DESY Testbeam Analysis

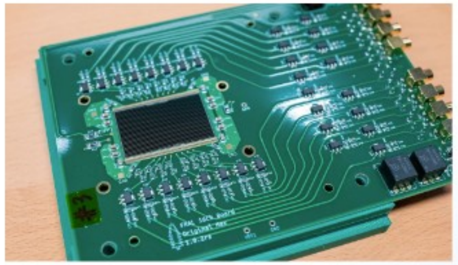
SCIPP

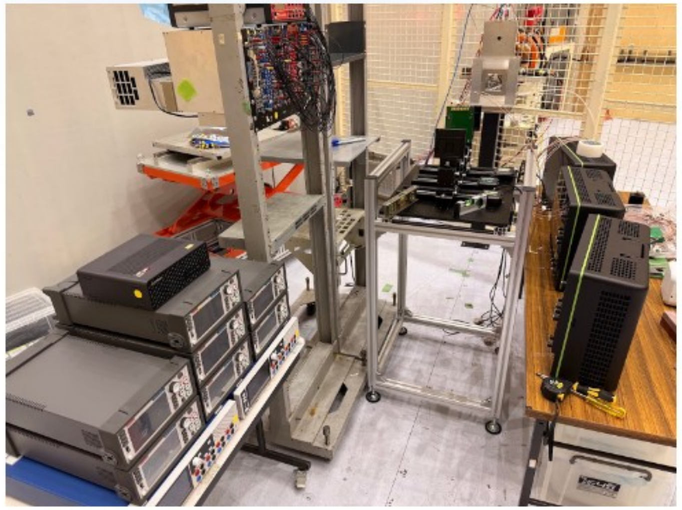
Andreas Gsponer, Miles Davis, Simone Mazza

4/2/2026

Testbeam Campaigns

- **DESY**
  - 3 strip sensors, 2 pixel sensors, CAEN digitizer
- **KEK**
  - 4 strip sensors + 2 pixel sensors, Scope / RFSoC
- **RARiS**
  - 5 sensors with scope
  - 3 sensors with QTC + nestDAQ
    - Japanese SRO DAQ will be tested with AC-LGAD
    - nestDAQ formats SRO data compatible with EIC reconstruction framework (EICrecon). Online reconstruction under discussion

