

EIC Residuals

**EIC LBL meeting updates
23 January 2024**

Beatrice Liang-Gilman

Process

Events used:

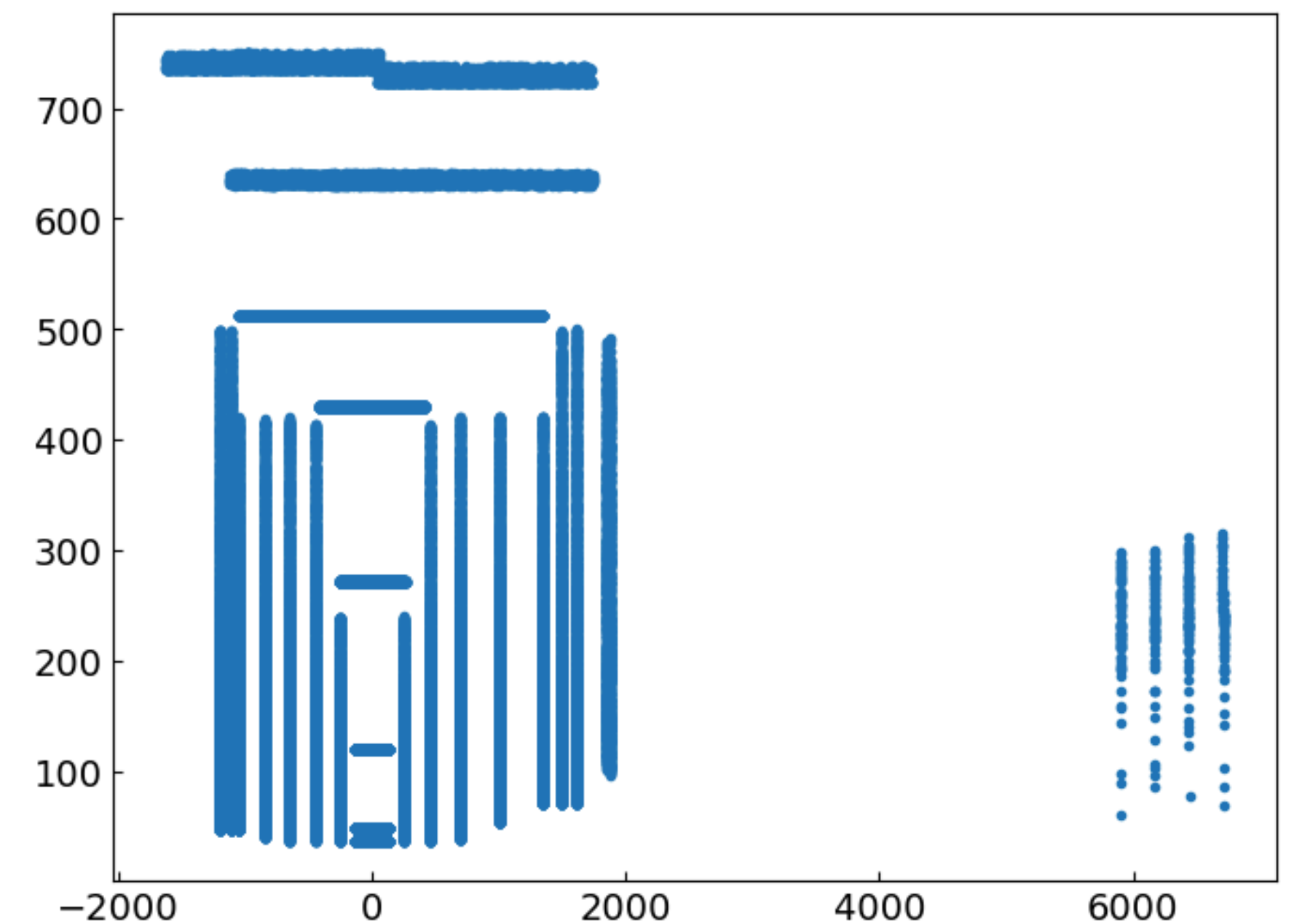
- Single muon events, 10,000 events

Calculating residuals:

- Compare the “CentralTrackSegment.points” with the “RecHits” to see how the hits compare to the reconstructed track
- Needed to do it this way in an offline analysis in order to get 3D positions - other data structures have a 2D “local” position that needs ACTS to decode
- Determined by pseudorapidity whether a hit was in the barrel/endcap regions
- Found the track point with the closest distance to the reconstructed hit in $\Delta z(\Delta r)$ for the barrel(endcap) to find the displacement in $\Delta r(\Delta z)$ to calculate the residual

