June Beamtime Analysis

Hardwaremeeting 25th July 2024

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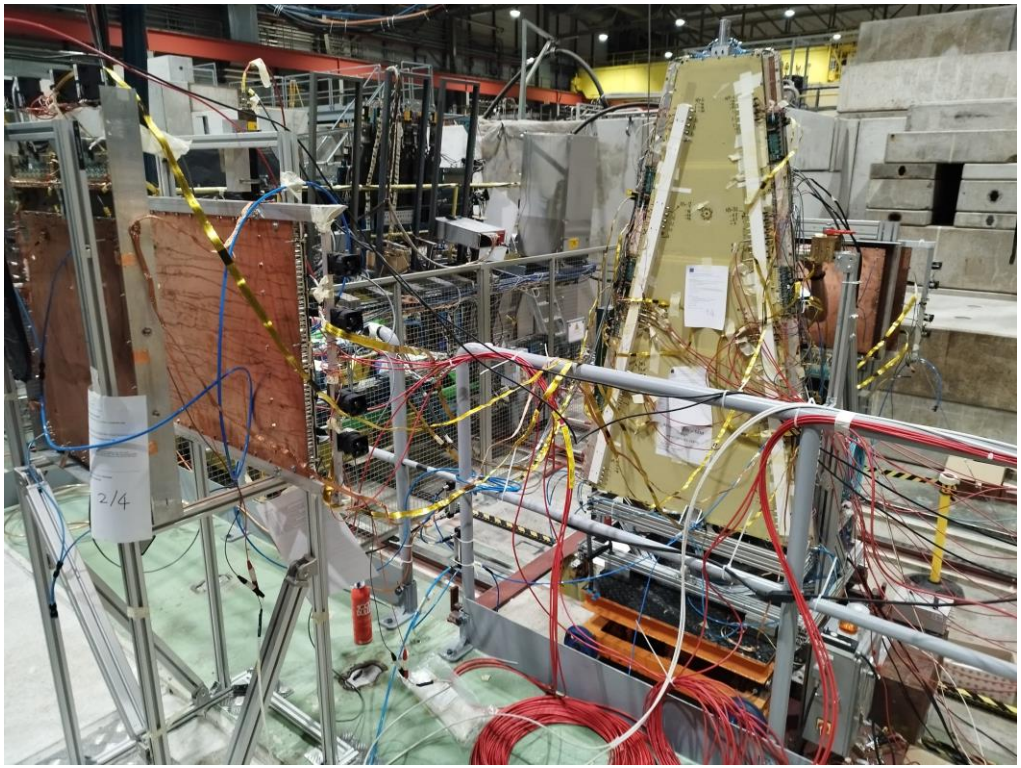
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

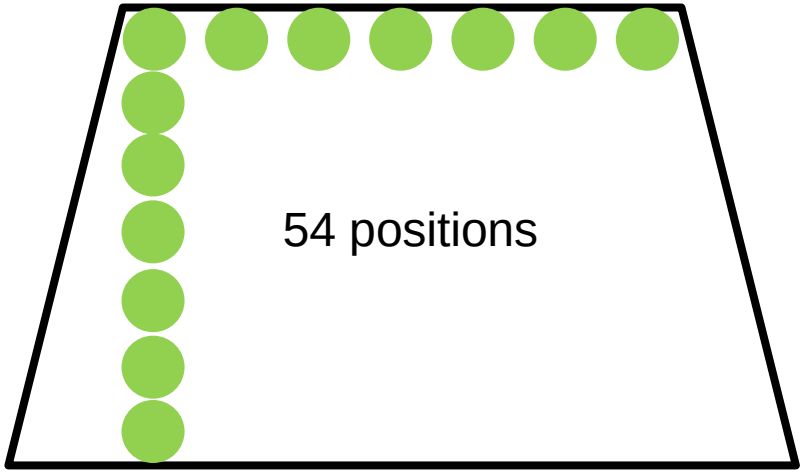
Setup



- SM1 M40 (irradiated in GIF++ for 3 years)
- 4 tracking MM (3 prec, 1 non-prec.)
- 2 scintillators for coincidence trigger
- 120 GeV pion/proton beam (d=10cm)

