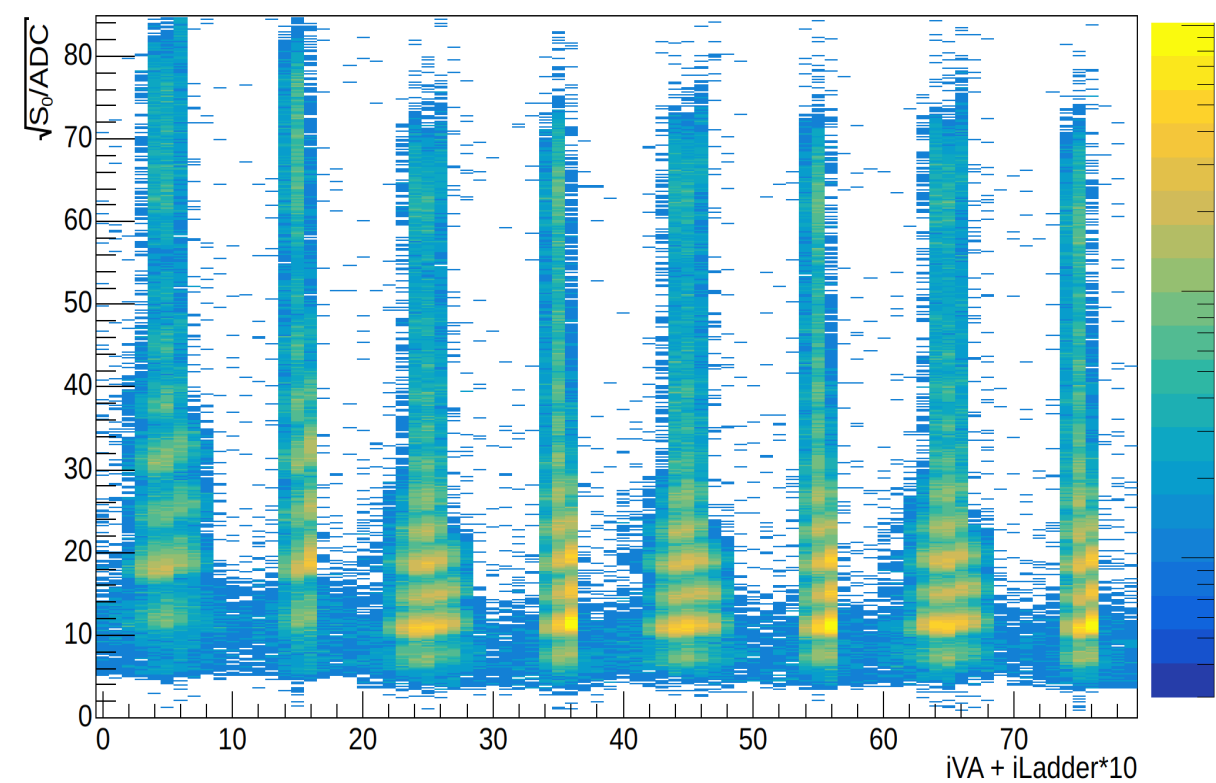
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clus_sig       = 16924.3,
                17683.9, 9411.62, 9521.86, 9889.21, 9683.89,
                9383.7, 8913.48
clus_q         = 21.5918,
                21.9741, 22.8958, 22.9835, 23.0227, 23.0682,
                22.7194, 22.2934
```

Reduced Data Format:

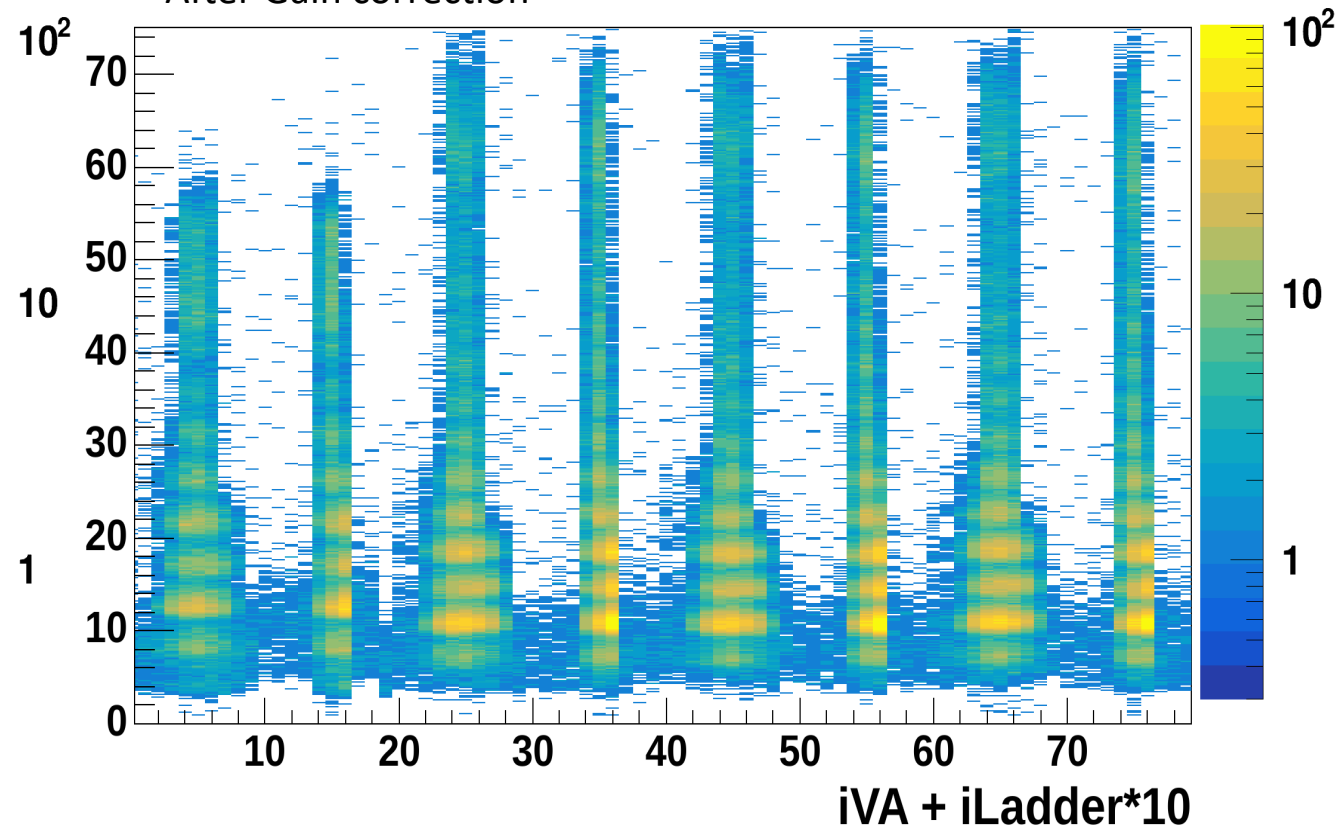
Int_t event	DAQ Event Number
UInt_t trigger	I2C Trigger Number