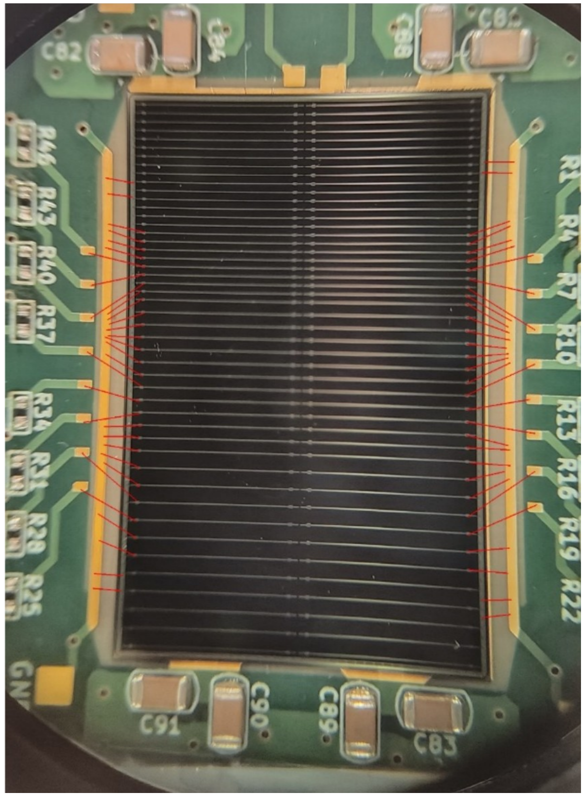


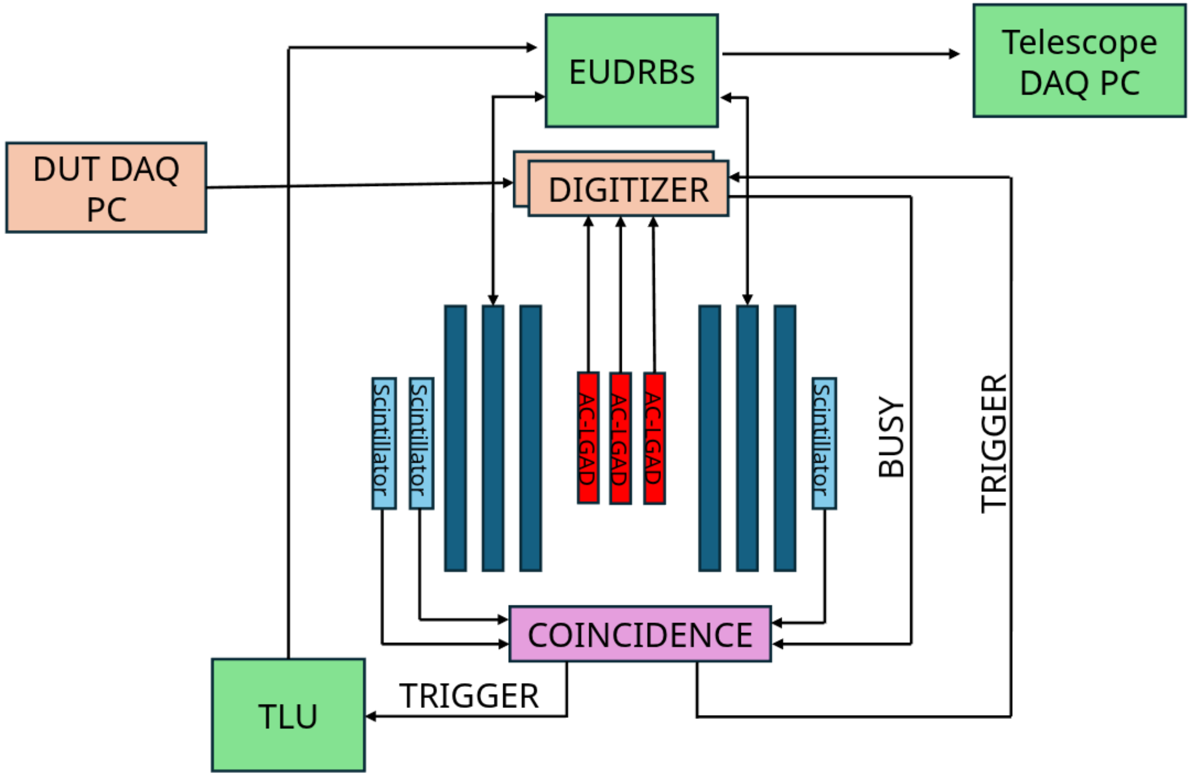


From https://indico.bnl.gov/event/31413/contributions/120398/attachments/68393/117519/gunji_TOF_2026_0120.pdf

Setup and Sensors

- Full size BTOF sensors (2 columns à 1 cm x 500 µm)
- 5 channels read out on each side using two CAEN DT5742 @ 500 Mhz / 5 Gsa/s
- Results will be shown for Run 143, three AC-LGAD layers («A», «B», «C»), all at 185V bias read out in “Pattern 2”





Corryvreckan Analysis

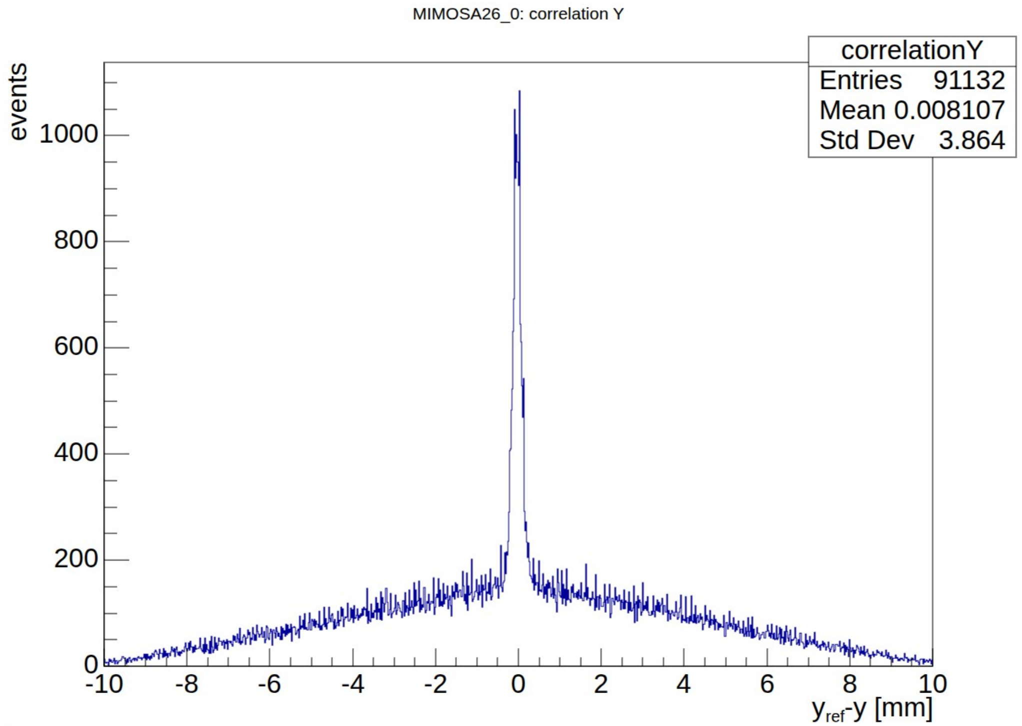
- Corryvreckan natively supports EUDAQ2 data and is well suited for DESY testbeam data
- Implemented pre-processing for waveform data (baseline removal, Pmax, CFD50 all saved in a ROOT file)
- Added new event loader for pre-processed ROOT files