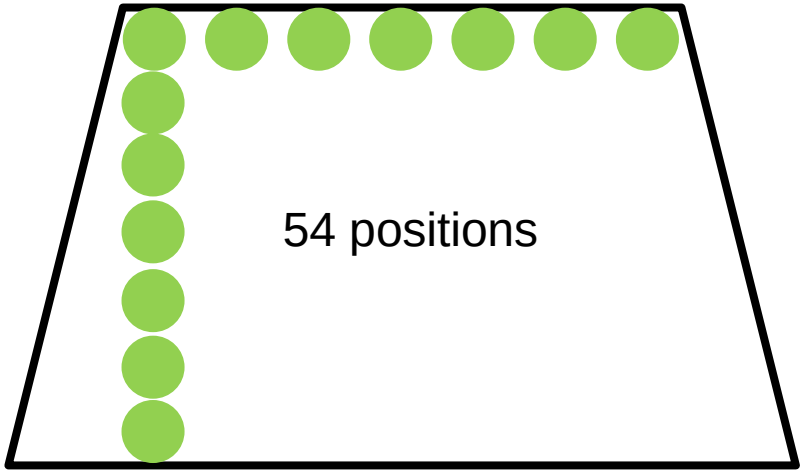
Measurement Schedule

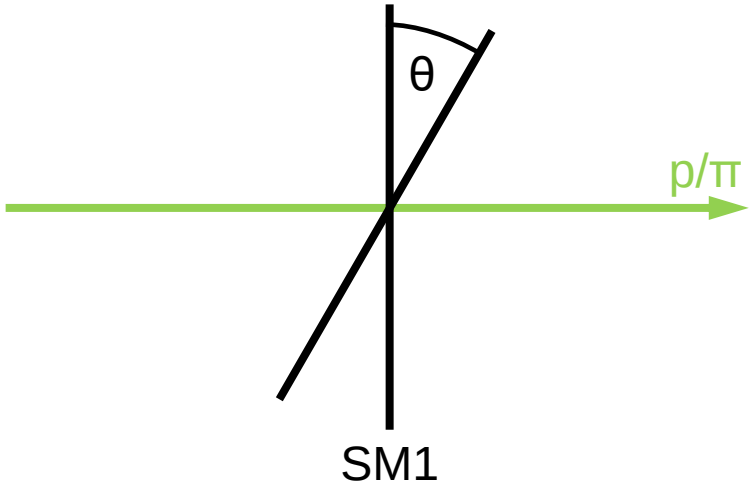
- Surface Scan (54 positions) of PCB3 at 5 voltages (490 V, 500 V, 510 V, 520 V, 530 V) (NB: ATLAS runs at 505V 100 m below surface ~ 490 V) → Covered by Valerio few weeks ago



