ARCADIA FNAL meeting

31-10-24

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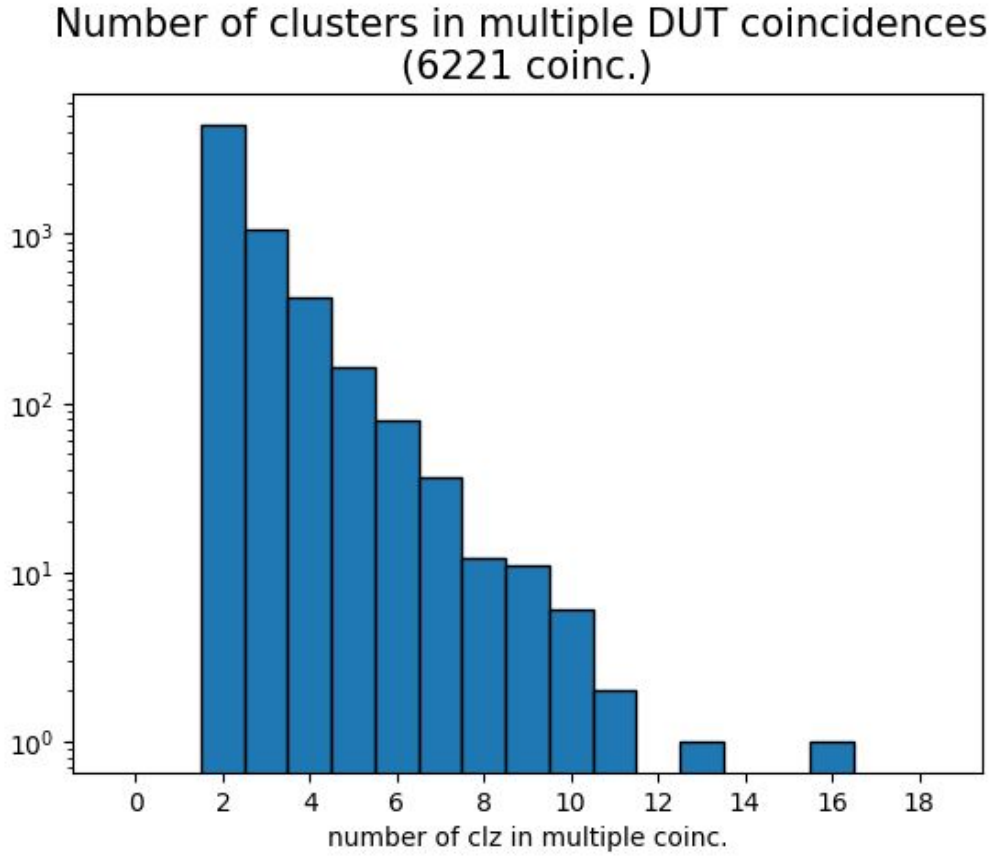
TB analysis: status

What's new

- Study on coincidences with more than one cluster on DUT
- Study of possible multiple scattering events
- Study on highest threshold (VCASN = 1)
- Efficiency: study squared vs radial spatial cut
- In-pixel efficiency map

Multiple clusters on DUT coincidences

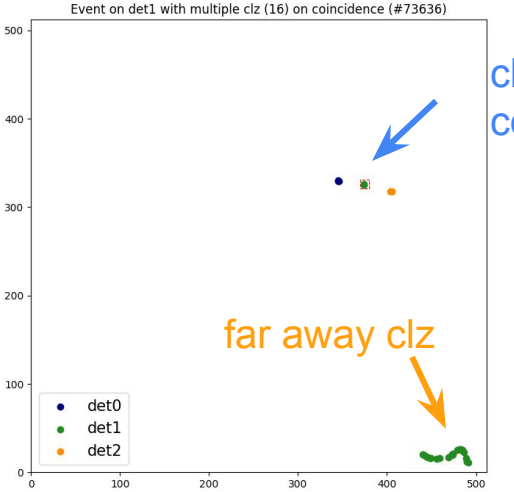
Study of coincidences with multiple clz on DUT
TW = 25

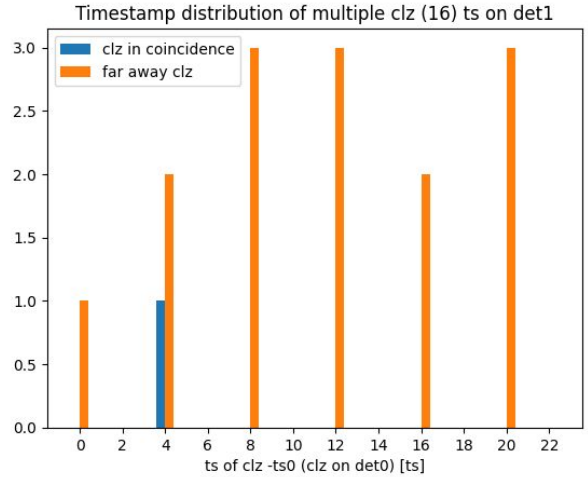


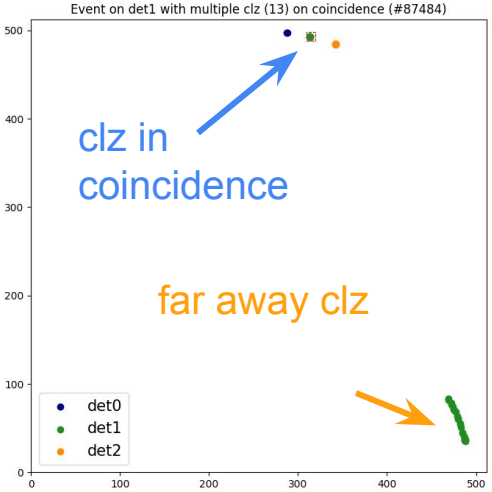
number of coincidences with 1 clz per plane on DUT: 201123

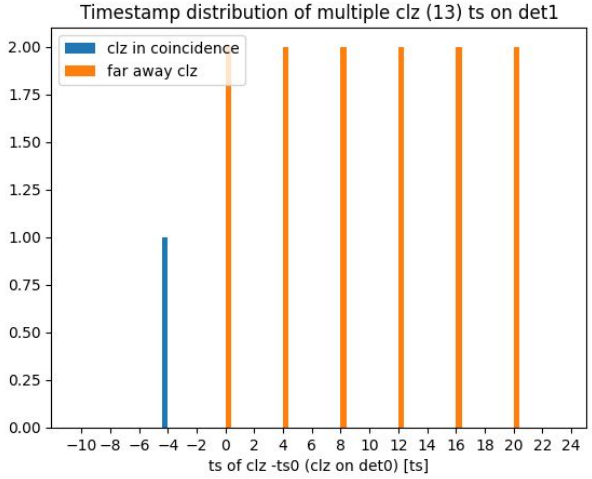
3% of coincidences have more than one cluster on DUT

Study of coincidences with multiple clz on DUT (TW = 25)

