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Check missing hits in tracking

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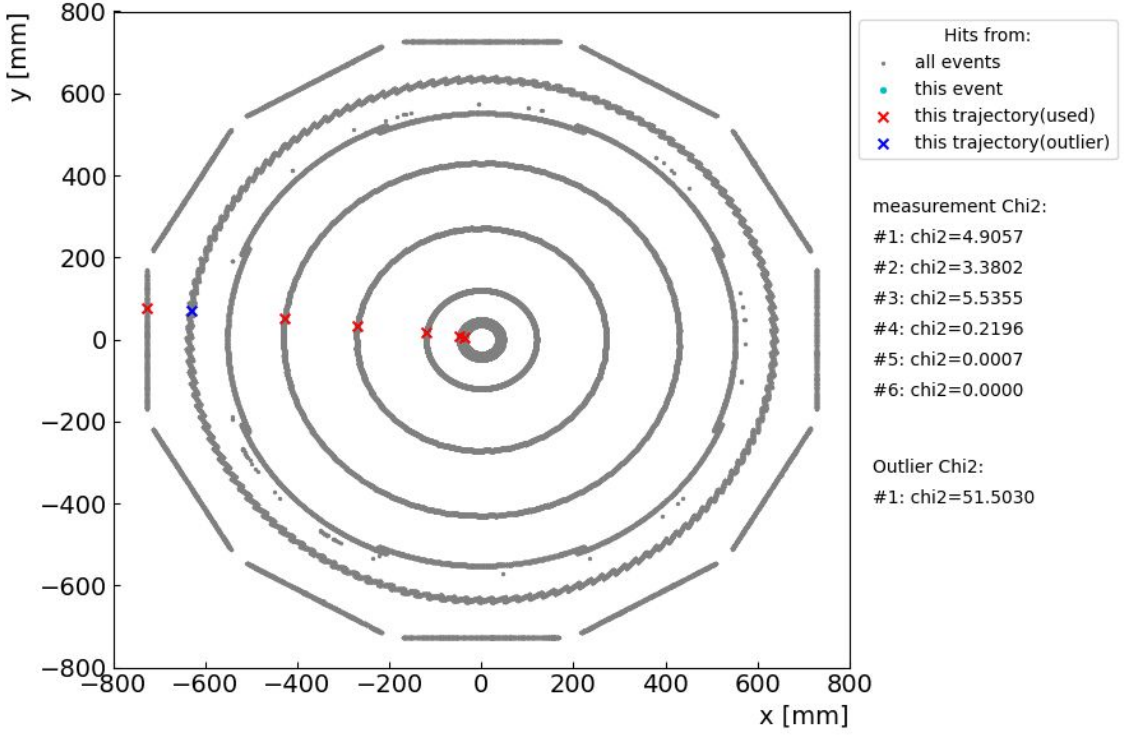
ePIC tracking++ meeting

Sept 5, 2024 (page 1-8)

Sept 12, 2024 (page 9-11)

Two types of missing hits in tracking:

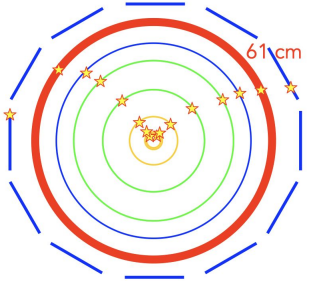
- **hole**: discontinuity of trajectory (does not include endpoints) b/c no tracker hits available on that tracking surface.
- **outlier**: hits available but severely deviates from projected trajectory therefore not used in reconstruction (default cut: chi2>15)

