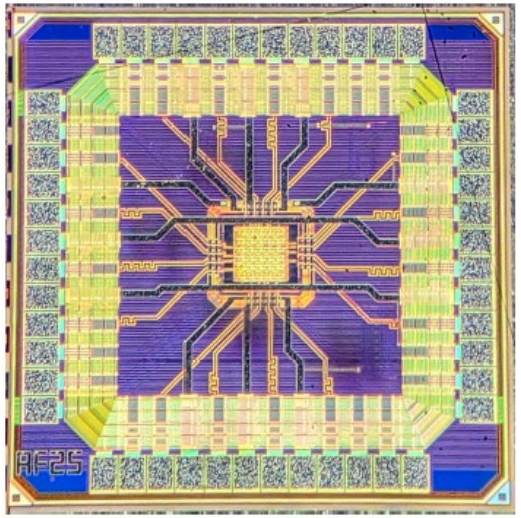
OpAmp Paper Update



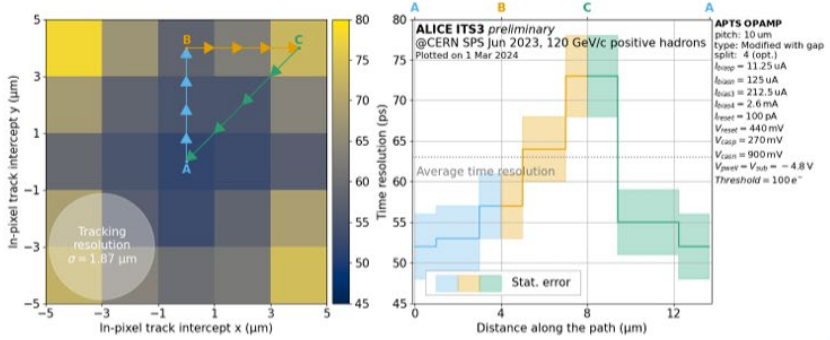
Angelo Colelli, Francesco Barile, Rajendra Patra, Shyam Kumar, Triloki Triloki
University of Bari and INFN sez. Bari

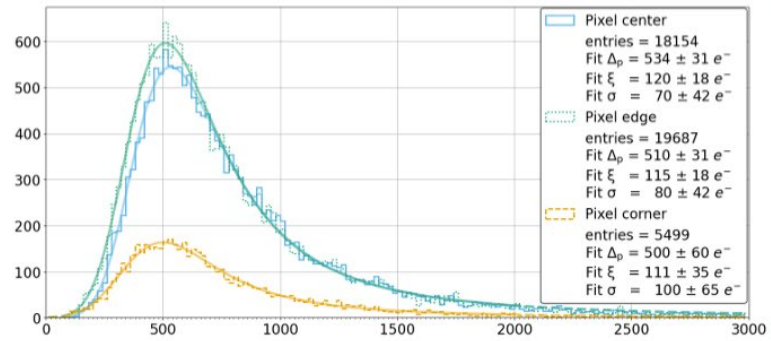
OPAMP Data Analysis Status and Next Steps

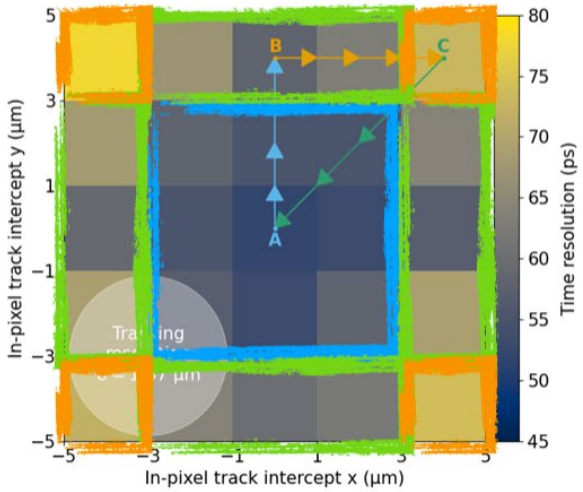
- Pre-Analysis (Data Quality Assurance) **-> Ongoing**
- Use the K_α database for analog clusterization in order to optimize the DQA **-> Ongoing**
- Corryvreckan and timing analysis
- Draft manuscript (June 2025?)

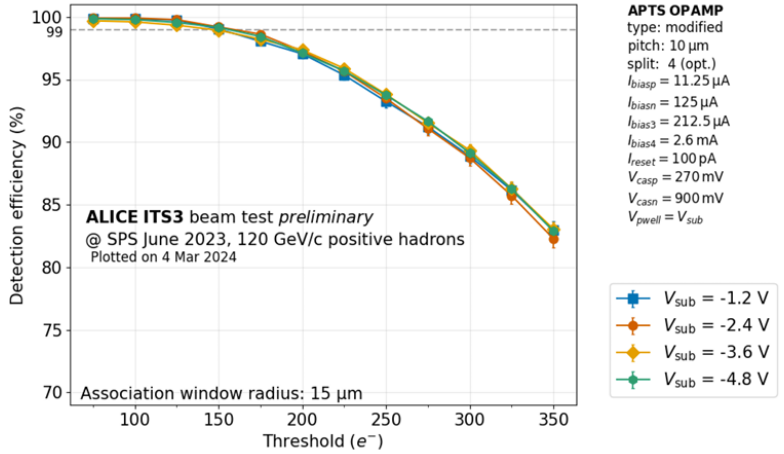
OPAMP Data Analysis goals and workflow

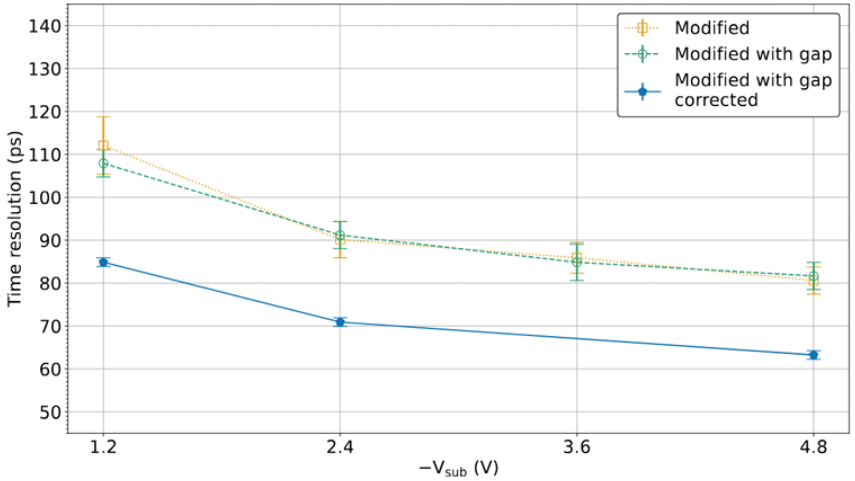
- Efficiency at different clusterization threshold
- Timing trend for each configuration
- Landau trend for each configuration
- Timing correction
- Timing in pixel