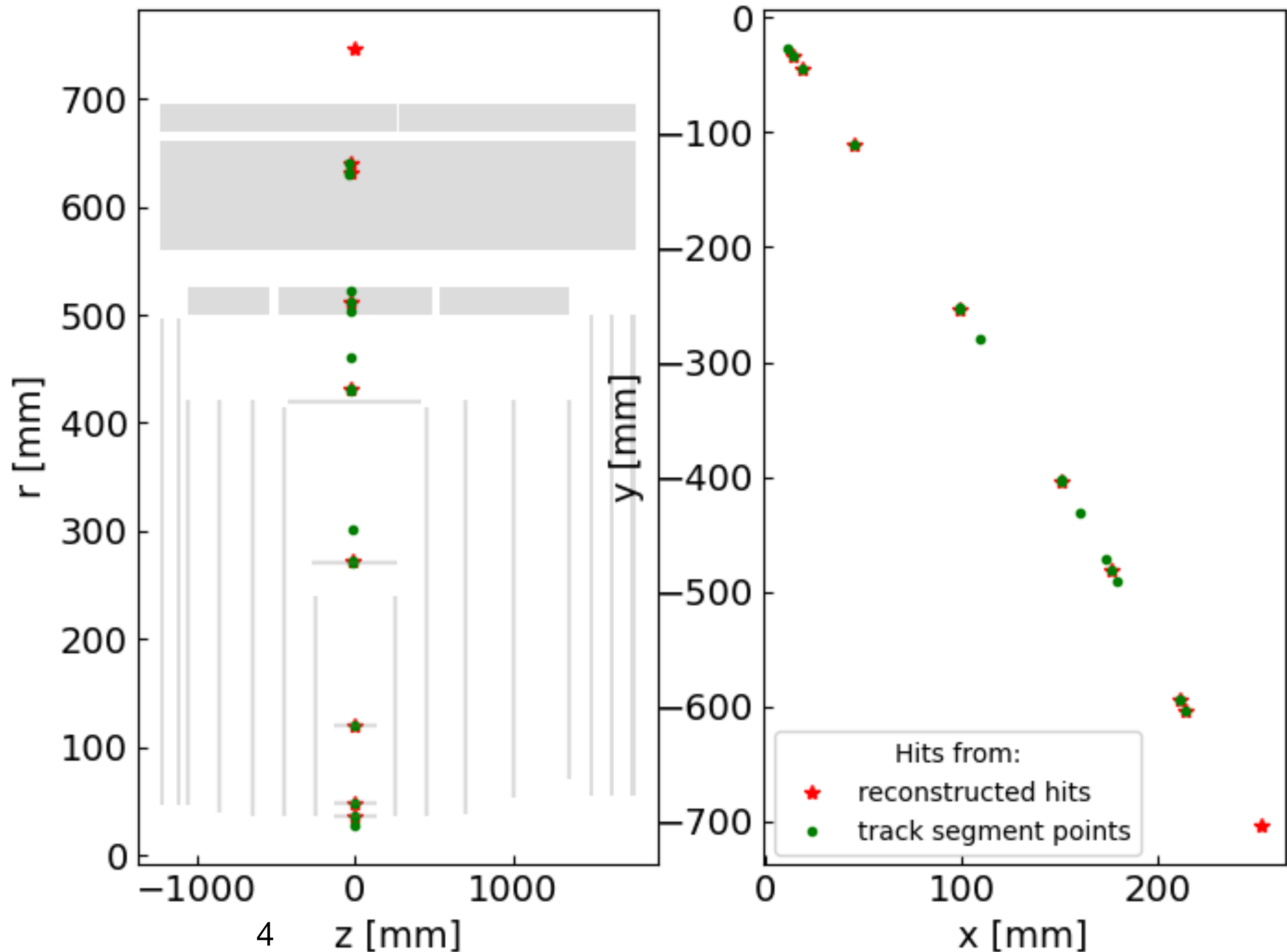
The different collections

- Barrel:
 - SiBarrelTrackerRecHits
 - SiBarrelVertexRecHits
 - TOFBarrelRecHit
 - MPGDBarrelRecHits
 - MPGDDIRCRecHits
 - OuterMPGDBarrelRecHits
- Endcap:
 - BackwardMPGDEndcapRecHits
 - SiEndcapTrackerRecHits
 - TOFEndcapRecHits
 - ForwardMPGDEndcapRecHits
- Other collections ignored for now
- Multiple layers included in a given collection



