Simulation Parameters Tuning and Comparison with Real Data

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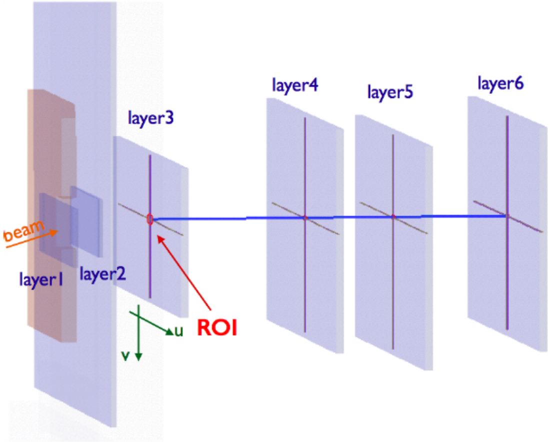
1. 2017 BT data
2. Ci and gain calibration in MC
3. hot channels
4. on data calibration for dE/dX (SP, low momentum determination etc.)

test beam



taken at DESY (Hamburg, Germany) in 2017 (2016 and 2014)

- magnetic field off run 111, 5 GeV
- magnetic field on run 400, 4 GeV

Charge distribution for clusters of different size

Input Events = 600k

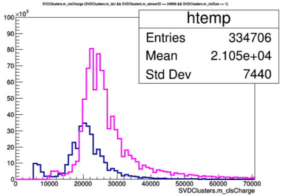
Cluster Charge

Cl-size = 1
Cl-size = 2

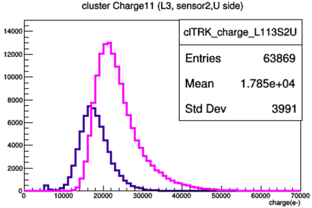
Layer 3 (Sensor 2)

U-Side

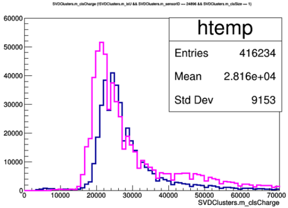
Simulatio

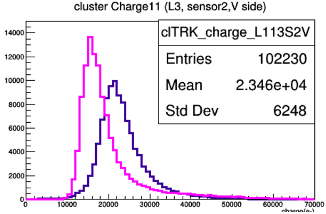


Test beam data
Run 400 (Magnet ON)



V-Side





Manish Kumar presentation

Strip detector readout model

- Charge collection:
  - floating strips accumulate charge in the same way as readout strips
  - captive coupling leads to redistribution of signal among neighboring strips

234 M. Krammer, H. Pernegger / Nucl. Instr. and Meth. in Phys. Res. A 397 (1997) 232–242

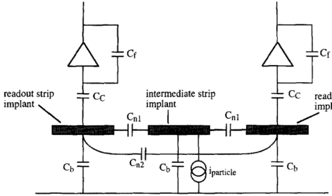
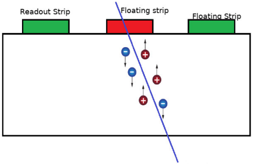


Fig. 1. Schematic layout of a detector making use of capacitive charge division. The current source represents a particle traversing the detector at the position of the intermediate strip.



- corected in MC by introducing the theoreticaly predicted numbers unfortunatly C_i is know with $\pm 30\%$ precision.
- described in details in note by G.Rizzo `https://confluence.desy.de/download/attachments/81958637/signal_and_charge_loss_with_floating_strip_v2.pdf?version=1&modificationDate=1514542152253&api=v2`
- Can gain and c_i be refine based on data ?

Signal S_i on i channel

$$S_i = \kappa \sum_{k=2}^{2} \kappa_{|k|} S_{i+k}, \text{ where : } \kappa = \frac{C_c}{2C_i + C_b + C_c}, \kappa_0 = 1, \kappa_1 = \frac{C_i}{2C_i + C_b}, \kappa_2 = \frac{0,5C_i}{2C_i + C_b + C_c}.$$

TB Data charge calibration

First idea:
Gain can be extracted from distribution of single strip clusters vs c_i

Layer 3

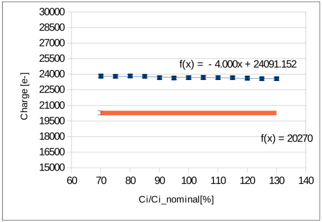


Fig.1: Layer 3, Side = ’V’, ClusterSize=1.