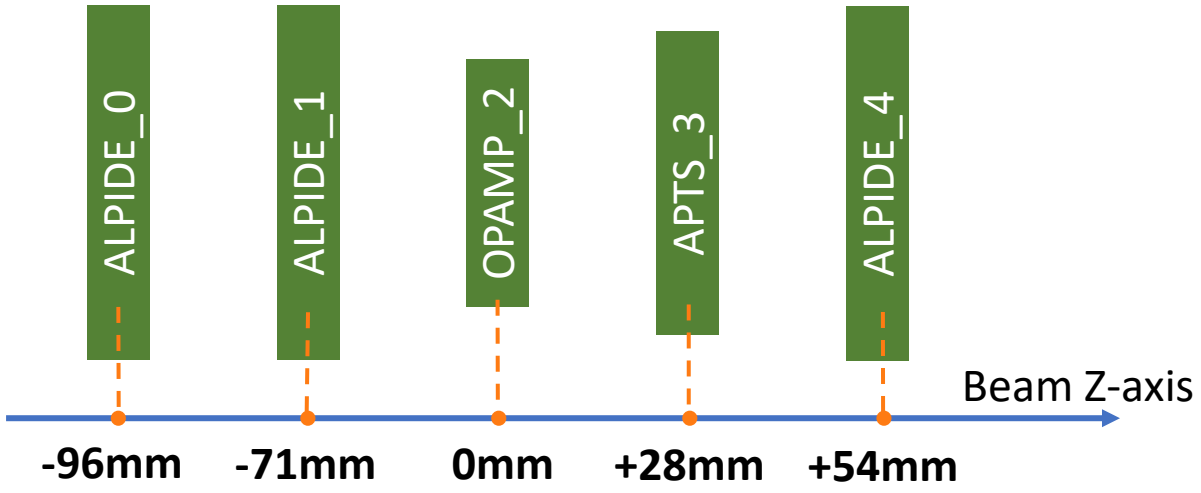




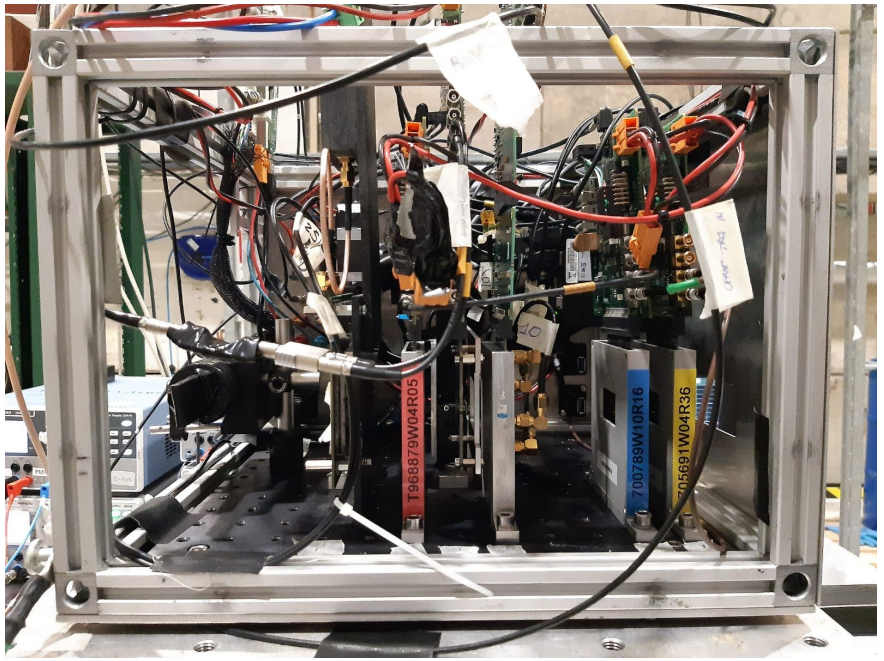




OPAMP TB setup @ SPS-CERN October 2024

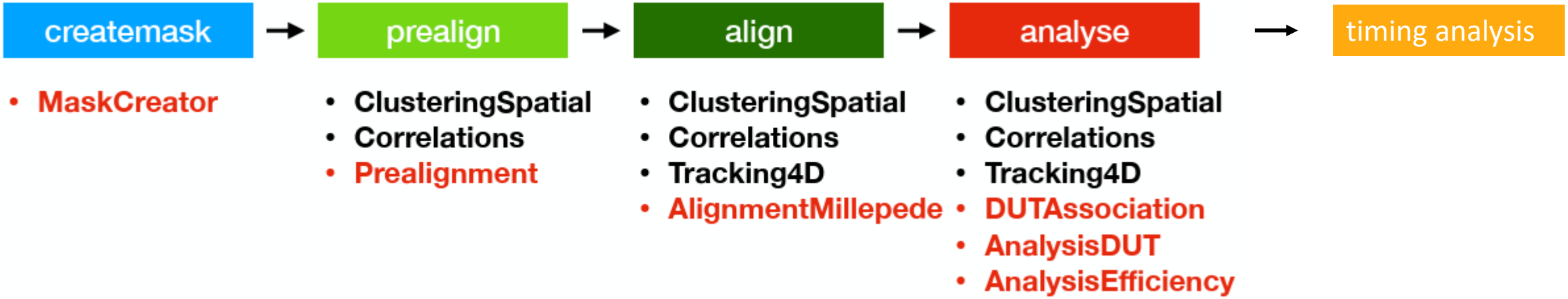


HV (bias)	nDataset	Tot Ev
4.8V	21	210k
7.2V	23	230k
10.8V	36	360k
14.4V	14	140k
18V	7	70k