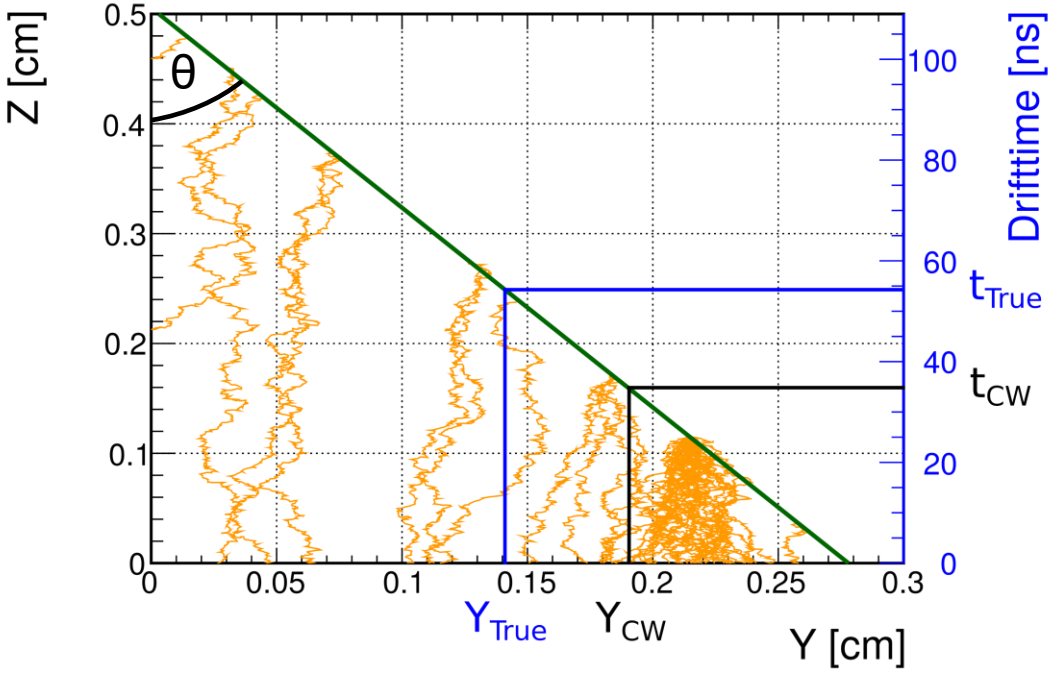
Measurement Schedule

- Surface Scan (54 positions) of PCB3 at 5 voltages (490 V, 500 V, 510 V, 520 V, 530 V) (NB: ATLAS runs at 505 V 100 m below surface ~ 490 V) → Covered by Valerio few weeks ago
- Performance investigations under different angles of inclination:
  - → Perpendicular, 10, 15, 20, 24, 29 deg
  - → Voltages: 490 V, 500 V, 510 V, 520 V, 530 V
  - → Focus on comparison of Centroid and Clustertime corrected centroid reconstruction method





Reminder: Clustertime Correction Method



Centroid position $$Y_{CW} = \frac{\sum_i q_i \times y_i}{\sum_i q_i}$$

Clustertime $$t_{CW} = \frac{\sum_i q_i \times t_i}{\sum_i q_i}$$

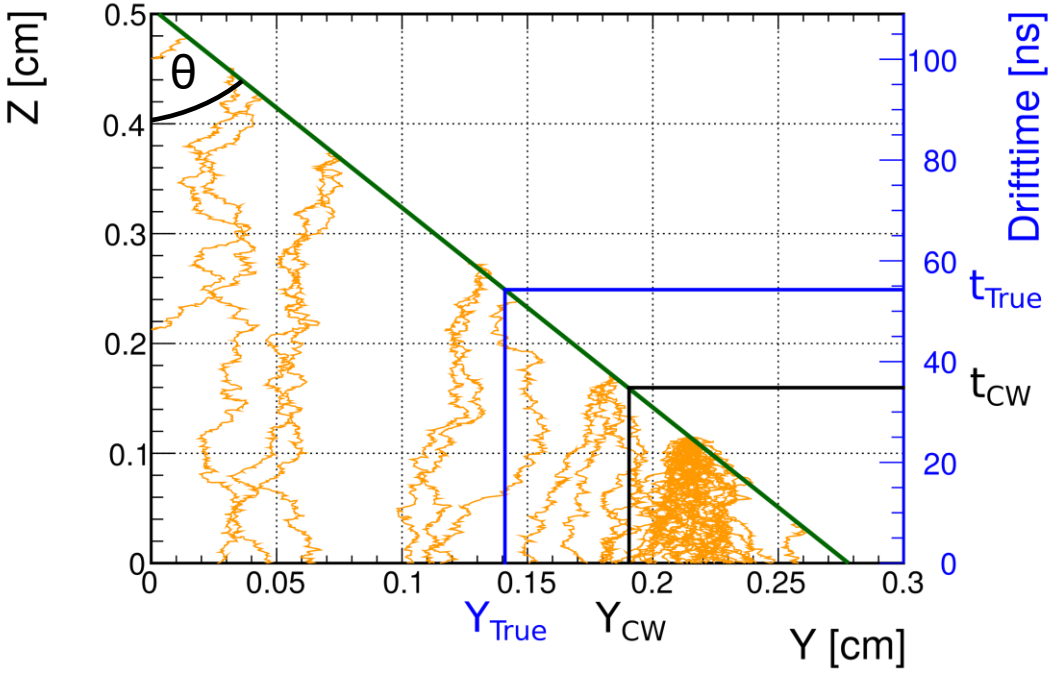
Theoretical correction principle:

$$\Delta Y = Y_{True} - Y_{CW} = \Delta t \times v_{Drift} \times \tan(\theta)$$

with θ being the angle of inclination

Method developed in PHD Flierl (LMU)