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Float_t trck_bx	Term b of the track projection in XZ plane, $X = a + bZ$
Float_t trck_ay	Term a of the track projection in YZ plane, $Y = a + bZ$
Float_t trck_by	Term b of the track projection in YZ plane, $Y = a + bZ$
Float_t trck_chi2	Global track fit normalized chi2
Int_t clus_nstrip[8]	Number of strips in each cluster
Int_t clus_add[8]	Seed address of each cluster
Float_t clus_seed[8]	Seed signal of each cluster
Float_t clus_eta[8]	Cluster position estimation in interstrip units
Float_t clus_sig[8]	Cluster total signal
Float_t clus_q[8]	Cluster estimated charge
Float_t trck_trunc_q	Global track charge evaluation (trunc. mean, removed the maximum value of 8 sensors)
Float_t trck_trunc_q_rms	Global track charge evaluation RMS

Gain correction

Before Gain correction

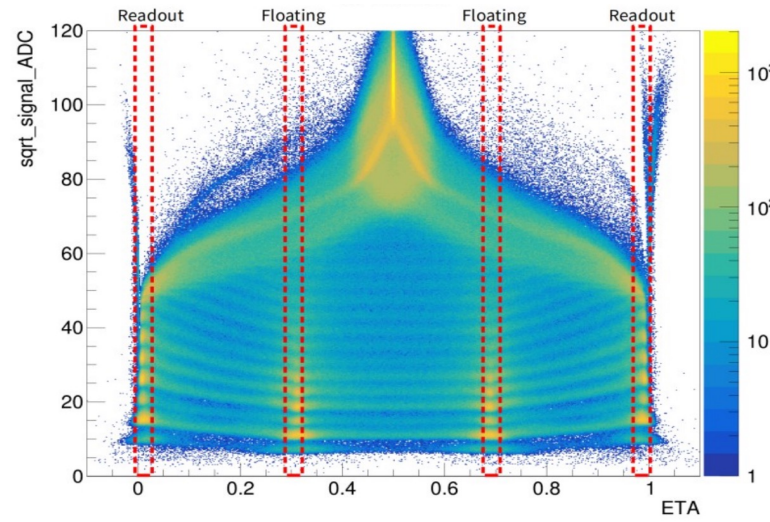


After Gain correction

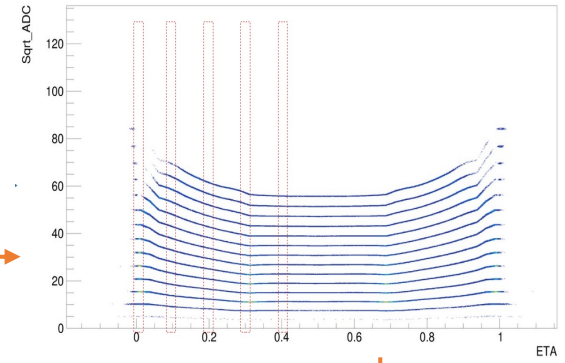


Process of Eta correction

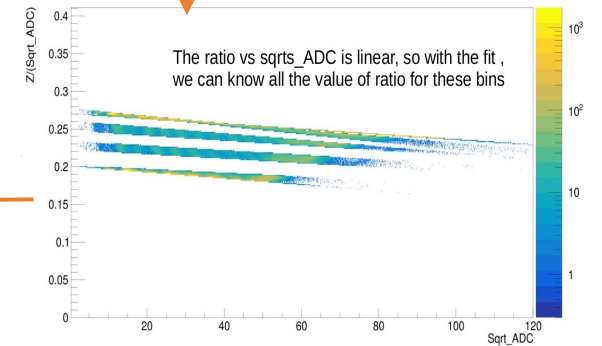