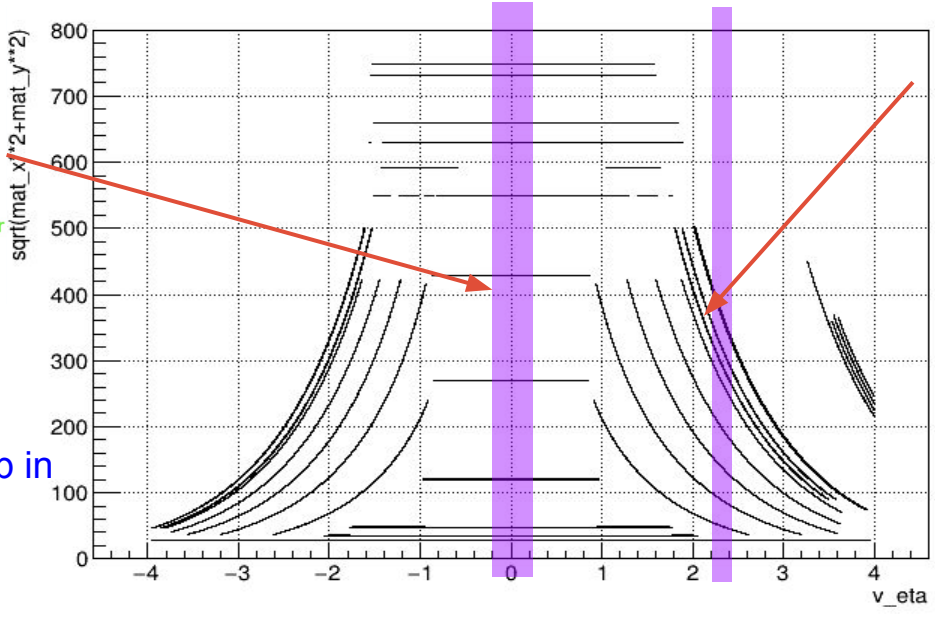


First look of Missing hits:

- **holes** → # of available tracker hits per particle → geometry, DD4hep simulation
- **outliers** → # of tracker hits used in track reconstruction → tracking algorithm and cuts

- **Simulation samples:**
  - 10k single pi+ at 5 GeV, uniform in phi and eta:
    - central: -0.2<eta<0.2
    - forward: 2.2<eta<2.4
  - eic-shell version 24.08, standard ePIC geometry
  - realistic seeding





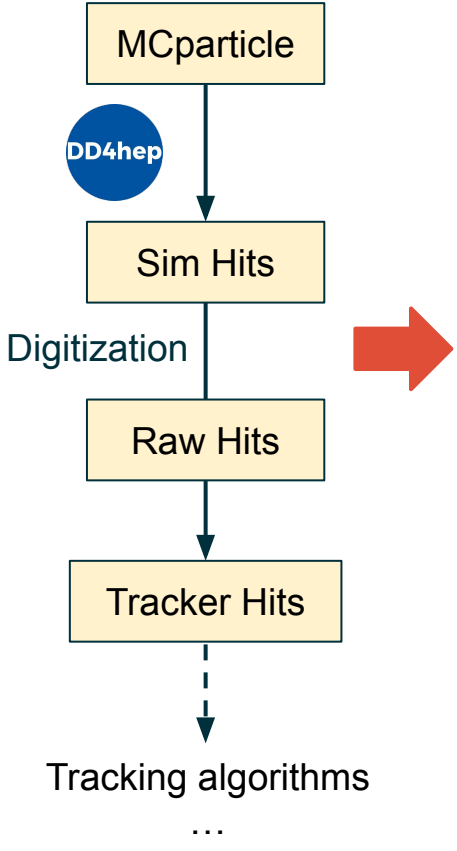
- central region:
  - 8 barrel layers
  - acceptance gasp in outer MPGD

- forward region:
  - missed the innermost vertex barrel
  - 8 disks (5 Si + 2 MPGD + 1 TOF)

Central region

-0.2<eta<0.2

Missing tracker hits:



