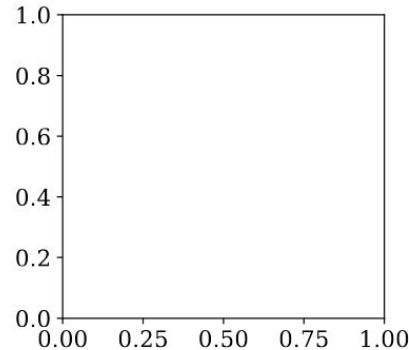
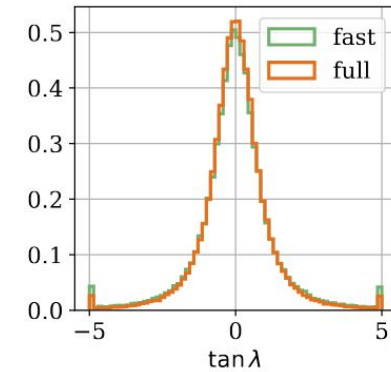
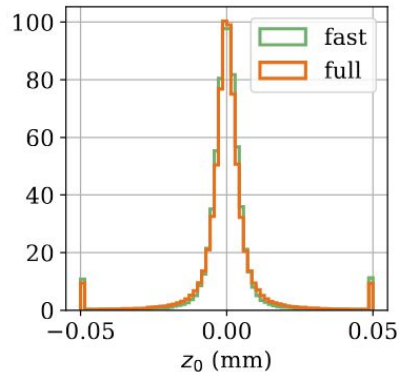
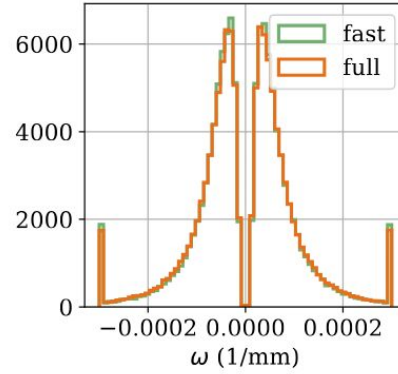
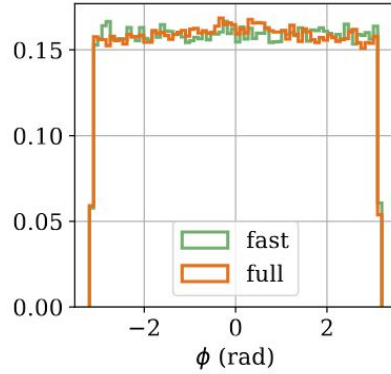
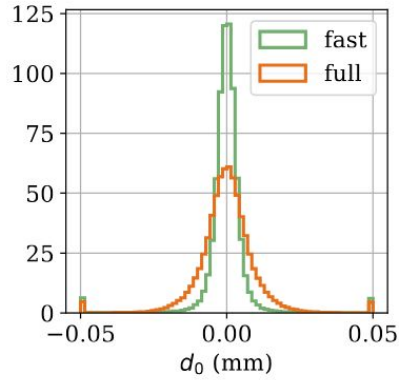




