ÖAW AUSTRIAN ACADEMY OF SCIENCES

HEPHY INSTITUTE OF HIGH ENERGY PHYSICS

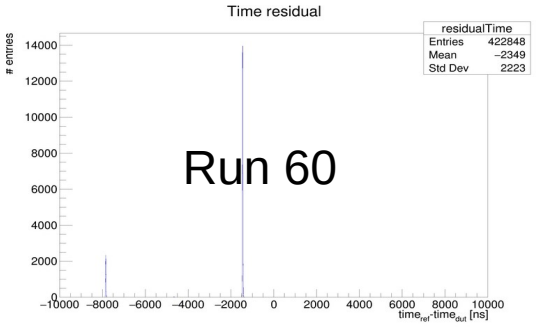
RD50 HV-CMOS Meeting

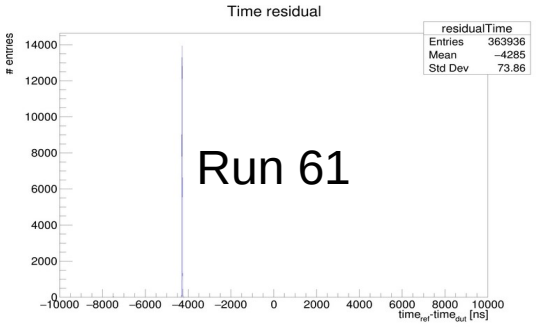
# DESY Test Beam Apr. 24

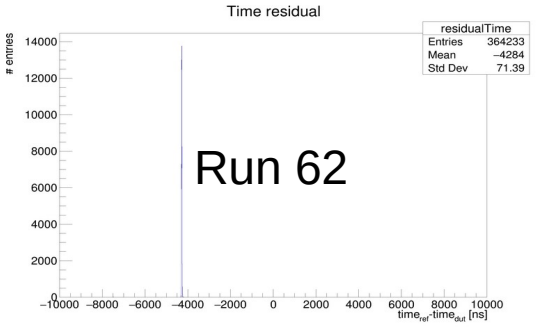
## Investigating inconsistencies

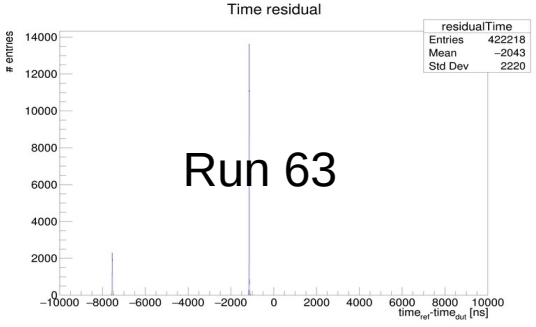
**Bernhard Pilsl**

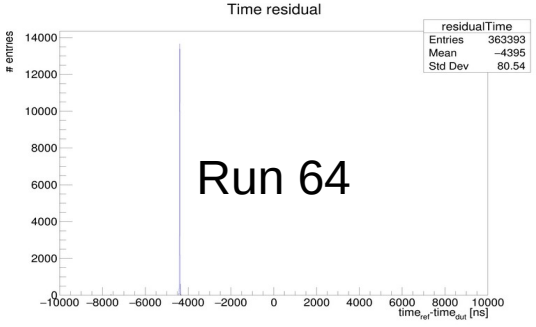
# Time offsets

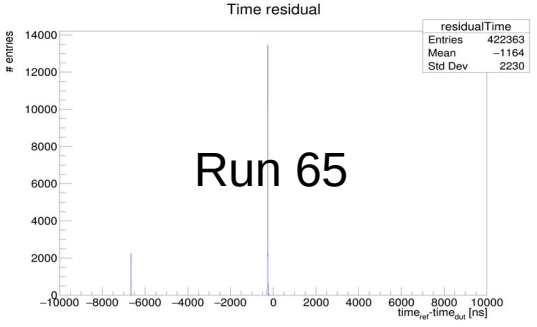


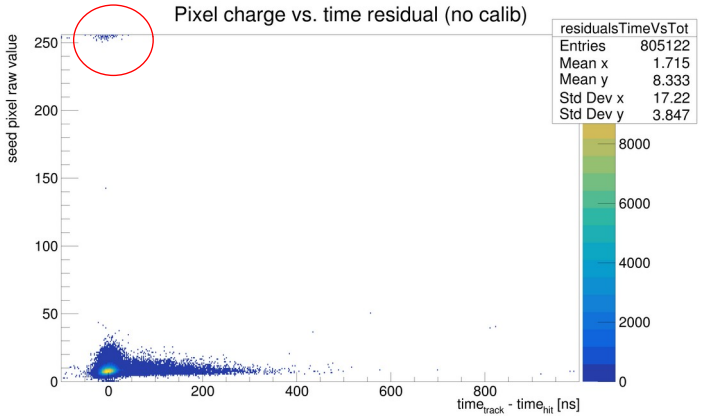



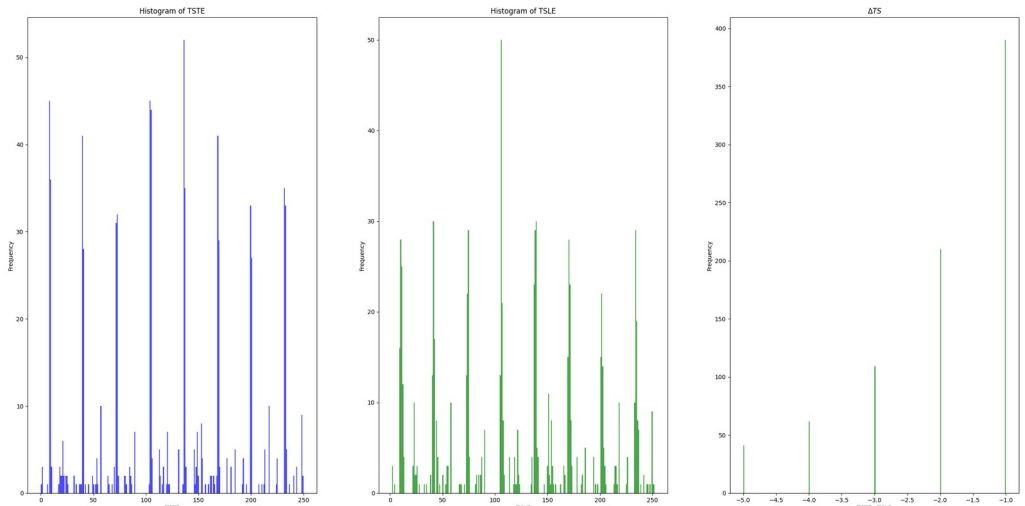




Time offsets are **not** constant
Proper analysis of a lot of runs will be delivered (by Harald)

# Large ToT values



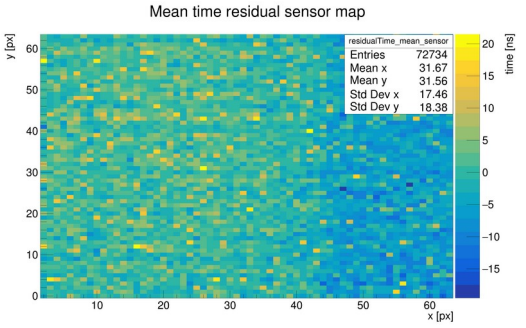



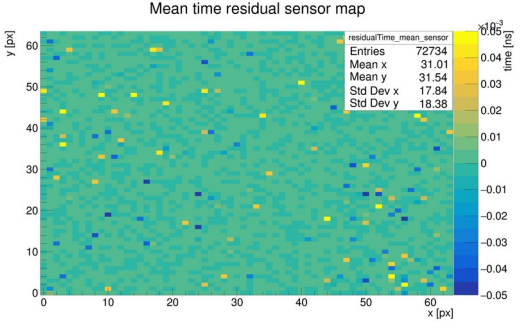

- We encountered large ToT values
- Calculation: ToT = $TS_{TE} - TS_{LE}$
  - If ToT < 0 → Overflow → ToT += 256
- Putting $TS_{TE}$ and $TS_{LE}$ of events with ToT > 250 into histograms
  - Regular spacing between peaks (~32) observed
  - TS values of peaks all contain bit 4 set

| TSTE Peak | Binary representation |
|---|---|
| 136 | 0b10001000 |
| 8 | 0b00001000 |
| 104 | 0b01101000 |
| 40 | 0b00101000 |

# Correct mean time residuals

- Exracting mean of each pixel → apply for next analysis by subtracting offset (specific value for each pixel)
- Does clean up mean time residual map
- Statistics lesson learned → does not change σ → does not change time resolution
- Not constant over several runs



# Estimating noise rate: Fake Rate

- Rather new feature of *AnalysisEfficiency* module
- Checks if there are clusters on the DUT which can't be associated to a track