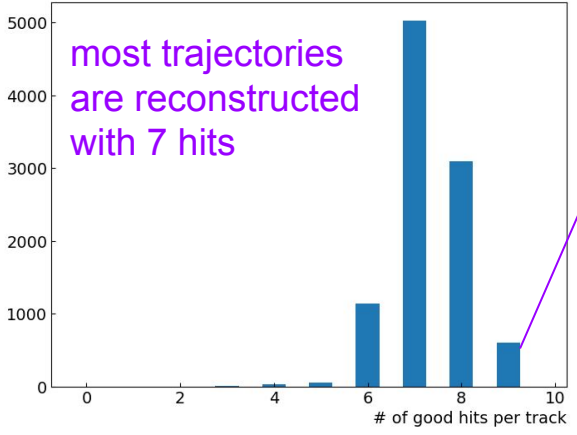
Detector	Rmin [mm]	Rmax [mm]	# of events with sim hits	with digi hits
Si Barrel L0	30	42	10000	10000
Si Barrel L1	46	60	10000	10000
Si Barrel L2	115	130	10000	10000
Si Barrel L3	265	280	10000	10000
Si Barrel L4	415	450	10000	10000
Inner MPGD Barrel	540	600	9988	8424
TOF Barrel	610	650	10000	10000
Outer MPGD Barrel	700	750	8234	6987

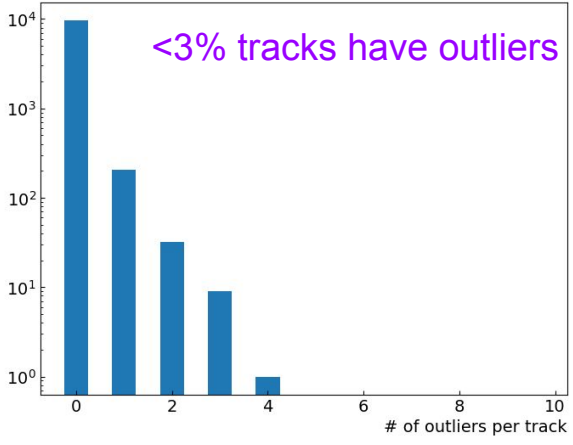
- MPGD lost >10% hits after digitization [https://github.com/eic/epic/issues/774]
- outer MPGD is known to have acceptance gap.