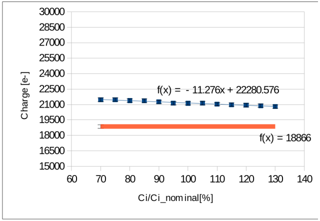


Fig.2: Layer 3, Side = ’U’, ClusterSize=1.

Layer 5

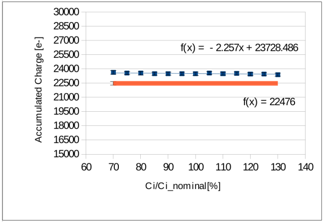


Fig.7: Layer 6, Side = ’V’, ClusterSize=1.

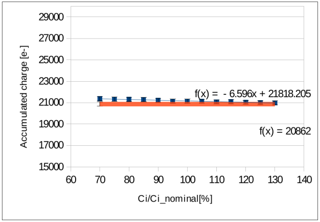


Fig.8: Layer 6, Side = ’U’, ClusterSize=1.

TB Data charge calibration

6. <u>Optimal gain</u> values, Charge comparison for $Ci/Ci_{nominal} \in [70\,;130]$, **Layer 3 sides "V" and "U". Layers 4-6 sides "V", ClsSize = 1,2**

6.1. Layer 3:

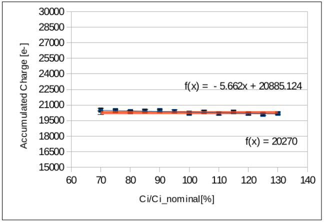


Fig.27: Layer 3, Side = 'V', ClusterSize=1.

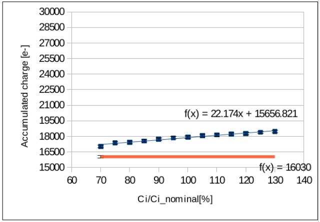


Fig.28: Layer 3, Side = 'V', ClusterSize=2.

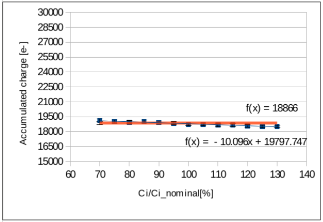


Fig.29: Layer 3, Side = 'U', ClusterSize=1.

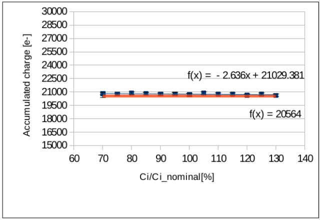


Fig.30: Layer 3, Side = 'U', ClusterSize=2.

TB Data charge calibration

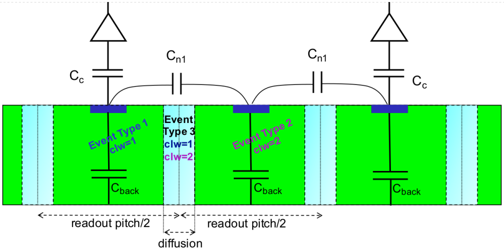


Fig. 2 Schematic cross section of the 3 sensor regions that contribute to different event type.

- **Event type 1** : track "close" to the readout strip → cluster with 1 strip clw=1
- **Event type 2** : track "close" to the floating strip → cluster with 2 strips clw=2
- **Event type 3** : track "at the edge" between the readout and floating strip → cluster with 1 or 2 strips depending on the cut on the S/N of the strip applied for clustering / data taking.

- type 1 high charge deposited in cluster size 1
- type 2 lower cluster charge in cluster size 2
- type 3 low charge if cluster size 1 and high when cluster size 2
- on v (or n) side were the amount of type 3 events is negligible , where the pitch size is large, clusters size 1 are expected to have higher charge then cs 2
- on u (or p) side where the amount of type 3 events are non negligible we can expect higher

