ACTS Integration for B0 Trackers

Sakib Rahman
University of Manitoba
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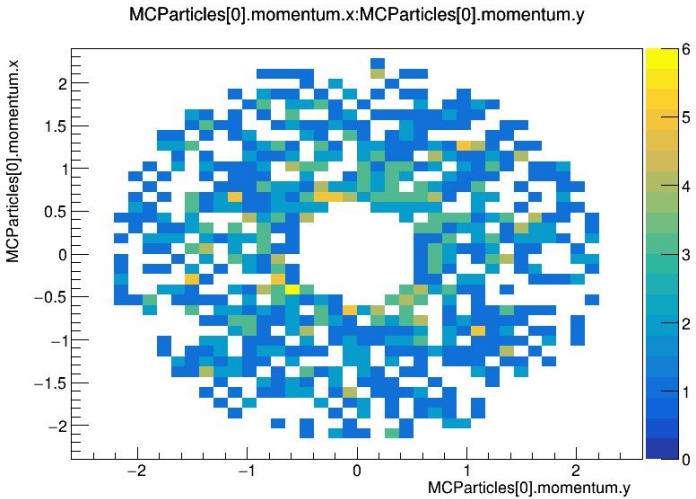
To Do List from Last Week

1) Understand what changed that's making navigation to B0 work apparently. Make sure that this is not an eicrecon artifact.
2) Only about 20% of generated events give reconstructed momentum. Can this be improved?
3) Test with realistic seeder

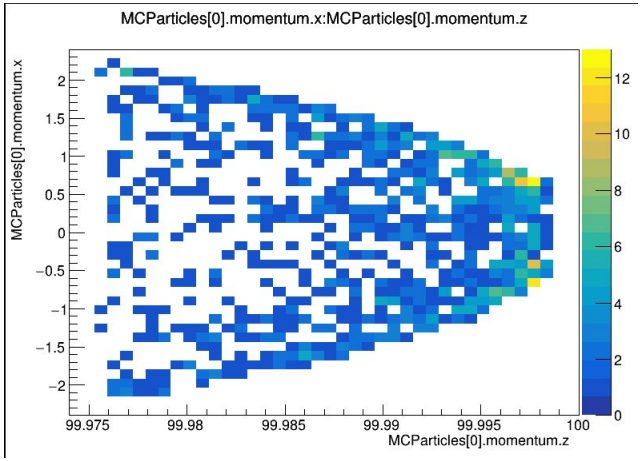
Study with 100 GeV protons

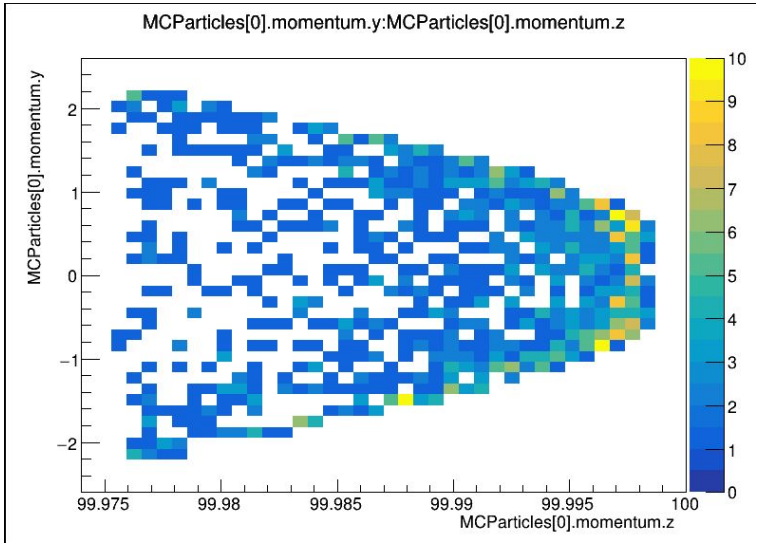
```
from DDSim.DD4hepSimulation import DD4hepSimulation
from g4units import mm, GeV, MeV, mrad
SIM = DD4hepSimulation()

SIM.enableGun = True
SIM.gun.thetaMin = 6*mrad
SIM.gun.thetaMax = 22*mrad
SIM.gun.momentumMin = 100*GeV
SIM.gun.momentumMax = 100*GeV
SIM.gun.distribution = 'uniform'
SIM.gun.particle = 'proton'
SIM.outputFile = 'result.edm4hep.root'
```