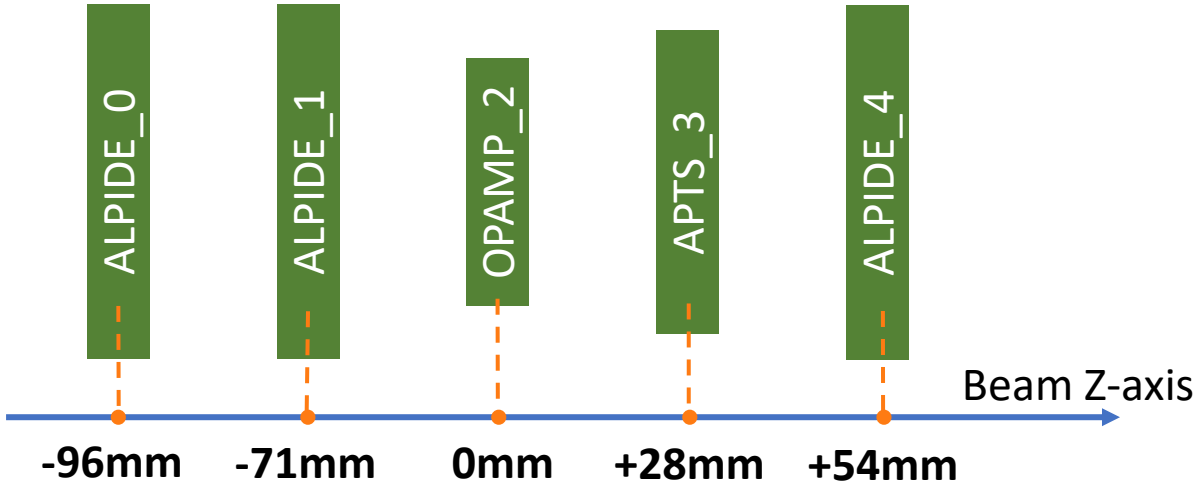


OPAMP Data Analysis goals and workflow

- Pre-Analysis (Data Quality Assurance)
- K_α database for analog clusterization
- Corryvreckan and timing analysis



Setup, Dataset and Geometry



The following work has been performed using Corryvreckan Analysis for:

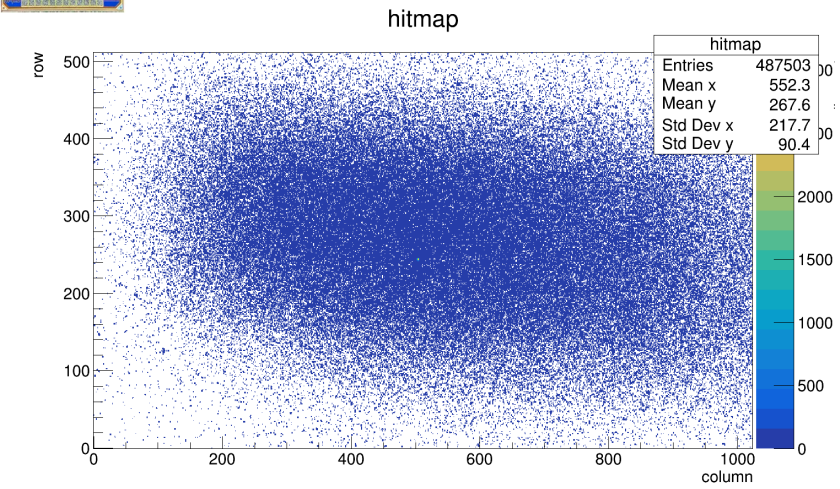
runID	HV	nTrg
401142723	4.8V	10000

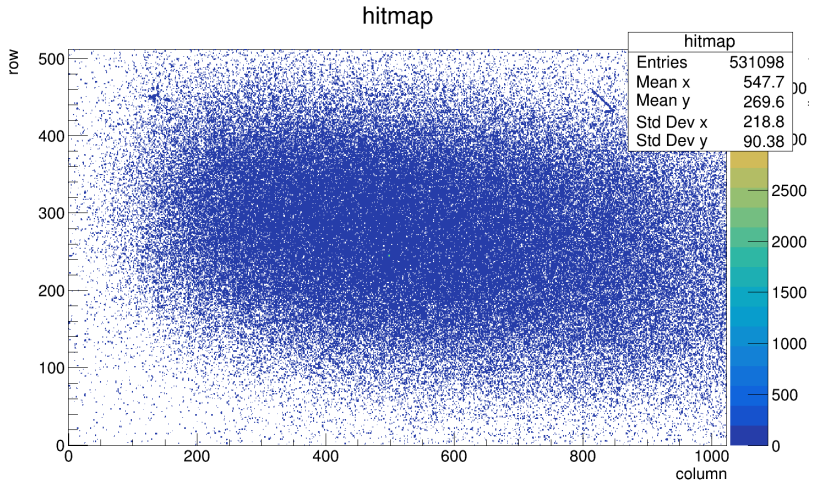
home > angelo > TB_Analysis > its-corryvreckan-tools > geometry > 2024-09_SPS_1REF-APTSOA-APTSSF-2REF.conf

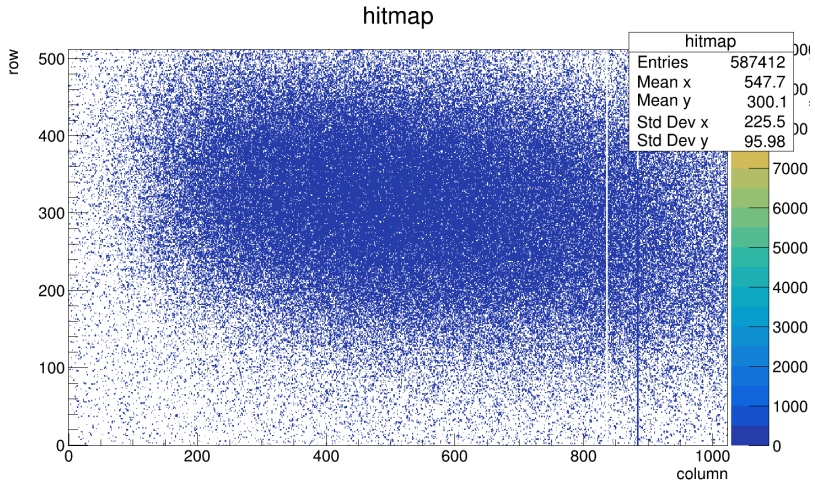
```
[ALPIDE_0]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,-96mm   # ori : 0um,0um,-96mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
roi = [[541,273],[541,213],[481,213],[481,273]]

# roi = [[435,290],[435,310],[460,310],[460,290]] #TODO change this?

[ALPIDE_1]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,-71mm   # ori: 0um,0um,-71mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
role = "reference"
roi = [[521,273],[521,213],[461,213],[461,273]]


[OPAMP_2]
type = "OPAMP"
role = "DUT"
position = 0mm,0mm,0mm
number_of_pixels = 4,4
pixel_pitch = 10.0um, 10.0um
spatial_resolution = 2.9um, 2.9um  # let's start from the binary resolution of the pixel
time_resolution = 10ns
material_budget = 0.0005  # plus the glue (pretty much unknown)
coordinates = "cartesian"
# calibration_file = "../calibration/OPAMP/fit_parameters.json" # TODO: update with the correct file from TORINO
calibration_file = "../calibration/OPAMP/fit_parameters_mio.json" # TODO: update with the correct file mio
orientation = 0deg,180deg,90deg  # ori : 0deg,180deg,90deg
orientation_mode = xyz

[APTS_3]
type = "APTS"
position = 0mm,0mm,28mm
number_of_pixels = 4,4
pixel_pitch = 15.0um, 15.0um
spatial_resolution = 4.3um, 4.3um  # let's start from the binary resolution of the pixel
time_resolution = 250ns
material_budget =  0.0005 #only the silicon without the glue
coordinates = "cartesian"
orientation = 0deg,0deg,270deg
orientation_mode = xyz
role = "DUT"

[ALPIDE_4]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,54mm   # ori 0um,0um,54mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
roi = [[533,311],[533,251],[473,251],[473,311]]
```