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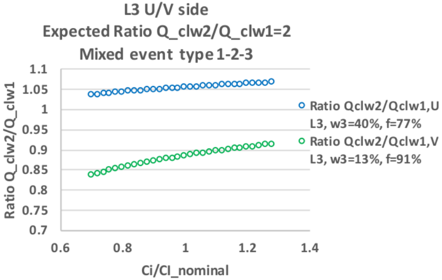
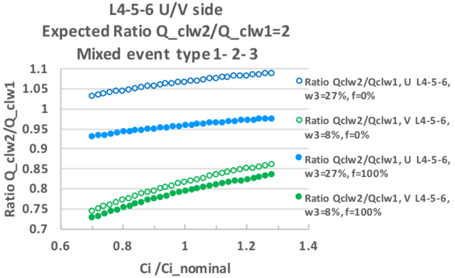
https://confluence.desy.de/download/attachments/81958637/signal_and_charge_loss_with_floating_strip_v2.pdf?version=1&modificationDate=1514542152253&api=v2

TB Data charge calibration





- We should start by getting the correct C_i from hat study
    - extract from simulation the ratio among cluster charge for clusters with 2 strips and cluster with 1 strip as a function of the interstrip capacitance.
    - measure the same ratio on testbeam data and find the best value for the interstrip capacitance in simulation that gives you the ratio found on data.
- get the gain like it was described earlier

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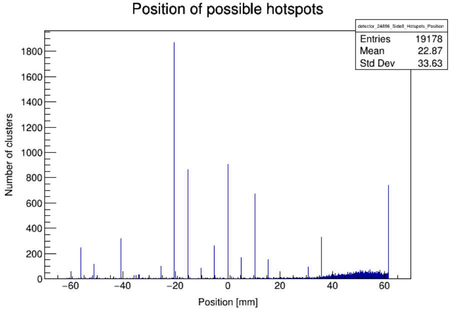
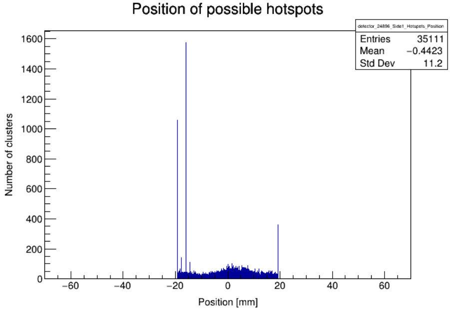
https://confluence.desy.de/download/attachments/81958637/signal_and_charge_loss_with_floating_strip_v2.pdf?version=1&modificationDate=1514542152253&api=v2

hot channels

- strips with noise $> 1.5\sigma$ are masked online (noisy strips),
- still we observe hot channels (wih large occupancy)
- can we find them and mask them online ?
- should we ?



run 400



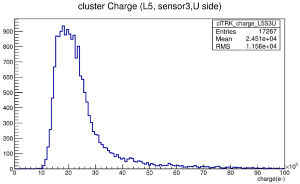
run 111

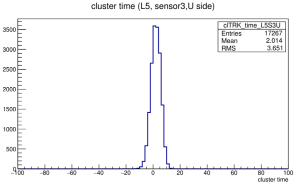
- run 111 : 41 hot channels observed
- run 400 : 61
- only 23 are the same
- run depended

hot channels

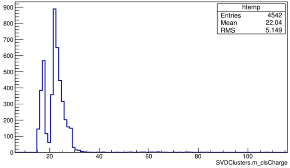
- charge and time distribution of clusters related to tracks layer 5 run 111

U side





- charge and time distribution of clusters related to hot channel same dssd run 111



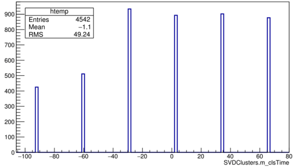


Figure : Cluster charge

Figure : Cluster time

Niharika Rout

hot channels

- still under study,
- seems that most of the hot strips are single time sample upset,
- if probability is relatively small the average noise is below 1.5σ,
- the current FADC zero suppression algorithm will not filter this kind of event,
- different online check can be proposed or eventually change of zero suppression algorithm can avoid such events (filtering on coincidence of at least two or three time sample over some threshold)

SVD charge measurement

- dynamic range 8 bits (256 levels)
- we have four measurement:
  - u and v side are measuring the same charge
- Simple Landau fit approach is not applicable -thin material
- several different types of detectors
- pulse online calibration probes only readout chain

toward dE/dX measurement

- single, multiple strip clusters calibration $E_{\text{calibrated}} = f_c \cdot E_{\text{measurement}} \rightarrow f_c$ from data,
- single detector measurement $\Delta E^i = \frac{E_u^i + E_v^i}{2}$,
- additional correction factor f_s between sides $\rightarrow$ from data (in TB data ≈ 1),
- we combine four measurements from different detectors:
  - we choose one detector as reference,
  - factors f_d^i derived from data,
  - $E^i_{\text{reference det. scale}} = f_d^i \cdot E^i$,