Fast vs. Full Sim: Track parameter comparison

Full Sim Meeting
Feb 12, 2025
Sara Aumiller

Track parameters

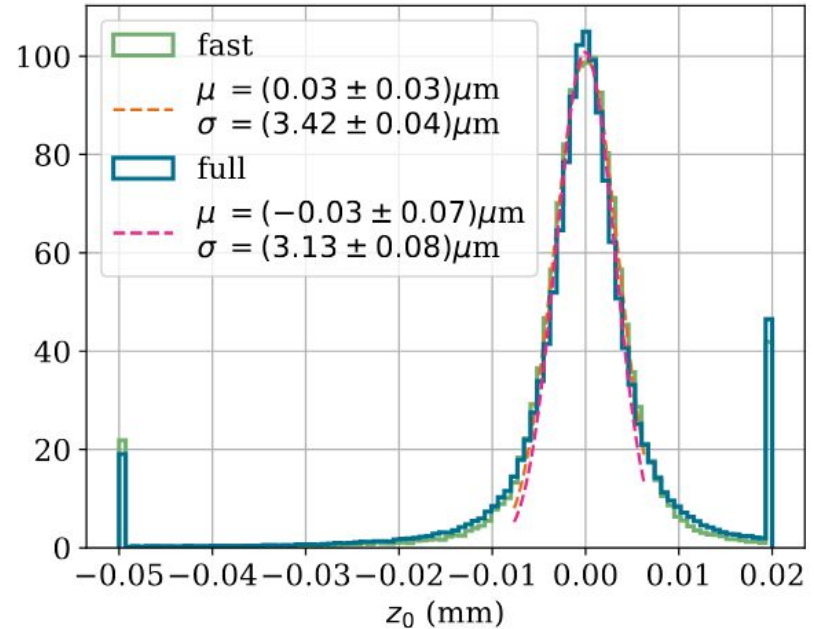
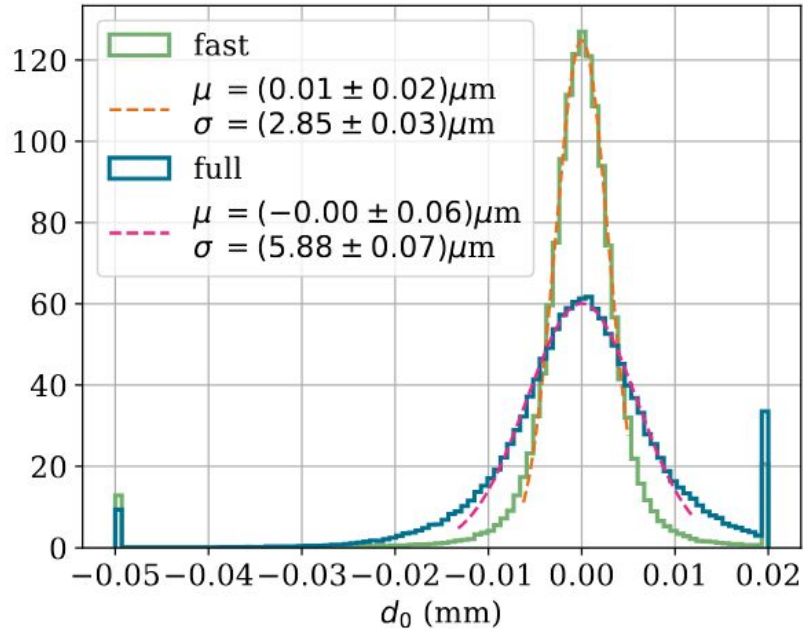


