General-Broken-Lines in Corryvreckan

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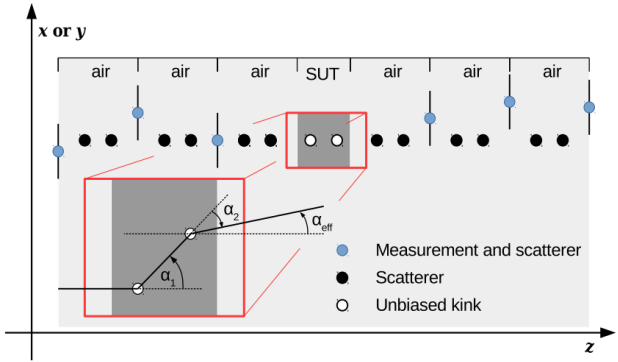
DESY

Jan 2020

GBL IN A NUTSHELL

- Previous fit: straight line $\rightarrow$ ignores scattering
- GBL combines uncertainties due to scattering and spatial resolution
- Assuming thin planes allows to ignore the displacement due to scattering
- Medium within planes can be approximated by two thin scattering layers
- GBL needs local residuals and scatters as input



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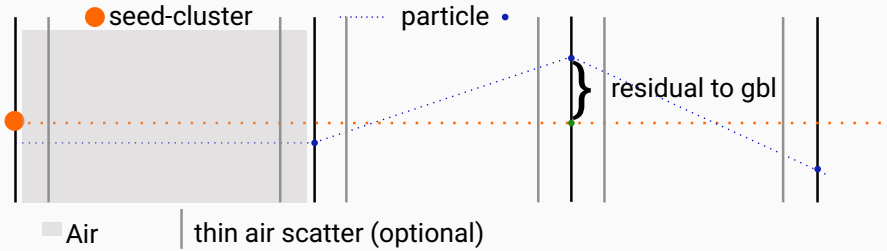
Corryvreckan Implementation I

- First cluster is used as seed
- Residuals are always defined in global plane at z-cluster

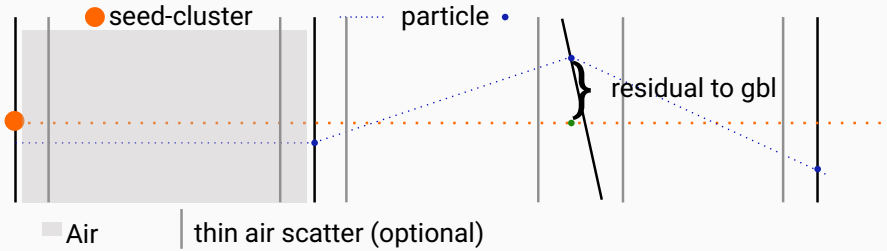
- Volume scatterers are placed at $z_i + \Delta_{z_{i,i+1}} \left(0.5 \pm \sqrt{1/12}\right)$
- This ignores rotations



Corryvreckan Implementation II

- Spatial resolution in global coordinates depends on rotation → ignored.

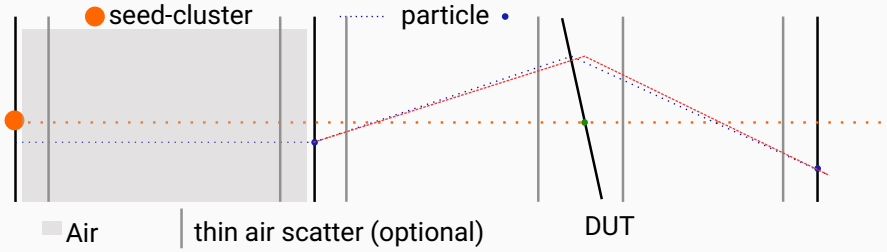
- Volume scatterers are placed at $z_i + \Delta_{z_{i,i+1}} \left(0.5 \pm \sqrt{1/12}\right)$
- Biased planes only a minor effect



Corryvreckan Implementation III

- Spatial resolution in global coordinates depends on rotation → ignored.

- DUT can cause issues for non-vanishing slopes and large rotations
- Cheap workaround: Set DUT as reference while aligning

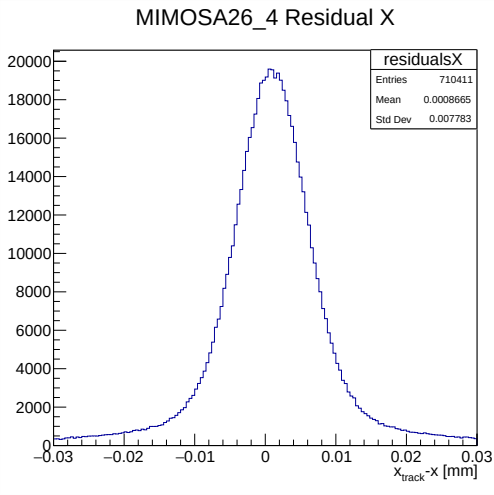


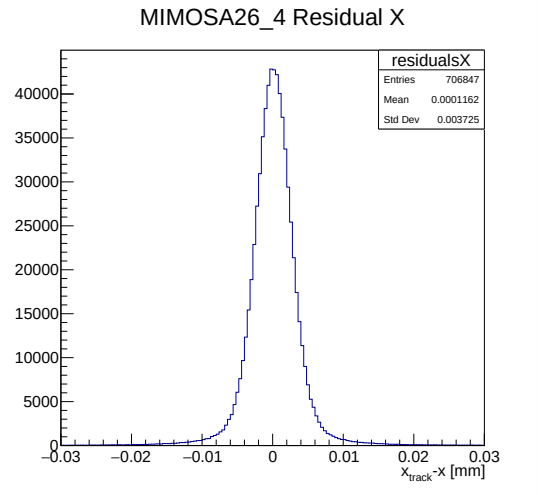
Configuring the Tracking4D Module

- Only supported in Tracking4D
- Configuration parameters:
  - track_model = ”gbl”
  - volume_scattering: Bool to enable volume scattering between the planes
  - volume_scattering_length: radiation length of the volume material
- Volume scattering causes the fit to fail in 0.1%-10% of the cases $\rightarrow$ under investigation

```
[Tracking4D]
momentum = 5.4GeV
track_model = "gbl"
spatial_cut_abs = 600um, 600um
time_cut_abs = 230us
min_hits_on_track = 7
exclude_dut = true
volume_scattering = true
volume_scattering_length = 304.2m
require_detectors = "Timepix3_0"
timestamp_from = "Timepix3_0"
```