Reminder: Clustertime Correction Method



Centroid position $Y_{CW} = \frac{\sum_i q_i \times y_i}{\sum_i q_i}$

Clustertime $t_{CW} = \frac{\sum_i q_i \times t_i}{\sum_i q_i}$

Theoretical correction principle:

$$\Delta Y = Y_{True} - Y_{CW} = \Delta t \times v_{Drift} \times \tan(\theta)$$

with θ being the angle of inclination

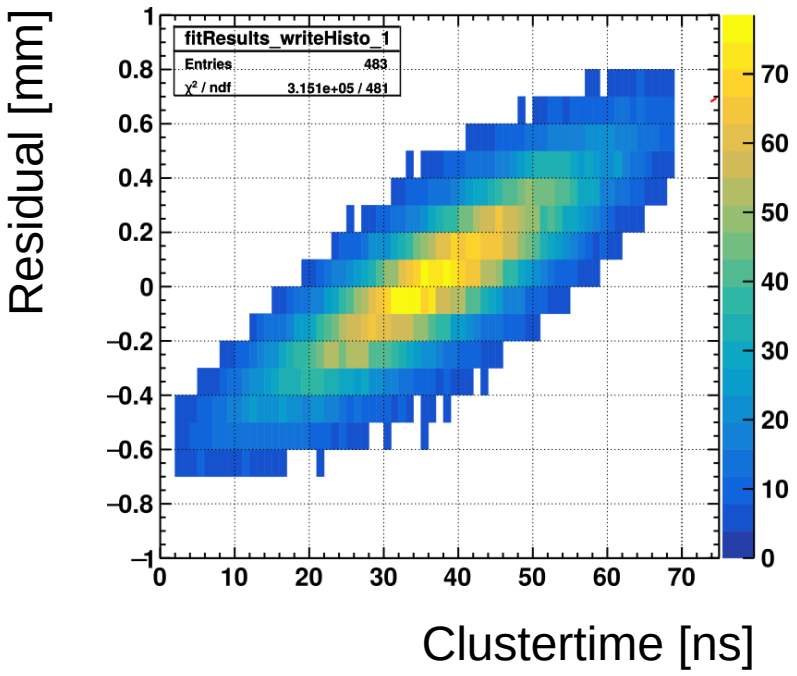
However: Analytic correction suffers from not yet resolved effects leading to wrong correction factors!

Method developed in PHD Flierl (LMU)