Charged particle in magnetic field

= helix trajectory:
described with 5
parameters

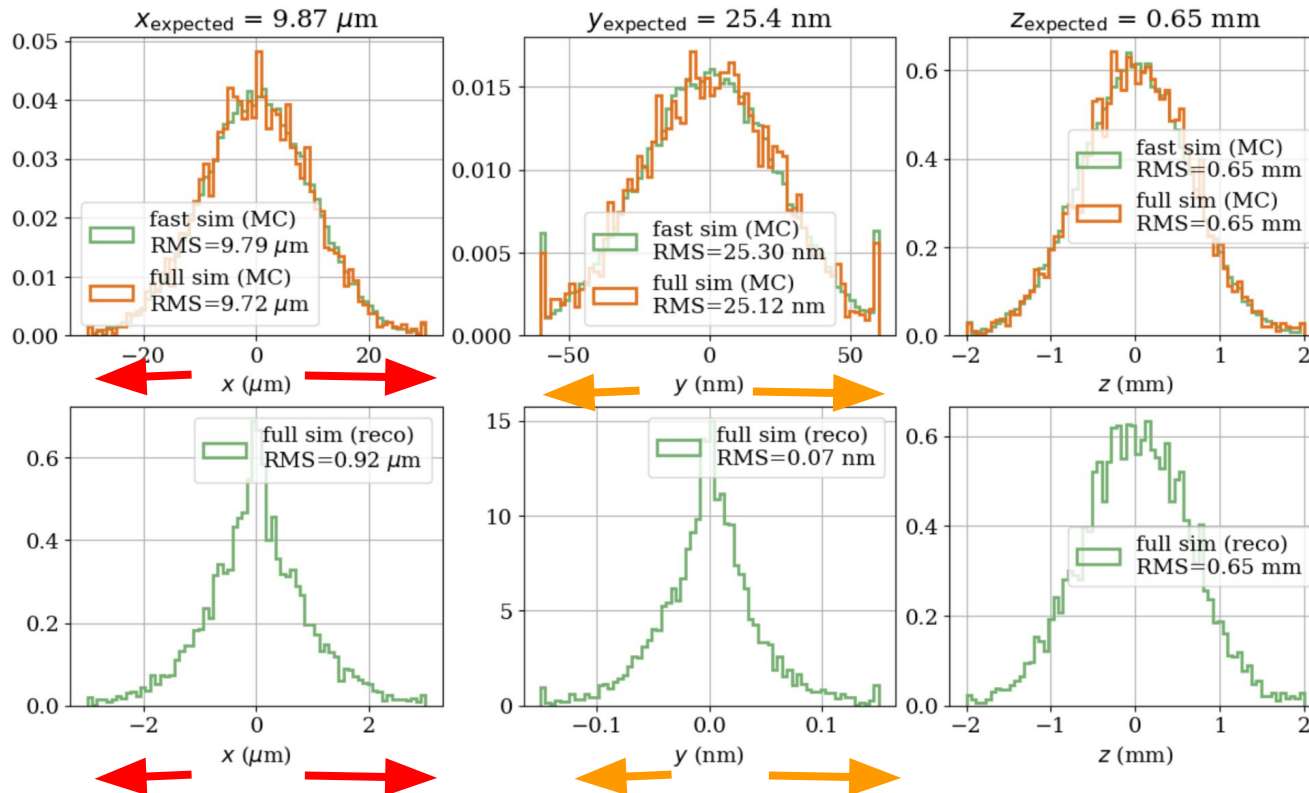
[Key4hep convention](#)

Differences in the impact parameters



What's the reason for the discrepancy in d_0 ?

Idea: Check the primary vertices (PV)



- x: **factor 10 too good** in reco full sim
- y: **factor 350 too good** in reco full sim
- z: as expected

1. PV Fix: Adapt beam spot constraints

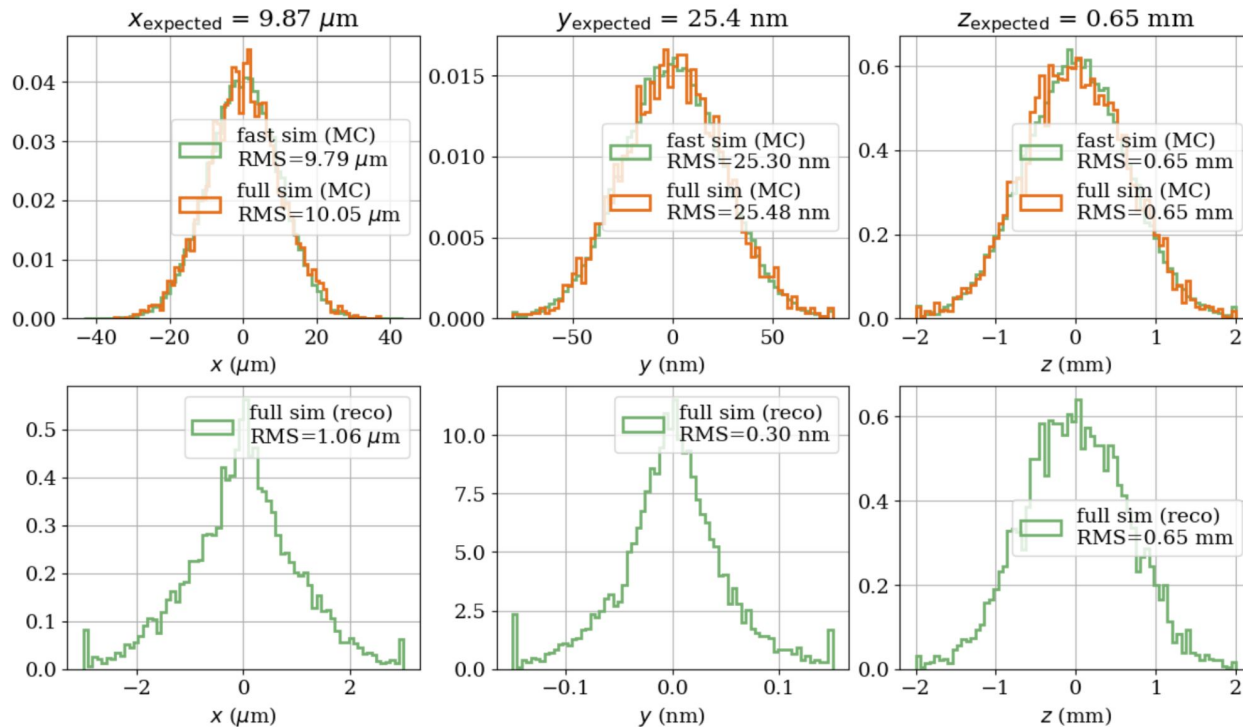
<https://github.com/key4hep/CLDConfig/pull/62>

```
CLDConfig / CLDConfig / CLDReconstruction.py ↑ Top
```