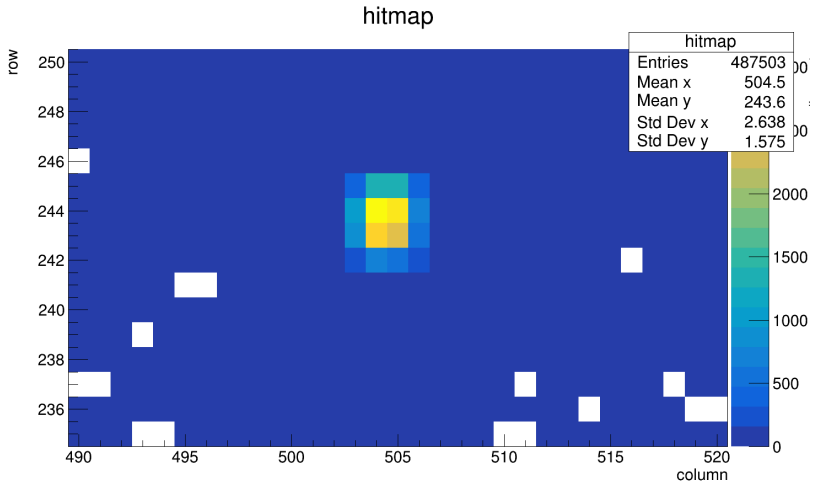
00_masking

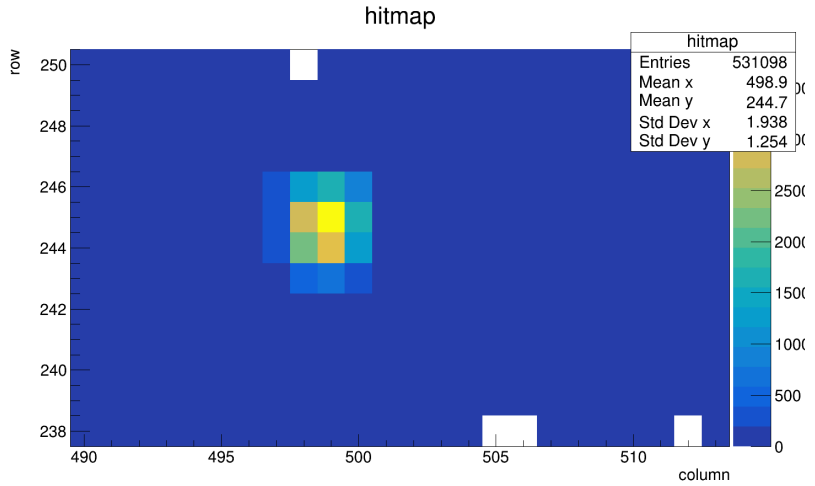
Pre-Analysis

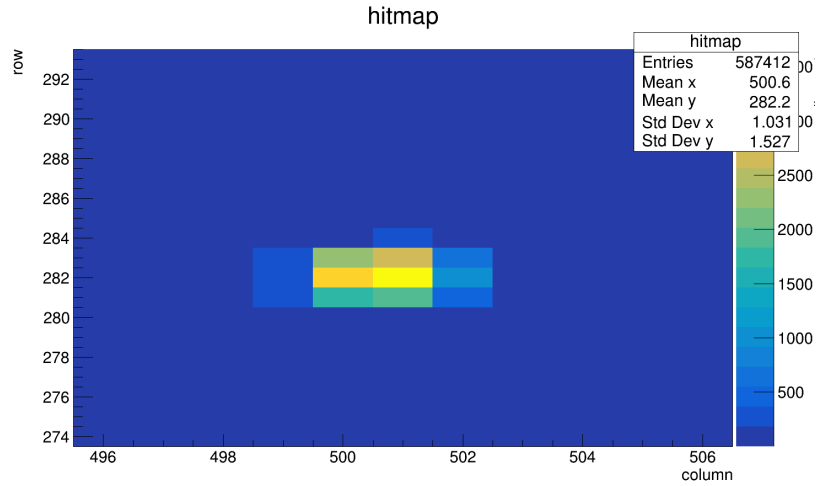












2024-09_SPS_1REF-APTSOA-APTSSF-2REF.conf

```
[ALPIDE_0]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,-96mm   # ori : 0um,0um,-96mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
roi = [[541,273],[541,213],[481,213],[481,273]]
```