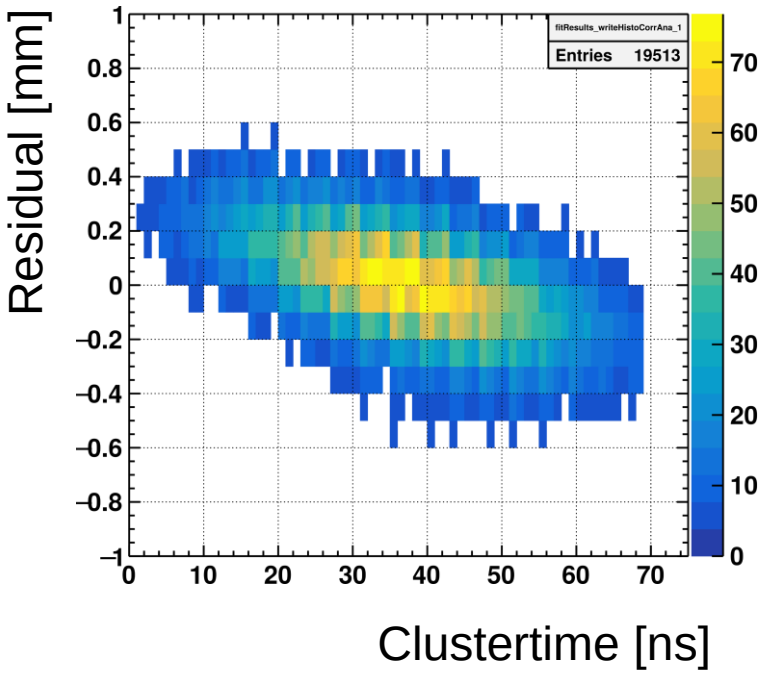
Analytic correction

$t_{True} = 37.19\,ns\,, \theta = 29°, v_{Drift} = 0.046\,mm/ns$

Uncorrected



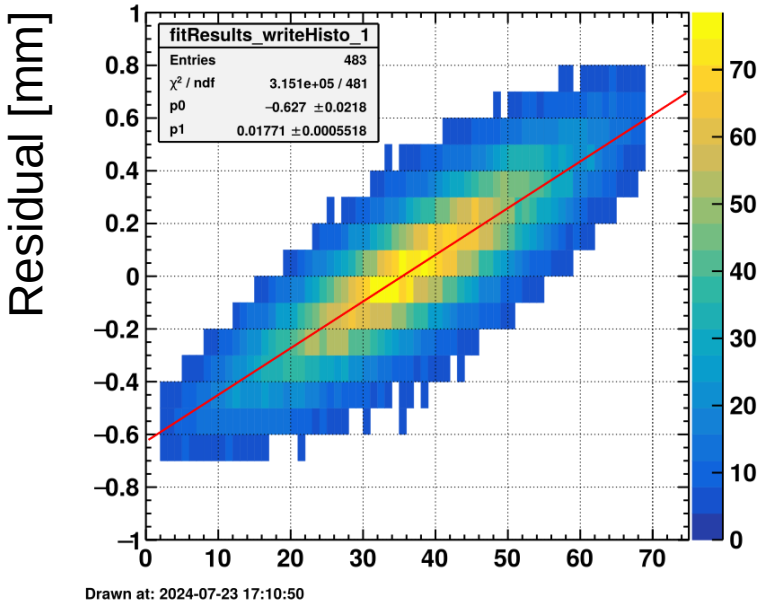
Analytically “Corrected”



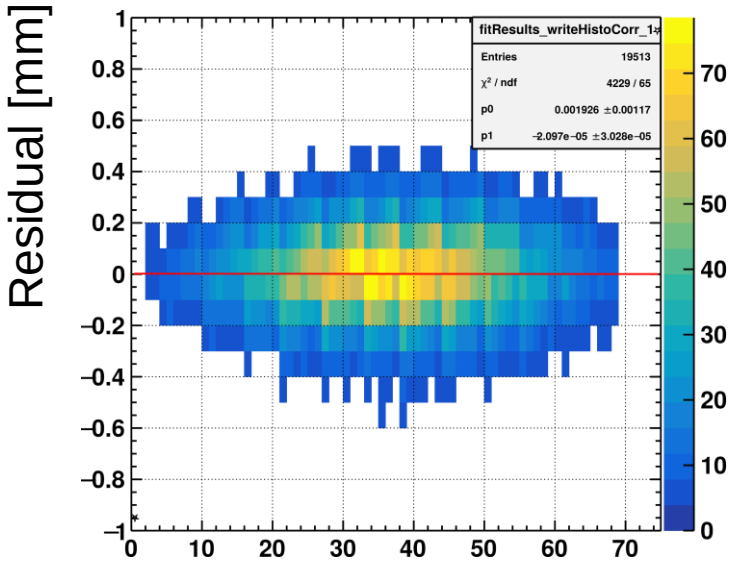
Improvement, but overcorrection by doing it purely analytical!