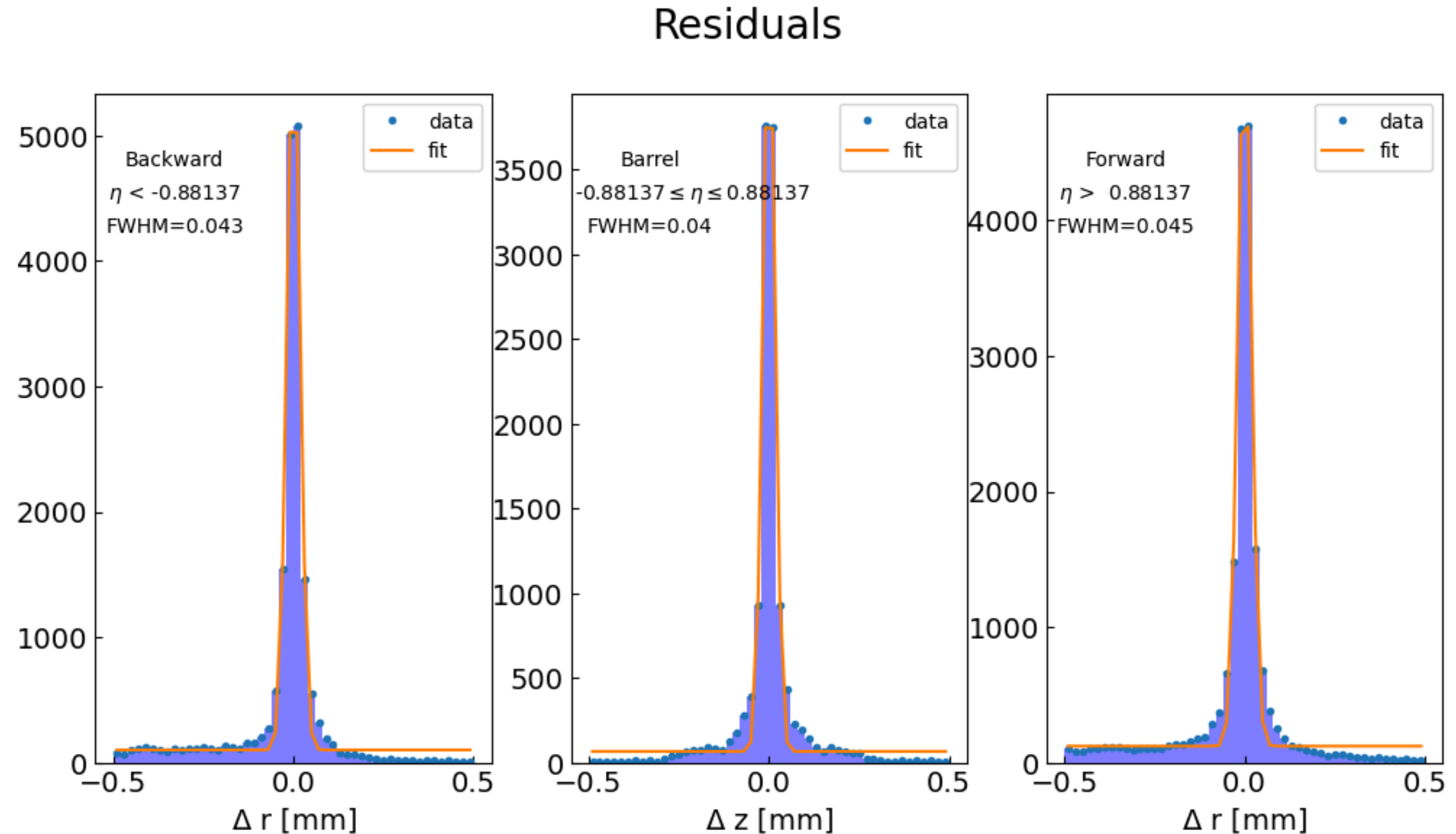
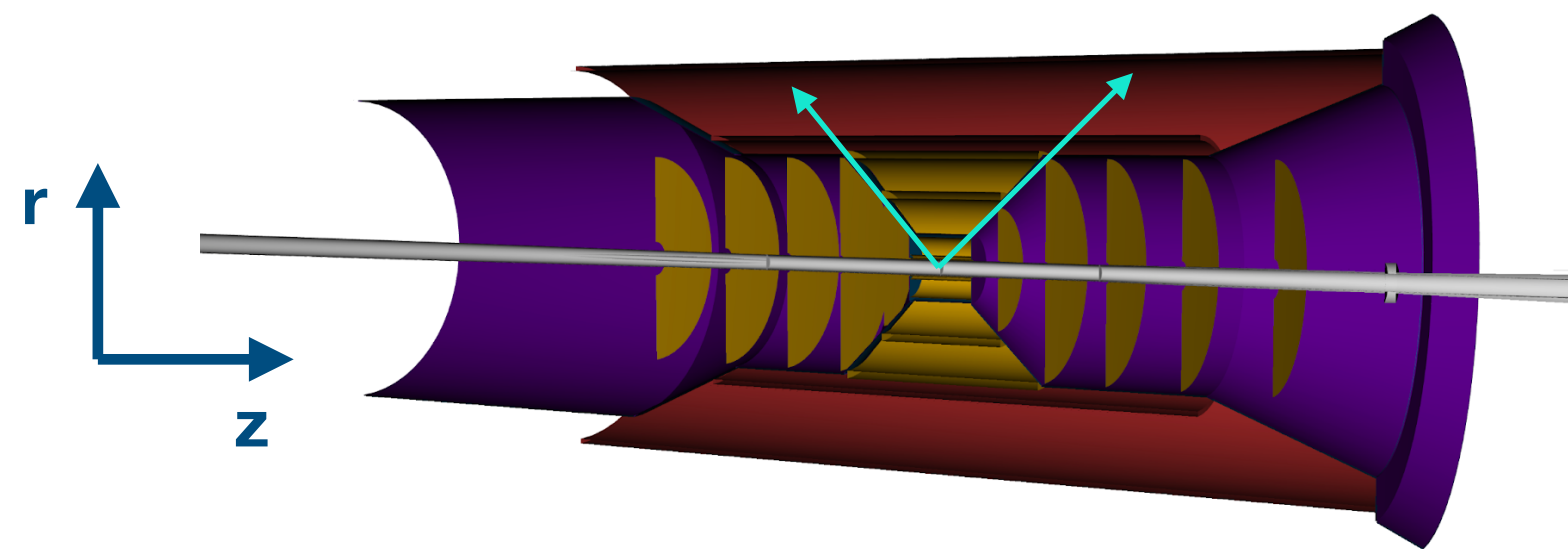
Example of a track

- Reconstructed hits
 - Plotted are both “measurementHits” and “outlierHits”
- Track segment points = the points on a track at each surface
 - Includes calibrated+uncalibrated states