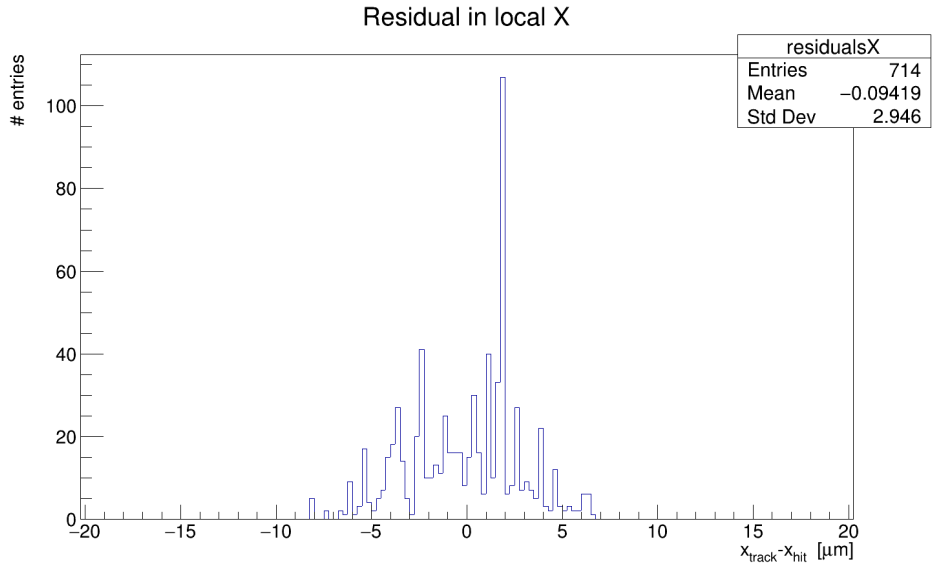
```
[ALPIDE_1]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,-71mm   # ori: 0um,0um,-71mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
role = "reference"
roi = [[521,273],[521,213],[461,213],[461,273]]
```

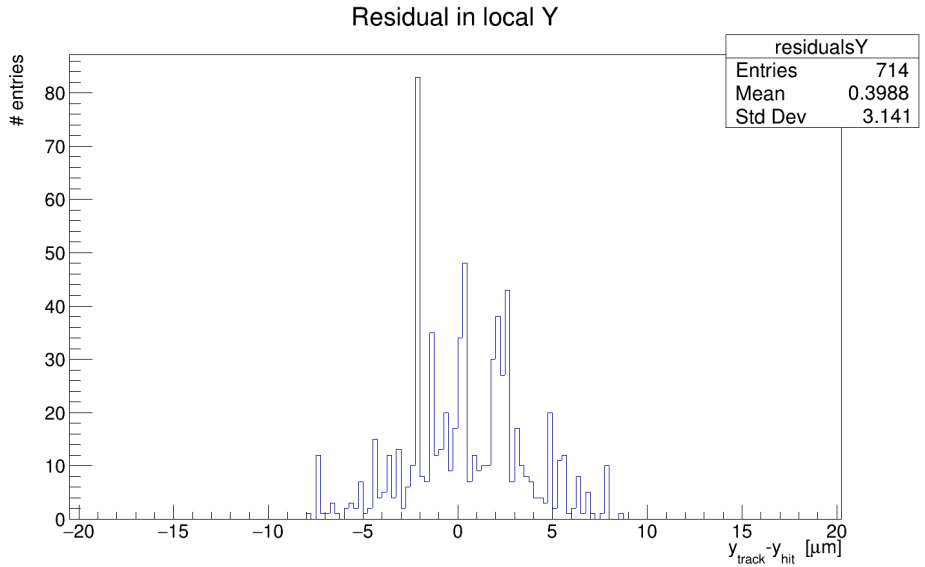
```
[ALPIDE_4]
type = "ALPIDE"
number_of_pixels = 1024,512
position = 0um,0um,54mm   # ori 0um,0um,54mm
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
roi = [[533,311],[533,251],[473,251],[473,311]]
```