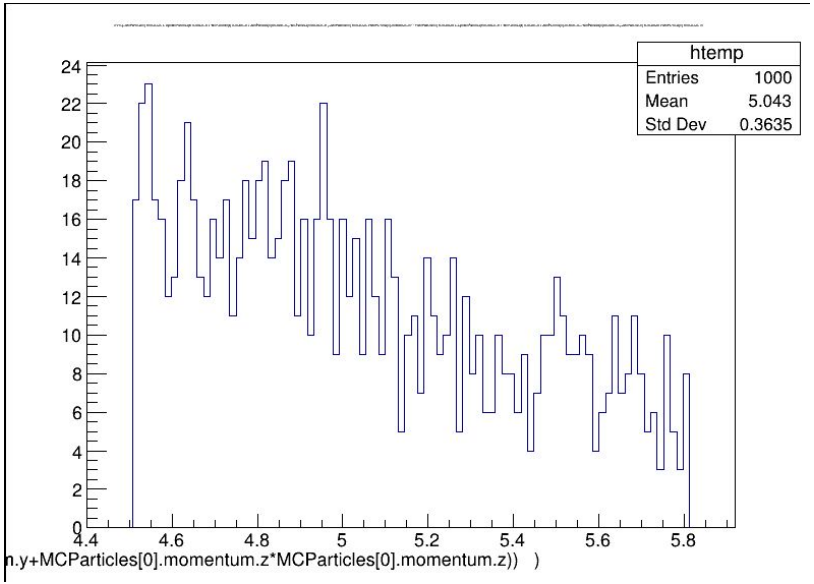


MCParticle[0] correspond to the generated proton

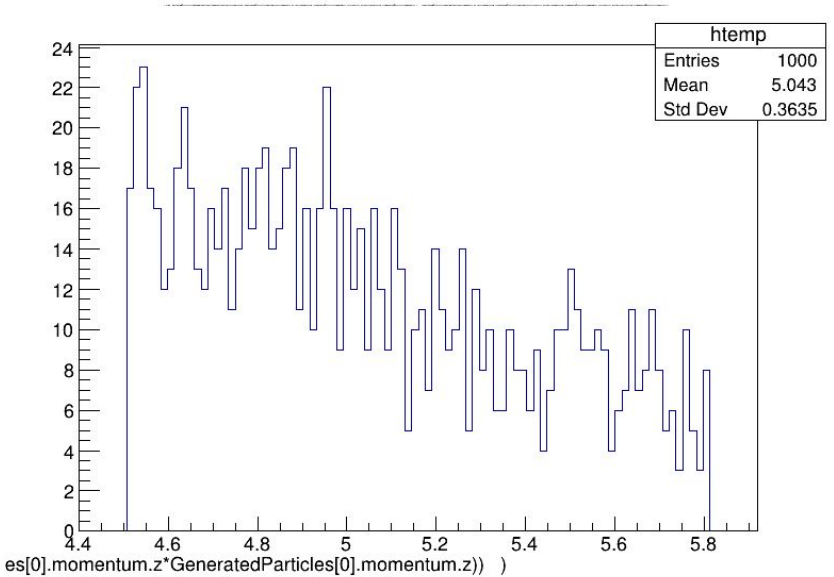




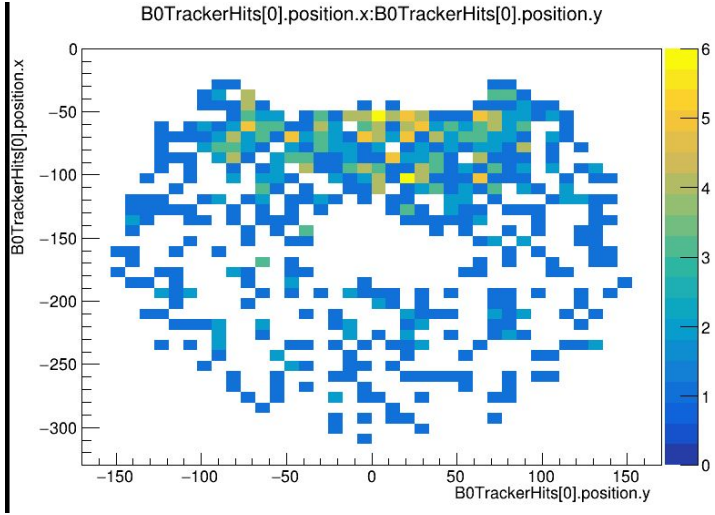
MCParticles Eta Distribution (Full sim root file)



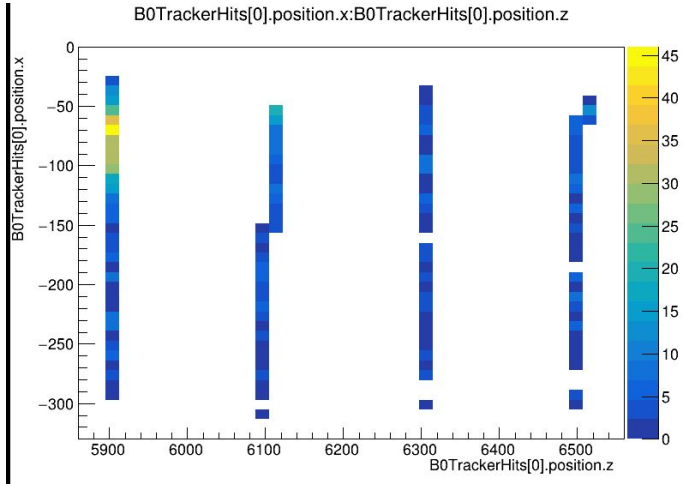
Generated Particles Eta Distribution (Reco root file)