Comparing the Resolution I

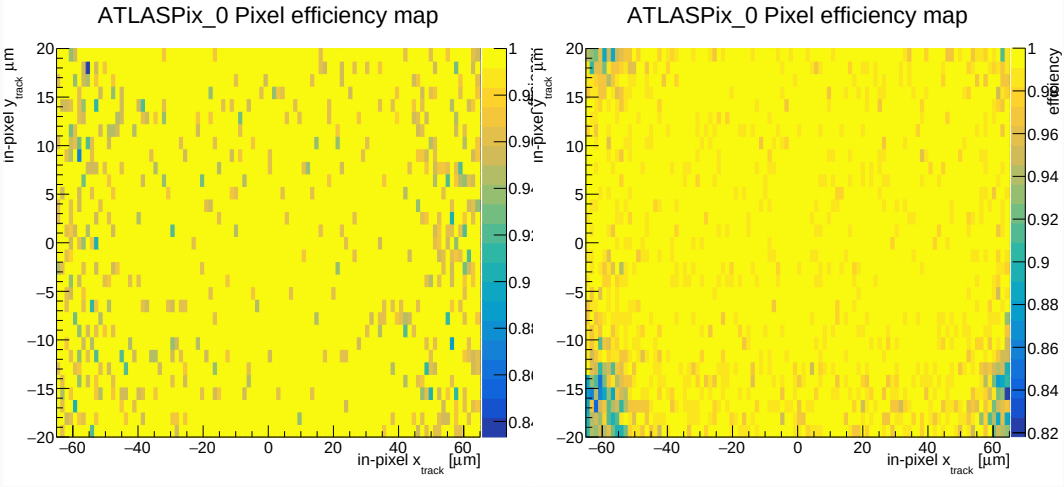




line: 7.7 μm

gbl: 3.7 μm

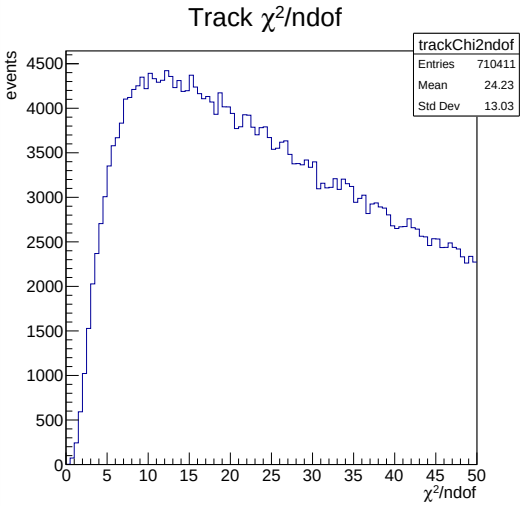
Comparing the Resolution II

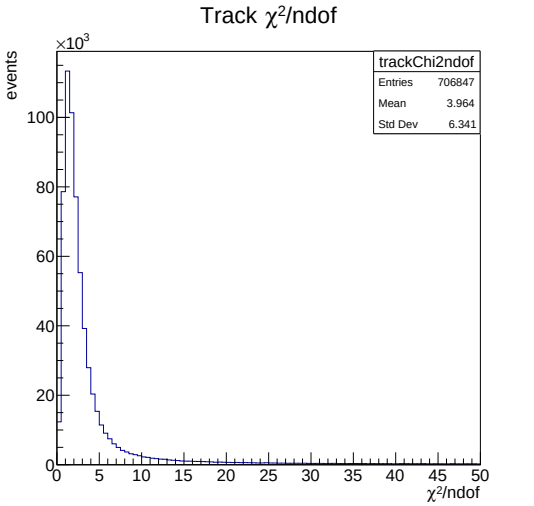


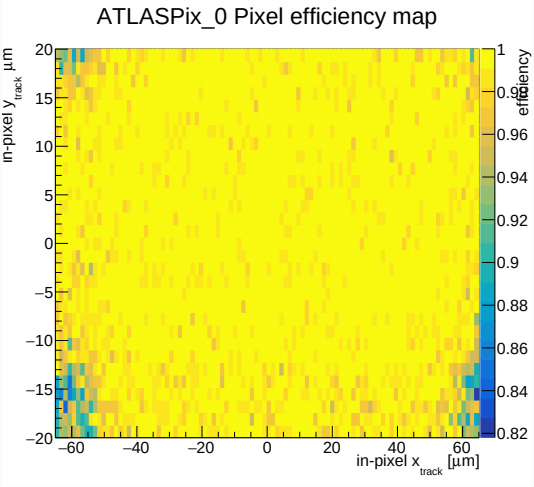
line: 99.35%

gbl: 99.30%

Comparing the Fit





Outlook

- First version is ready
- Solving the issue with the failures with air scattering
- Check if the alignment based on GBL is working
- Update TrackingSpatial
- Taking all rotations into account → inspired by the proteus implementation
- Improving the seed by using a connection line between first and last hit