The easy, brute-force, better way

Uncorrected



Corrected

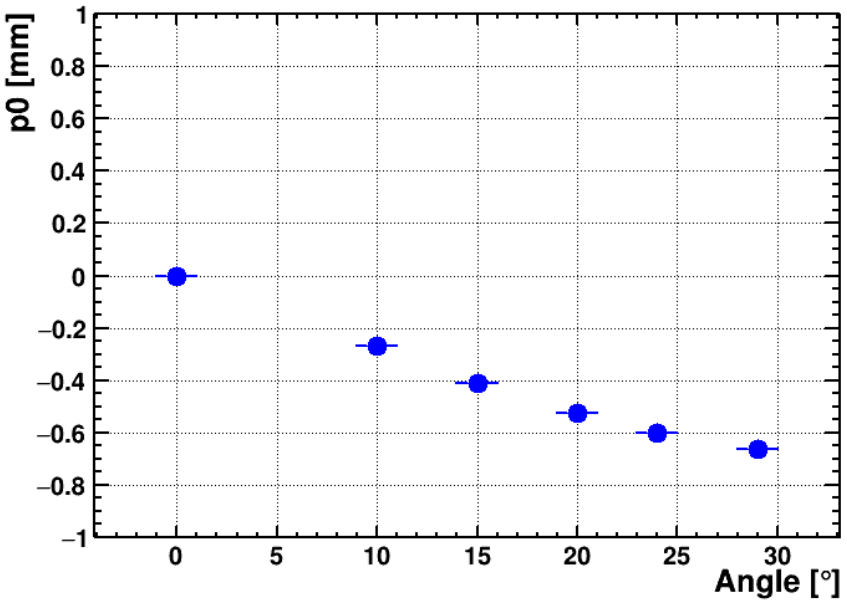


Pol1 Fit to correct for the correlation (just as correcting for detector misalignments!)