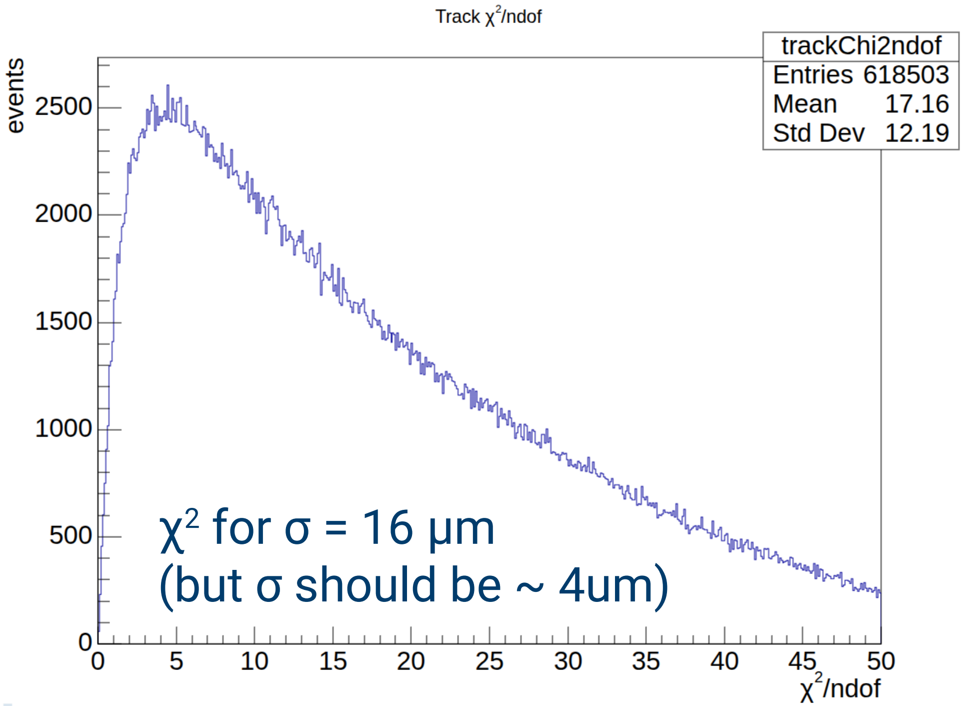
https://gitlab.cern.ch/corryvreckan/corryvreckan

```
[EventLoaderEUDAQ2]

name = "TLU_0"
get_time_residuals = true
file_name = "data/000143/run000143_251218031741.raw"
adjust_event_times = [["TluRawDataEvent", -115us, +230us]]

[EventLoaderEUDAQ2]
name = ["MIMOSA26_0", "MIMOSA26_1", "MIMOSA26_2", "MIMOSA26_3", "MIMOSA26_4", "MIMOSA26_5"]
file_name = "data/000143/run000143_251218031741.raw"
```

Telescope Alignment

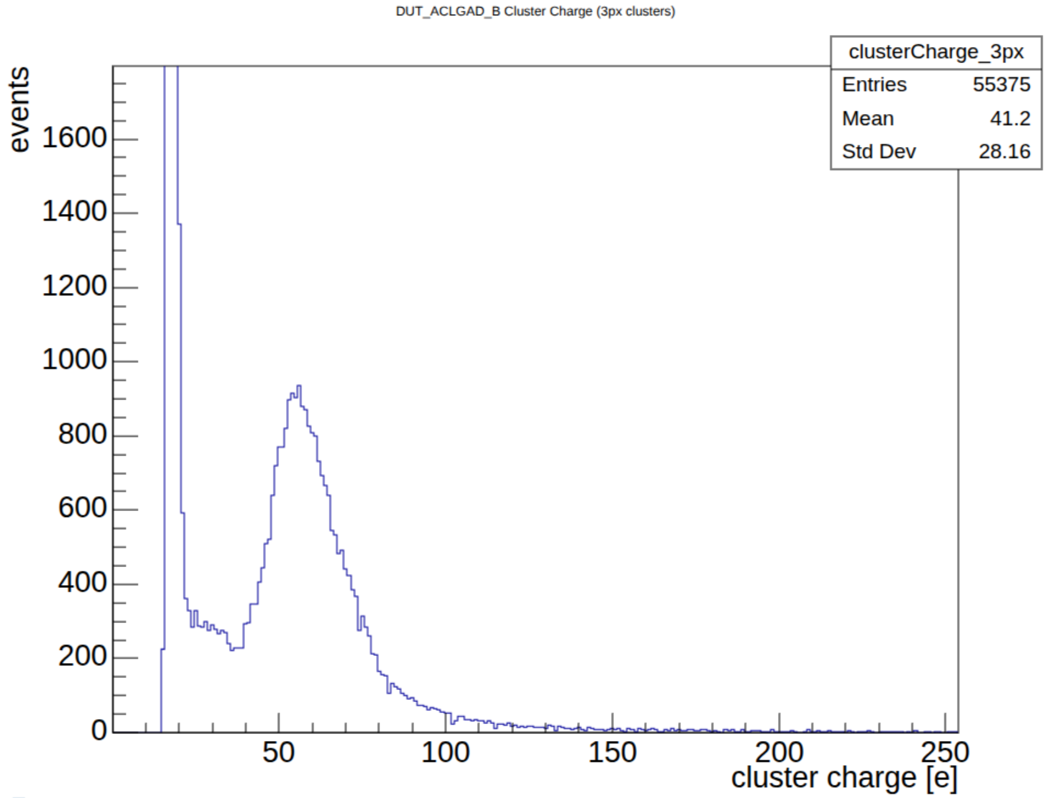
- First step : align telescope planes, create tracks using GBL (General Broken Lines)
- Do we have data / runs without any DUTs?
- Good results with [Prealignment], method = "maximum"
  However, some “background” / pedestal → scattering on DUT?
- Need to worsen presumed spatial resolution of MIMOSA plane to reach a reasonable χ^2
  (however, the shape seems OK)