Central region

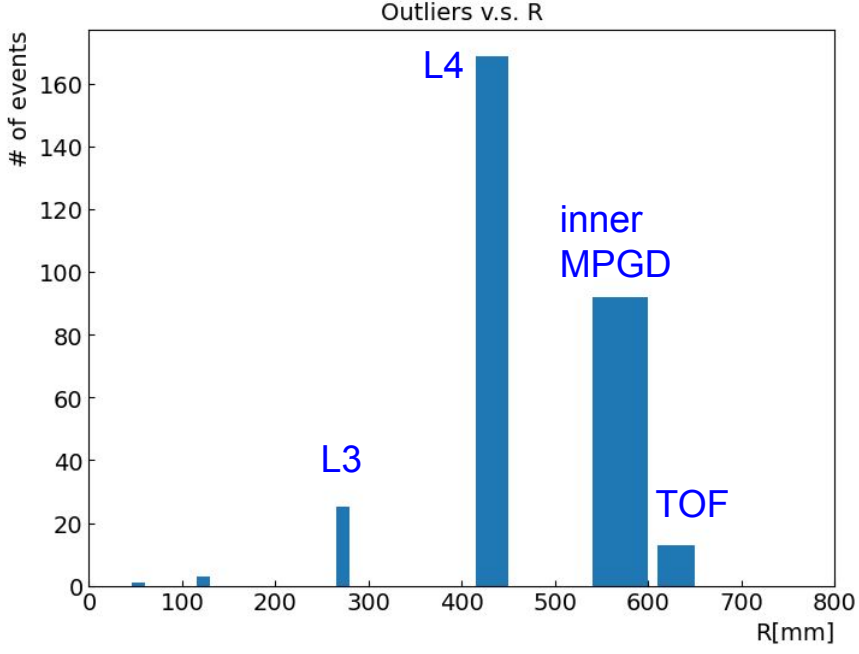
-0.2<eta<0.2

Hits not used in track reconstruction





some barrel layers can provide more than one hits through the overlapped areas



- detailed study on hits chi2/residual ongoing

Forward region

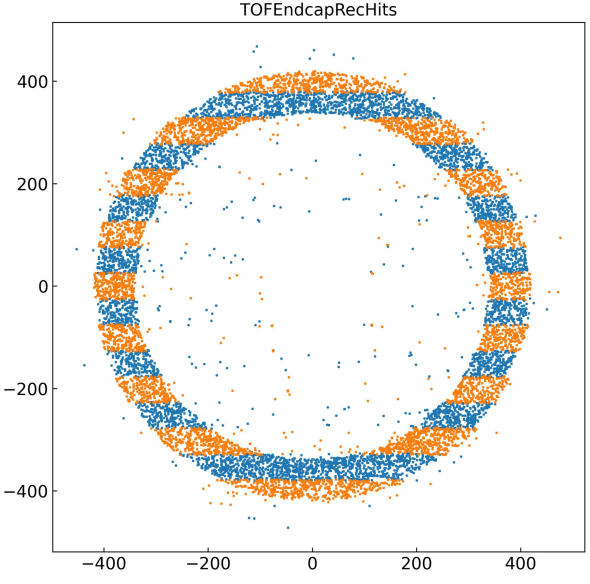
2.2<eta<2.4

Missing tracker hits:

Detector	Zmin [mm]	Zmax [mm]	# of event with sim hits	# of event with digi hits
Si disk 1	240	260	9996	9996
Si disk 2	440	460	9998	9998
Si disk 3	690	710	9995	9995
Si disk 4	990	1010	9989	9989
Si disk 5	1340	1360	9981	9981
MPGD disk 1	1480	1500	9966	7702
MPGD disk 2	1600	1620	9950	7758
TOF disk	1840	1880	10476	10475

