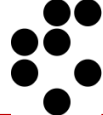


RD50-MPW3 SPS testbeam analysis: Tracking status report

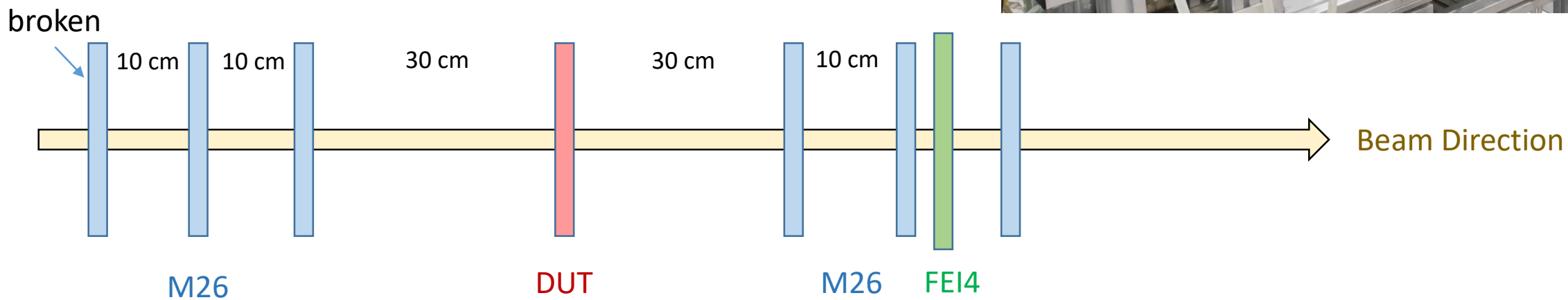
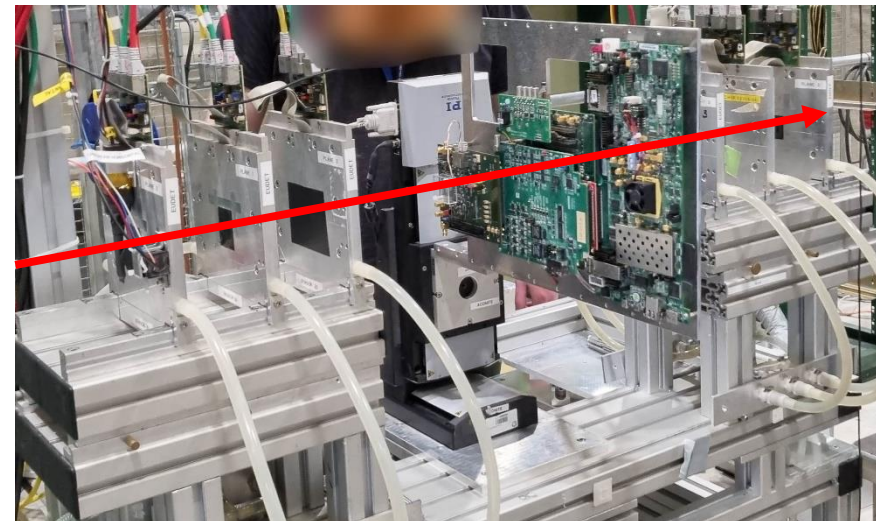
CERN-RD50 CMOS group meeting, 10 November 2022

Bojan Hiti

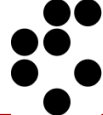


Introduction

- Testbeam with unirradiated RD50-MPW3 at CERN H6 with 120 GeV pions
- Using AIDA beam telescope in H6B
 - 2+3 Mimosas26 planes – pixel size $18 \times 18 \mu\text{m}^2$, time resolution 230 μs
 - 1 FEI4 plane – pixel size $250 \times 50 \mu\text{m}^2$, time resolution 25 ns
 - 1 DUT (called HEPHY DUT1) – not part of the tracking analysis



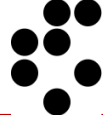
- Data analyzed with Corryvreckan



- Testbeam analysis consisting of multiple steps:
 1. Synchronizing data streams of Mimosa26 and FEI4 (and MPW3) ✓ Done, correlations observed
 2. Telescope alignment ✓ Done
 3. Track reconstruction ... In Progress
 4. Association of DUT hits with tracks and performance analysis ... Not yet
- Analysis process being set up on a typical data taking run (Run 960) using 100,000 events