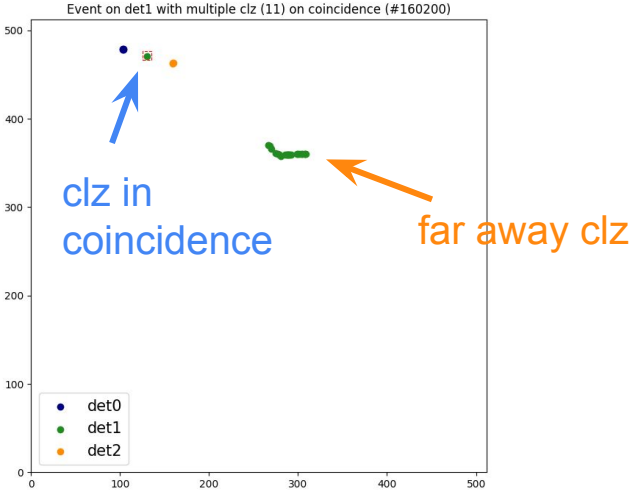


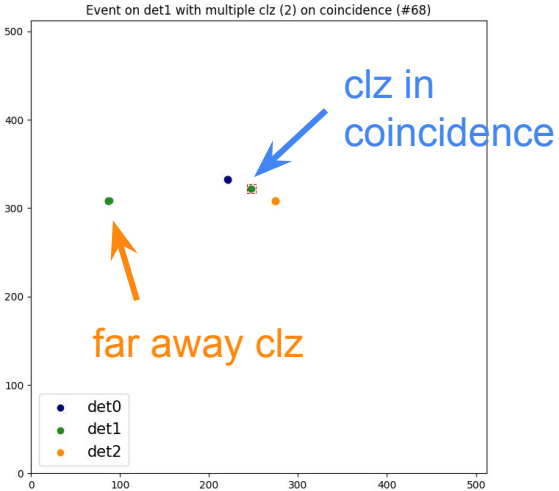


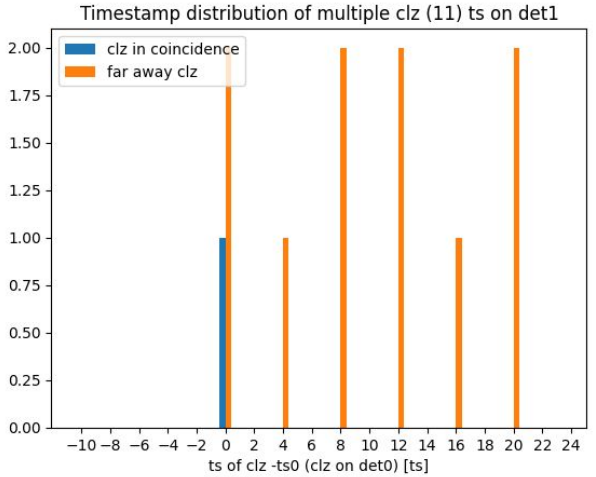


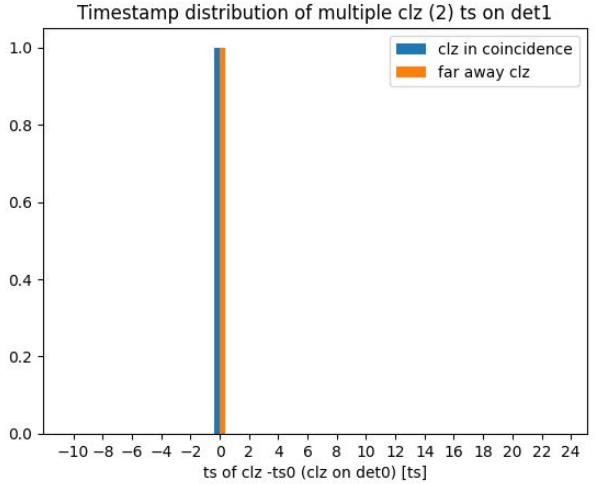


Study of coincidences with multiple clz on DUT (TW = 25)



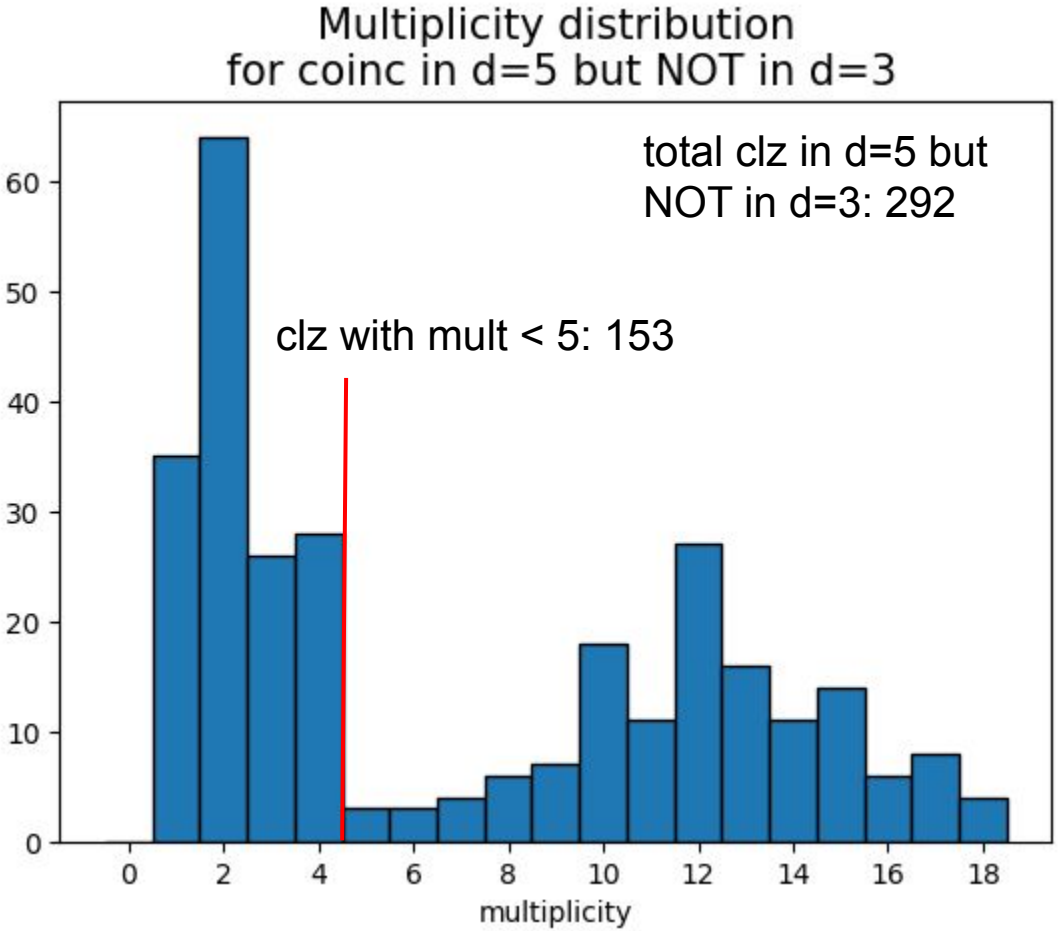




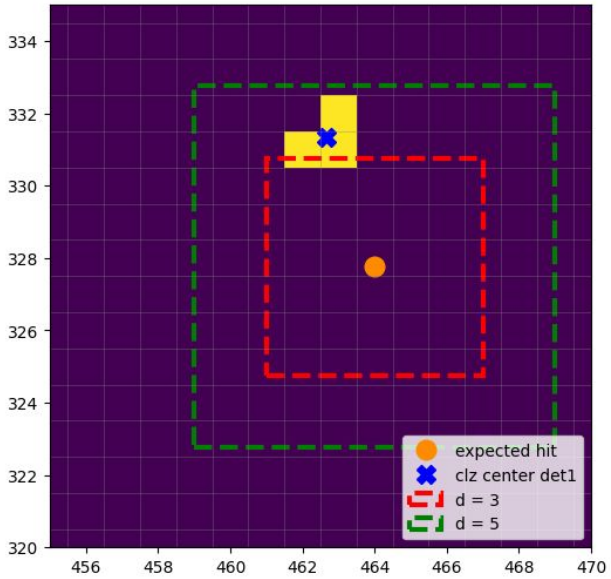


Multiple scattering

Study of multiple scattering: d = 5 vs d = 5 but NOT in d=3



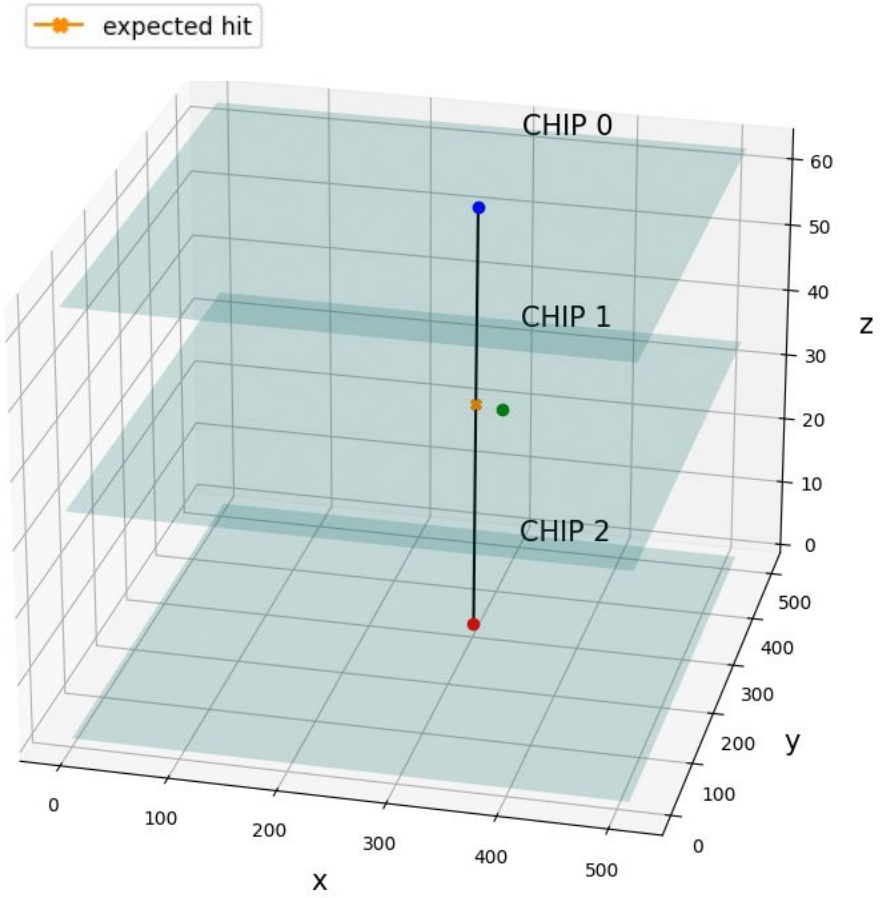
multiplicity distribution of clusters on DUT that are more included in spatial cut d = 5 but not in d = 3