- Method RADIUS:
  - Intersecting track(s) must be in vicinity of clusters (max. distance 2 x pixel pitch)
  - Results in 1.1 fake hits / event
- Method EDGE:
  - Any track intersecting the DUT (at any position) in the current event clears „fake flag"
  - Results in ~0.9 fake hits / event
- Both methods in my opinion have bugs
  - Atm trying to start discussion at https://corryvreckan-forum.web.cern.ch/t/noise-estimate-with-fake-rate-of-analysisefficiency-module/109

# Fake Rate: The current problems

- RADIUS method:
  - Comment in code and implementation do not match
  - Tracks intersecting DUT should be able to clear „fake flag“ of cluster when in vicinity
  - Actually intersecting tracks are being skipped and no check is being performed
- EDGE method:
  - Only events with **a** fake hit or **no** track put into histograms
  - Basically no „good“ entries
  - Implemented fix → ~0.45 fake hits / event
  - Next problem: Most fake hits occur in events where some telescope planes got hit, too few for track fitting though → Looks like scattered particles
  - Implemented another fix: If hits on detector upstream to DUT has hits → consider DUT hits **not** fake

# Fake rate: Results with „fixes“

- Using method edge and considering hits not fake when telescope next to DUT (upstream) got hits
- Fake pixel / event ~0.0017
  - Corresponds to (with 20µs event rate) noise rate of ~80Hz
  - Still huge
  - In most checked events with fake hits other telescope planes got hits (but not chosen veto plane)
- Needs more investigation and discussion on how to tackle problem properly