No fired pixels in the ROI

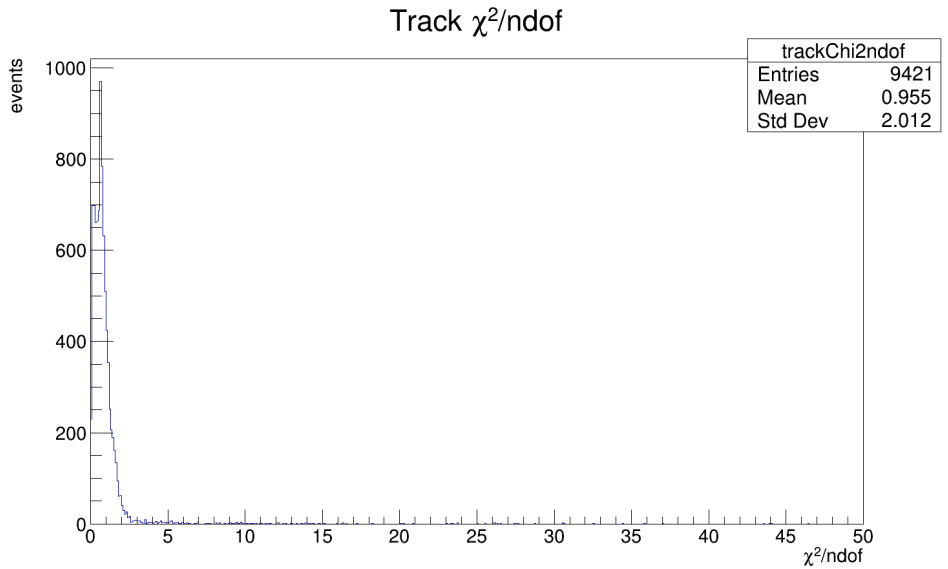
09_analyse : LocalResidual X and Y

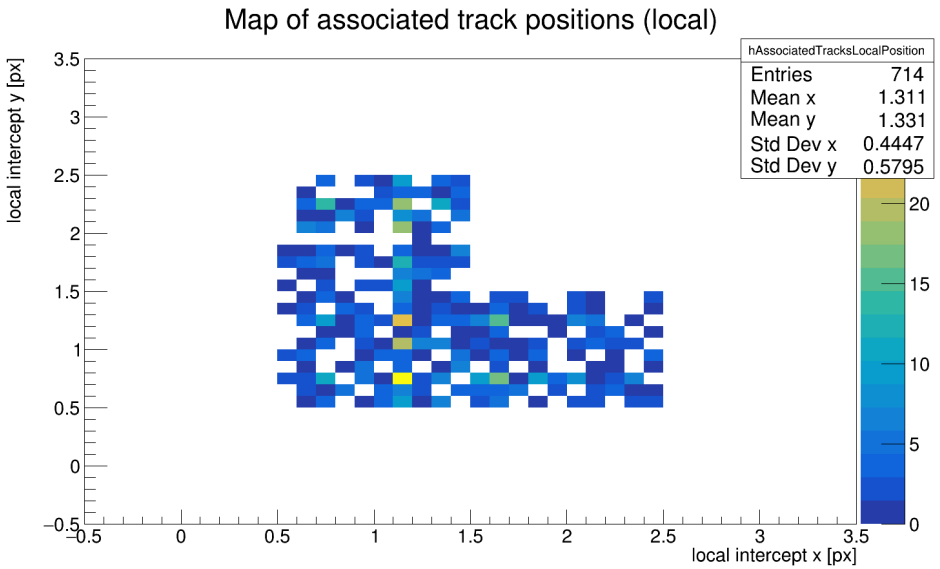
Pre-Analysis





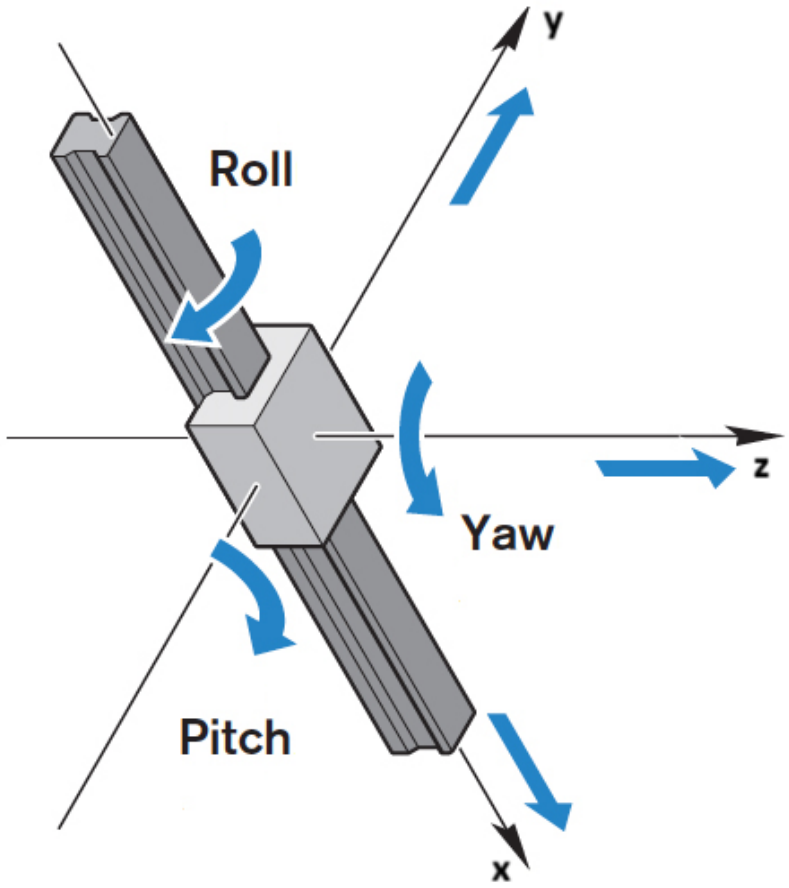
OPAMP_4 Standard deviation ≈ 3um





Orientation parameter investigation - Part 1

Goal: study how the initial parameters influeces the alignment algorithm ([AlignmentMillepede])