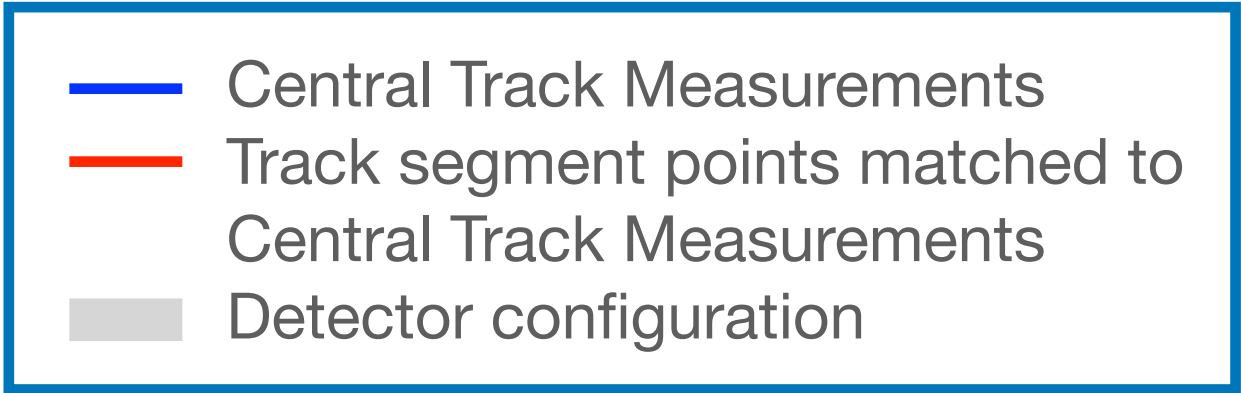


Residuals per eta region

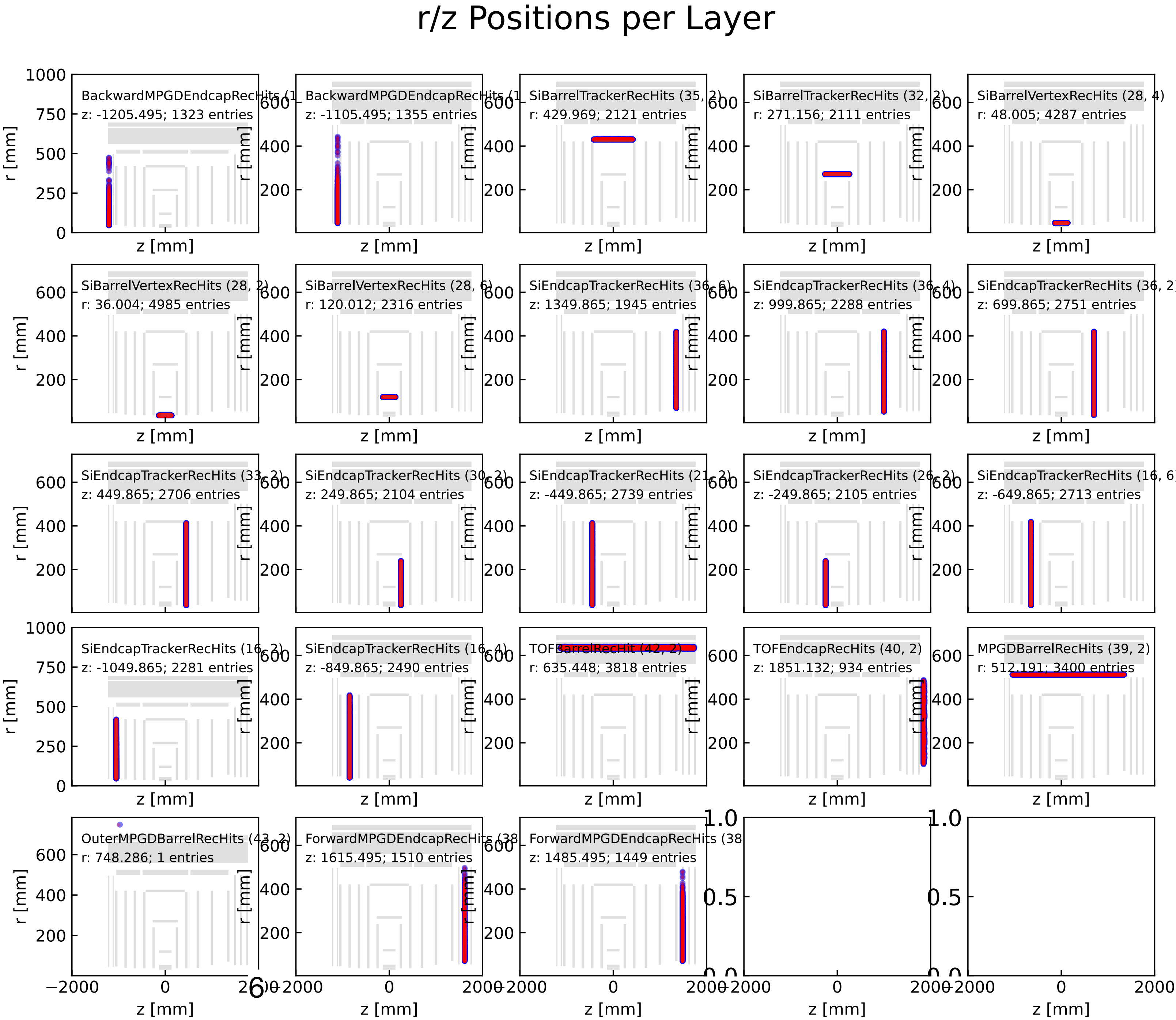
- Residuals shown for different eta regions
- Tail seen on the forward/backward regions - unsure what it is from