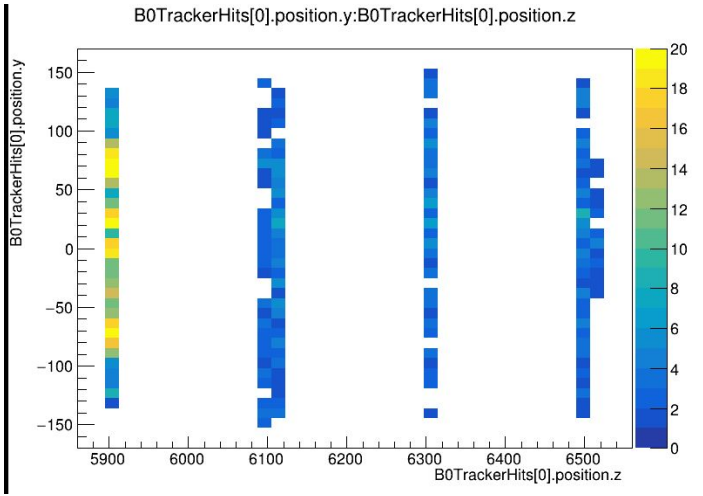


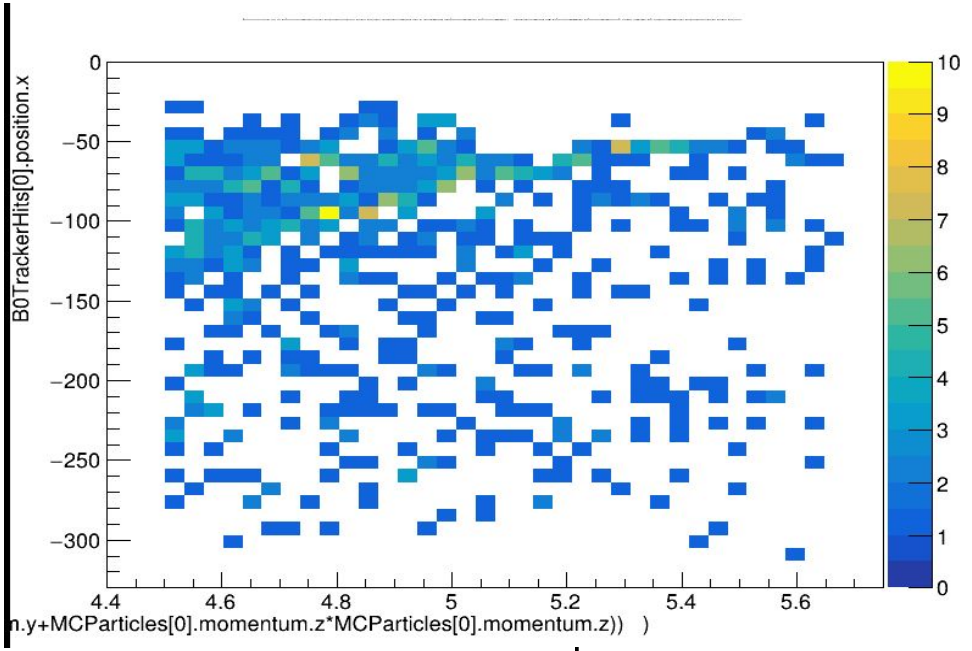
Hits on B0

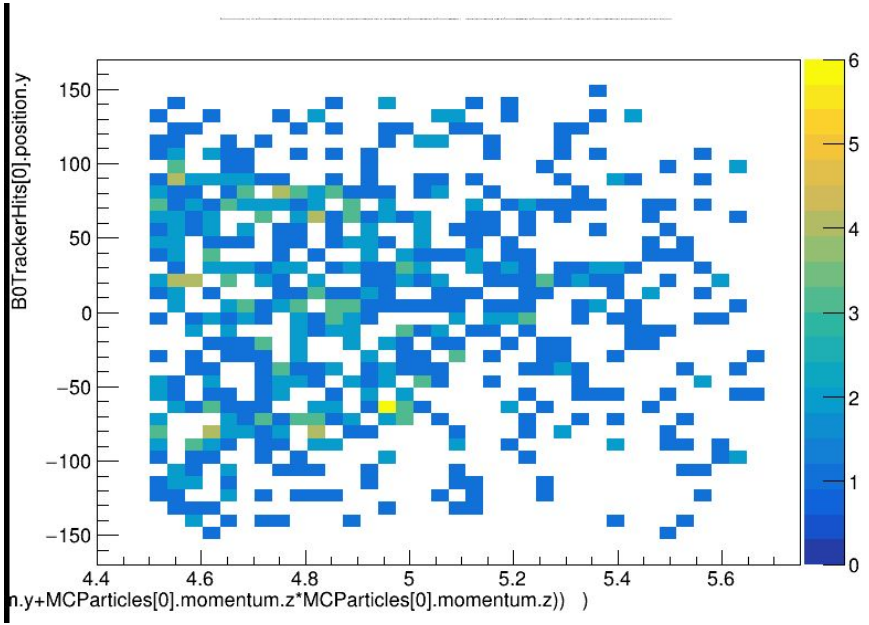


B0TrackerHits[0] is the first hit on any B0 plane for a event (not necessarily the generated proton)