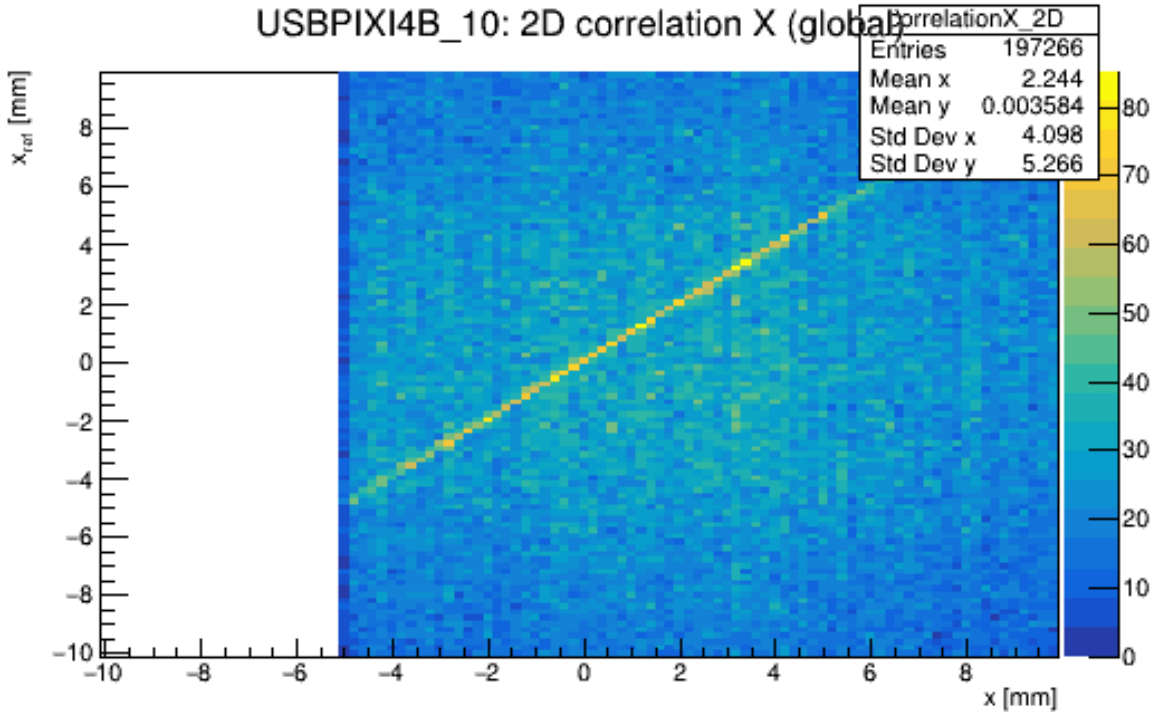
Analysis workflow in Corryvreckan:

- Data Loading
- Masking noisy pixels
- Clustering
- Coarse Alignment (Correlations)
- Fine Alignment (Track based)
- Track Reconstruction