r/z positions per layer

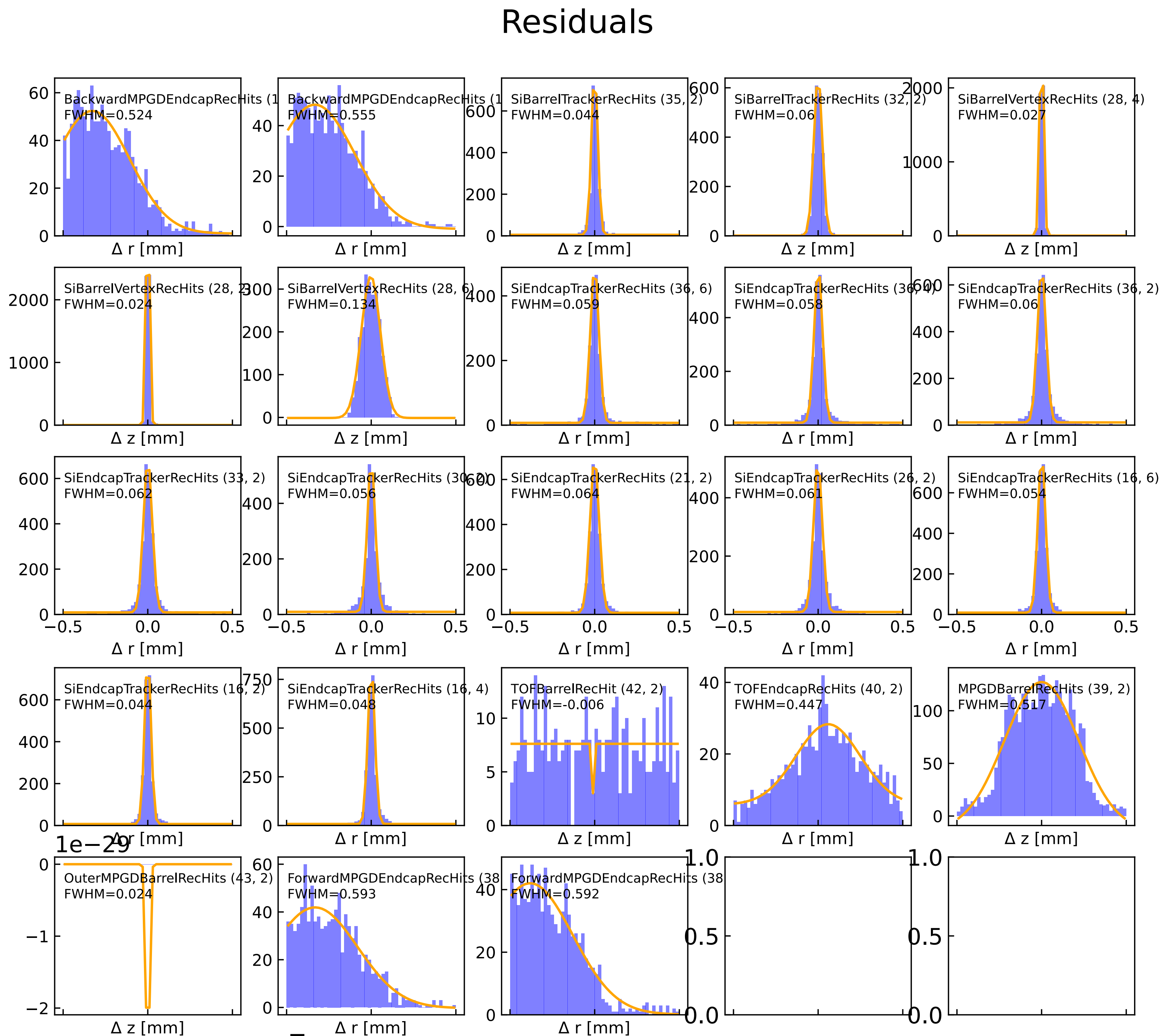


- Visually, it looks like the measurements line up nicely with the track points



Residuals per layer

- Silicon peaks are narrower
- Layers that are further out have wider residuals
- Appears to be missing outer MPGD hits - currently investigating