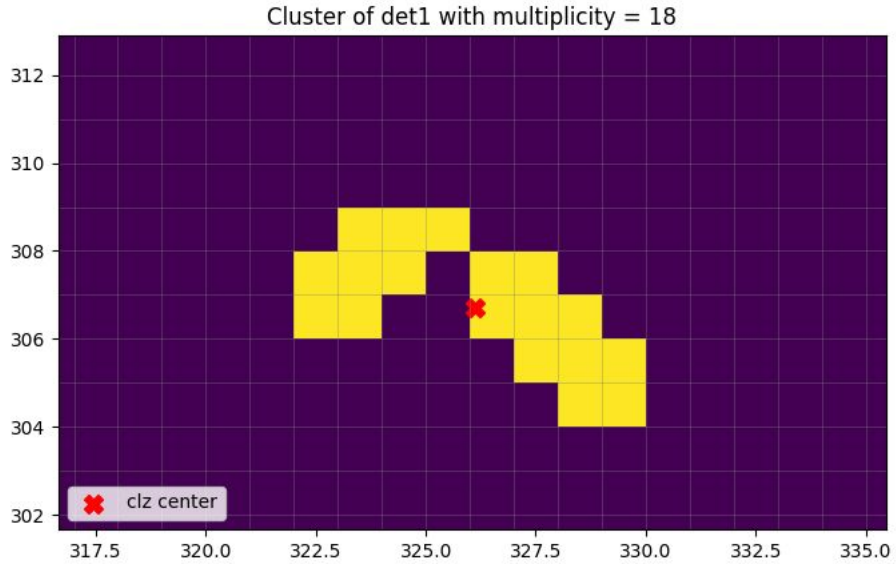


<u>two-peak structure?</u>

Study of multiple scattering: d = 5 vs d = 3

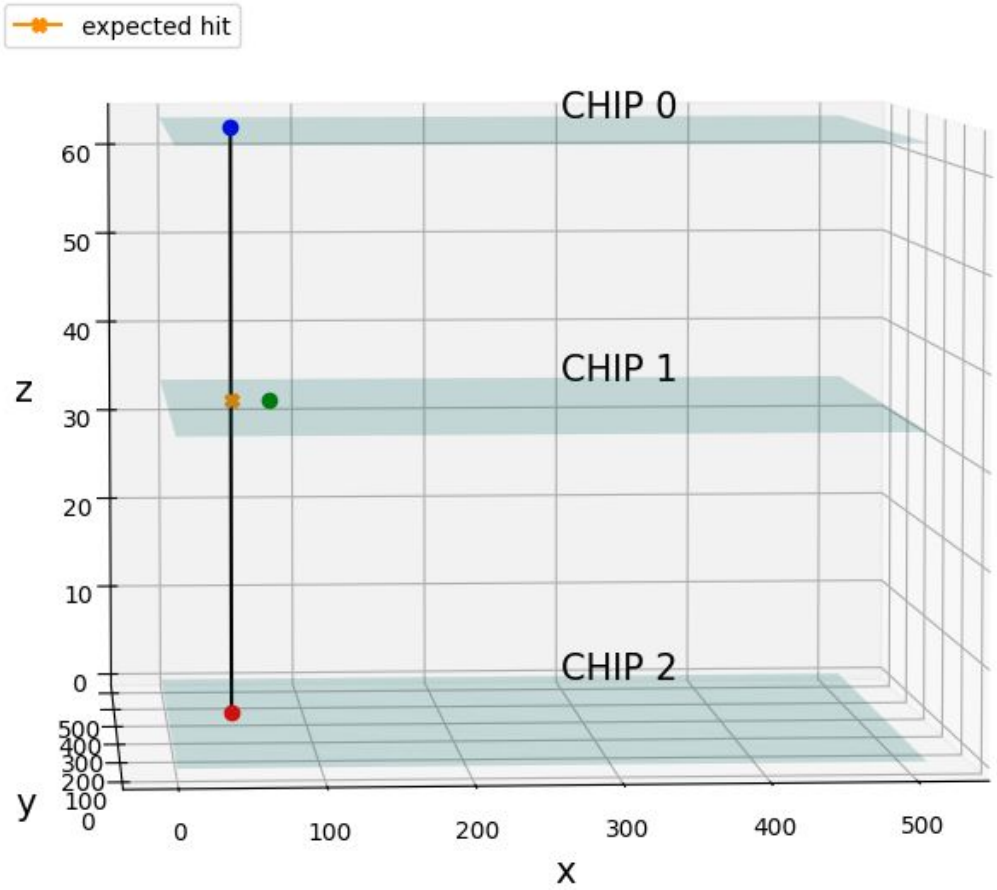
Coincidence with large cluster

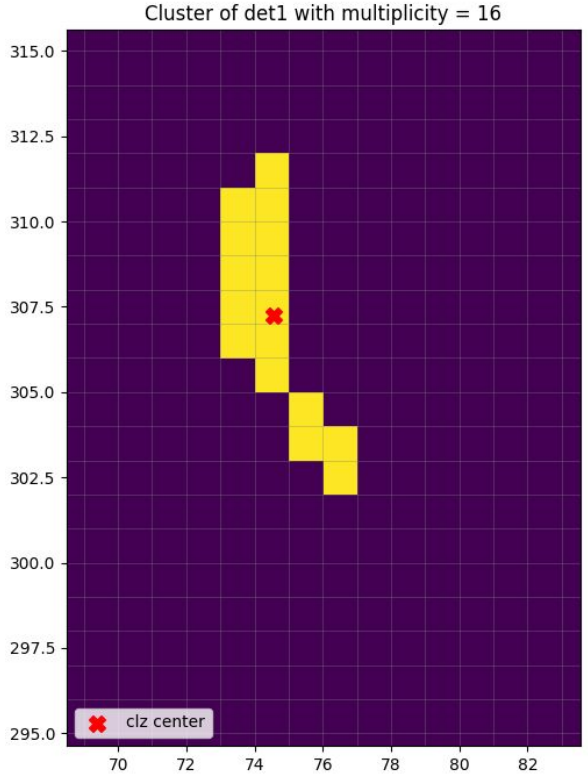




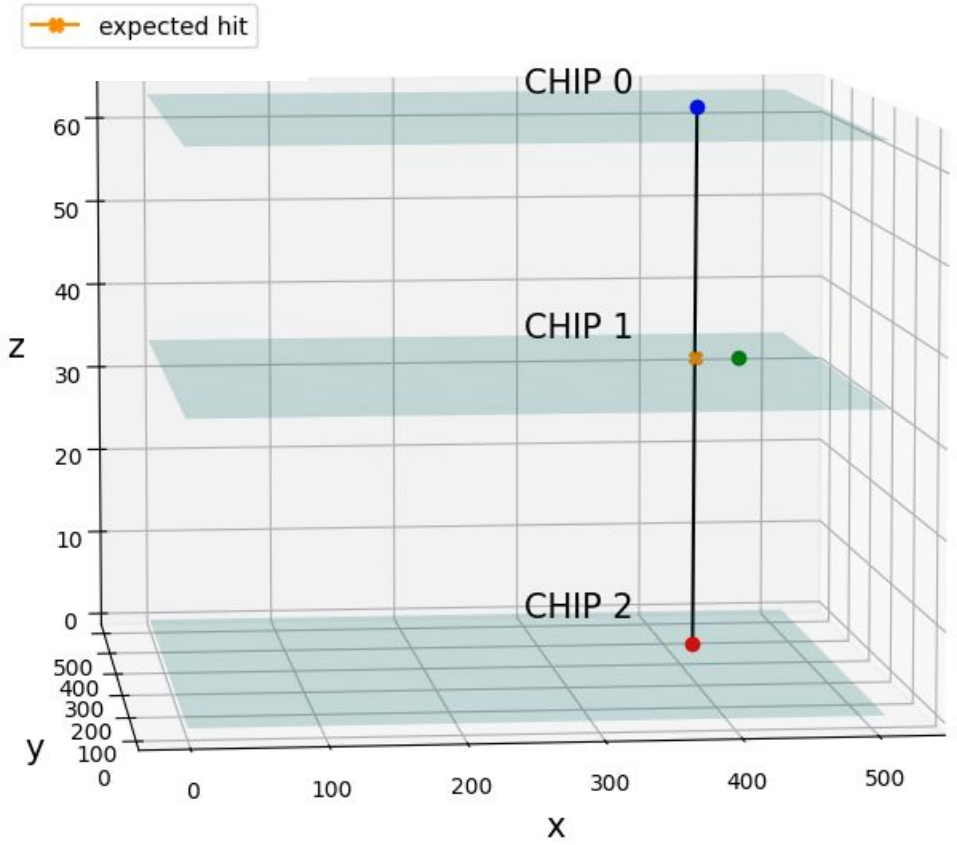
Study of multiple scattering: d = 5 vs d = 3