1. Find the charge line
2. Calculate the ratio $Z/\sqrt{\text{ADC}}$ for each bin each Z (e.g. I did only 4 bins)
3. Calculate the ratio for all bins, we can get the conversion function (the z-axis represents the ratio $Z/\sqrt{\text{ADC}}$)



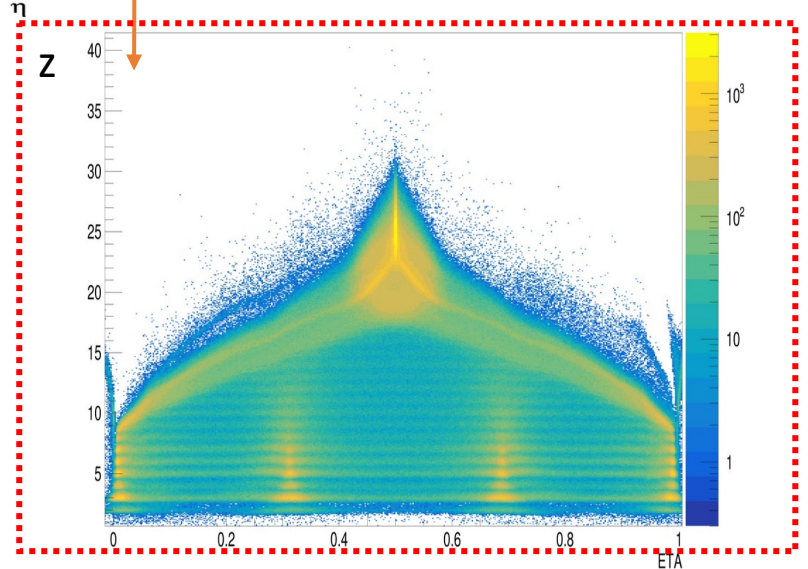
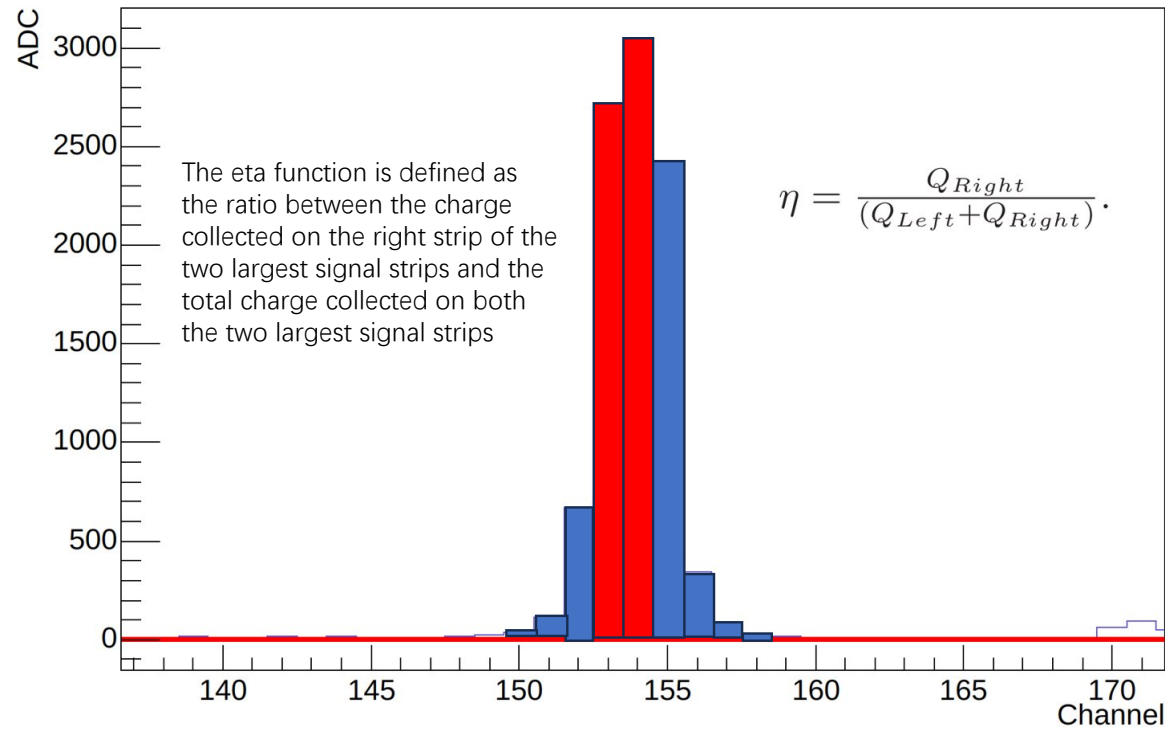
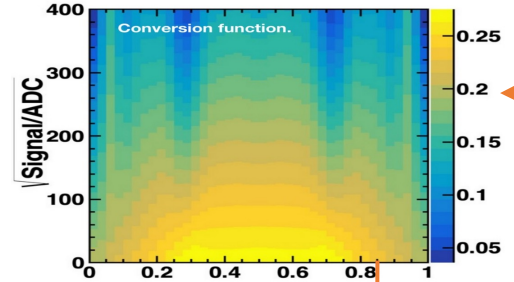
(1)

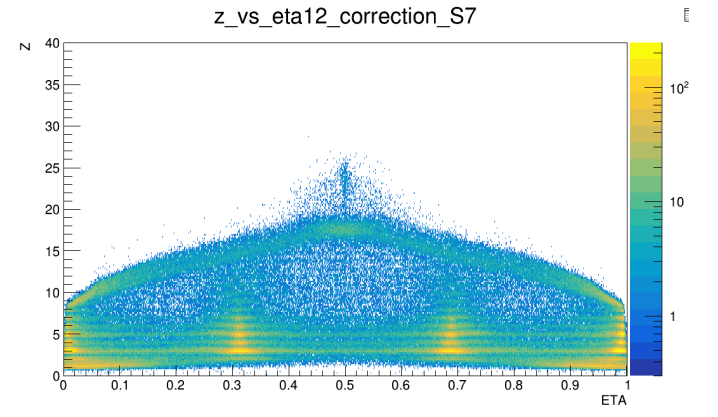
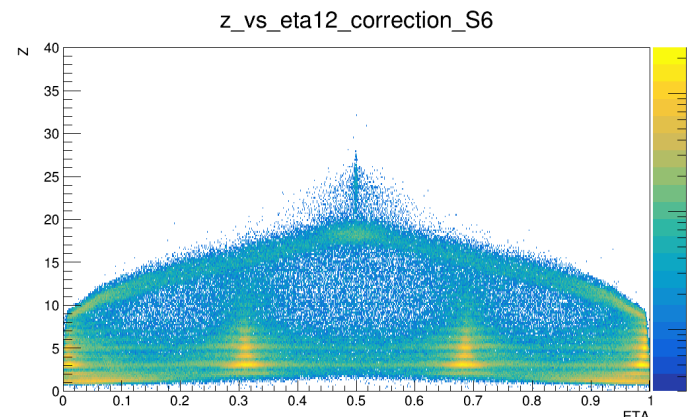
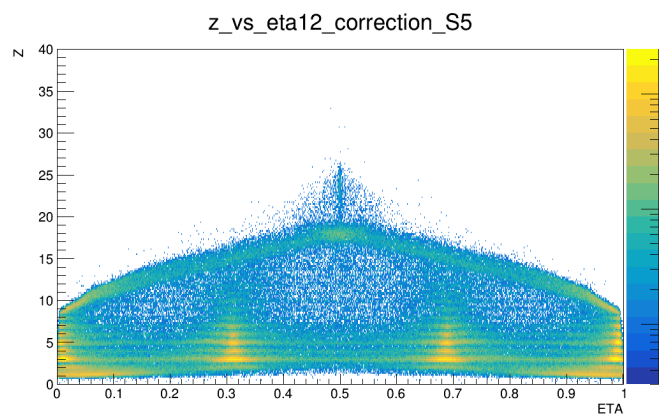