SVD charge measurement

dE/dX measurement

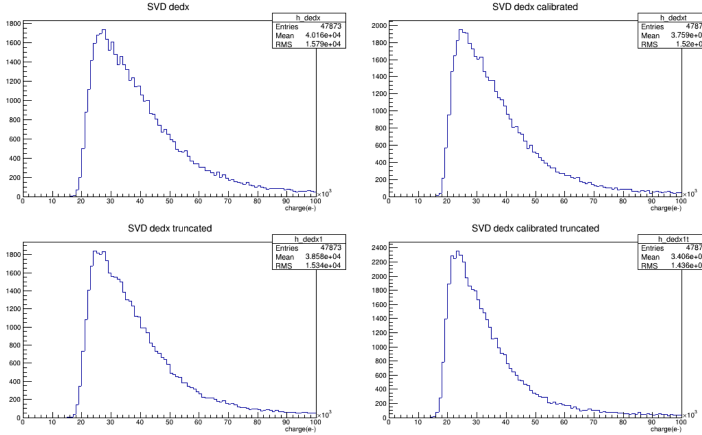
- four measurements,
- removing hit with largest deposited energy,
- the other three hits have symmetric distribution
- COG $\rightarrow$ measured energy loss

calibration on data

- factors f_s, f_d and f_c determined from data
- track associated hits,
- reference detector - one of layer 3 detector
- some of the factors ≈ 1 from TB (f_s)
- f_c and f_s define with in single detector easy
- factors $\approx \#$ DSSD $\cdot 3$ should be stored in calibration database (?)
- factors relatively easy determine $\rightarrow$ mean values of histograms
- f_d require iterative procedure but easy (pairs of histograms)

calibration results on TB data

average charge of clusters associated to track



- Cluster associated with tracks,
- at least 4 clusters per track (regardless which side),
- truncation : removing one cluster with largest charge on each side
- room for improvement → next page

SVD charge measurement

- factors determined for 2017 beam test (run 400) range from 0.85 too 1.12
- still some factors are missing for some dssd's (due to low statistic)
- The charge is not divided by path length in silicon $\rightarrow$ tail should disappear
- module for factors determination is ready for Beast phase II but not tested on MC

for SP

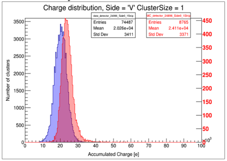
- factors can be used for QI calculations
- PDF approach is more powerful

conclusion

- Rough comparison to data and correction of MC was introduce
- Still we need on data measurement of gain adjustment and c_i
  - gain is only measured online only in readout chain (from preamplifier)
  - C_i can change with time while DSSD's are irradiated
- Zero suppression algorithm study
- hot channels
- efficiency of hit finding

backup

3.1. Layer 3:



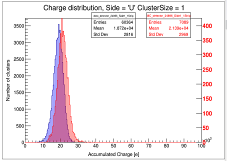


Fig.9: Layer 3, Side = “V”, ClsSize = 1.

Fig.10: Layer 3, Side = “U”, ClsSize = 1.

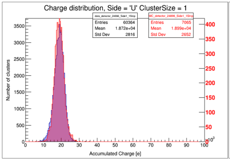


Fig.19: Layer 3, Side = “U”, ClsSize = 1, with truncation

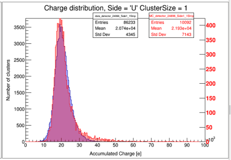


Fig.20: Layer 3, Side = “U”, ClsSize = 1, without truncation

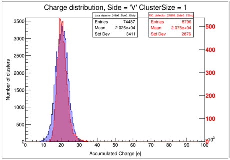


Fig.17: Layer 3, Side = “V”, ClsSize = 1, with truncation

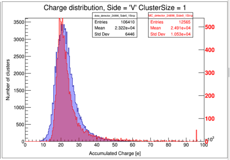


Fig.18: Layer 3, Side = “V”, ClsSize = 1, without truncation