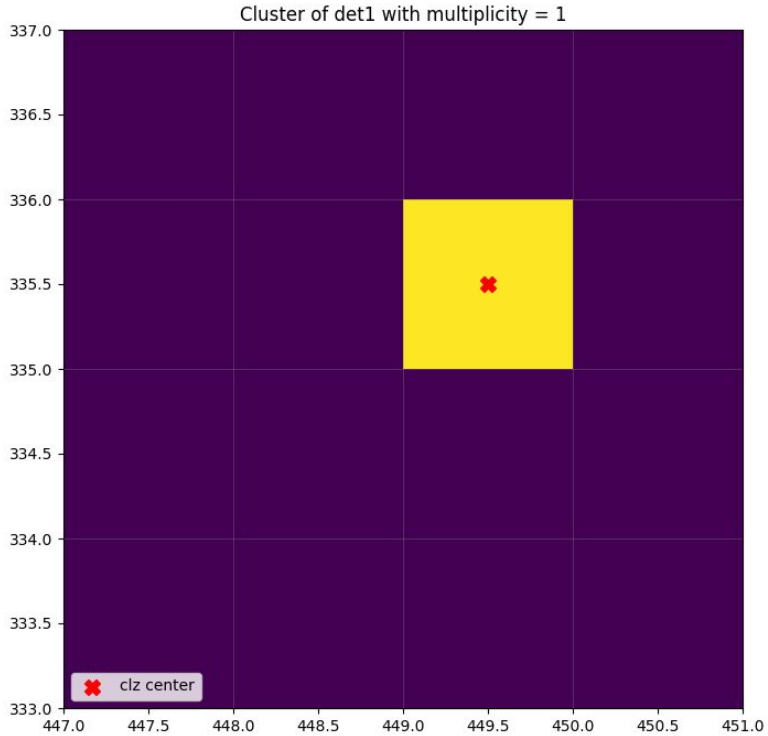
Coincidence with large cluster



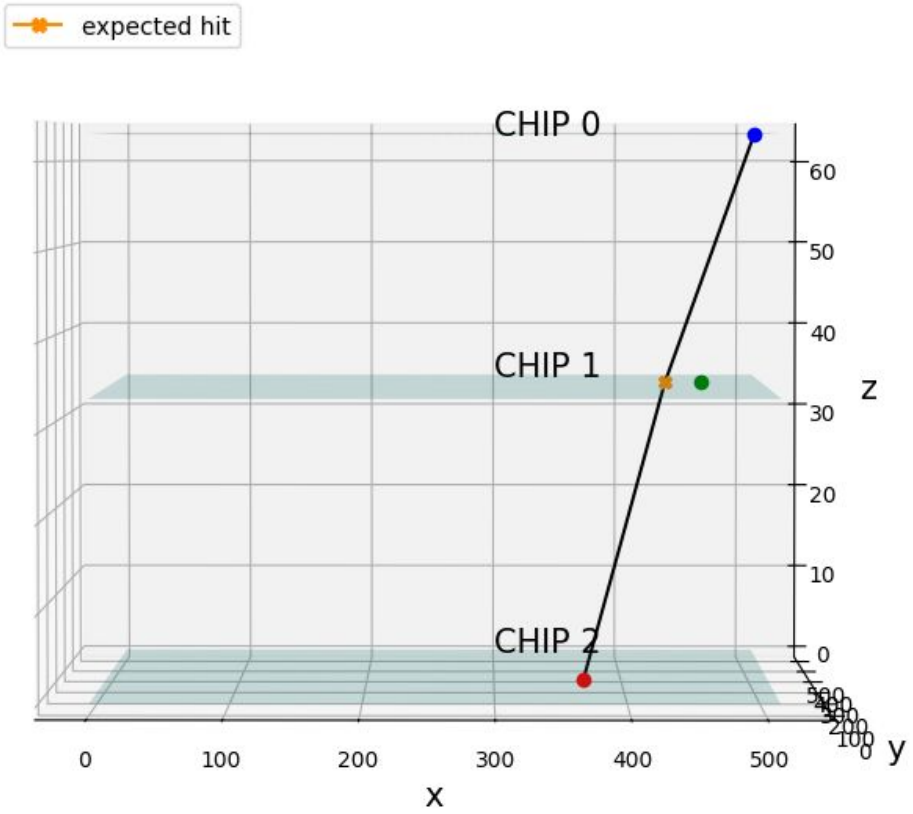


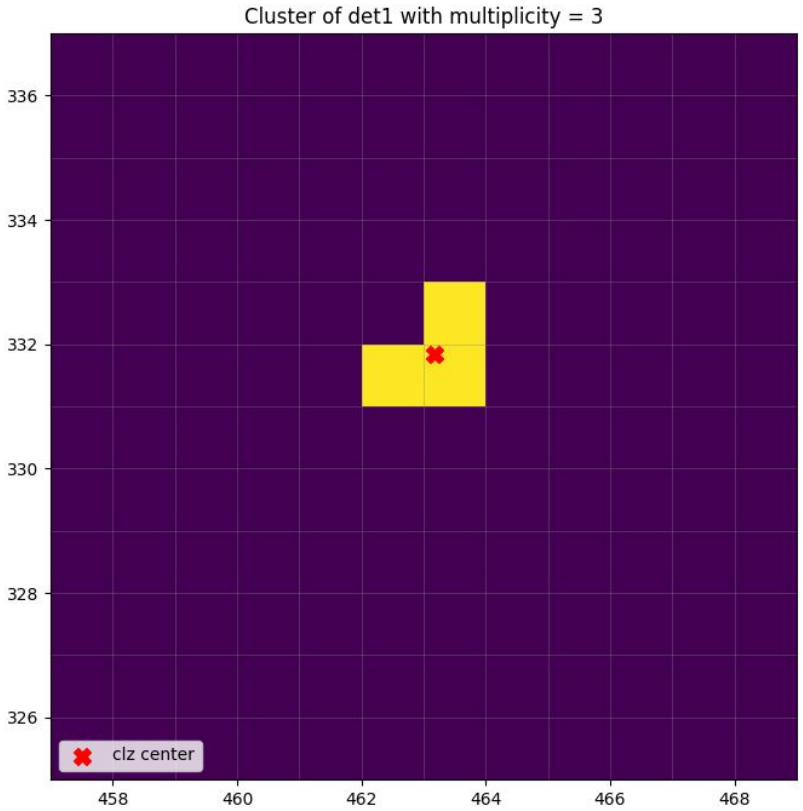
Study of multiple scattering: d = 5 vs d = 3
Events @ 5 sigma from expected hit → Multiplicity = 1





Study of multiple scattering: d = 5 vs d = 3
Events @ 5 sigma from expected hit → Multiplicity = 3

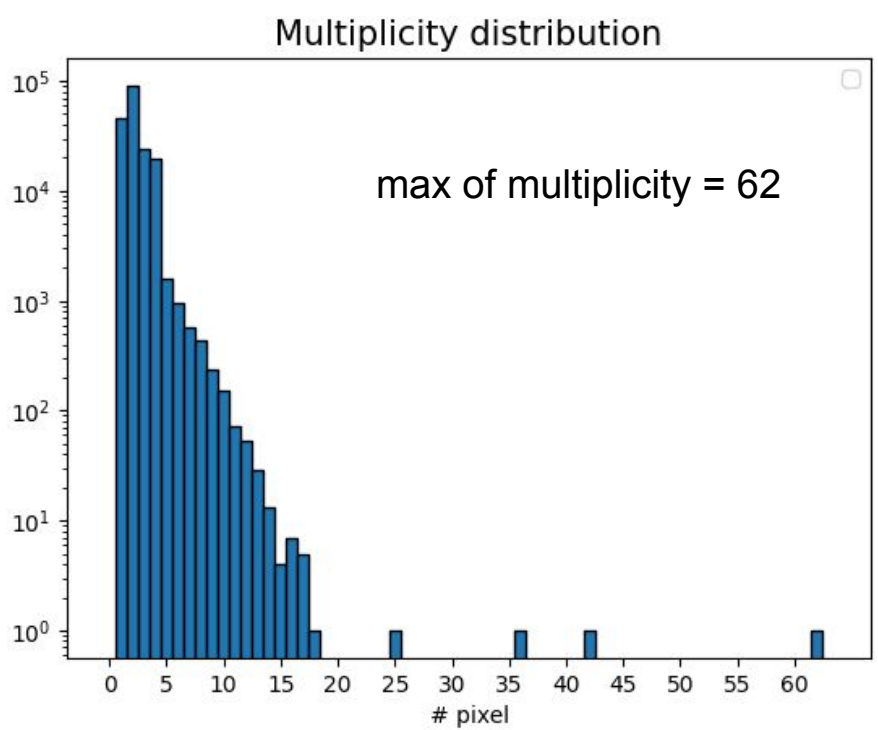


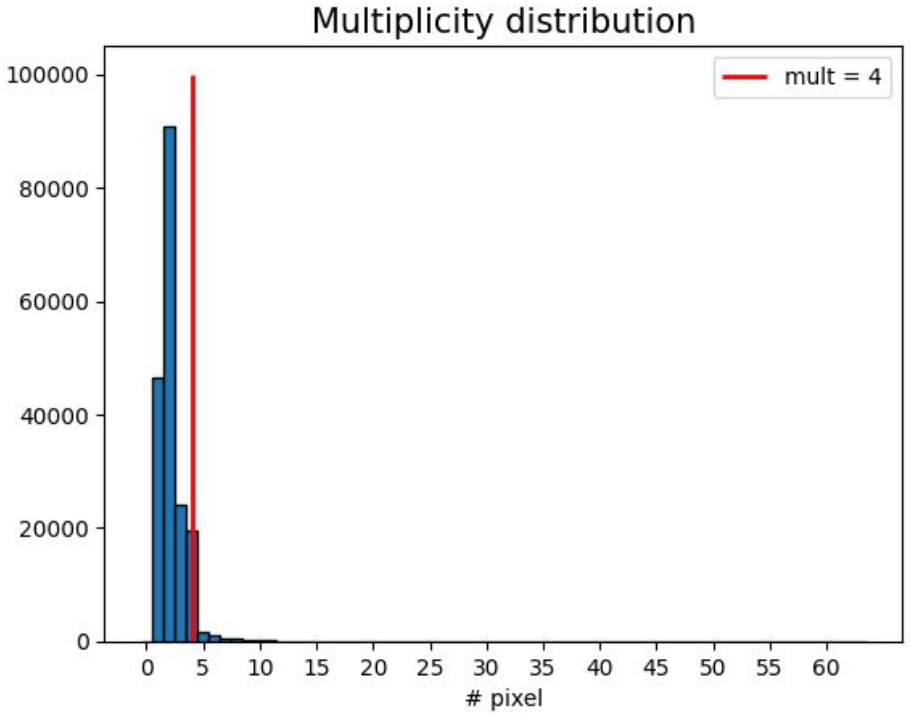


Study of highest threshold run (VCASN = 1)