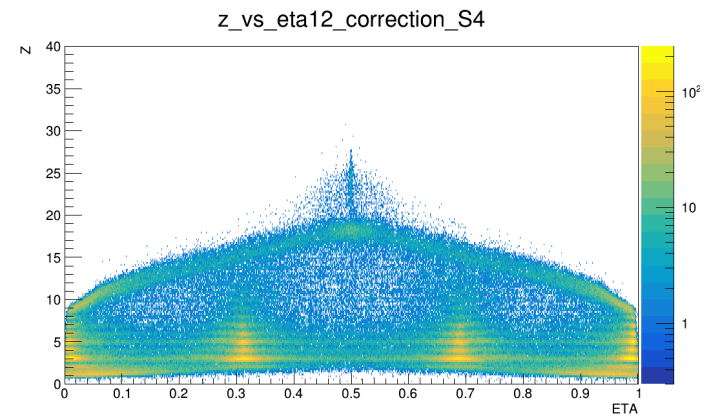
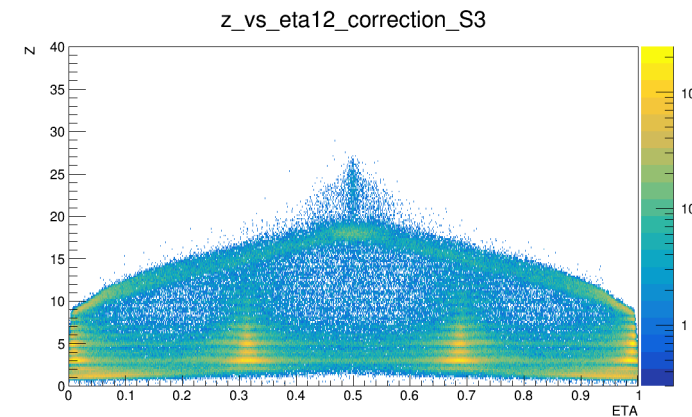
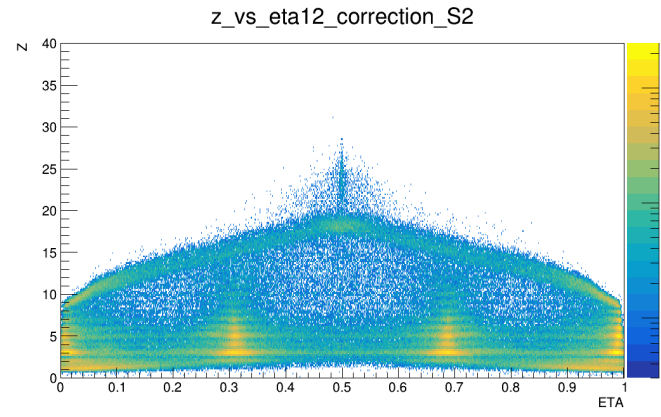
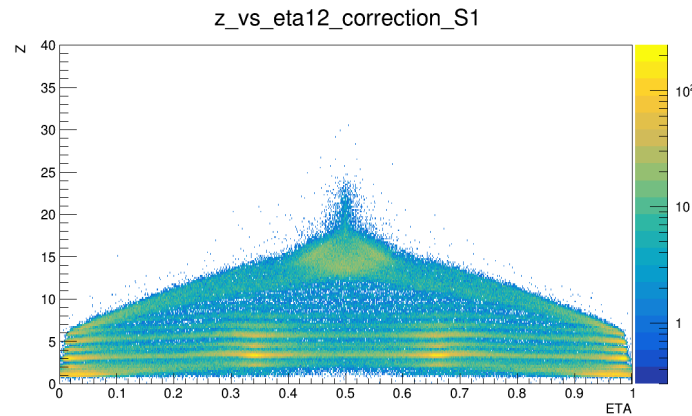
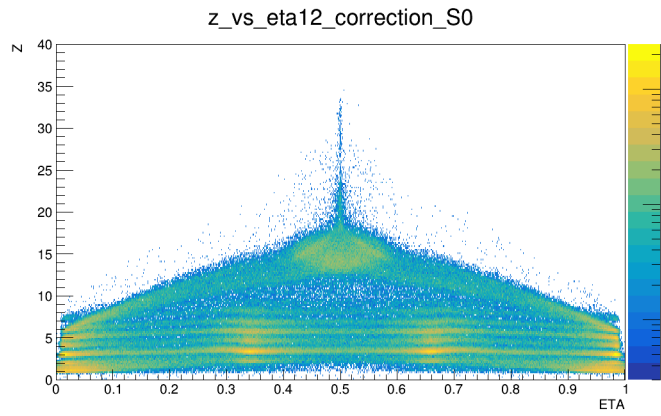


(2)

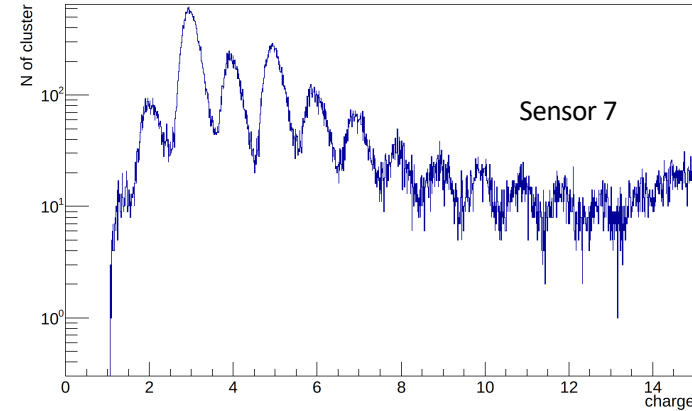
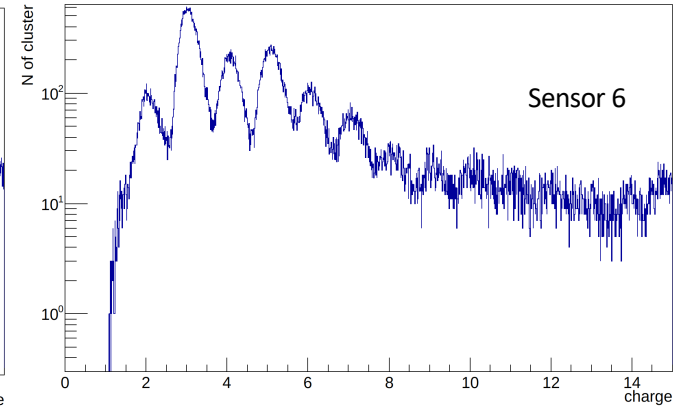
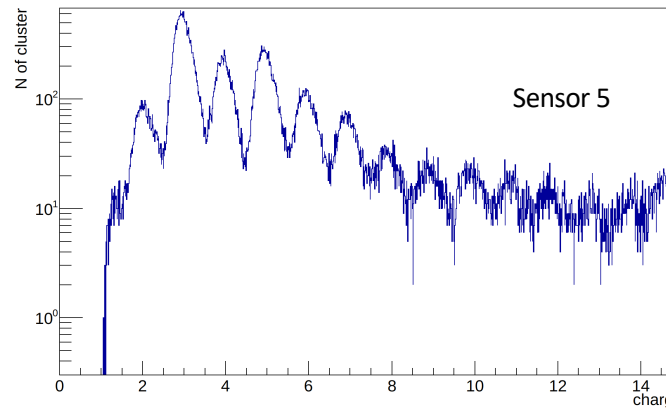
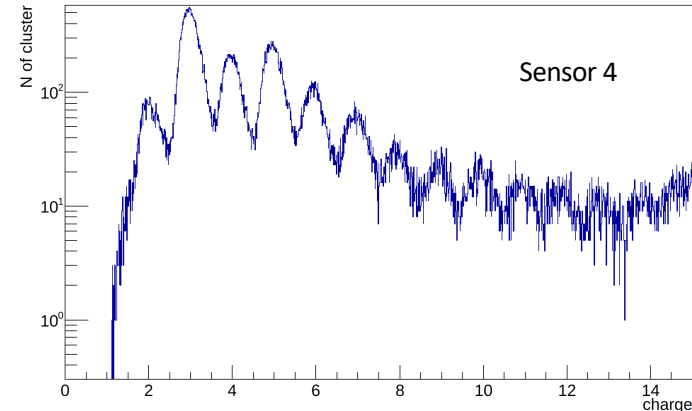
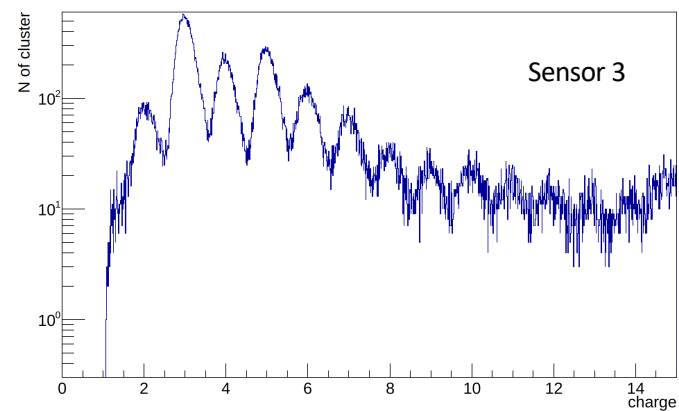
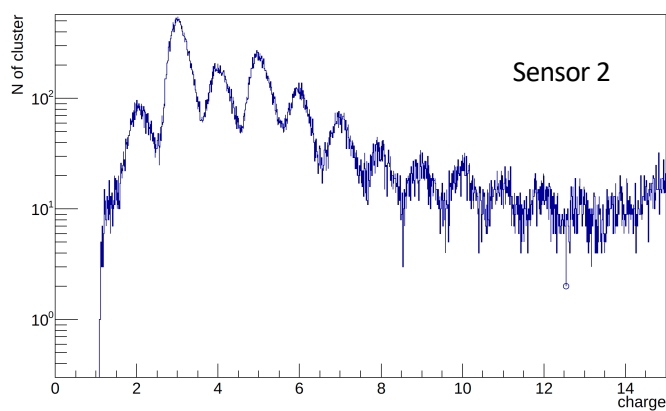
