

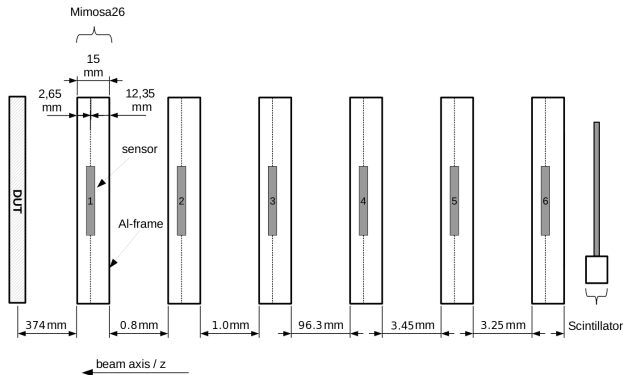
Update on reconstruction of tracks

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Nikhef

September 25, 2017

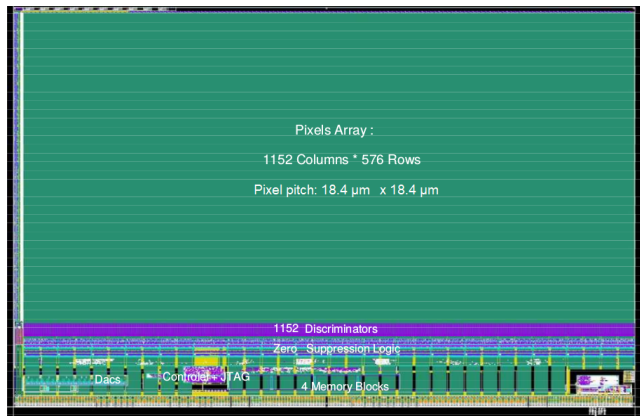
Detector setup



Thesis Pascal Wolf Bonn, 2016

Triggered by a scintillating plane
6 mimosa planes

Mimosa telescope



MIMOSA26 User Manual, 2011

Detector with digital silicon pixels

Rolling shutter readout with 115.2 μs per frame

Matching and selection

- Each telescope frame (115.2 μs) can have a range of triggers
- Try to decode trigger number in timepix using rising edge only
- Save timepix tracks within 400 ns of a trigger

For each frame, attempt to match all events of the timepix with triggers in the range

- Telescope
 - ▶ Require hits in at least 4 planes
- Timepix
 - ▶ Require at least 20 hits

Match if x and y agree within 1.5 mm.

Fit procedure

- Independently align telescope
- Rotate and shift timepix to match telescope frame (beam is parallel to z-axis)
- Do a double simple linear regression fit in the telescope frame
 - ▶ Still to do: introduce errors and weights

Tests from run 351

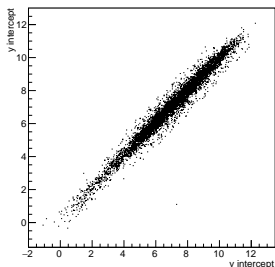
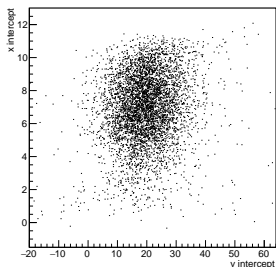
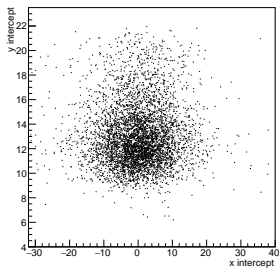
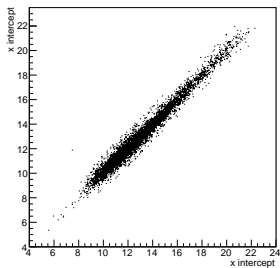
Run 351

length	6s
triggers	7744
V grid	350 V
E drift	280 V/cm
rotation	17 degree
	0 degree
threshold	700e

- 6358 triggers with tracks in telescope and timepix
- 5059 matched tracks
- For the moment, a drift speed of $75\mu\text{m}/\text{ns}$ was *assumed*