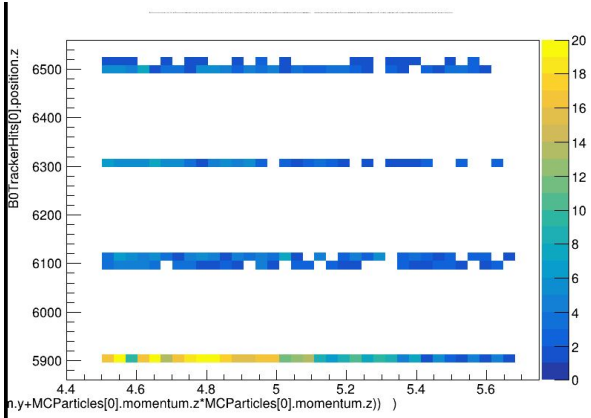


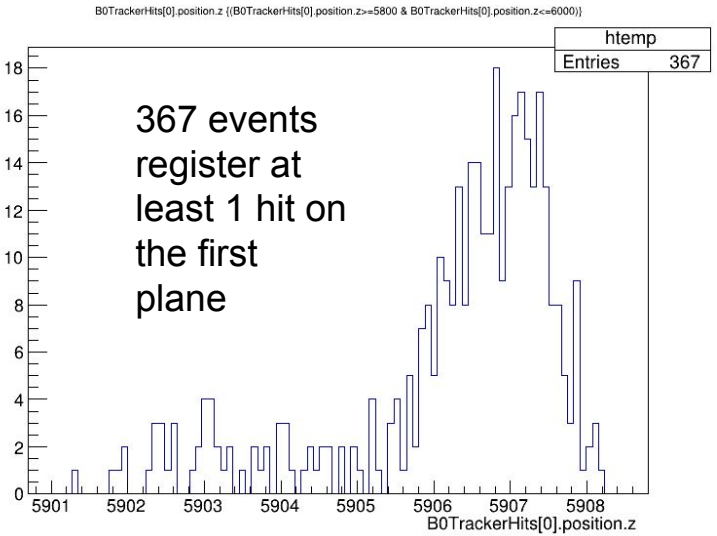




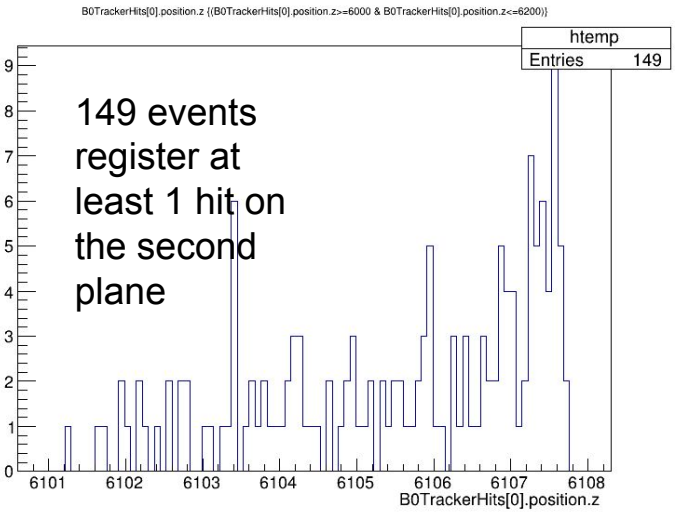


B0HitPosition vs
Eta distribution

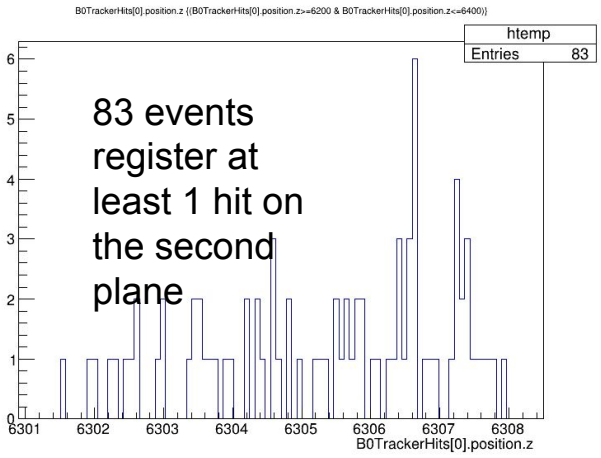




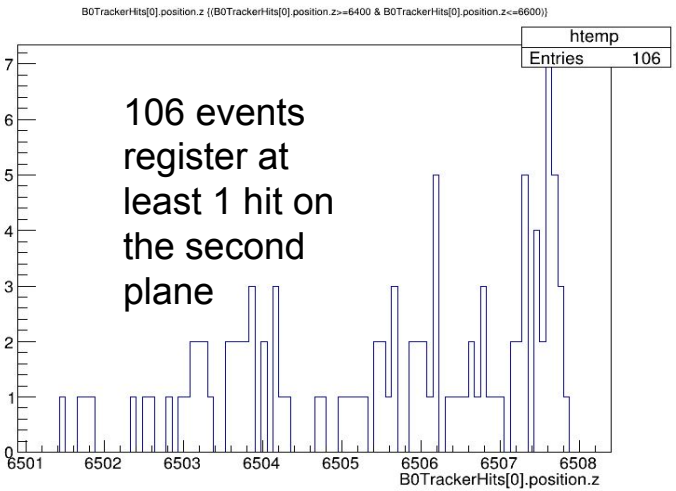
367 events register at least 1 hit on the first plane