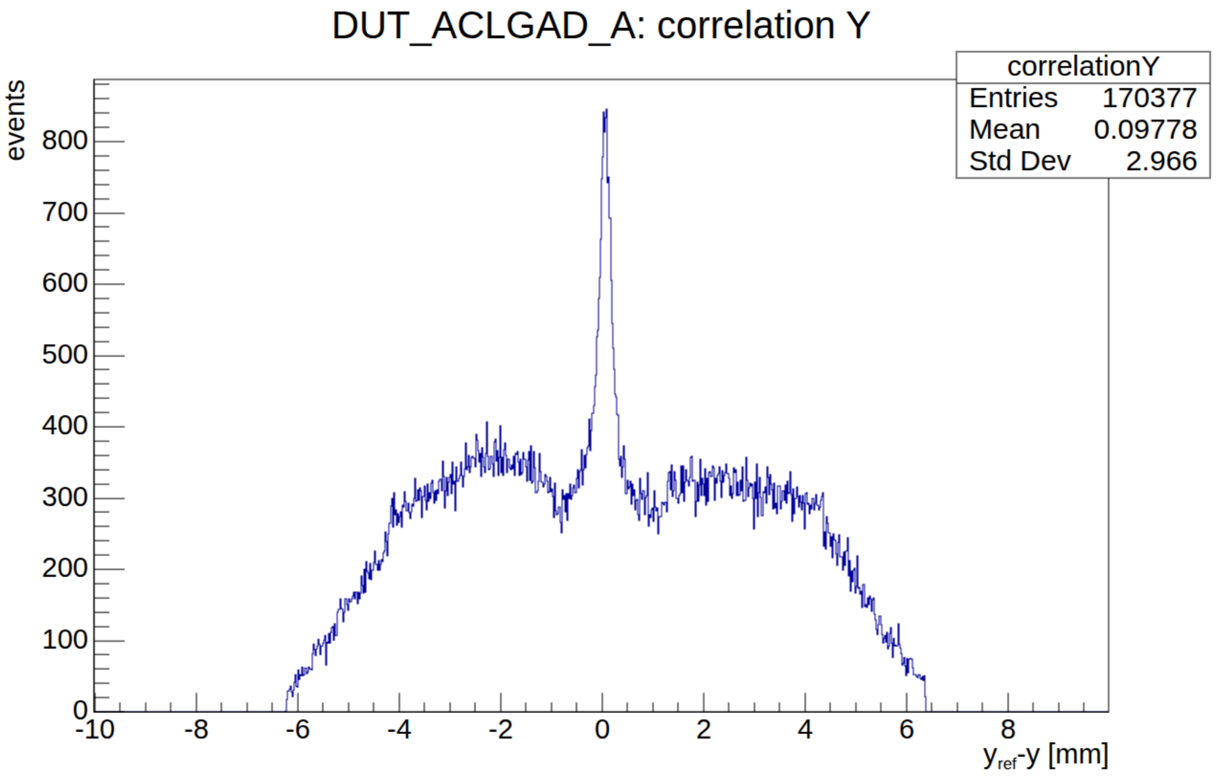




AC-LGAD Data

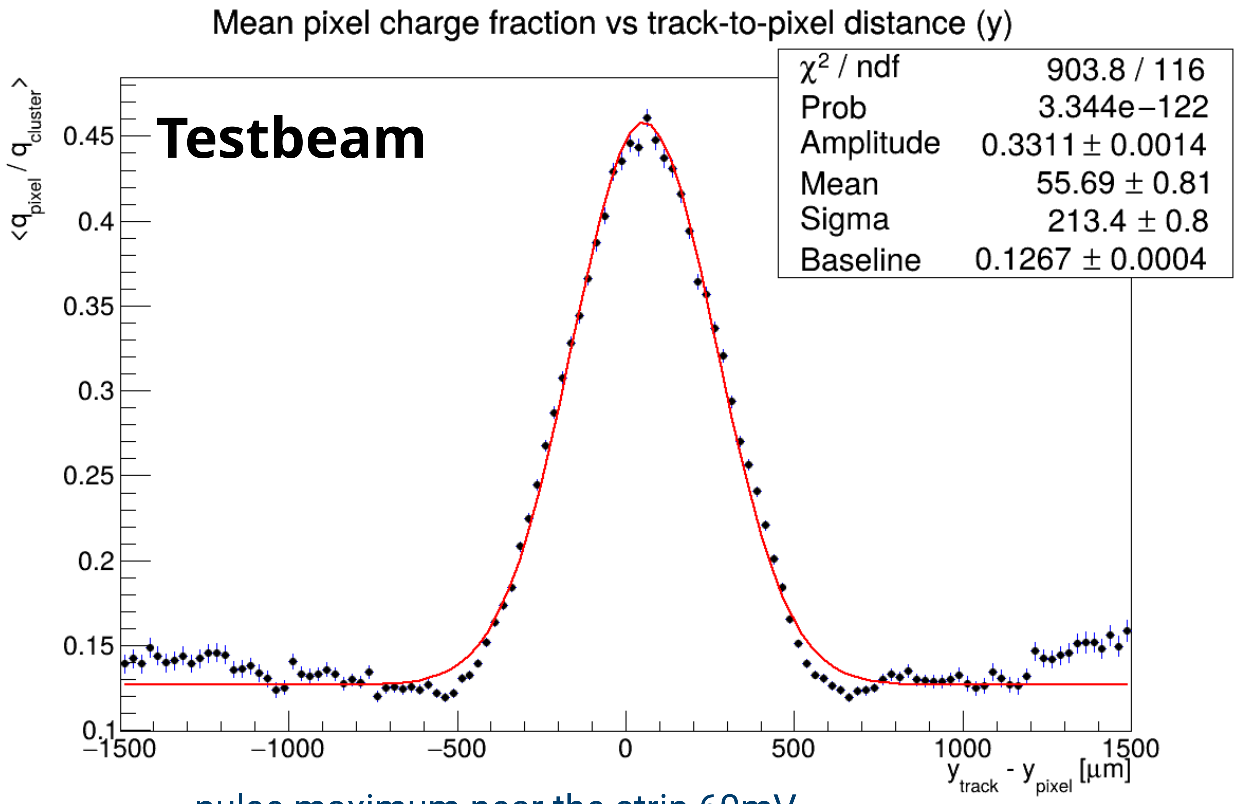
- For now, just using Pmax (> 5 mV) and center-of-gravity charge sharing
- Cluster charge distribution has Landau shape, MPV~60mV
- Good correlations with telescope reference plane (MIMOSA26_2)