Study of VCASN 1 data

No cut on clusters multiplicity, all clusters are analysed





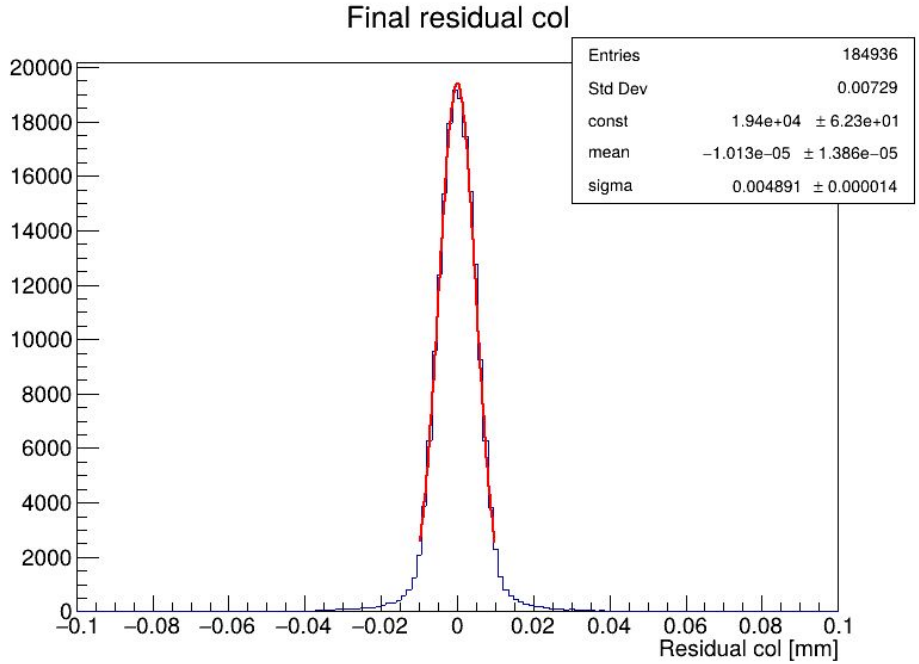
total number of clz → 184936

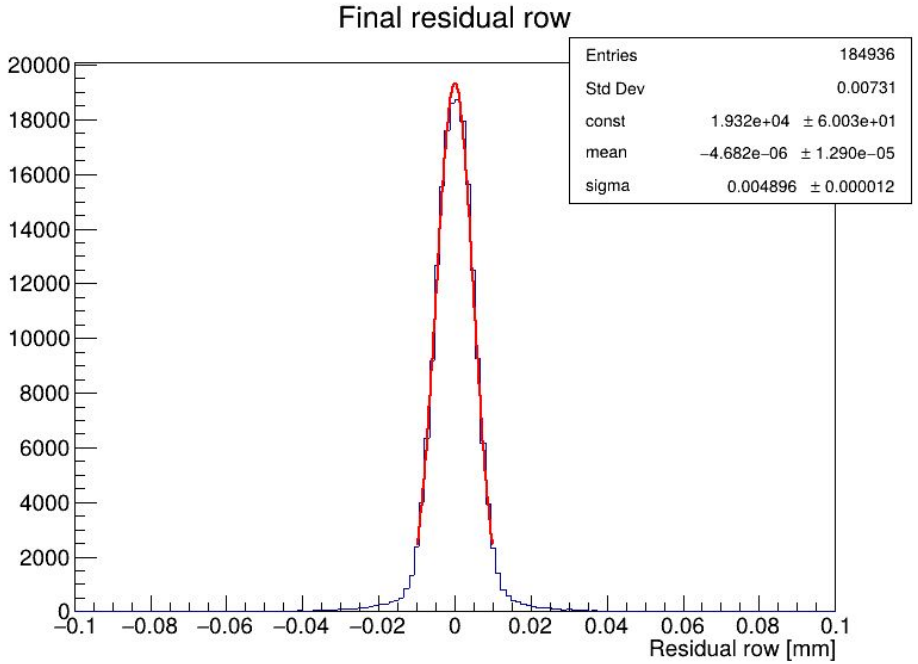
number of clz wih mult <= 4 → 180817 (97.77%)

Study of VCASN 1 data

No cut on clusters multiplicity, all clusters are analysed

fit @ 2 sigma





sigma columns → 4.891 um (default run @VCASN = 5 sigma col → 4.734 um)

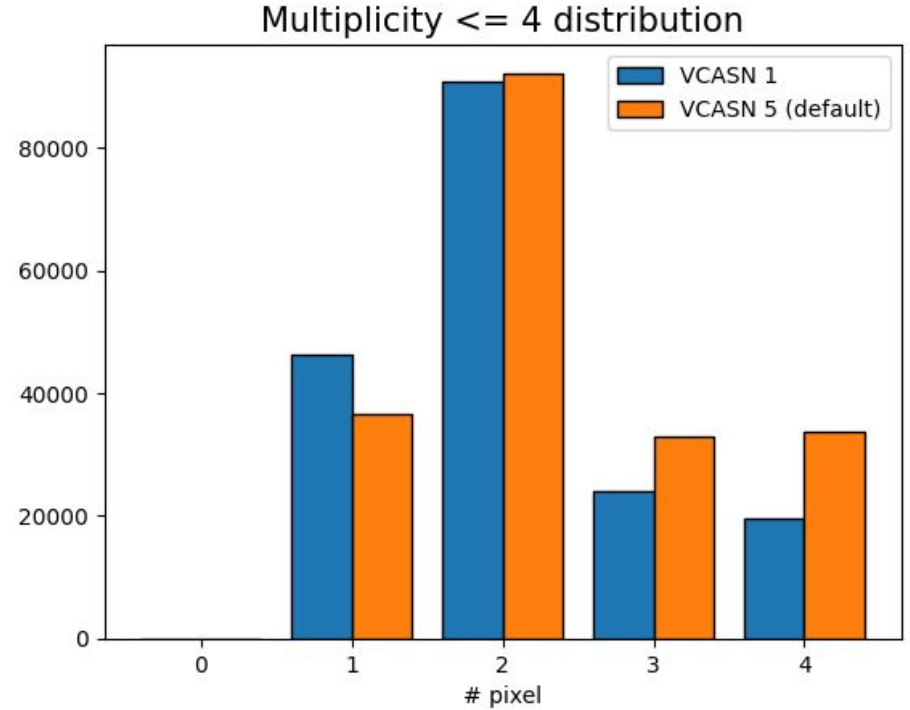
sigma rows → 4.896 um (default run @VCASN = 5 sigma row → 4.637 um)

Study of VCASN 1 data

analysis of clusters with multiplicity ≤ 4

number of clz wih mult <= 4 → 180817

- number of clz with mult = 1 → 46382 (25.65%)
- number of clz with mult = 2 → 90805 (50.21%)
- number of clz with mult = 3 → 24164 (13.36%)
- number of clz with mult = 4 → 19466 (10.77%)



For VCASN = 1

- single-pixel clz are approximately half of double-pixel clz
- single-pixel clz are more than for VCASN = 5