FWHM at different layers

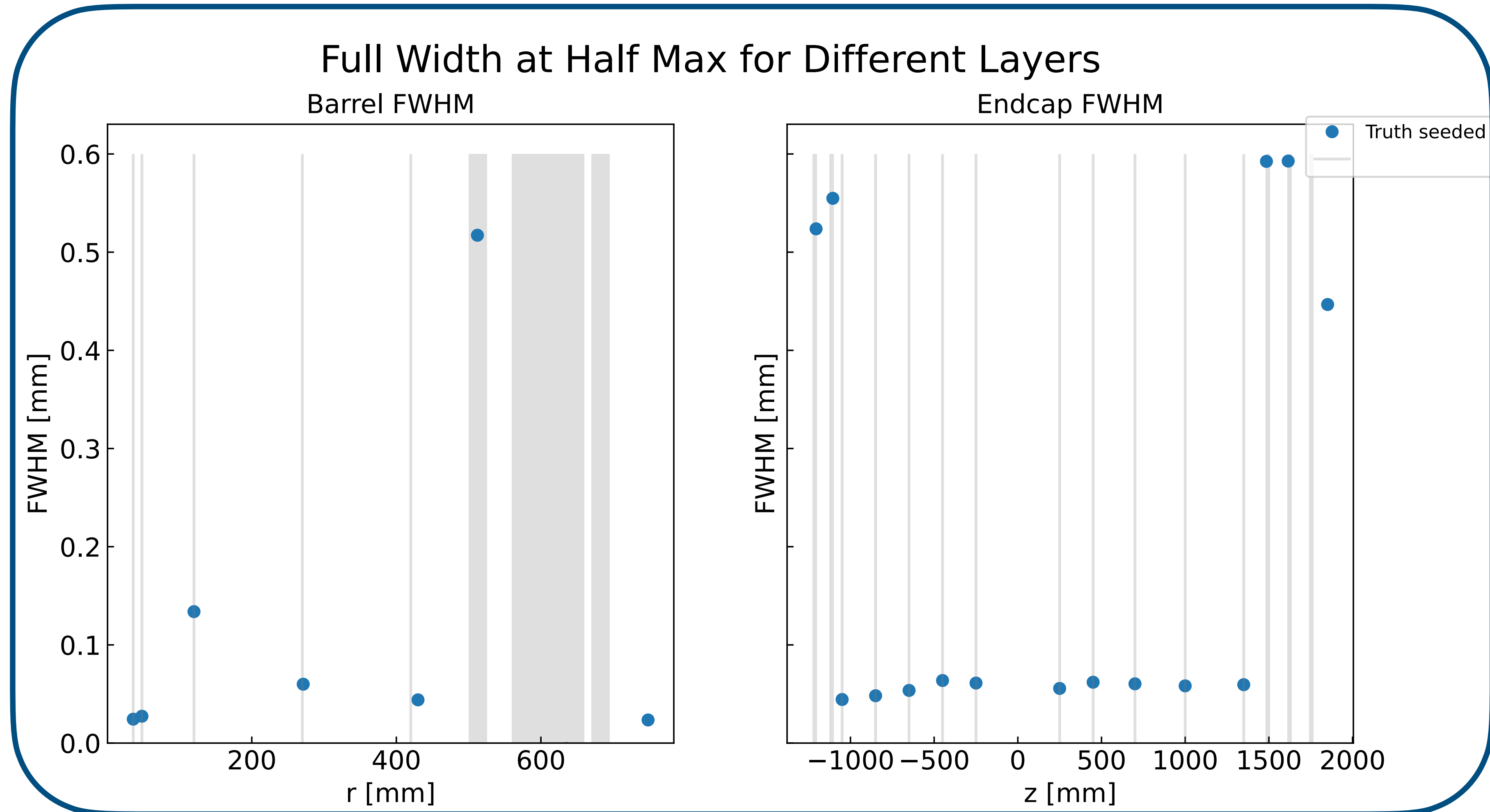
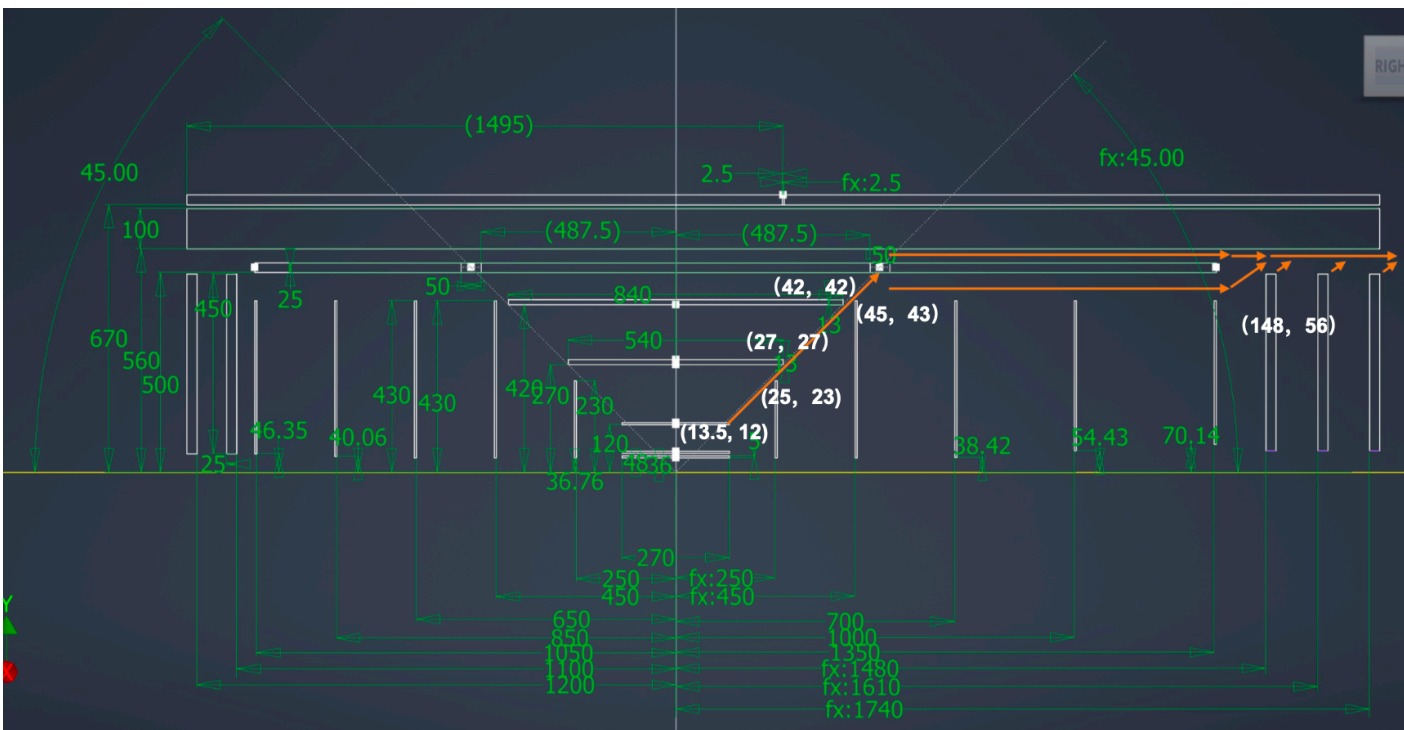
*See different TOF endcap coordinates at: <https://eic.jlab.org/Geometry/Detector/Detector-20231031150001.html>

Region	Layer	radius [mm]	length [mm]	X/X0
IB	L0	36	270	0.05 %
	L1	48	270	0.05 %
	L2	120	270	0.05 %
OB	L3	270	540	0.25 %
	L4	420	840	0.55 %

Region	Disk	z [mm]	inner radius* [mm]	outer radius [mm]	X/X0
EE	ED0	-250	36.76	240	0.24 %
	ED1	-450	36.76	415	0.24 %
	ED2	-650	36.76	421.4	0.24 %
	ED3	-850	40	421.4	0.24 %
	ED4	-1050	46.35	421.4	0.24 %