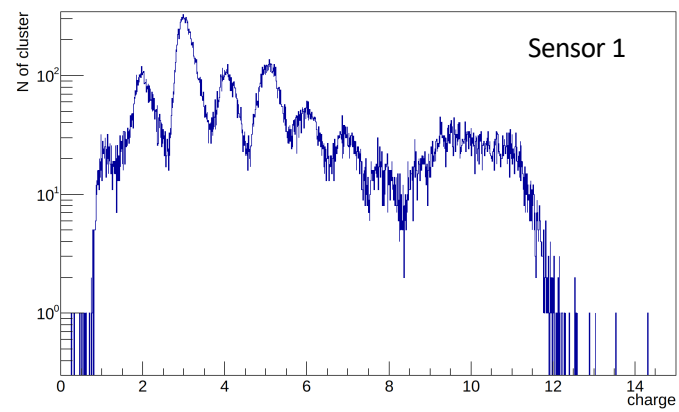
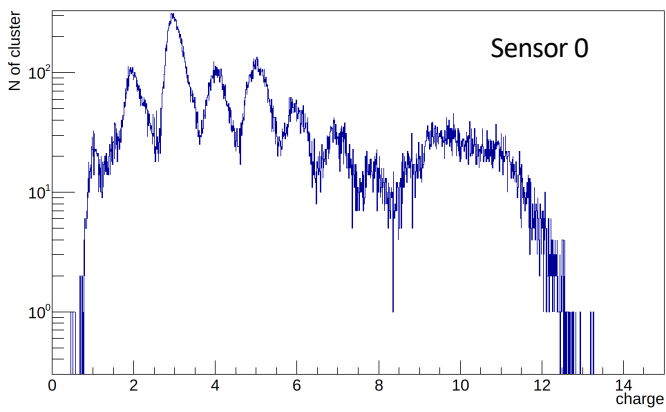


(3)





Cluster estimated charge



Note: Beam Test 2023 HERD, run448

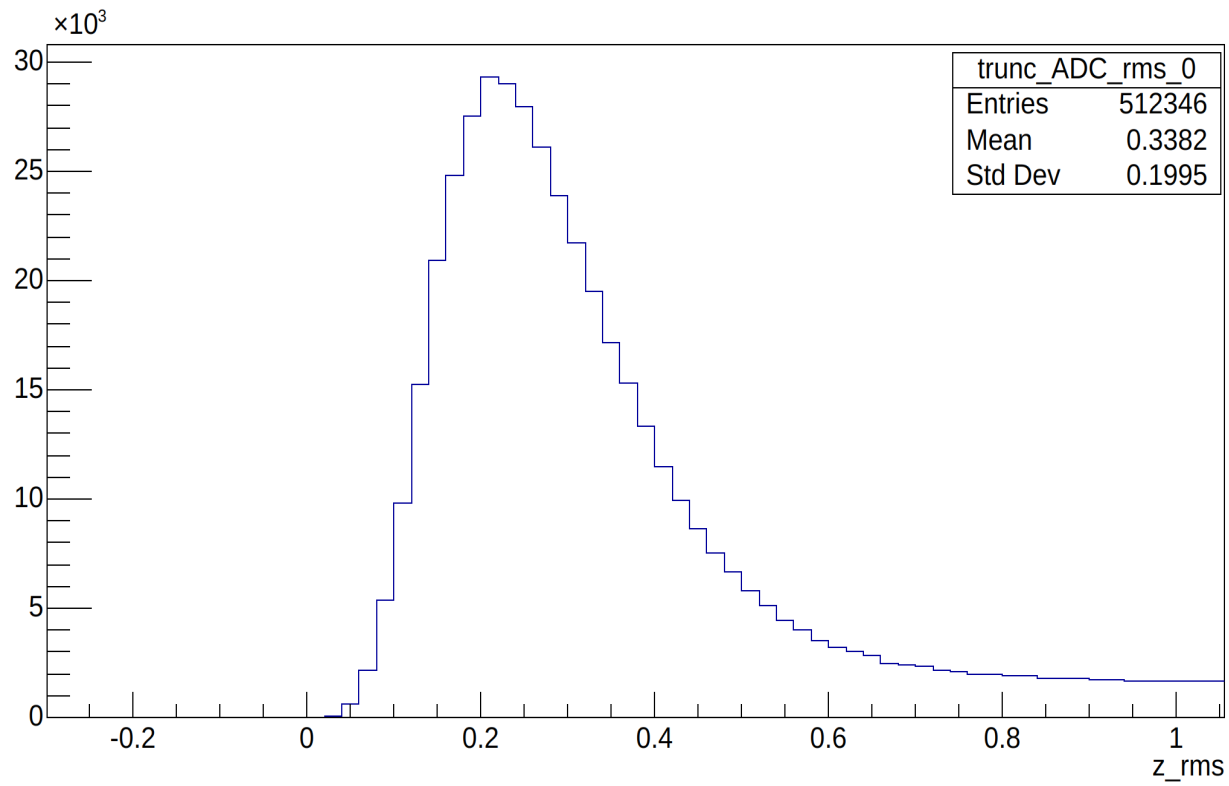
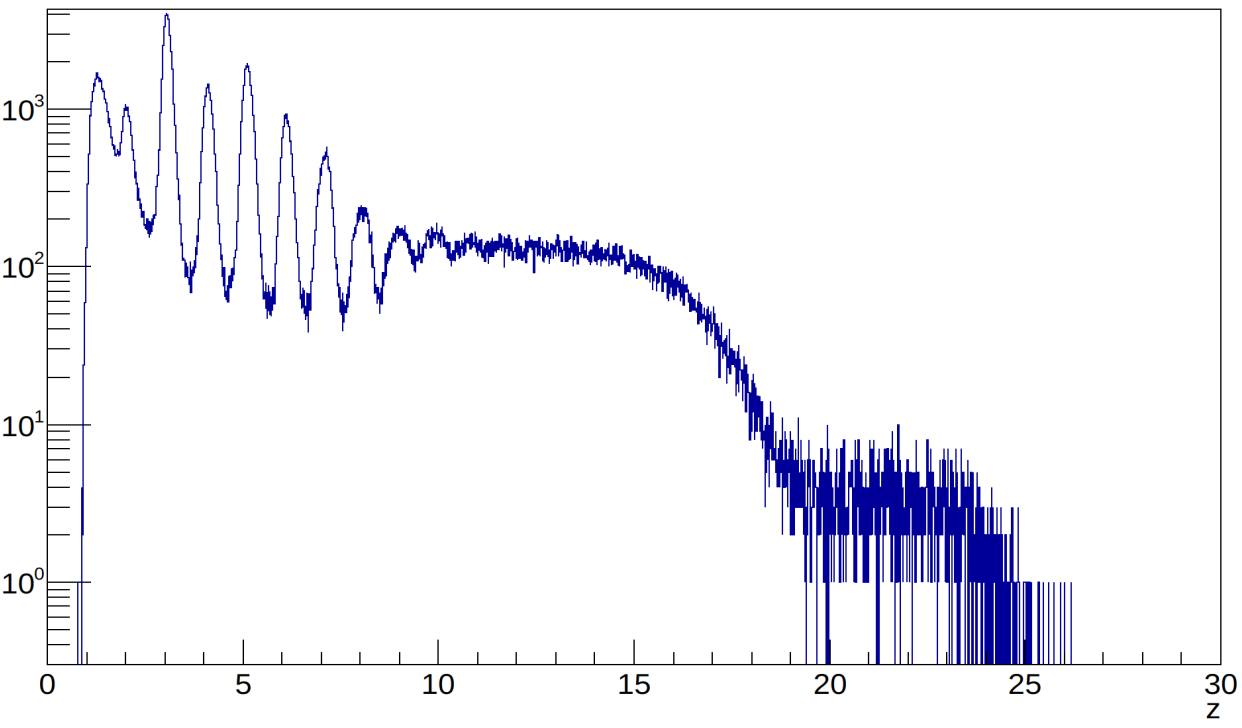
Data Format

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root [5] SCDIT_2023->Show(999)
=====> EVENT:999
event          = 1595
trigger        = 1208
trck_nhit      = 8
trck_ax        = -9.08027
trck_bx        = 8.72467e-05
trck_ay        = 5.70937
trck_by        = 0.00221576
trck_chi2      = 2.61736
trck_trunc_q   = 22.4972
trck_trunc_q_rms = 0.514914
clus_nstrip    = 18,
                21, 13, 16, 12, 15, 16, 14
clus_add       = 357,
                259, 357, 263, 358, 260, 359, 258
clus_seed      = 1374.81,
                1361.66, 2896.61, 2879.66, 2952.91, 3006.18,
                2913.76, 2803
clus_eta       = 0.498026,
                0.499217, 0.498825, 0.500704, 0.50171, 0.488291,
                0.463693, 0.542384
clus_sig       = 16924.3,
                17683.9, 9411.62, 9521.86, 9889.21, 9683.89,
                9383.7, 8913.48
clus_q         = 21.5918,
                21.9741, 22.8958, 22.9835, 23.0227, 23.0682,
                22.7194, 22.2934
```

Reduced Data Format:

Int_t event	DAQ Event Number
UInt_t trigger	I2C Trigger Number
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Float_t trck_trunc_q_rms	Global track charge evaluation RMS

Global track charge evaluation (trunc. mean)



fine