Data Synchronization

- Correlations between Mimosa26 reference plane and FEI4 observed



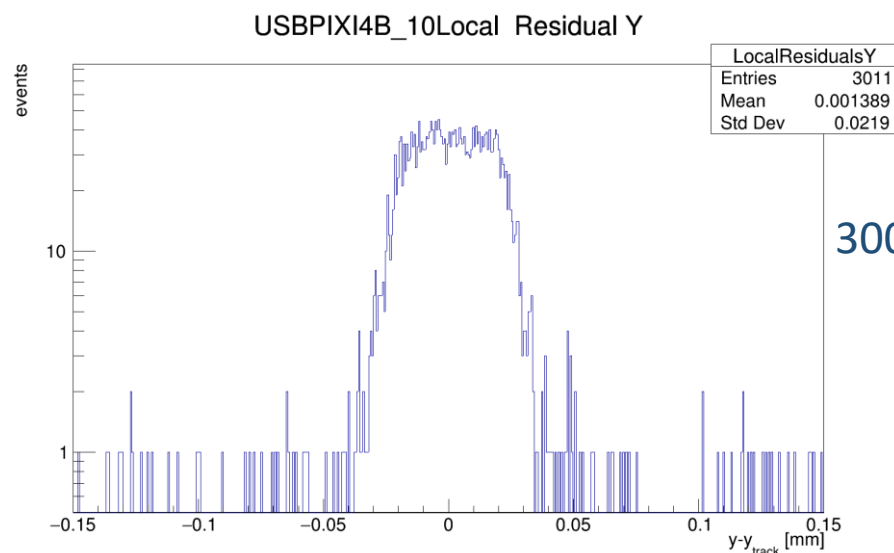
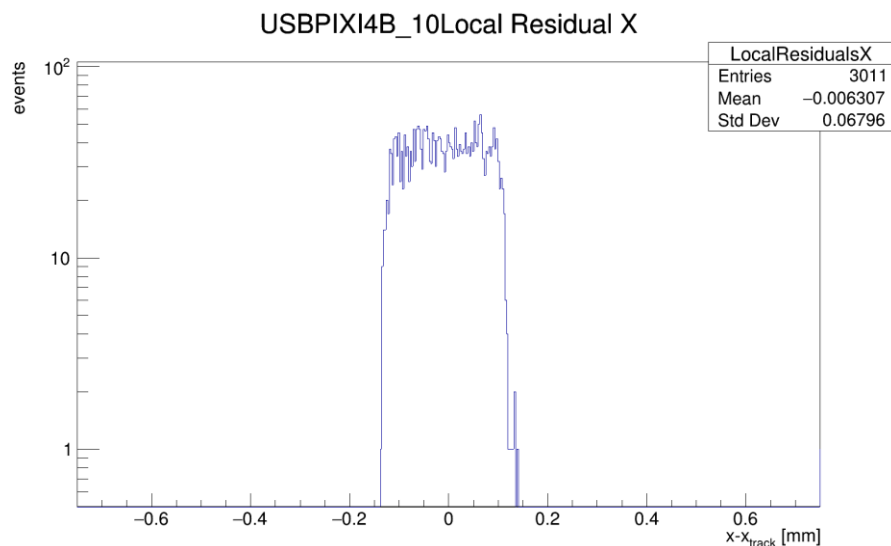
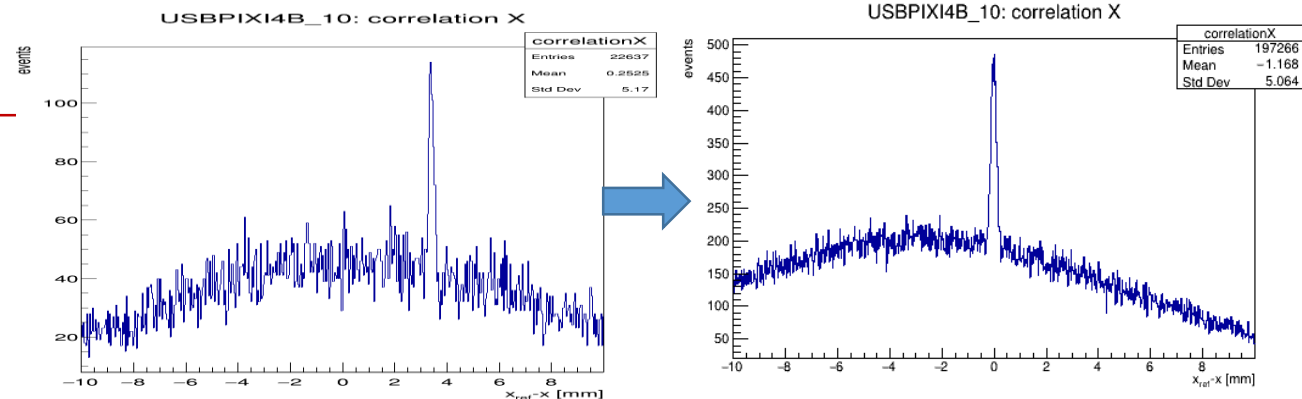
Alignment

- **Step 1: Coarse Alignment**

- Shift planes so that **Correlations** centered at zero

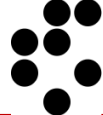
- **Step 2: Fine Alignment**

- One telescope plane at a time, cycle iteratively between planes
- Reconstruct **Tracks** through reference planes, adjust **Position and Rotation** of processed plane to minimize **Chi2**