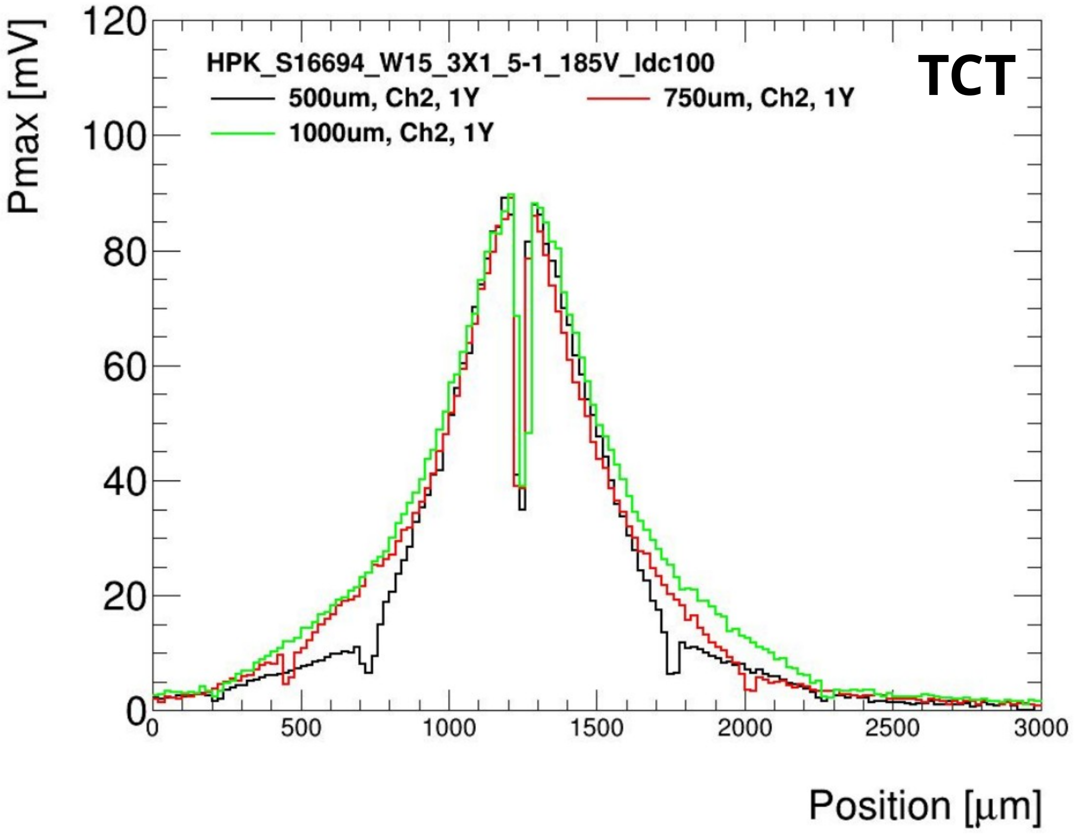


Charge Sharing Profiles

- Pfrac (charge collected by a single strip) vs. position from beam telescope
- As expected, a Gaussian charge collection profile is visible.
- Unknown pedestal → improve cuts?