Study of VCASN 1 data
analysis of clusters with

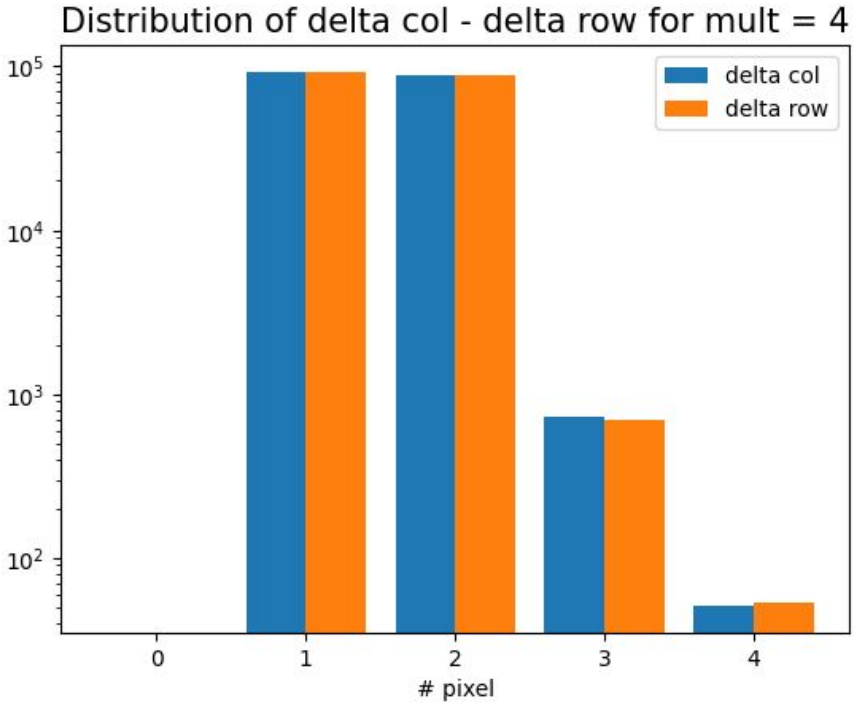
multiplicity = 2

total number of clz with multiplicity = 2
90805

- 45949 have delta col = 2
- 44924 have delta row = 2

“vertical” and “horizontal” 2-pixel clusters equally distributed

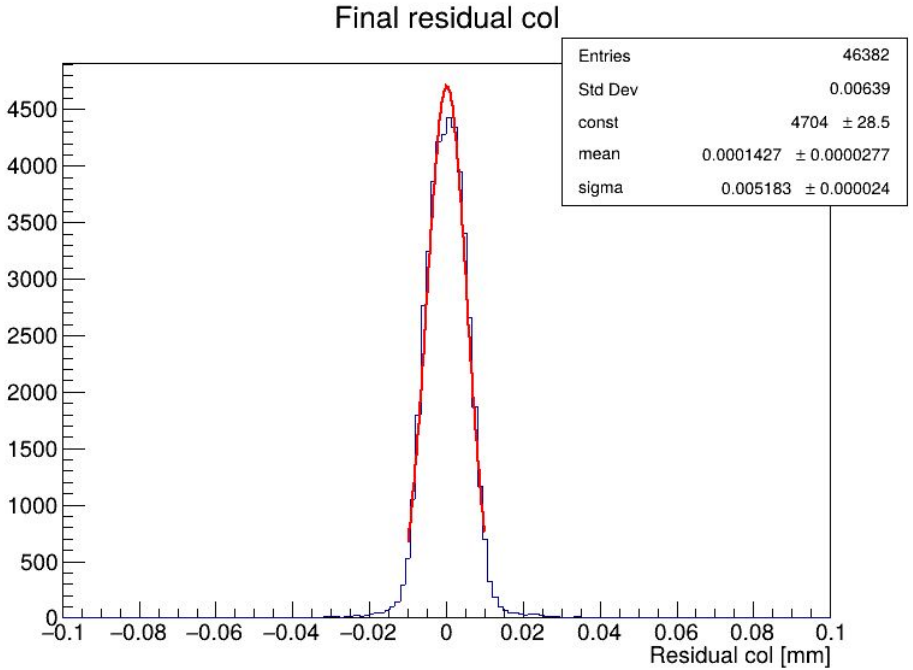
multiplicity = 4

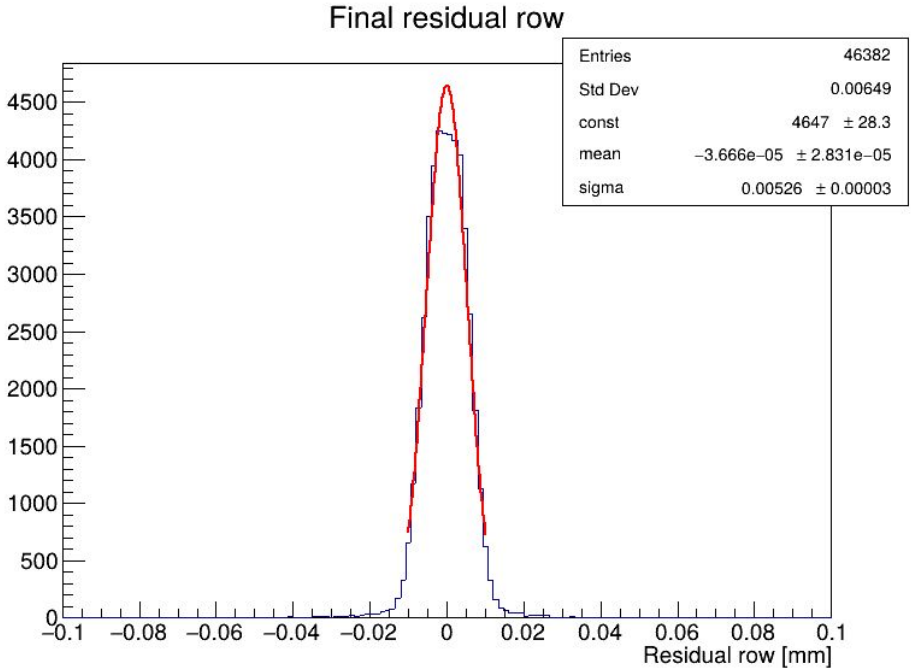


#clz with mult = 4 & delta col = 4 → 51
clz with mult = 4 & delta row = 4 → 53

Study of VCASN 1 data
analysis of clusters with

multiplicity = 1





sigma columns → 5.183 um
sigma rows → 5.260 um

Efficiency

Efficiency

**after alignment some row or col values are shifted outside the sensor area*

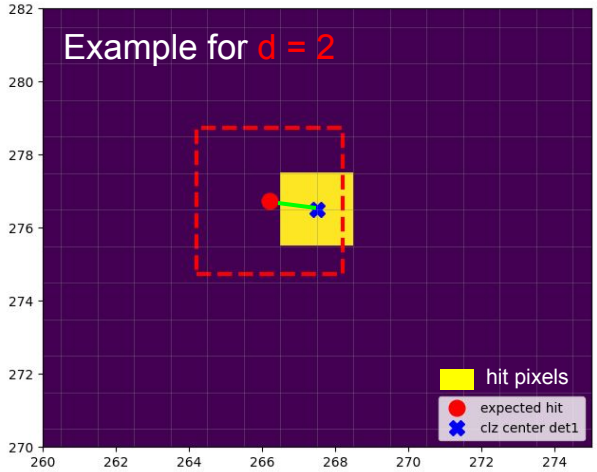
New algorithm

1. With tracks from previous tracking algorithm (one cluster on all planes), perform alignment and tilt correction
2. Cut events out of sensor area [0,512] *
3. Select events in time coincidence with time window (tw) between external planes 0,2
4. Look for clusters on plane 1 in same time window (tw) applying spatial cut:

abs (cluster center - expected hit) < **d [pixel]**

(squared fiducial area around the expected hit on det1)

NOTE: If there is more than one cluster on plane 1,
select the closest to the expected hit.