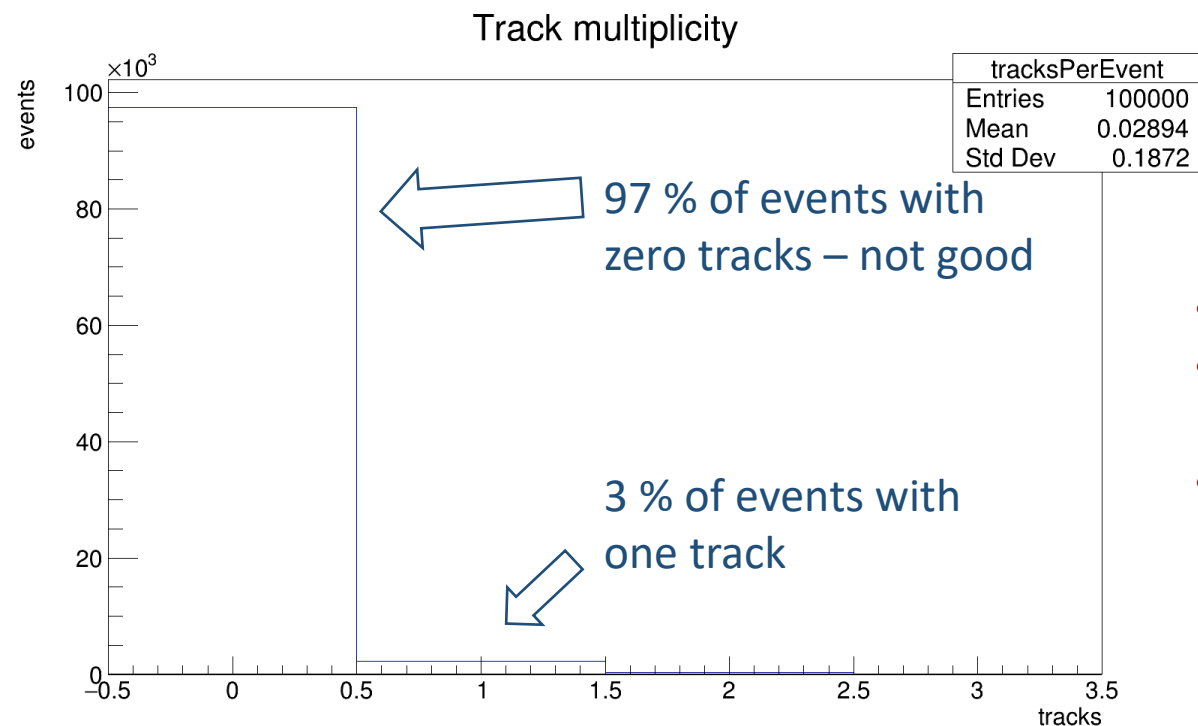
3000 tracks

- After Fine Alignment track residuals in FEI4 in [x,y] slightly off zero [- 6 um, 1 um], matching FEI4 pixel size
- Expect further improvement with larger dataset



Track Reconstruction

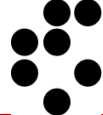
- Straight Track fitting
- Require hit in all 5 Mimosa + 1 FEI4 plane
 - 5 Mimosa alone are read out over a long time (230 μ s) \rightarrow large track multiplicity, harder DUT association
 - FEI4 used as "Time Anchor", ideally 1 track per Event
- Run 960 tracking results:



- No tracks reconstructed in 97 % events
- The cause are missing hits in FEI4 – only 3 % of events have a hit in FEI4
- If only require a hit in any 5 Planes \rightarrow Track multiplicity of 6.8