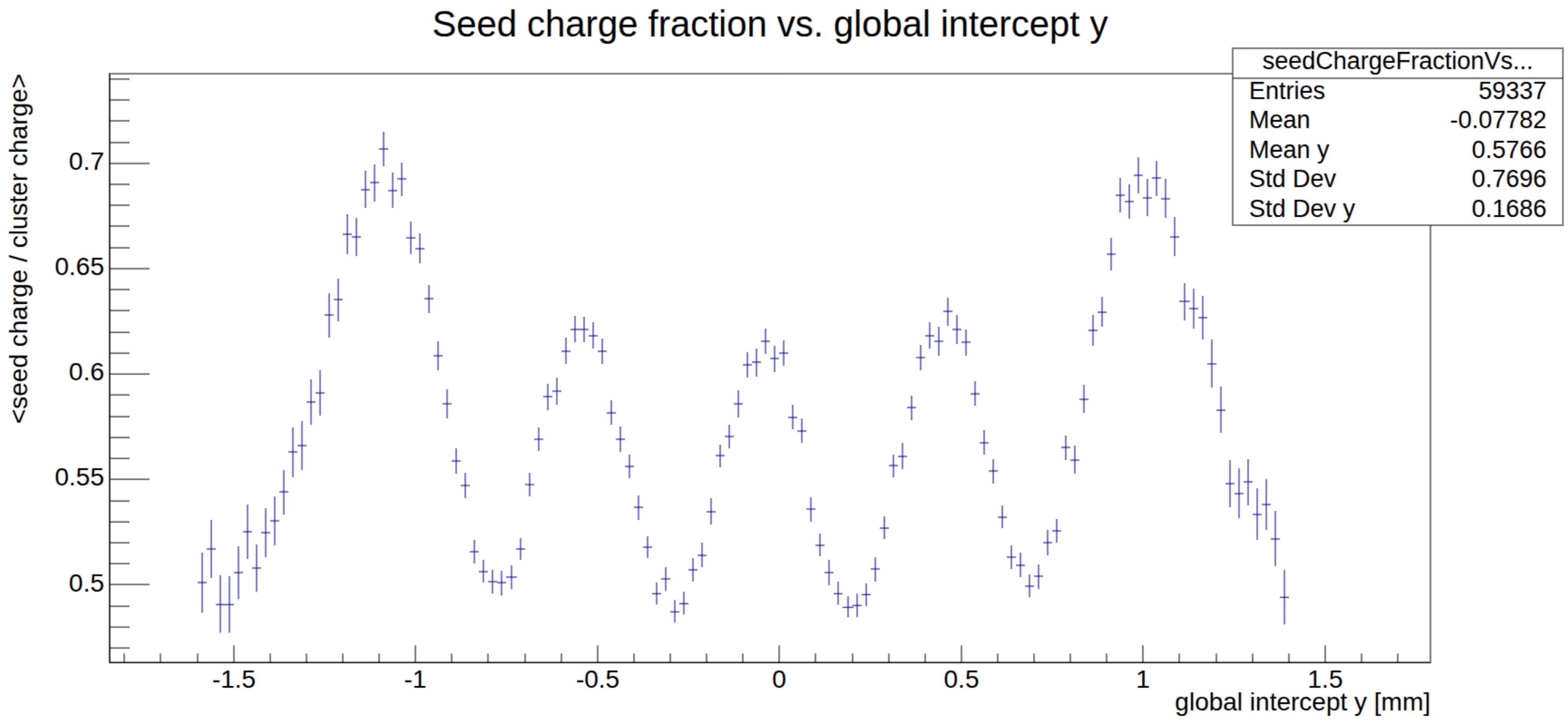


pulse maximum near the strip 60mV



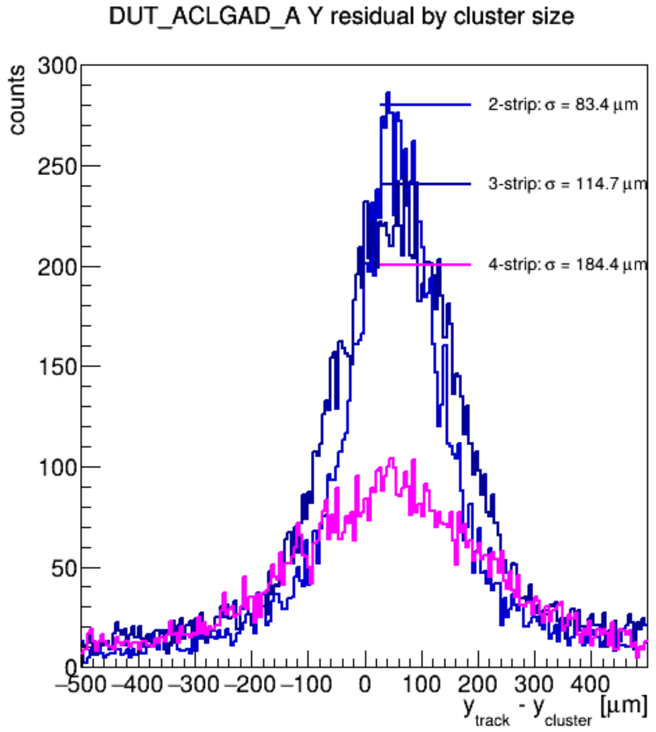
Charge Sharing

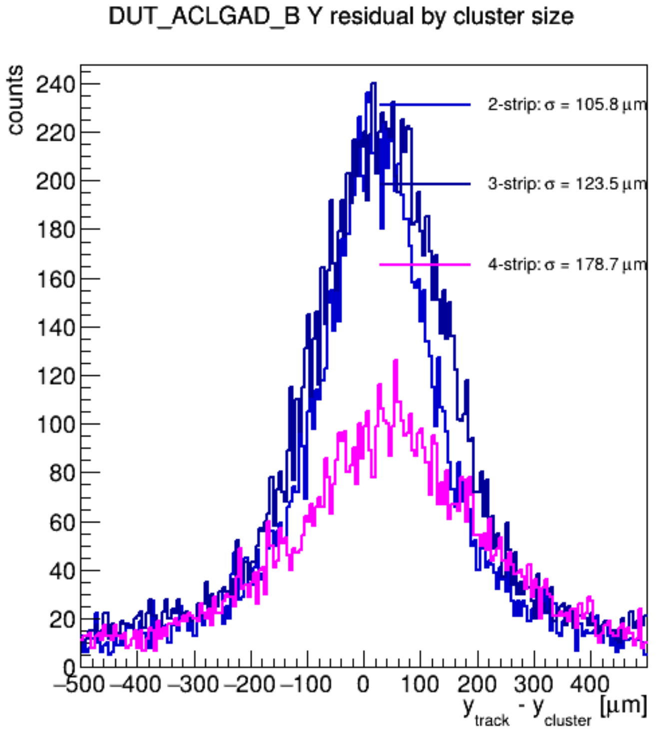
- Seed = strip with highest amplitude
- In between strips, we see a 50:50 charge fraction
- Closer to the strip center, there is strip which clearly collects a majority of the charge

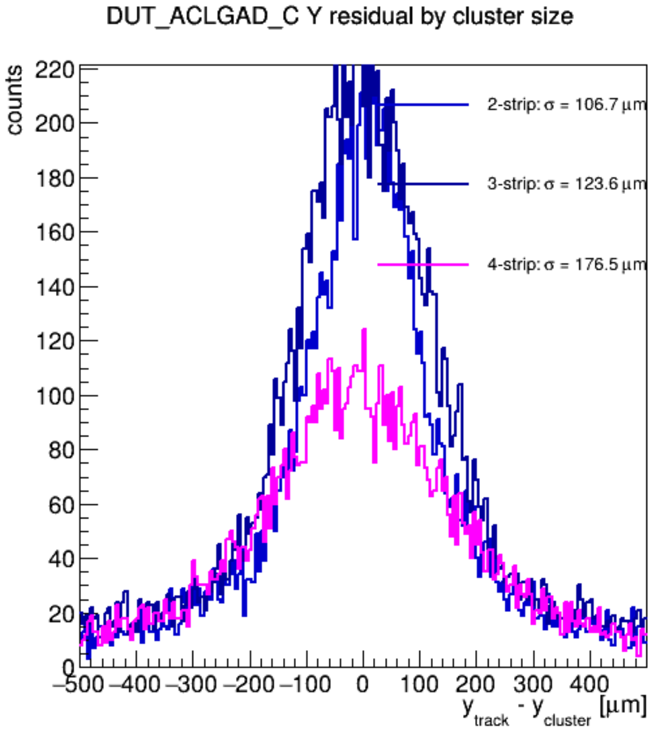


Spatial Resolution

- Spatial resolution is around 100 μm, higher than expected
- Telescope residuals are smaller than 30 μm, likely not the culprit