Code Blame 192 lines (161 loc) · 8.61 KB Raw Copy Download Edit

```
77     raise RuntimeError("Too many XML files for the detector path, please only spec
78
79     # from https://github.com/HEP-FCC/FCCeePhysicsPerformance/blob/d6ecee2c2c3ed5d76db
80     # for december 2022
81     BEAM_SPOT_SIZES = { 91: (5.96e-3, 23.8e-6, 0.397),
82                          160: (14.7e-3, 46.5e-6, 0.97),
83                          240: (9.8e-3, 25.4e-6, 0.65),
84                          365: (27.3e-3, 48.8e-6, 1.33),
85                          }
86
```

1. PV Fix: Adapt beam spot constraints



- x: factor 10 too good in reco full sim
- y: factor 80 too good in reco full sim
- z: as expected

Helped for y but did not fix the problem

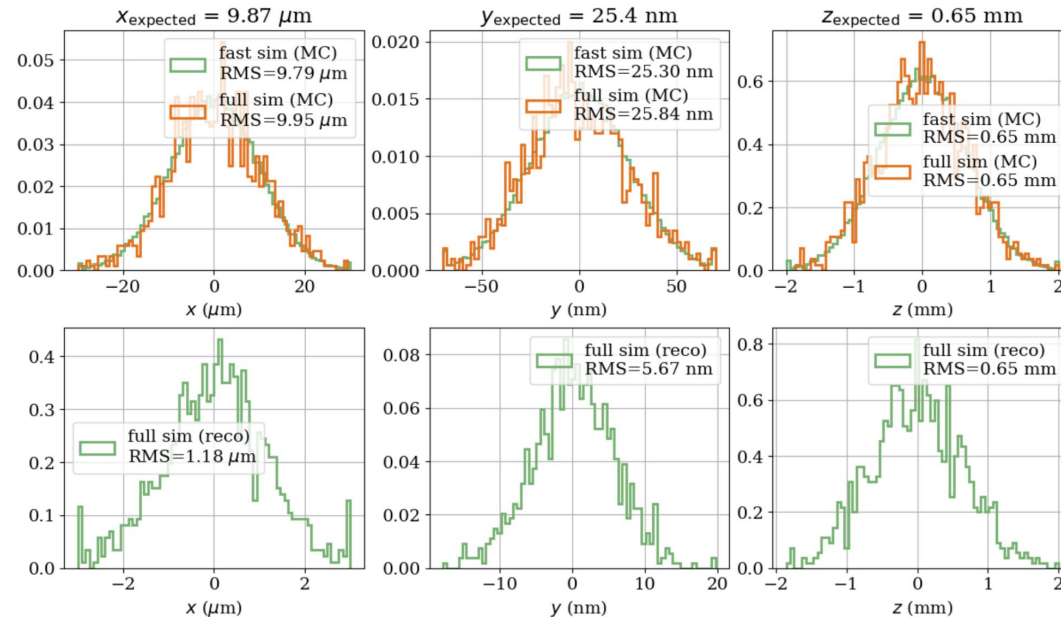
2. PV Fix: Set beam spot smearing to true