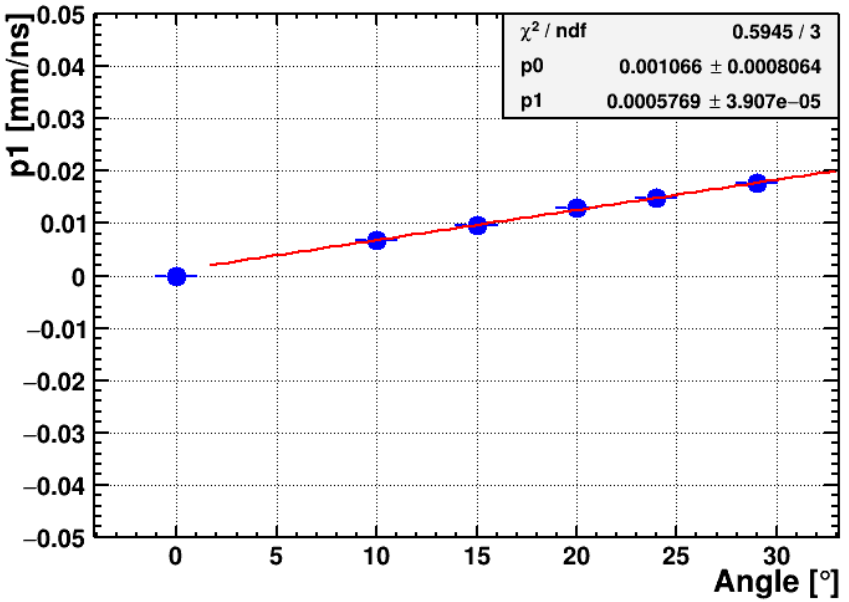
Correction parameters

Linear fit: $p_0 + t \times p_1$

p_0



p_1

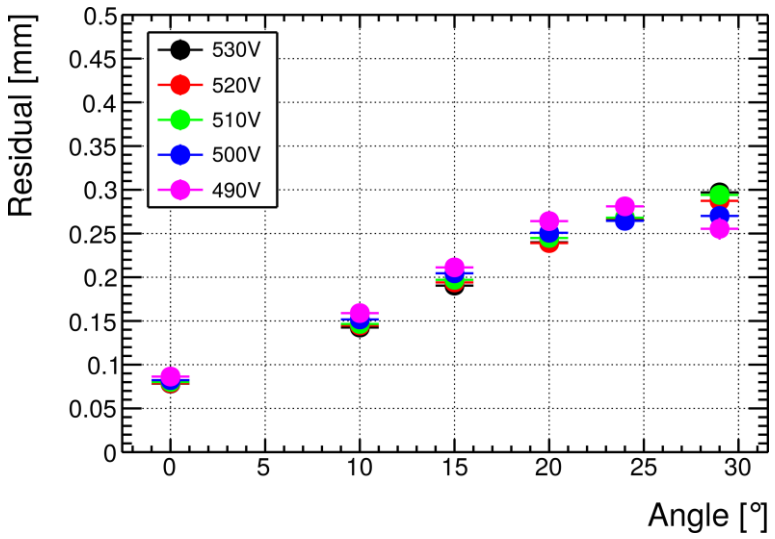


Correlation parameter p_1 scales linearly with angle → Extrapolatable!
p_0 is only a shift of the residual → easily correctable

Core Residuals

(σ_{core} of double gaussian)

Centroid



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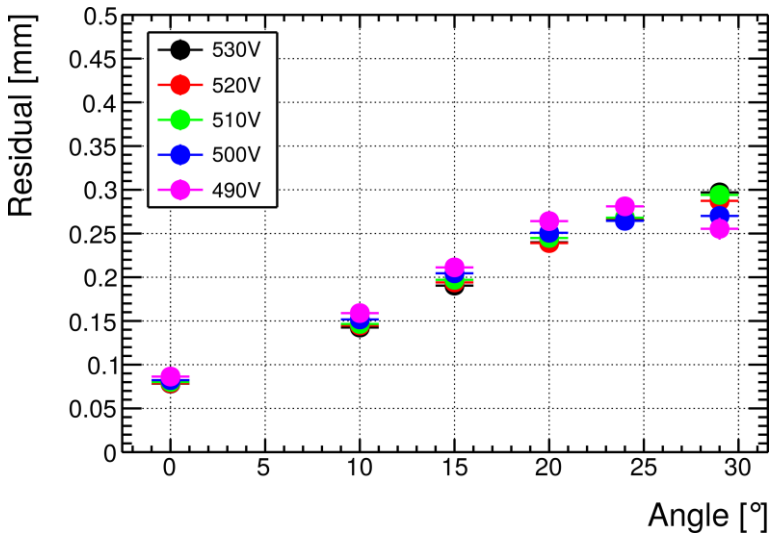
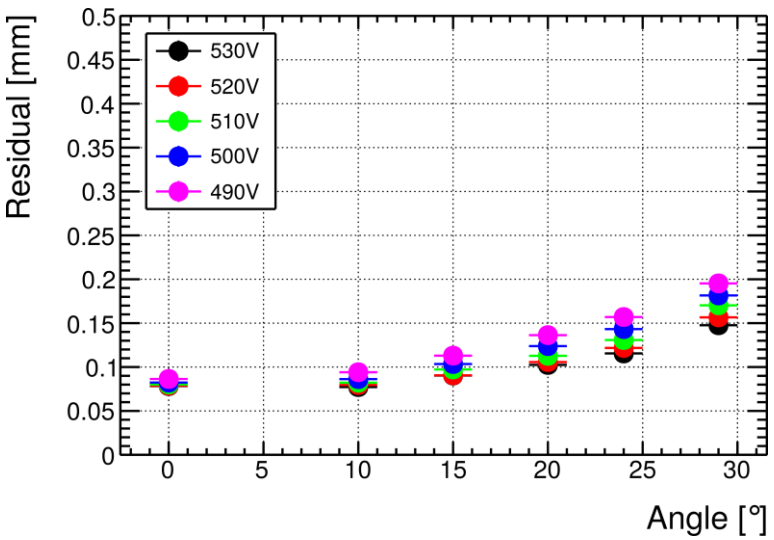


Time Corrected



Better than 200 µm even for 490V at 30 deg!

Summary

Position reconstruction under various angles was investigated:

- Good results <300 µm are obtained using the centroid method with good alignment routine even at 29 deg and 490 V
- Improvement of the resolution using a position reconstruction depending on the Clustertime
- It was shown that the analytical implementation is very error prone and the simpler correction using a pol1 fit should be used

- Resolutions of <200 µm for 490V are achieved (<150 µm for 530 V) at 29 deg of inclination
- Up to 15 deg <100 µm should be possible using this method

Backup: Residual Comparison