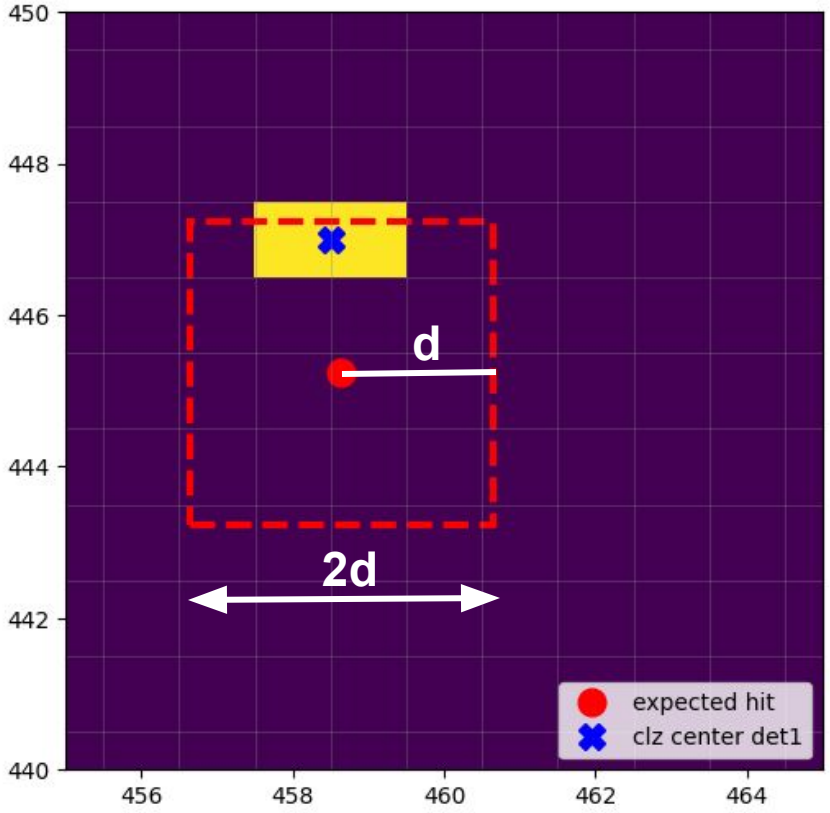
5. Compute efficiency as

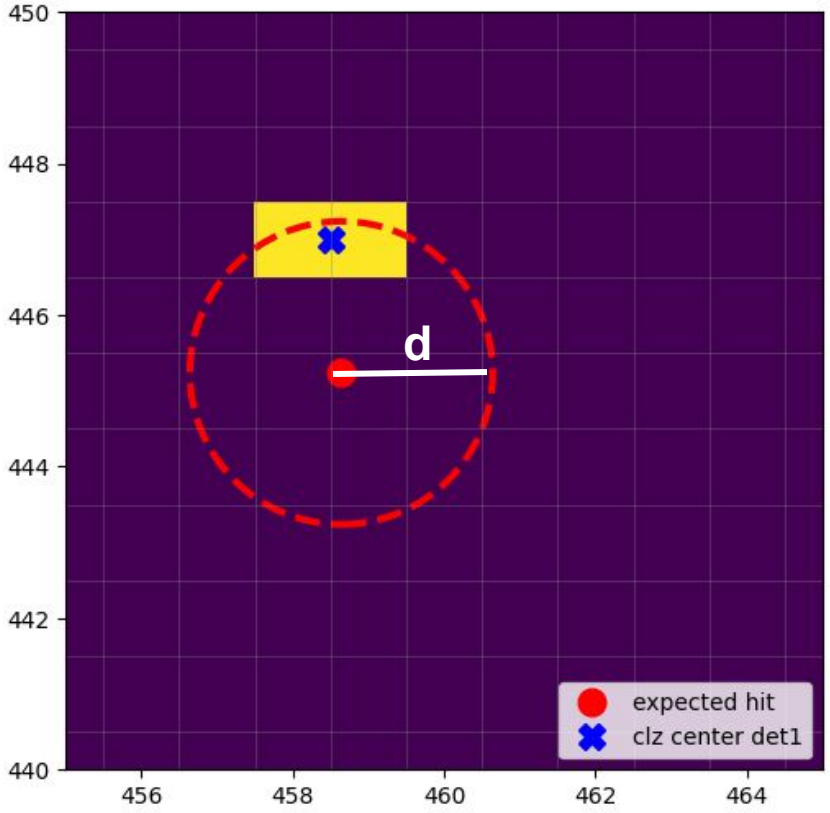
$$efficiency = \frac{\#\ complete\ coincidences\ 0,1,2}{\#\ complete\ coincidences\ 0,1,2 + \#\ incomplete\ coincidences\ 0,2}$$

Efficiency: Squared vs radial cut study

abs (cluster center - expected hit) < **d [pixel]**

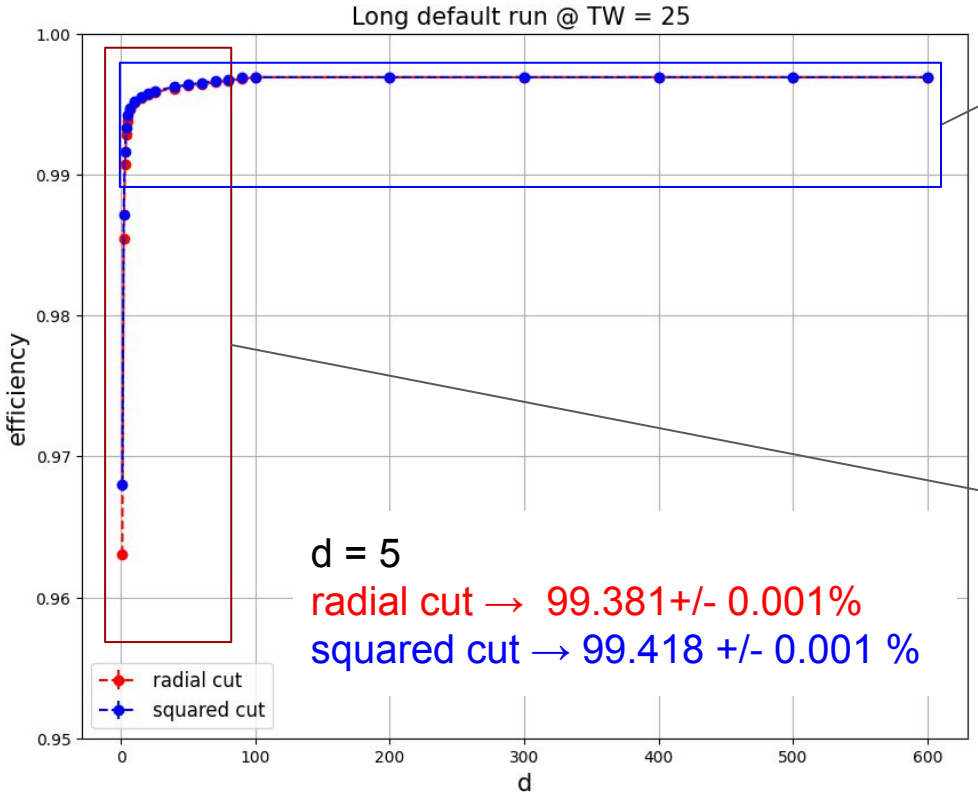
example for d = 2

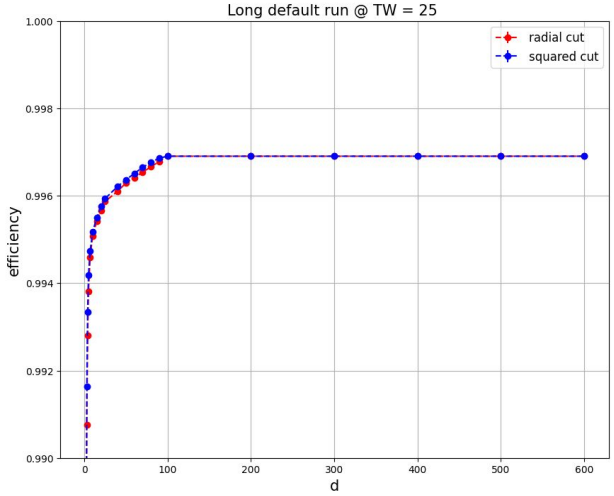


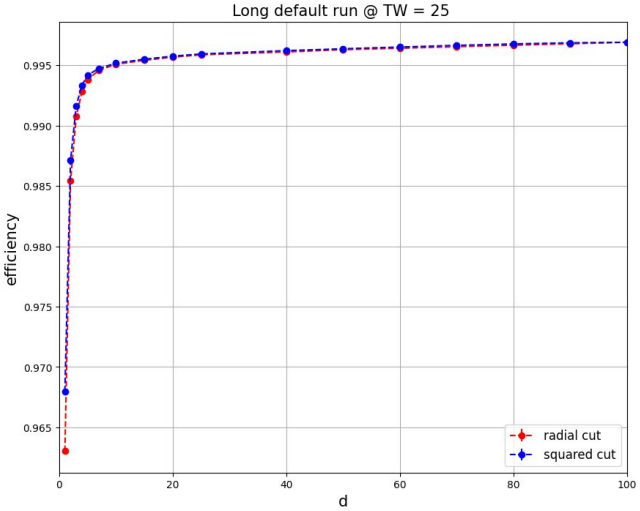


Efficiency: Squared vs radial cut study @ TW = 25

Long default run @VCASN = 5







In-pixel efficiency map

In- pixel efficiency

Algorithm:

1) Efficiency algorithm to find *complete coincidences 0,1,2* and *incomplete coincidences 0,2*
   Parameters used
   - Time Window = 25 ts
   - Spatial cut = 5 [pixels]

   } From last meeting they seemed to be the best set of parameters

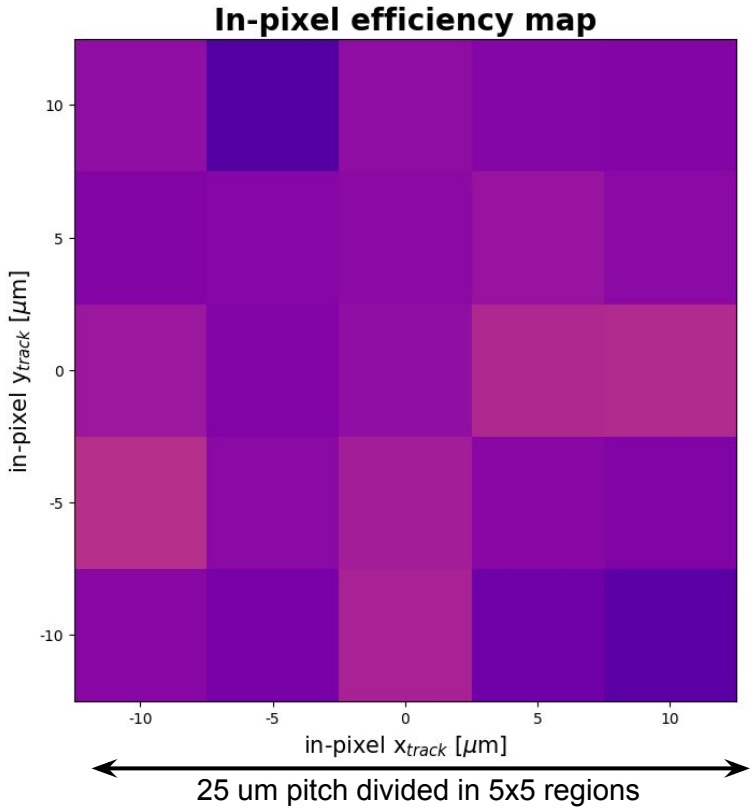
2) Pixel is subdivided into 25 subregions M[i][j] (with M = 5x5 matrix) and for each in-pixel subregion the efficiency is computed considering only tracks with the expected hit on DUT inside it.