Idea from
@Leonhard

[CLDConfig/CLDConfig/HighLevelReco/JetAndVertex.py](#)

Line 122 in [f9db347](#)

```
122 "PrimaryVertexFinder.BeamspotSmearing": ["false"],
```



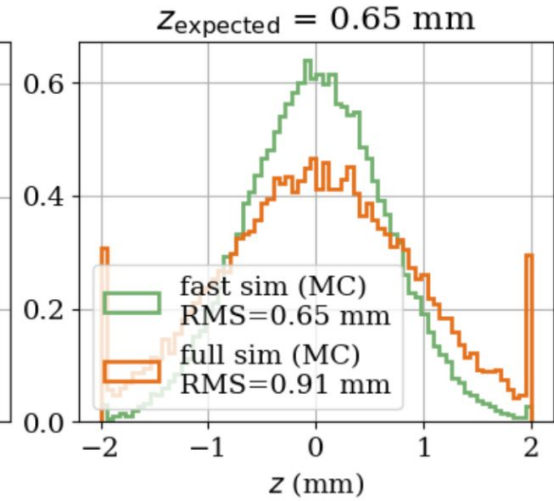
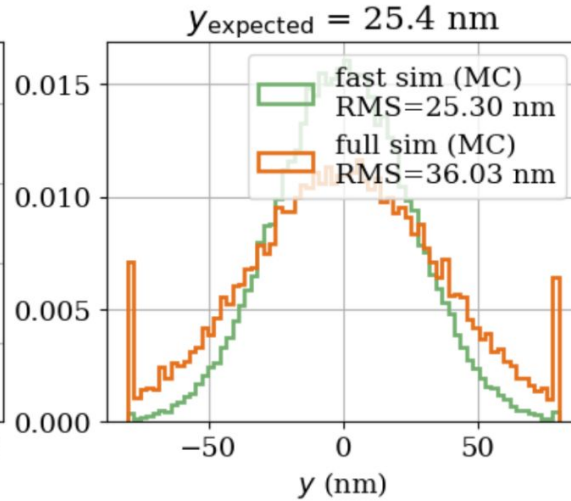
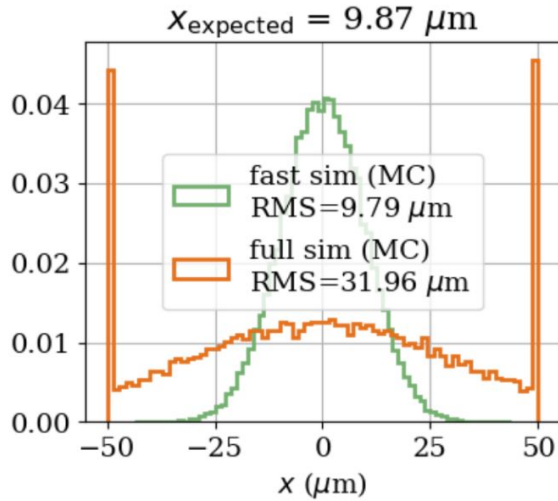
- x: factor 10 **too good** in reco full sim
- y: factor 5 **too good** in reco full sim
- z: as expected

3. PV Fix: ???

Any ideas?