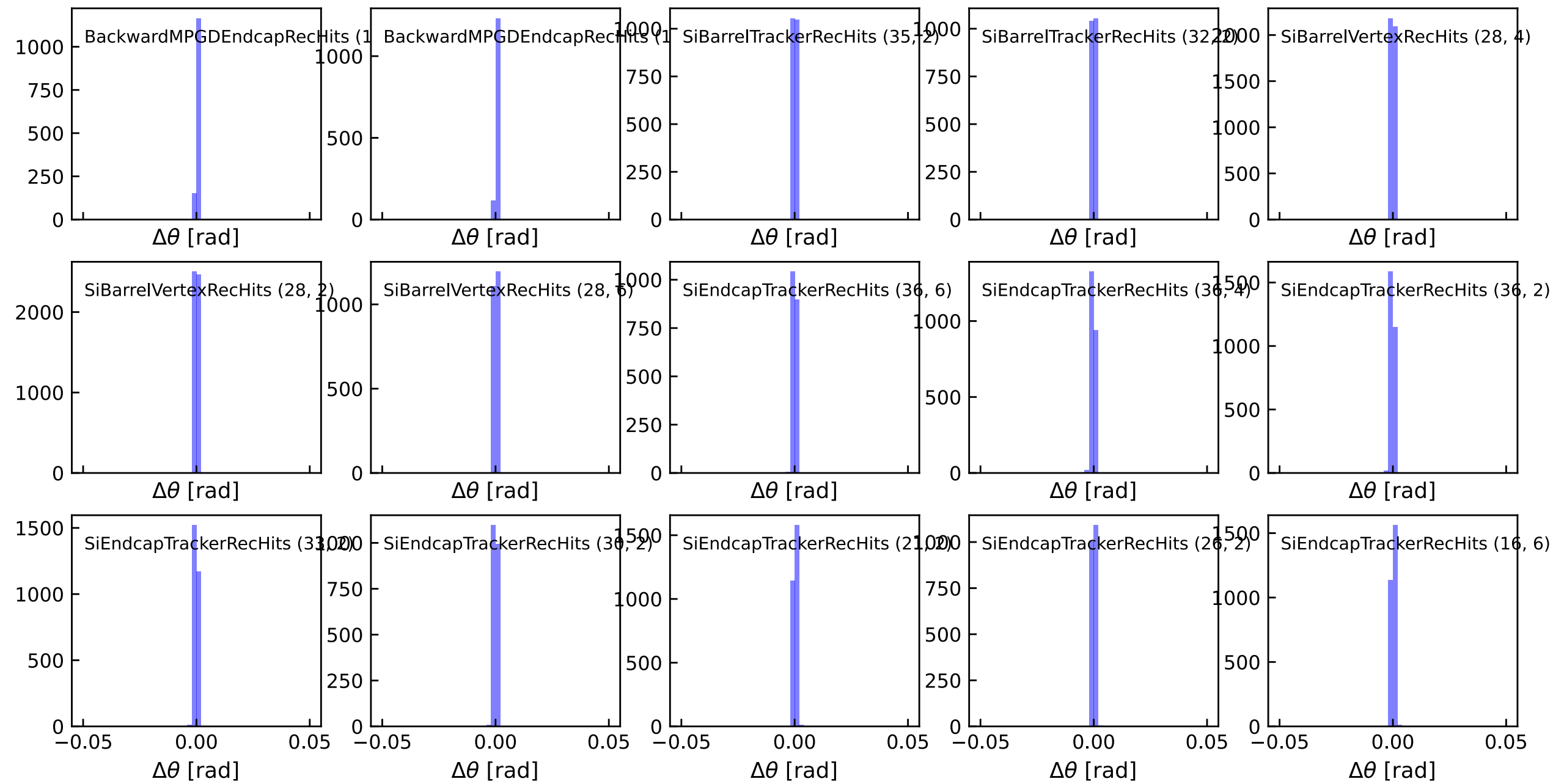
Region	Disk	z [mm]	inner radius* [mm]	outer radius [mm]	X/X0
HE	HD0	250	36.76	240	0.24 %
	HD1	450	36.76	415	0.24 %
	HD2	700	38.46	421.4	0.24 %
	HD3	1000	53.43	421.4	0.24 %
	HD4	1350	70.14	421.4	0.24 %