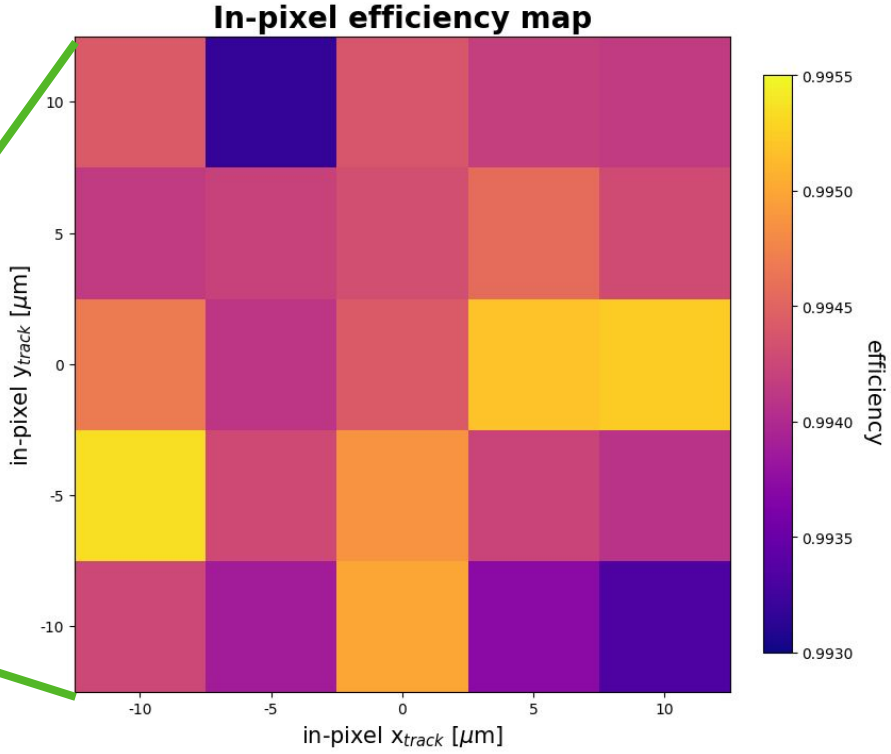
3) Compute In-pixel efficiency matrix as

$$M[i][j] = \frac{M_{012}[i][j]}{M_{012}[i][j] + M_{02}[i][j]}$$

In-pixel efficiency map @ TW = 25 + d = 5
All data
Statistics: ~ 15k entries per bin

61 spills @ VCASN = 5

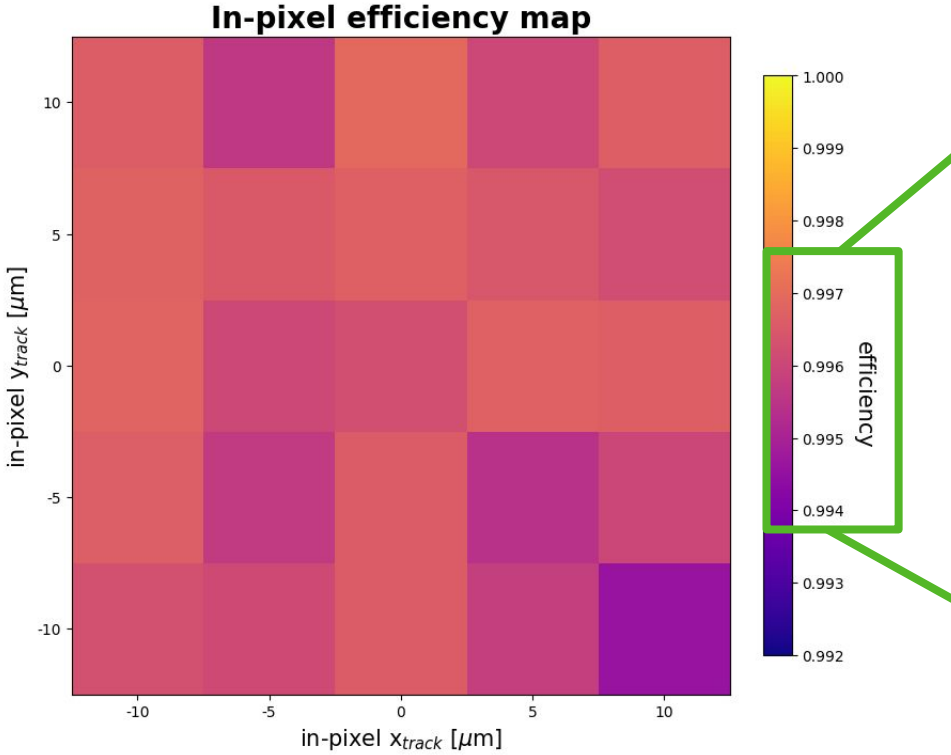


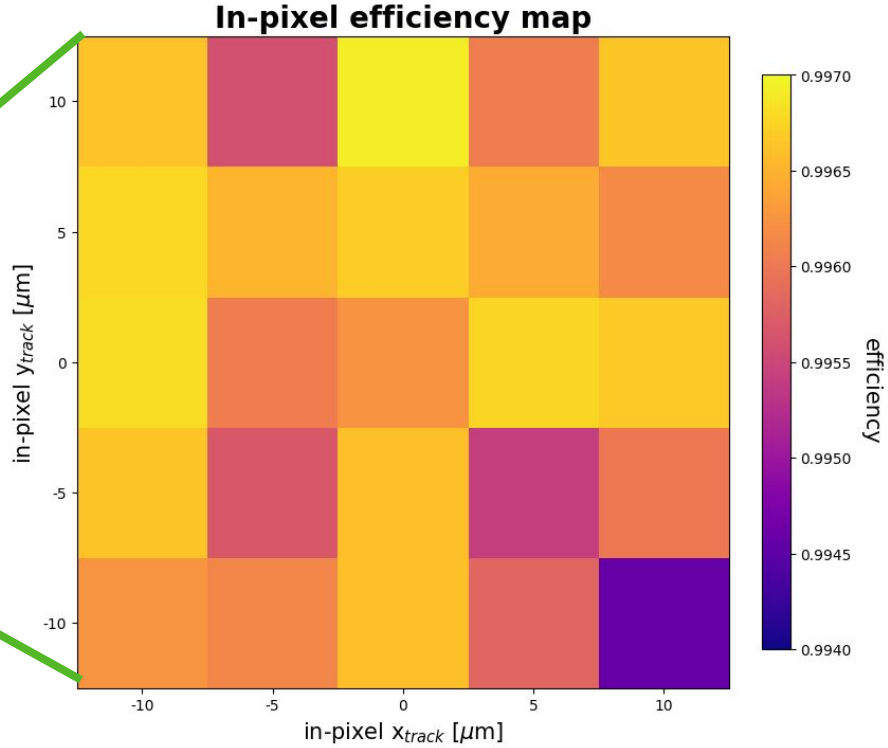


No significant difference:
maximum efficiency variation ~ 0.25%

In-pixel efficiency map @ TW = 25 + d = 5
Data from clusters with multiplicity = 1, 2
Statistics: ~ 9k entries per bin

61 spills @ VCASN = 5



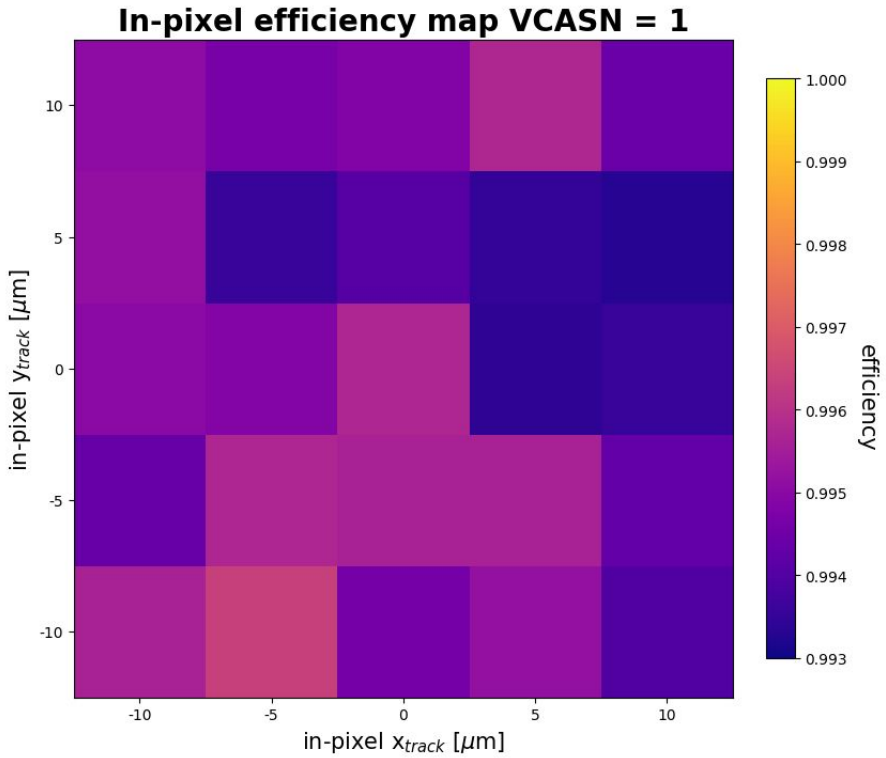


No significant difference:
maximum efficiency variation ~ 0.3%

In-pixel efficiency map @ TW = 25 + d = 5
Statistics: ~ 9k entries per bin

20 spills @ VCASN = 1

All data
Statistics: ~ 7k entries per bin



Multiplicity 1 and 2
Statistics: ~ 5k entries per bin