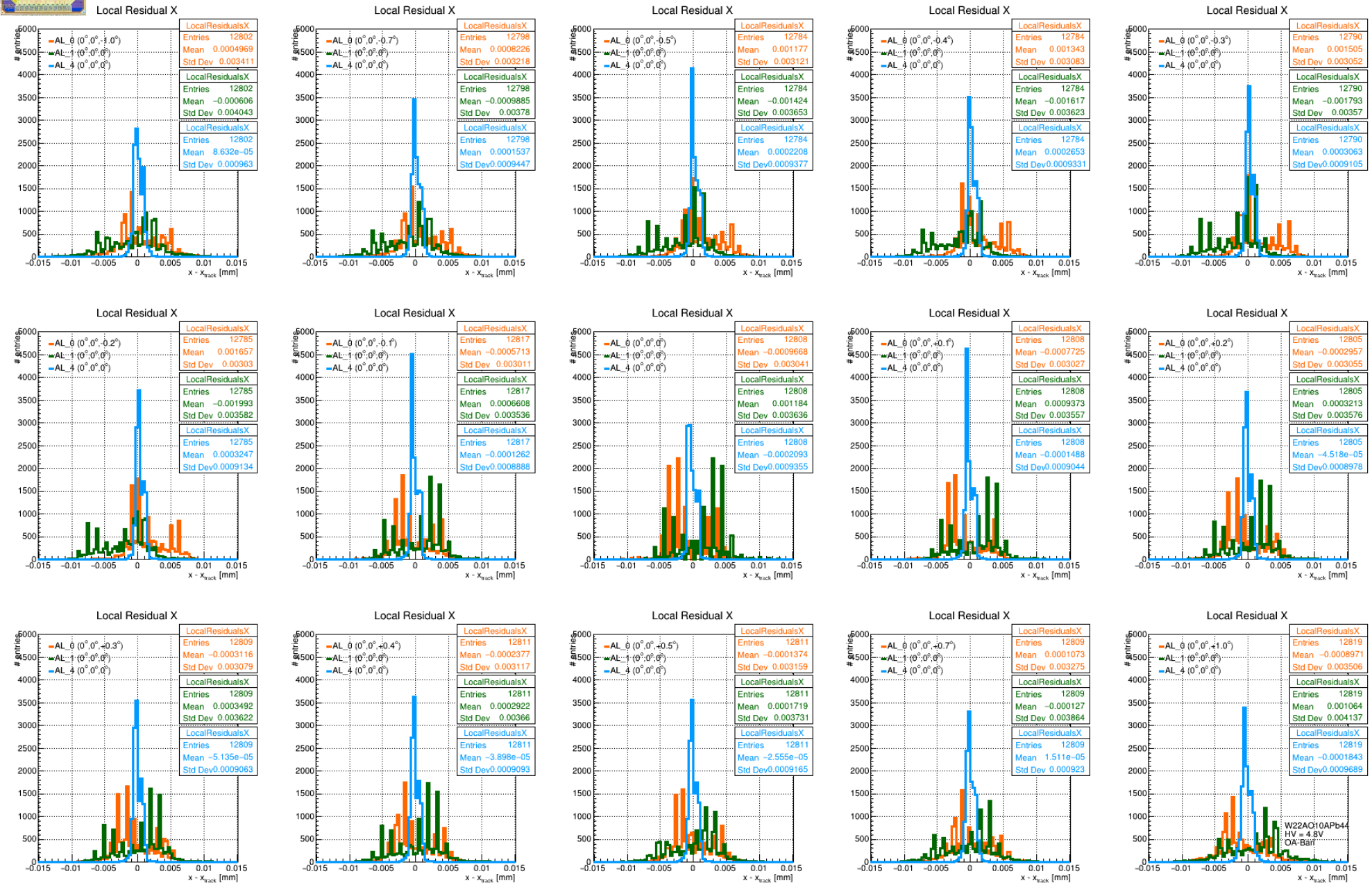


[ALPIDE_0] (deg)		
Roll	Pitch	Yaw
0	0	-1
0	0	-0.7
0	0	-0.5
0	0	-0.4
0	0	-0.3
0	0	-0.2
0	0	-0.1
0	0	0
0	0	+0.1
0	0	+0.2
0	0	+0.3
0	0	+0.4
0	0	+0.5
0	0	+0.7
0	0	+1

```
[Tracking4D]
track_model           = "gbl"  # straightline , gbl
time_cut_abs          = 1e99
spatial_cut_abs       = 1mm,1mm
min_hits_on_track     = 3
exclude_dut           = true
require_detectors     = "ALPIDE_0", "ALPIDE_1", "ALPIDE_4" # ori
# require_detectors     = "ALPIDE_1", "ALPIDE_4"
momentum              = 120GeV
unique_cluster_usage = true  # only use a cluster for one track.
chi2/ndof is kept. Default to falsed
reject_by_roi         = true
max_plot_chi2         = 100    # default to 50
```

```
[AlignmentMillepede]
residual_cut          = 0.1mm
residual_cut_init     = 1mm
iterations            = 3 # 3
dofs                  = true, true, false, false, false, true # ori ( T
# dofs                  = true, true, false, true, true, true
sigmas                = 50um, 50um, 50um, 0.005rad, 0.005rad, 0.005rad
exclude_dut           = true
number_of_stddev      = 0
convergence           = 10e-5
```

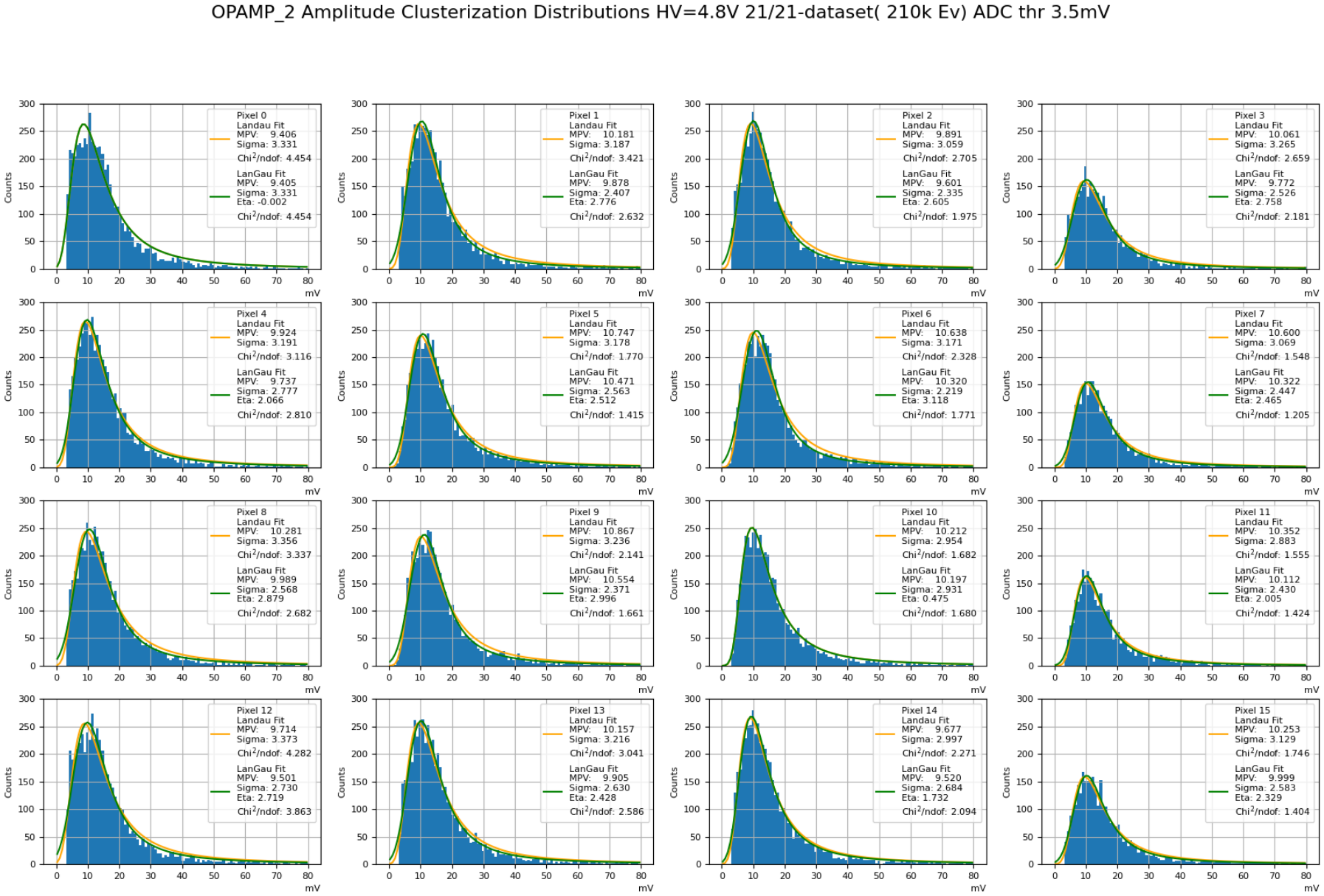
02 align telescope: ResidualsX



- Quite similar results in all configurations for ALPIDE_0 and ALPIDE_1 distribution.
- Slight influences of the angular rotation on the ALPIDE_4 distribution.
- Broader distributions for Yaw=+/- 1°