Note: Fix on the way - vertex smearing

Solved by
@Brieuc
@Juraj

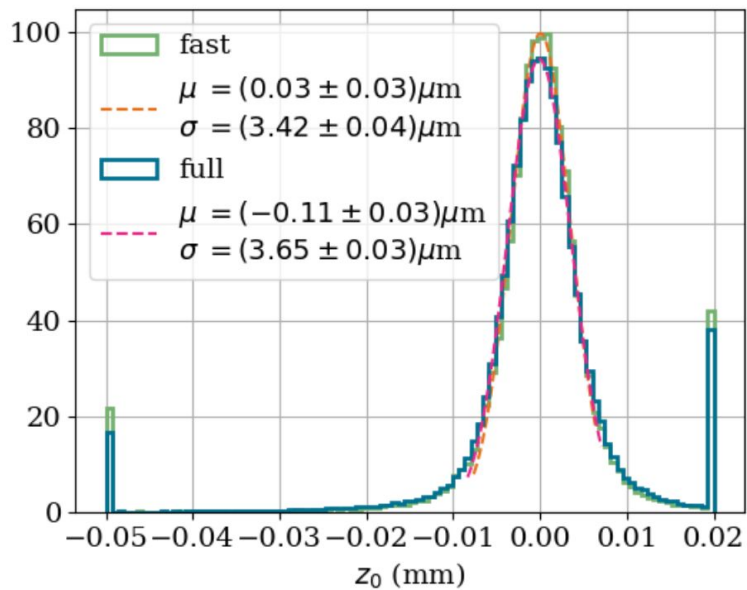
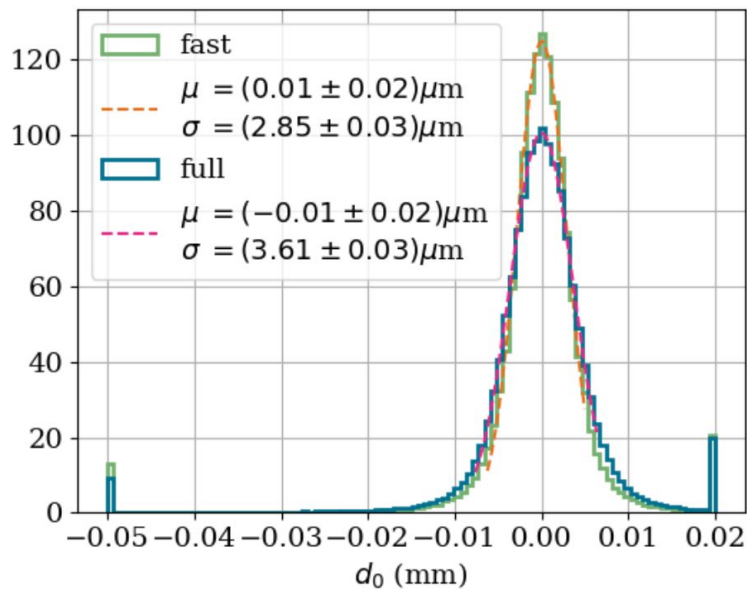
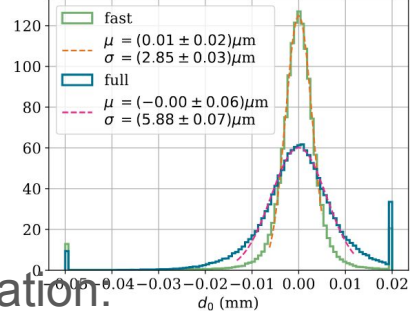


Already fixed: Vertices were smeared twice!