lost hits after digitization

TOF has two (overlapped) detector planes with ~2cm separation in z

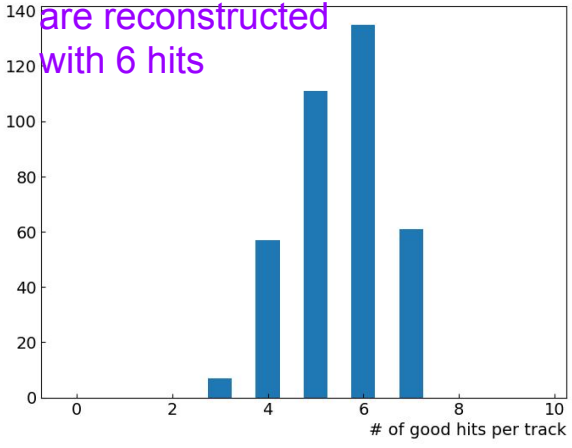


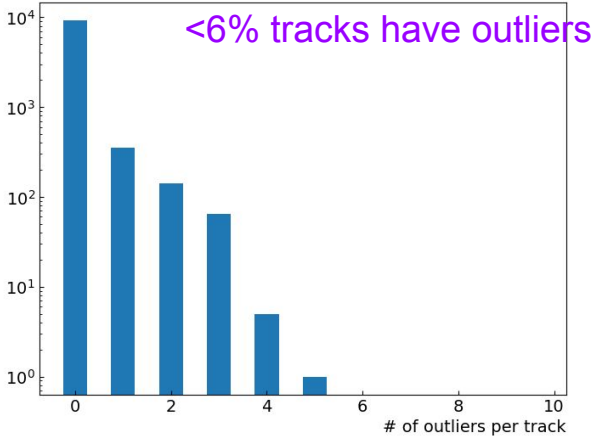
Forward region

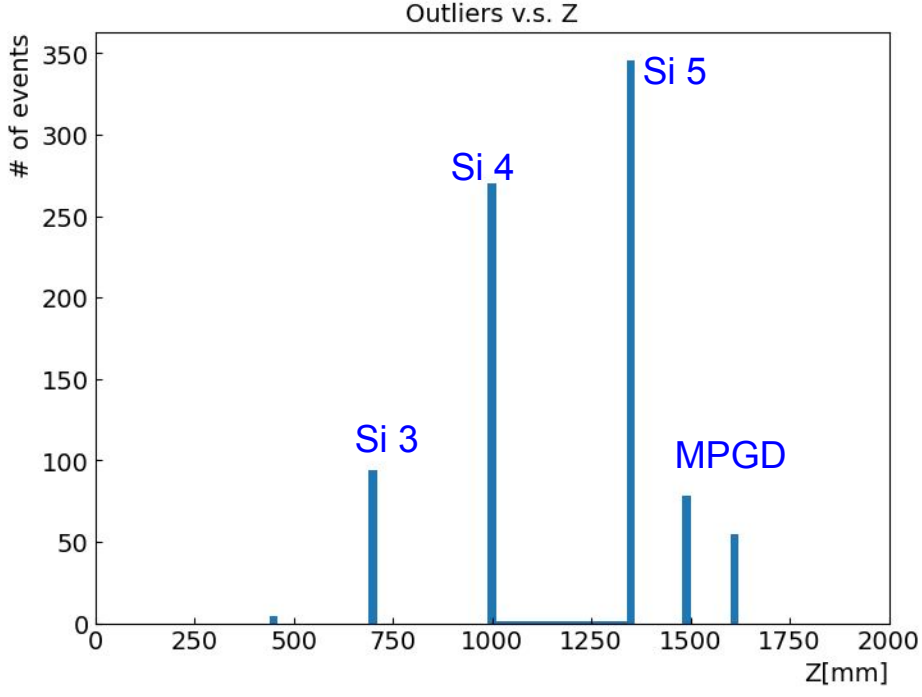