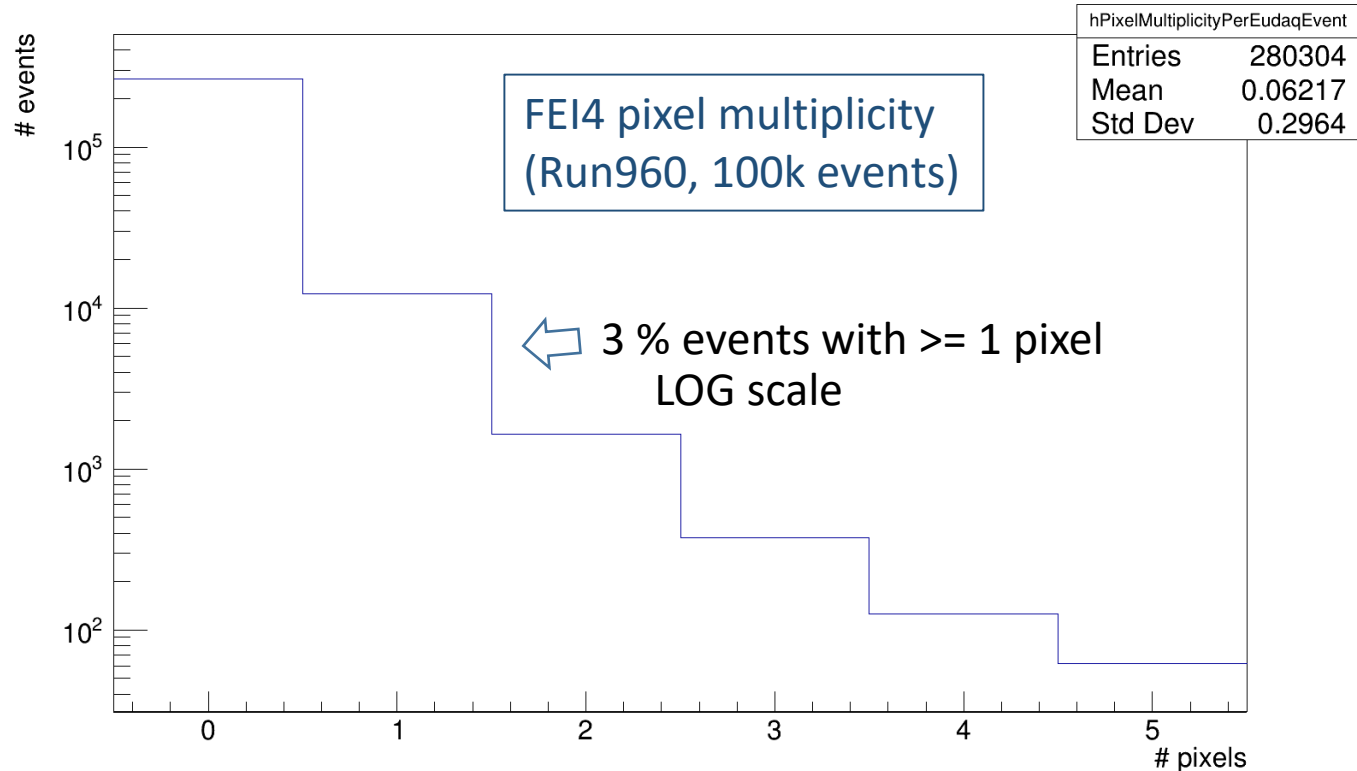
Investigating ...