Correlation of intercept

intercept is correlated

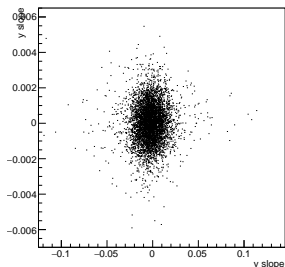
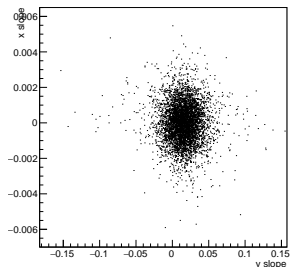
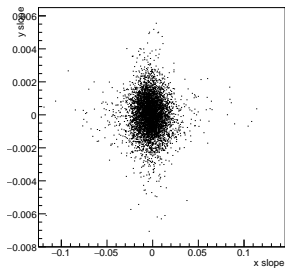
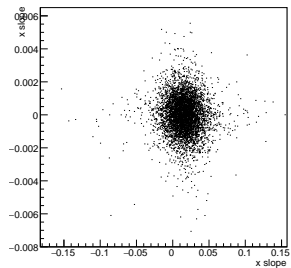


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Beamtest reconstruction

Correlation of slopes

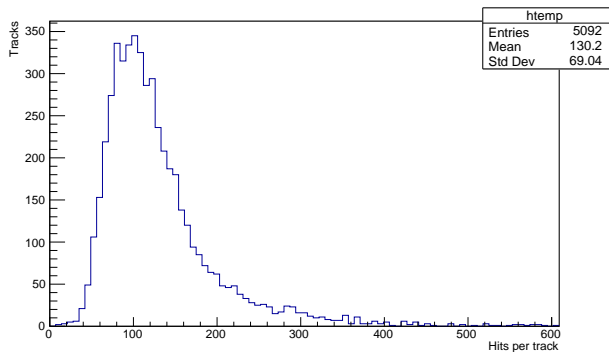
slopes are uncorrelated



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Beamtest reconstruction

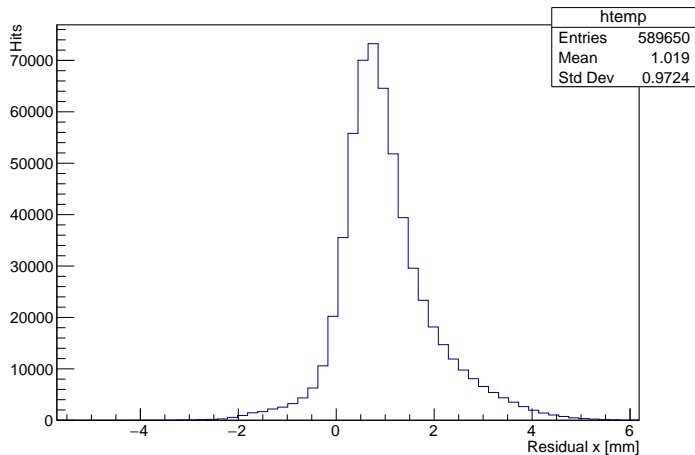
Number of hits per track



Track length is ~ 14.6 mm

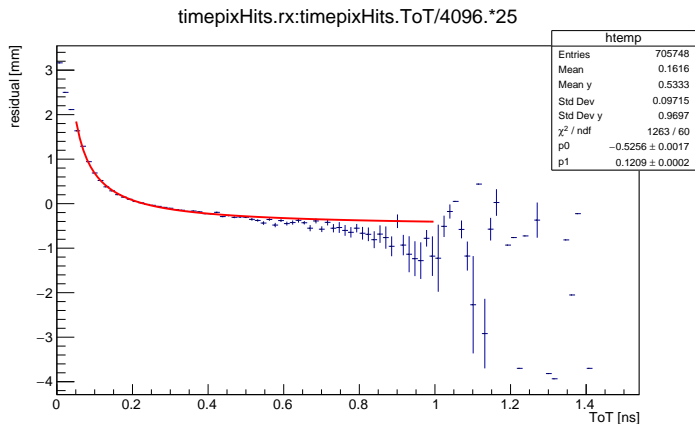
Time walk

x-residuals before correction



Time walk

Correction

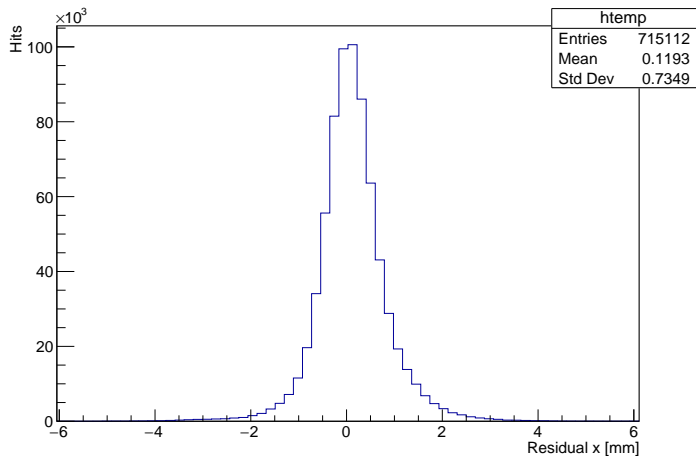


Reject hits with $\text{ToT} < 0.05$

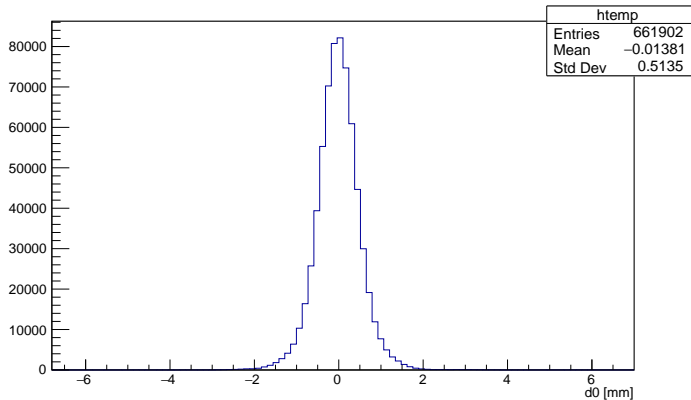
Fit $1/x$ function and subtract this from x-position

Time walk

x-residuals after correction

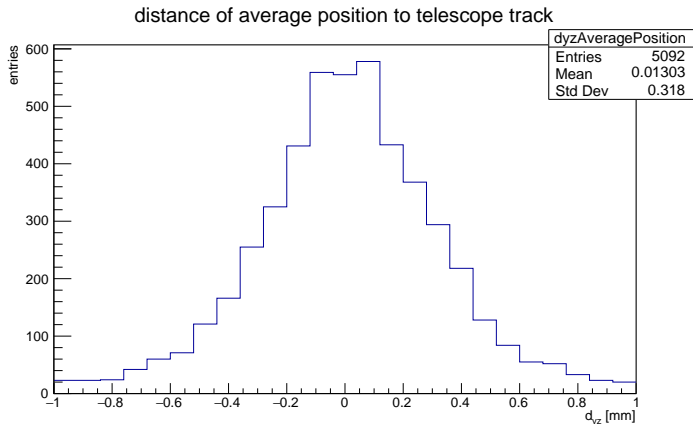


d_0 -residuals per hit



From Gauss fit $\sigma_{d_0} = 0.466$ mm

d_0 -residuals from average hit position in cluster

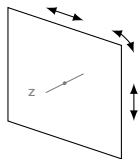


The residual is large. This can indicate a problem in alignment

Conclusion

- Telescope and timepix tracks are matched
- Work on alignment and residual is ongoing

Align telescope planes



Align with 3 degrees of freedom: x, y shifts and rotation around z
Fix z position and assume all detectors perpendicular to the z -axis

Find corrections from residuals

- Find mean of residuals using gauss fit
- Find rotation using histogram of $\Delta\phi = (yr_x - xr_y)/(x^2 + y^2)$, where x, y are the hit coordinates with respect to the average hit position and r is the residual, histogram is weighted by $\sqrt{x^2 + y^2}$

Telescope alignment procedure

- ① Fit through points in plane 2 and 5
shift planes 1,3,4,5,6 in x and y
- ② Fit through points in plane 2 and 5
rotate plane 5 around its average hit position to match plane 2
- ③ Fit through points in plane 2 and 5
rotate all planes around their average hit position
- ④ Fit through points in all planes
check if converged.