https://wiki.bnl.gov/EPIC/index.php?title=Si_Vertex_Tracker

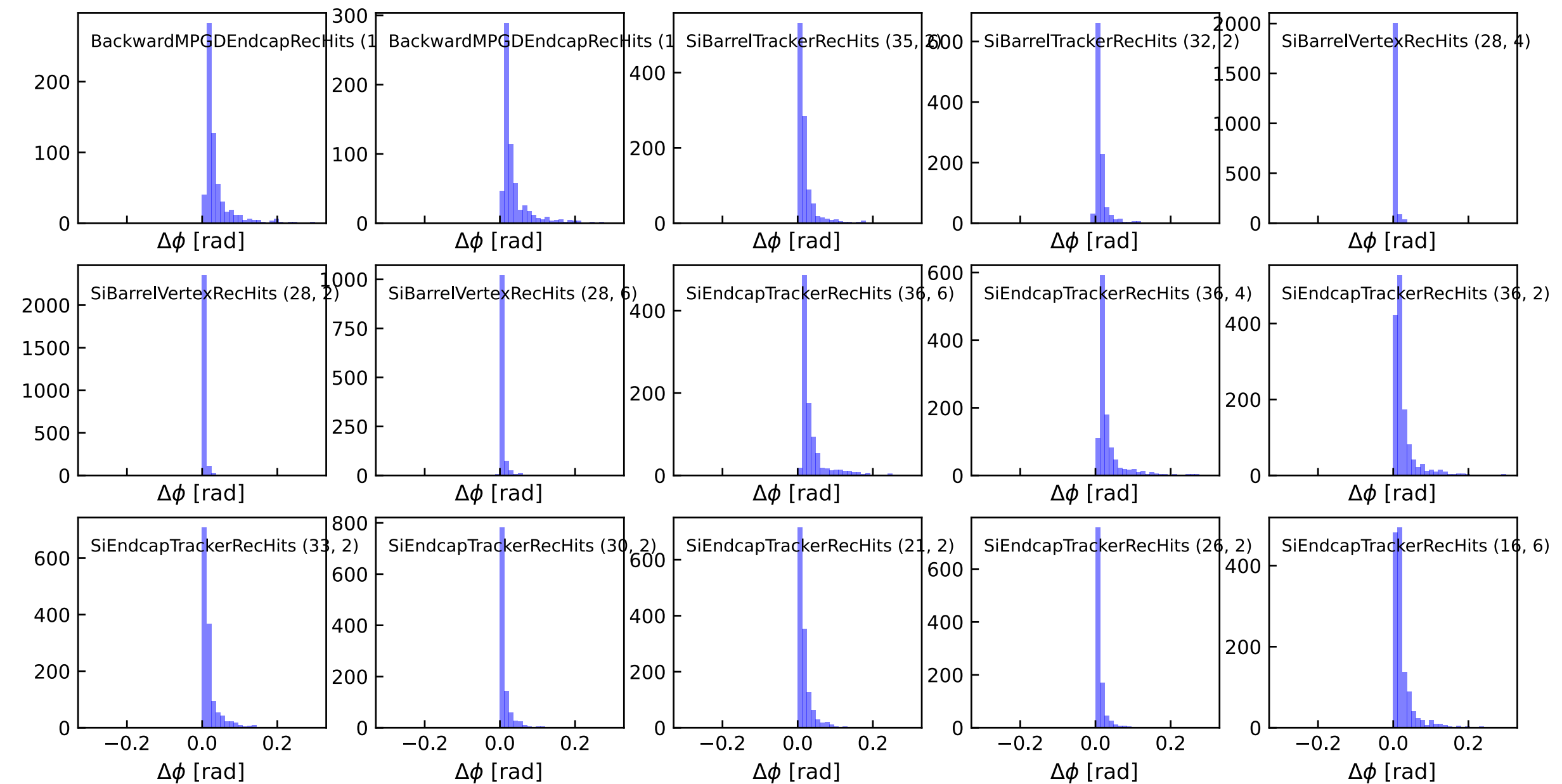
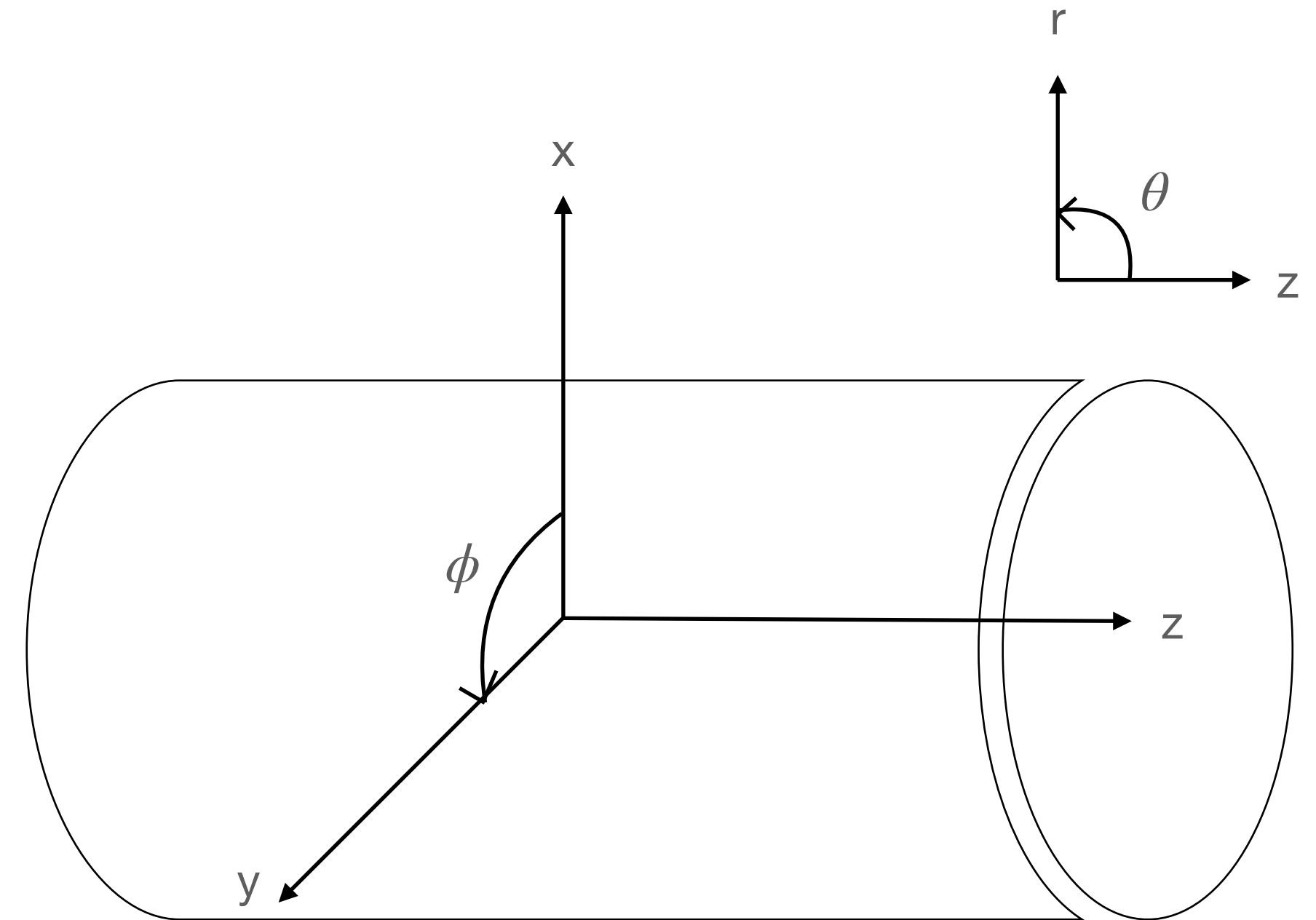


- Next: realistic seeding!

Angular residuals per layer



- Quick look at finding the difference in θ and ϕ
- $\Delta\theta$ appears to be very narrow for most cases



Next Steps

- Currently getting the realistic seeded residuals
 - Necessary data structure added in local repository
 - Events currently being reconstructed
- Make unbiased residuals
 - Apparently there is some functionality in ACTS to do this
 - <https://github.com/acts-project/acts/commit/c21fc44fbe914473e13880da58798f13dfd542a5>
- Run all residuals with DIS events