Backup

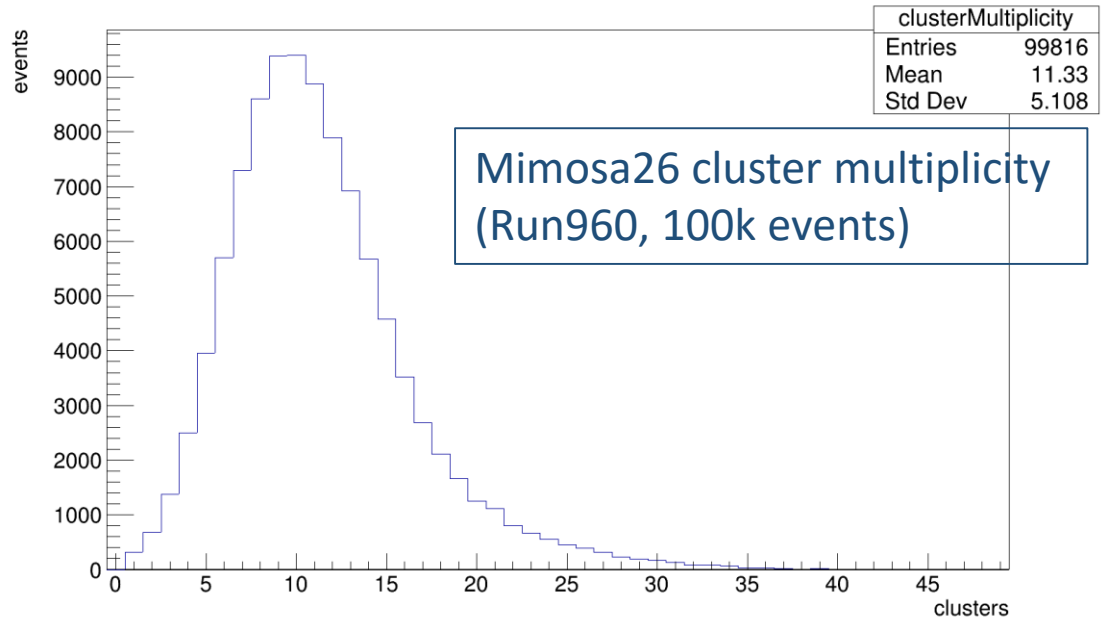


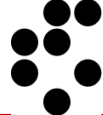
Mimosa and FEI4 Pixel Multiplicity

Pixel Multiplicity per EUDAQ Event



MIMOSA26_0 Cluster multiplicity





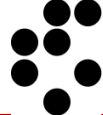
[Tracking4D]