Part 1 – OPAMP_2 Seed Amplitude Distribution Fit

K_α database



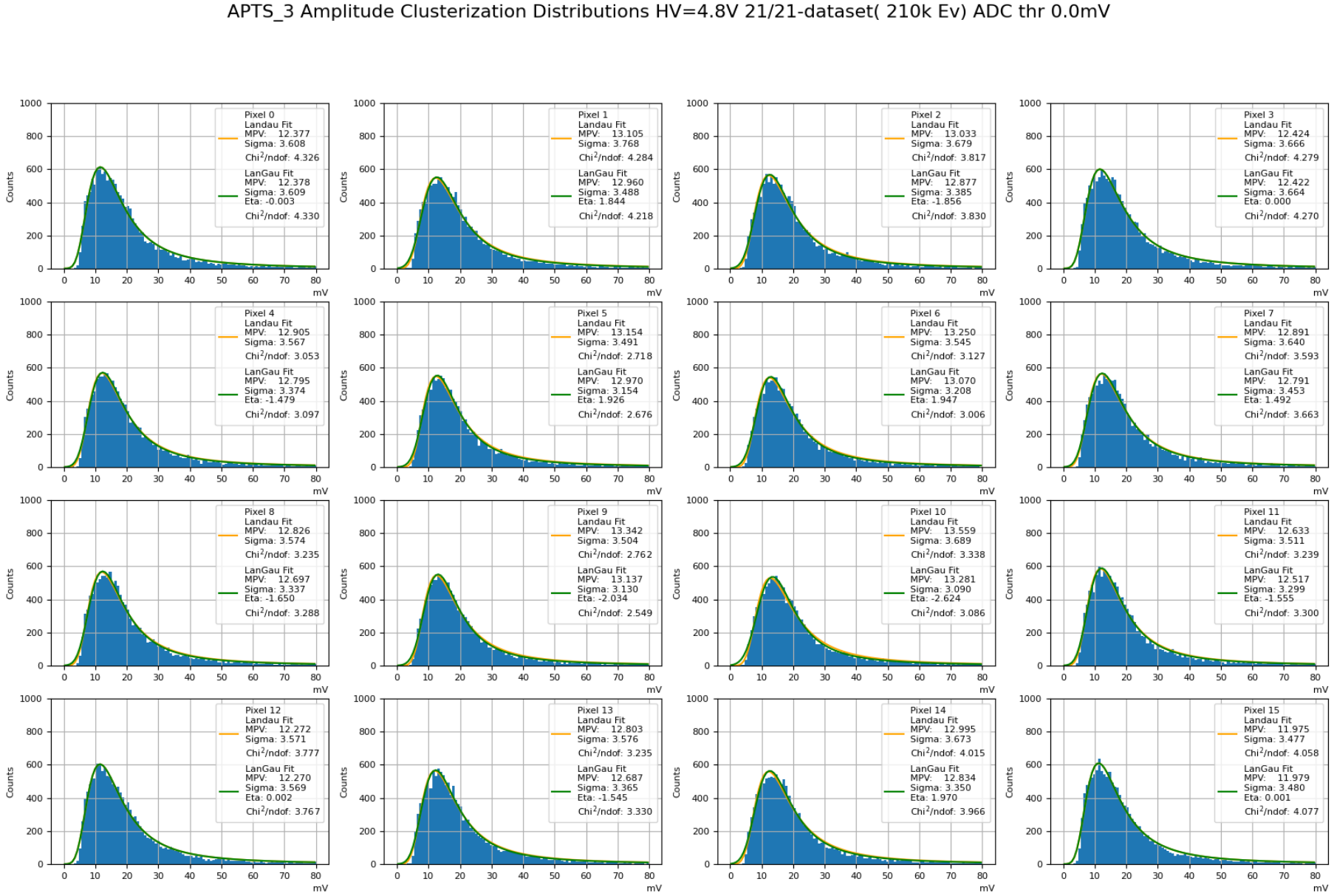
Goal:
Try to fit the distribution with a Landau and LanGaus function in order to calculate the MPV.

ADC threshold value @ 3.5mV:

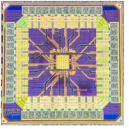
- Good compromise between pedestal cut and optimized fit.

Part 2 – APTS_3 Amplitude Seed Distribution Fit

K_α database



Goal:
Try to fit the distribution with a Landau and LanGaus function in order to calculate the MPV.



Part 3 – Pixel to Pixel Equalization

K_α database

Goal: Equalize the pixels w.r.t. one of them in order to use the same calibration conversion factor

Pixel 5 has been used as a reference

px	MPV	MPV_err	sigma	sigma_err	eta	eta_err	chi2_ndof	ndof		ratio	MPV_equalized [mV]	En_MPV [keV]	En_55Fe_ext [mV]	m_cal_ext [mV/keV]
0	9,405	0,23	3,331	0,123	-0,002	7,2	4,454	99		1,113	10,471	1,591	43,219	7,325
1	9,878	0,105	2,407	0,136	2,776	0,245	2,632	99		1,060	10,471	1,591	41,149	6,974
2	9,601	0,086	2,335	0,11	2,605	0,202	1,975	99		1,091	10,471	1,591	42,337	7,176
3	9,772	0,129	2,526	0,164	2,758	0,305	2,181	99		1,072	10,471	1,591	41,596	7,050
4	9,737	0,113	2,777	0,126	2,066	0,287	2,81	99		1,075	10,471	1,591	41,745	7,075
5	**10,471**	**0,085**	**2,563**	**0,104**	**2,512**	**0,202**	**1,415**	**99**		1,000	**10,471**	1,591	**38,819**	6,579
6	**10,32**	**0,091**	**2,219**	**0,127**	**3,118**	**0,21**	**1,771**	**99**		1,015	10,471	1,591	39,387	6,676
7	10,322	0,092	2,447	0,113	2,465	0,217	1,205	99		1,014	10,471	1,591	39,379	6,674
8	9,989	0,119	2,568	0,152	2,879	0,279	2,682	99		1,048	10,471	1,591	40,692	6,897
9	**10,554**	**0,095**	**2,371**	**0,127**	**2,996**	**0,22**	**1,661**	**99**		0,992	10,471	1,591	38,514	6,528
10	**10,197**	**0,094**	**2,931**	**0,086**	**0,475**	**0,686**	**1,68**	**99**		1,027	10,471	1,591	39,862	6,756
11	10,112	0,1	2,43	0,115	2,005	0,245	1,424	99		1,036	10,471	1,591	40,197	6,813
12	9,501	0,167	2,73	0,205	2,719	0,402	3,863	99		1,102	10,471	1,591	42,782	7,251
13	9,905	0,116	2,63	0,138	2,428	0,278	2,586	99		1,057	10,471	1,591	41,037	6,955
14	9,52	0,09	2,684	0,097	1,732	0,24	2,094	99		1,100	10,471	1,591	42,697	7,237
15	9,999	0,111	2,583	0,132	2,329	0,268	1,404	99		1,047	10,471	1,591	40,651	6,890

px	mean_pk1	rms_pk1		m_cal [mV/keV]
5	**38,819**	**0,738**		**6,579**
6	39,711	0,719		6,731
9	39,552	0,52		6,704
10	38,972	0,634		6,605

	En_pk1 [keV]
	5,9

Used in the Corryvreckan calibration file

Thanks