2.2<eta<2.4

Hits not used in track reconstruction

most trajectories are reconstructed with 6 hits

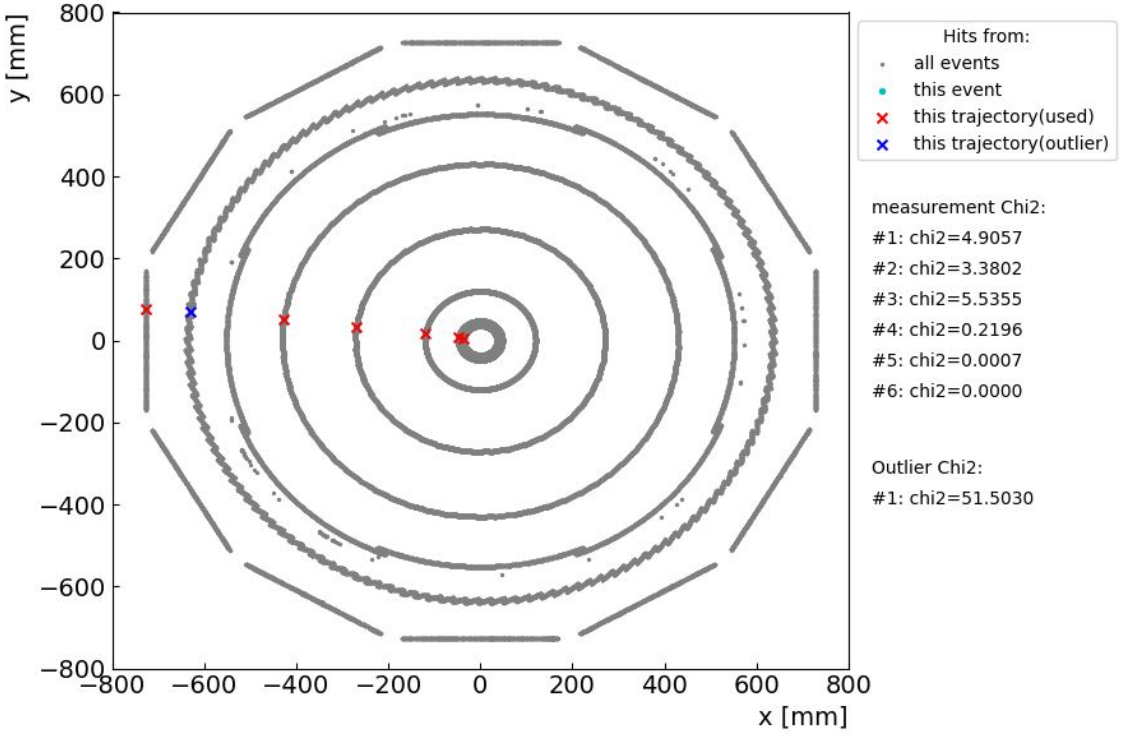




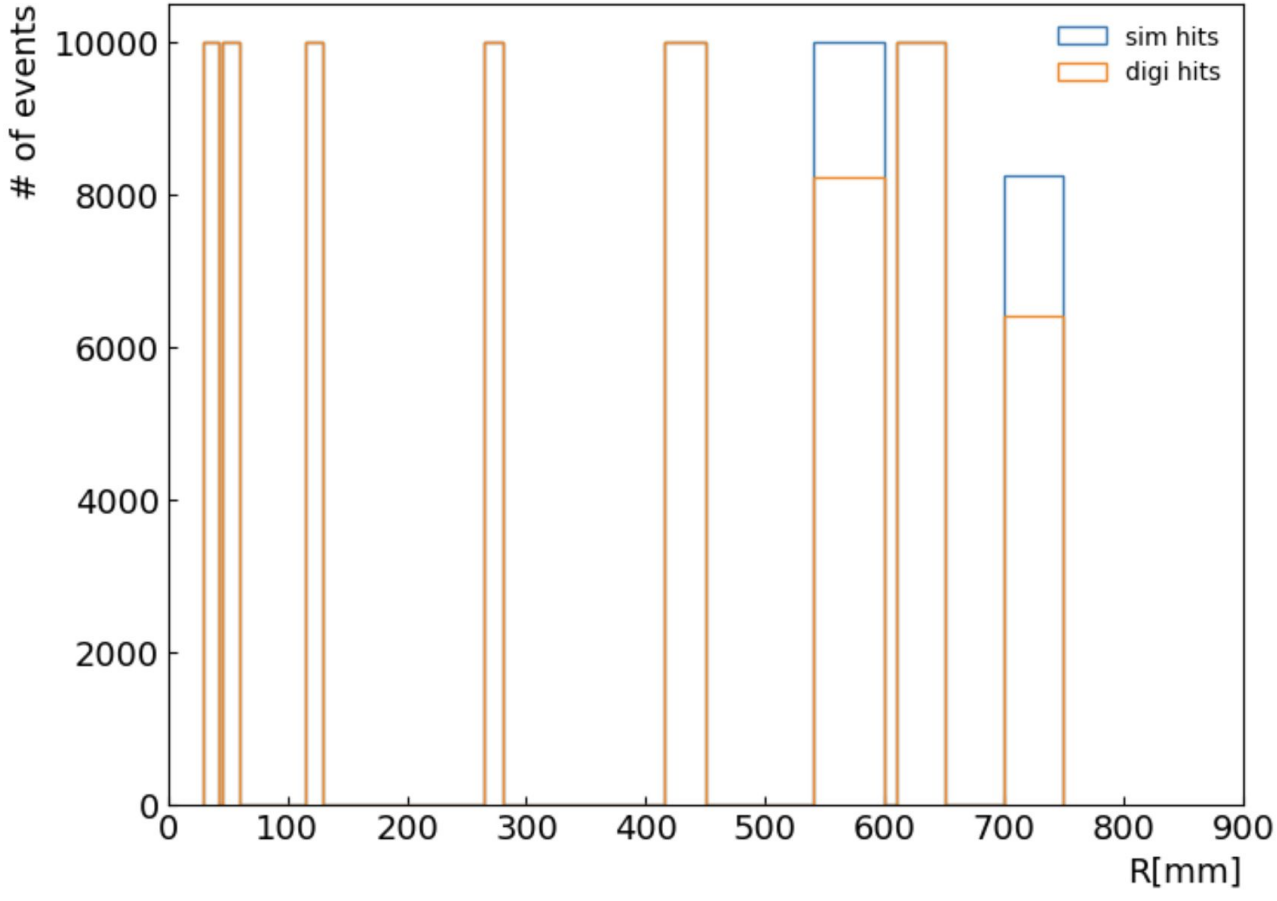


Conclusion

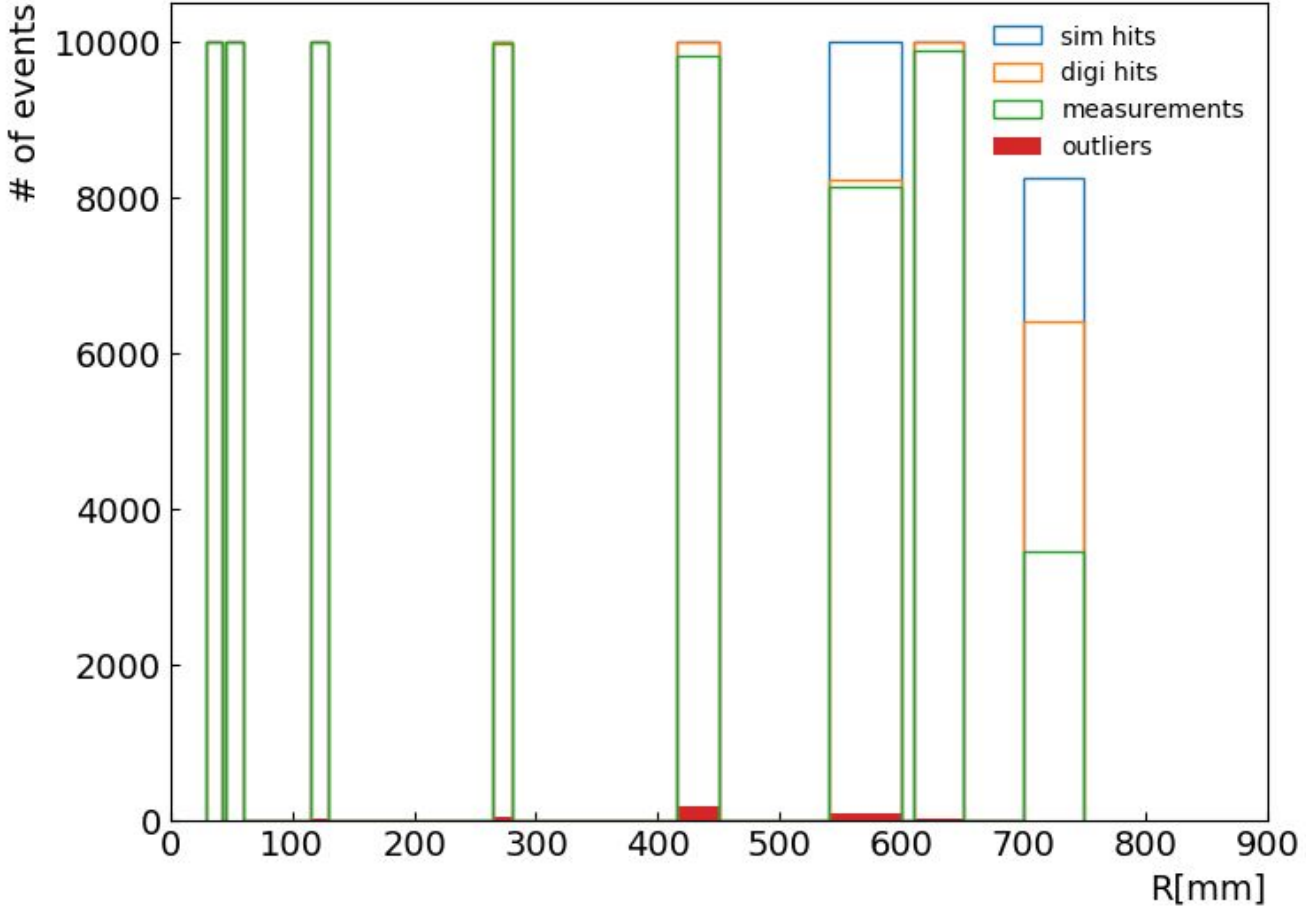
- >10% MPGD hits lost in digitization, check the threshold?
- more study needed to understand the hit chi2/residual



10k single pion+, 5GeV, -0.2<eta<0.2



10k single pion+, 5GeV, -0.2<eta<0.2



10k pion+, 5gev, 2.2<eta<2.4