min_hits_on_track = 6

spatial_cut_abs = 300um, 150um

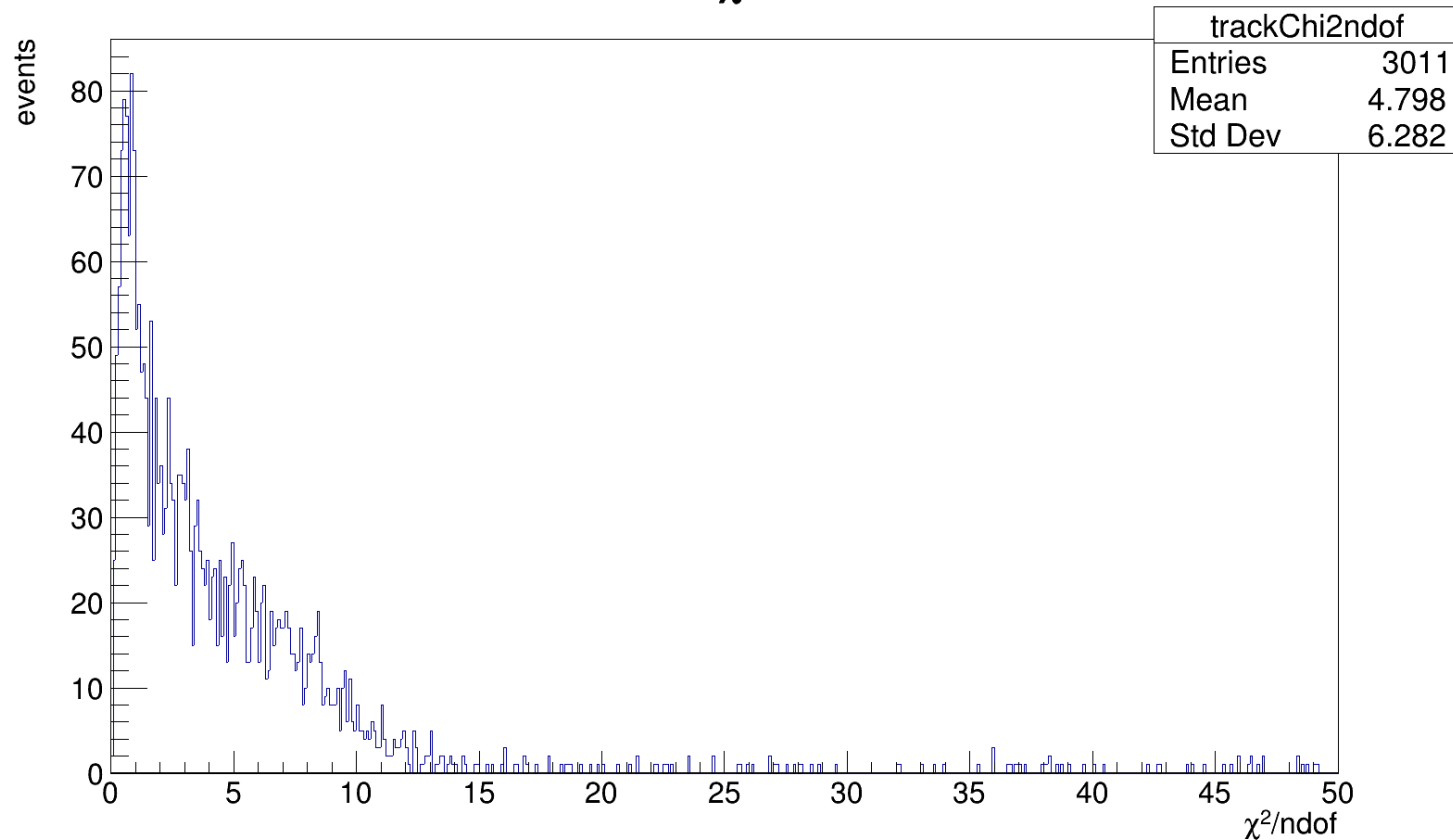
time_cut_abs = 200us

exclude_dut = true



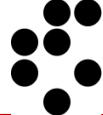
- Chi2/ndof not optimal → tail

Track χ^2/ndof



[Tracking4D]

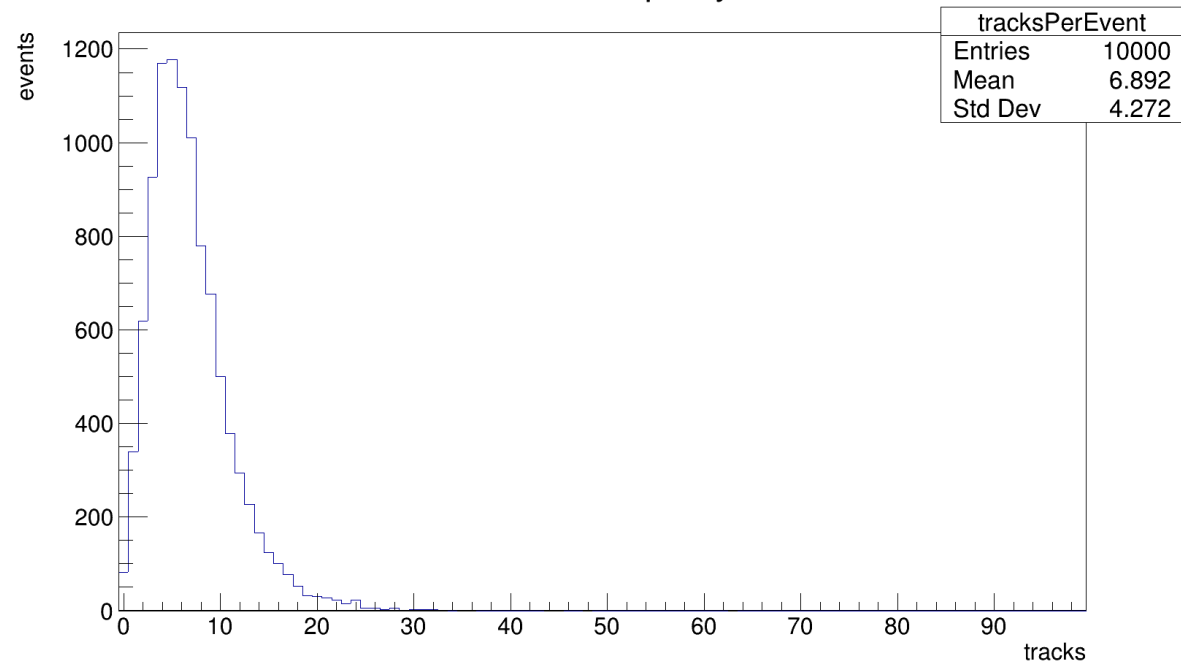
min_hits_on_track = 6
spatial_cut_abs = 300um, 150um
time_cut_abs = 200us
exclude_dut = true



Tracking with 5 planes only

- Require 5 planes hit per event

Track multiplicity



Track χ^2/ndof