PV not the only issue

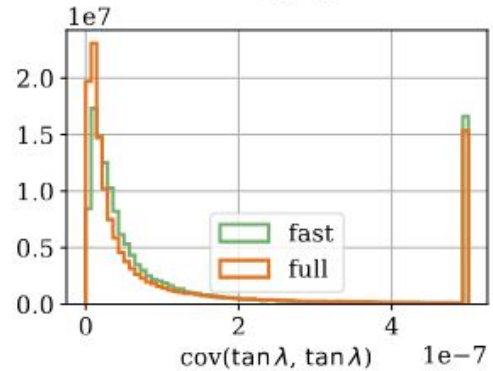
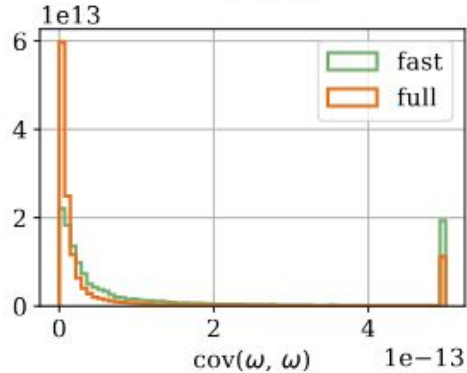
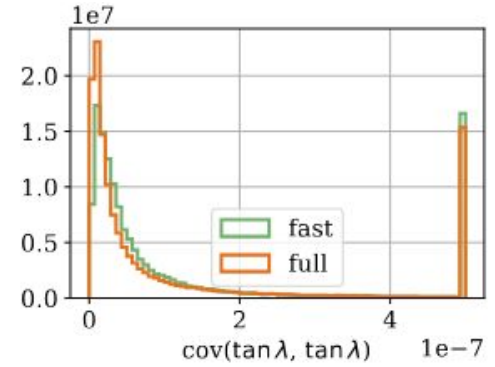
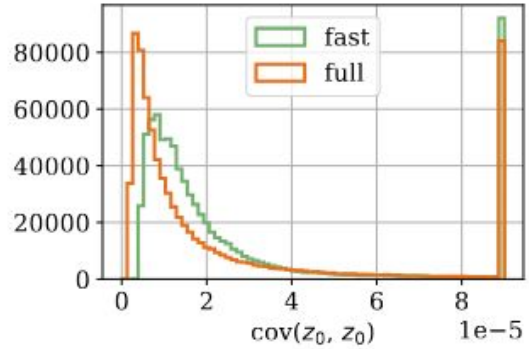
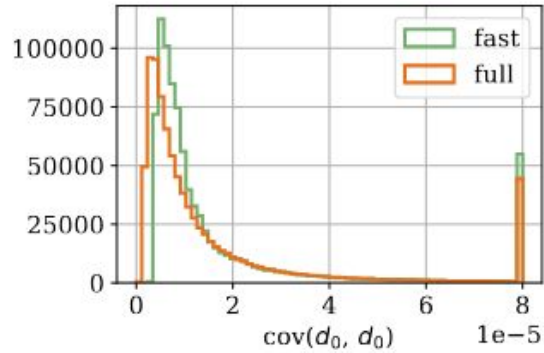
Even with perfect PV (MC), d_0 is not the same in fast vs. full simulation.

Reminder:



Other ideas?

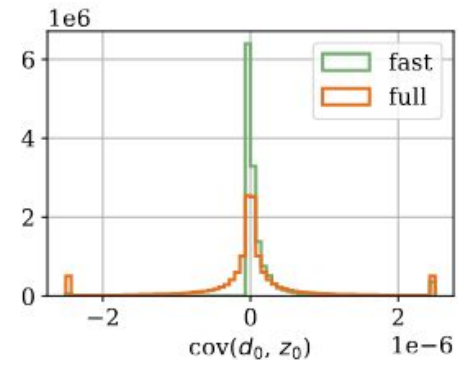
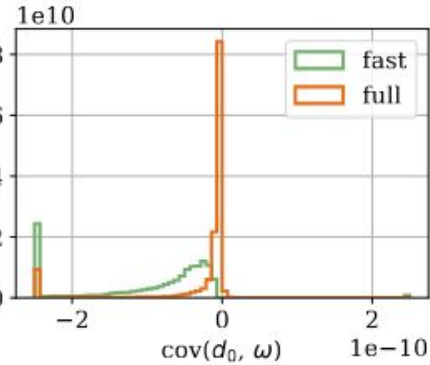
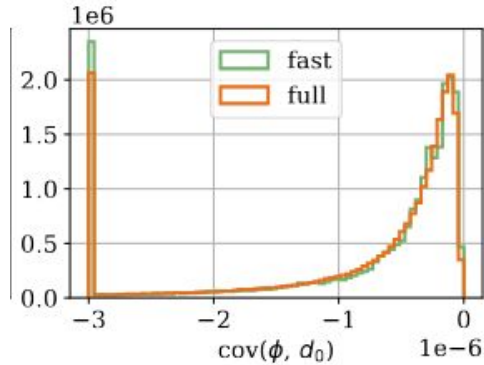
Covariance Matrix of track trajectory - diagonal elements



Retrieved from
`track.covMatrix` directly

-> visible differences,
shapes ok

Covariance Matrix - (selected) off-diagonal elements



- some distributions match
- some are completely off
- some have also different signs

Ideas?

Thanks for all your
help to debug this!

Summary

- d0 discrepancy due to
 - wrong reco PV in full sim
 - and other unknown issues
- Discrepancy in covariance matrix - no fixes yet
- Fixes:
 - beam spot constraints match beam parameters for different cm energies
 - vertex smearing is applied only once
 - reconstruction of PV considers beam spot smearing