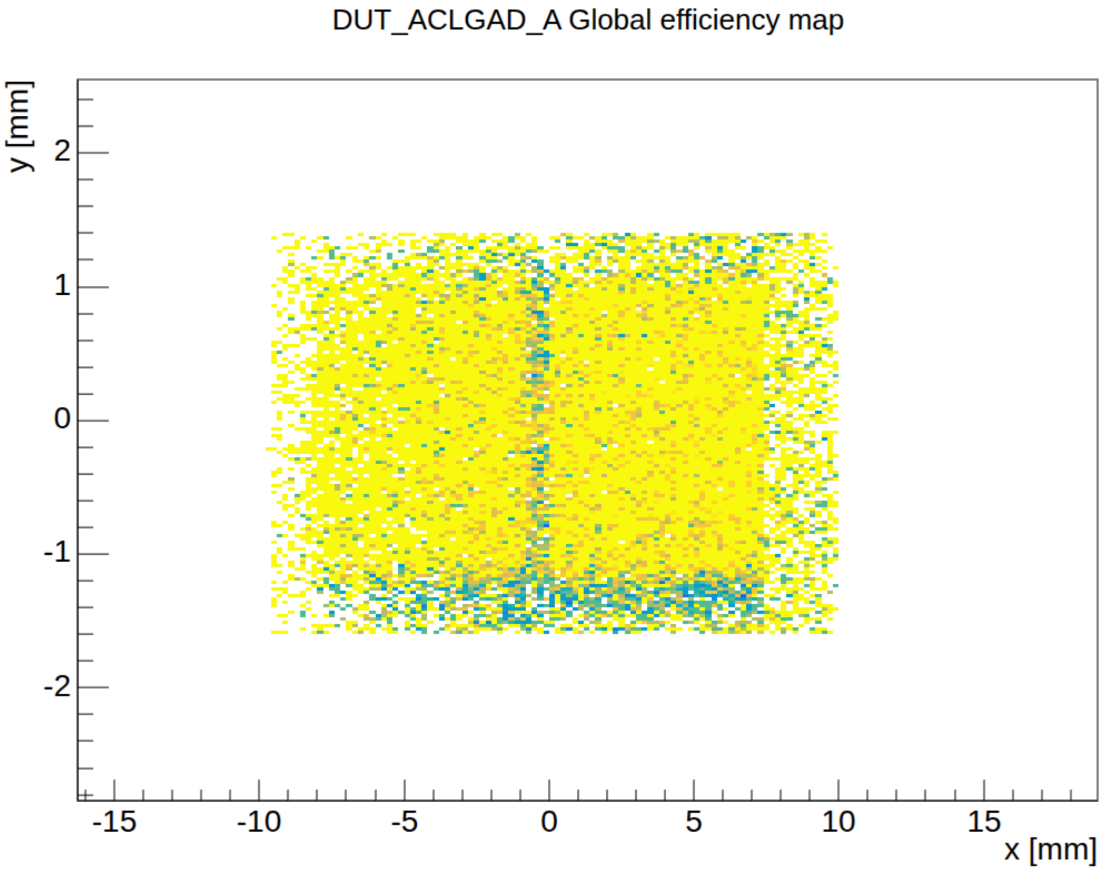


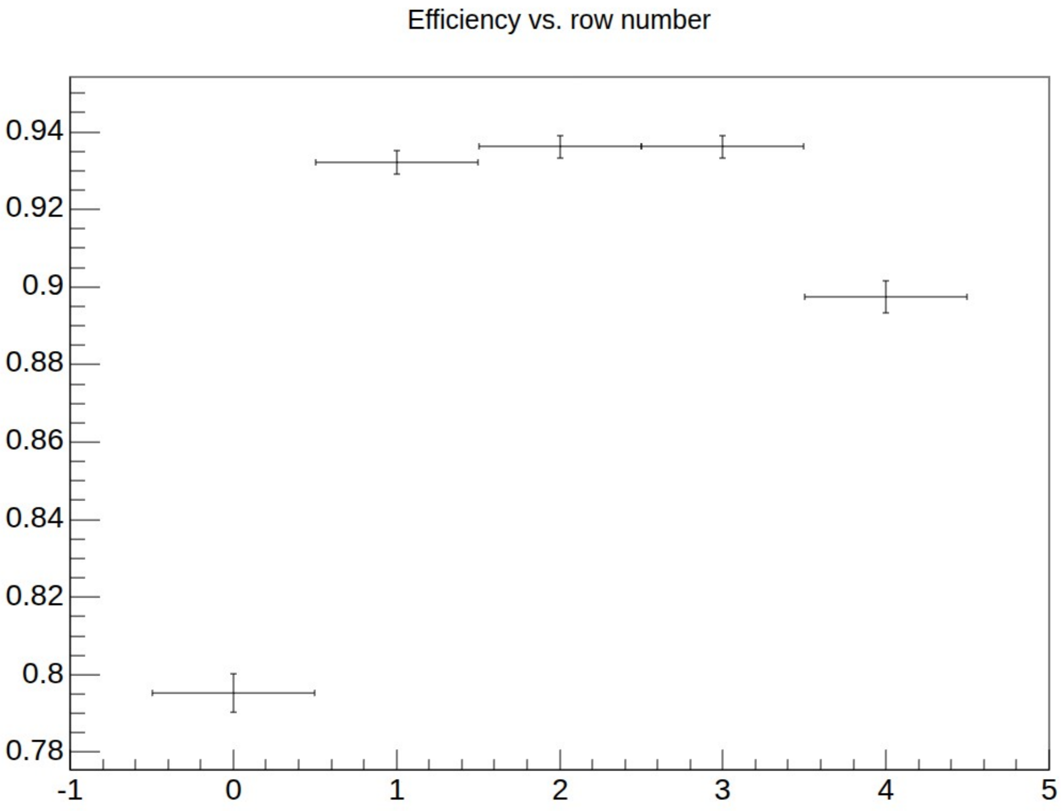




Efficiency

- Efficiency : Do we see a corresponding DUT hit for each telescope track?
- Efficicency map shows the structure of the detector with a small dead area between the two columns
- As expected, the three central rows show a higher efficiency than the ones at the edges





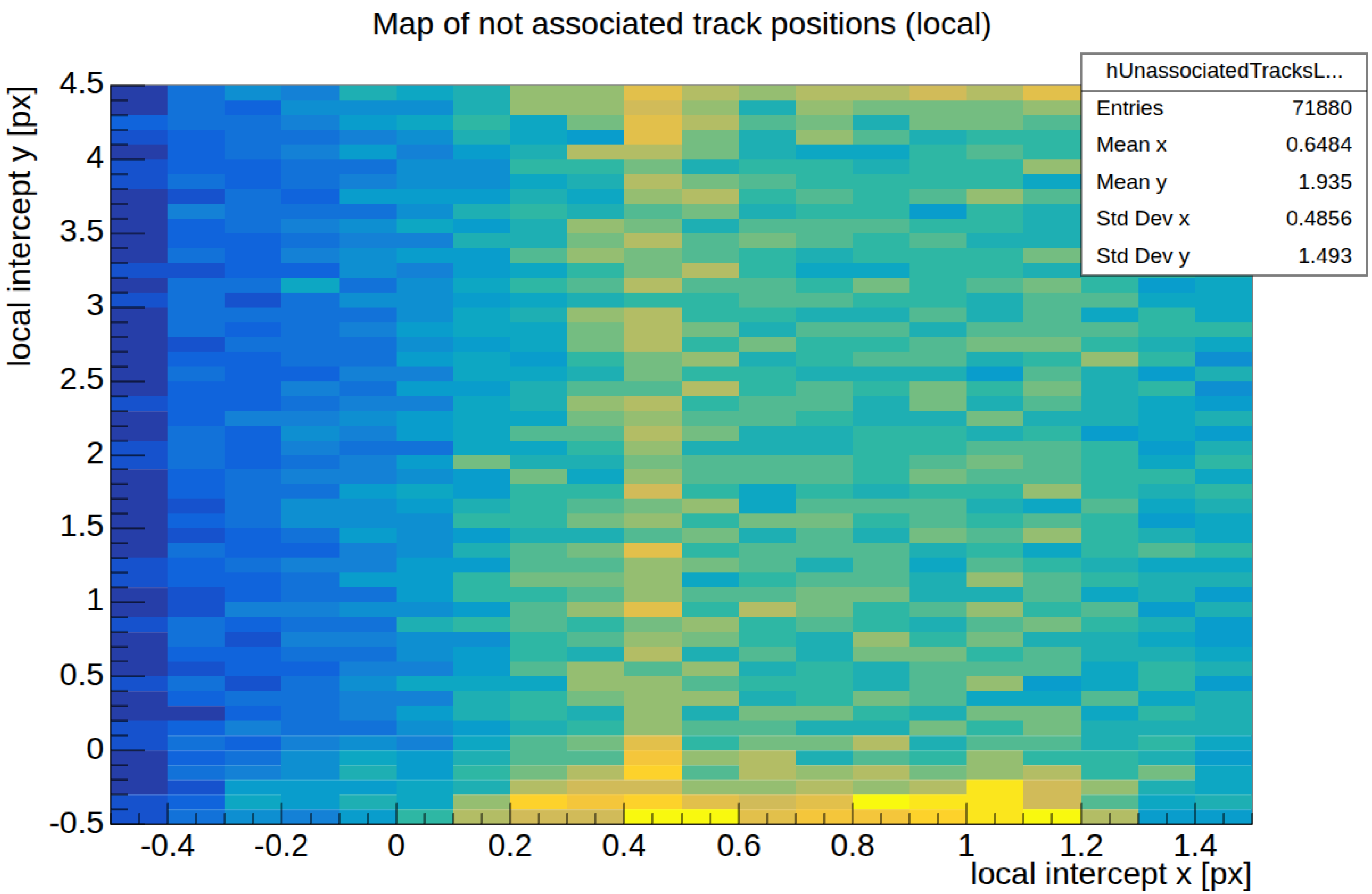
Next Steps

- Investigate lower than expected spatial resolution
- Compare results to TCT data, implemented proper charge sharing (via η-correction)

- Look at waveform features (such as ToA / ToT) and plot vs. Position

- Analyze pixel data (→position reconstruction alogirthm?)
  Analyze timing performance with DC-LGAD reference

Unassociated Tracks



Pfrac vs. Position