149 events register at least 1 hit on the second plane

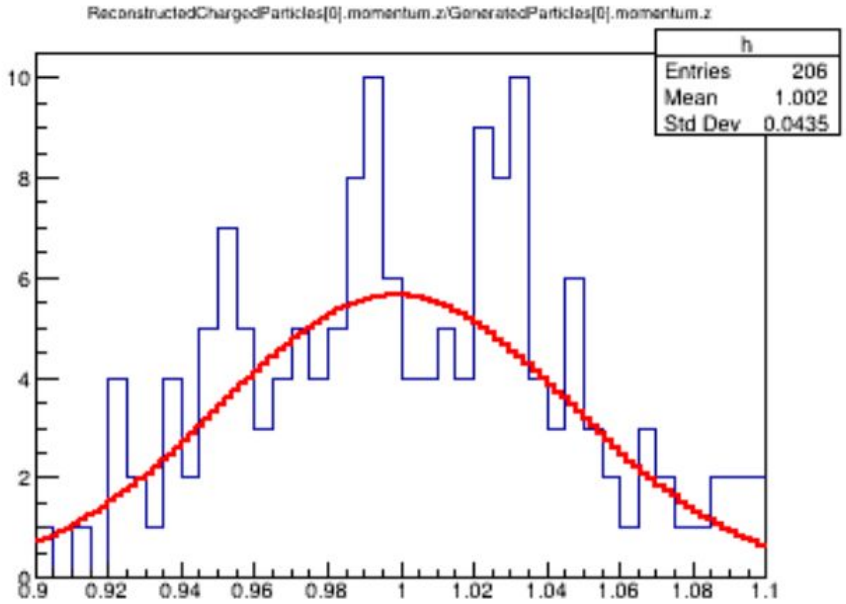


83 events register at least 1 hit on the second plane

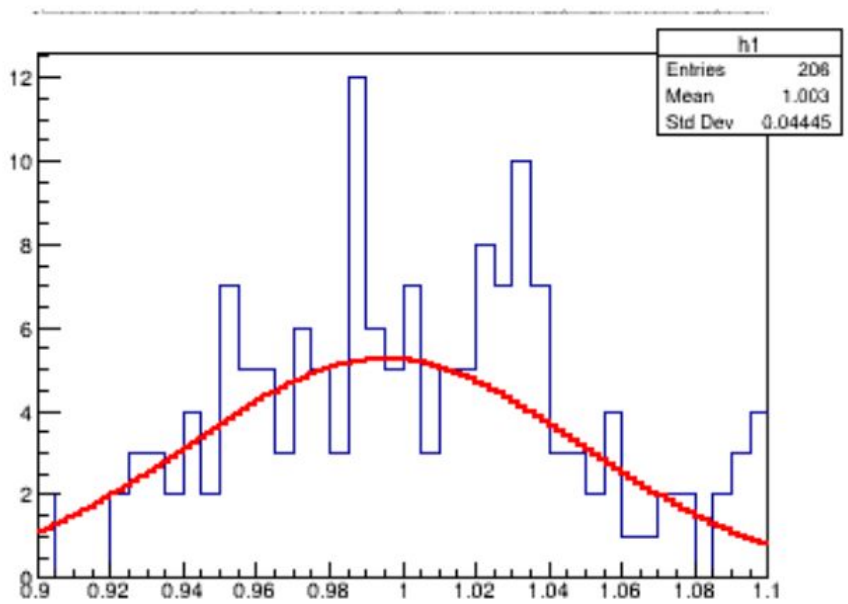


106 events register at least 1 hit on the second plane

Longitudinal

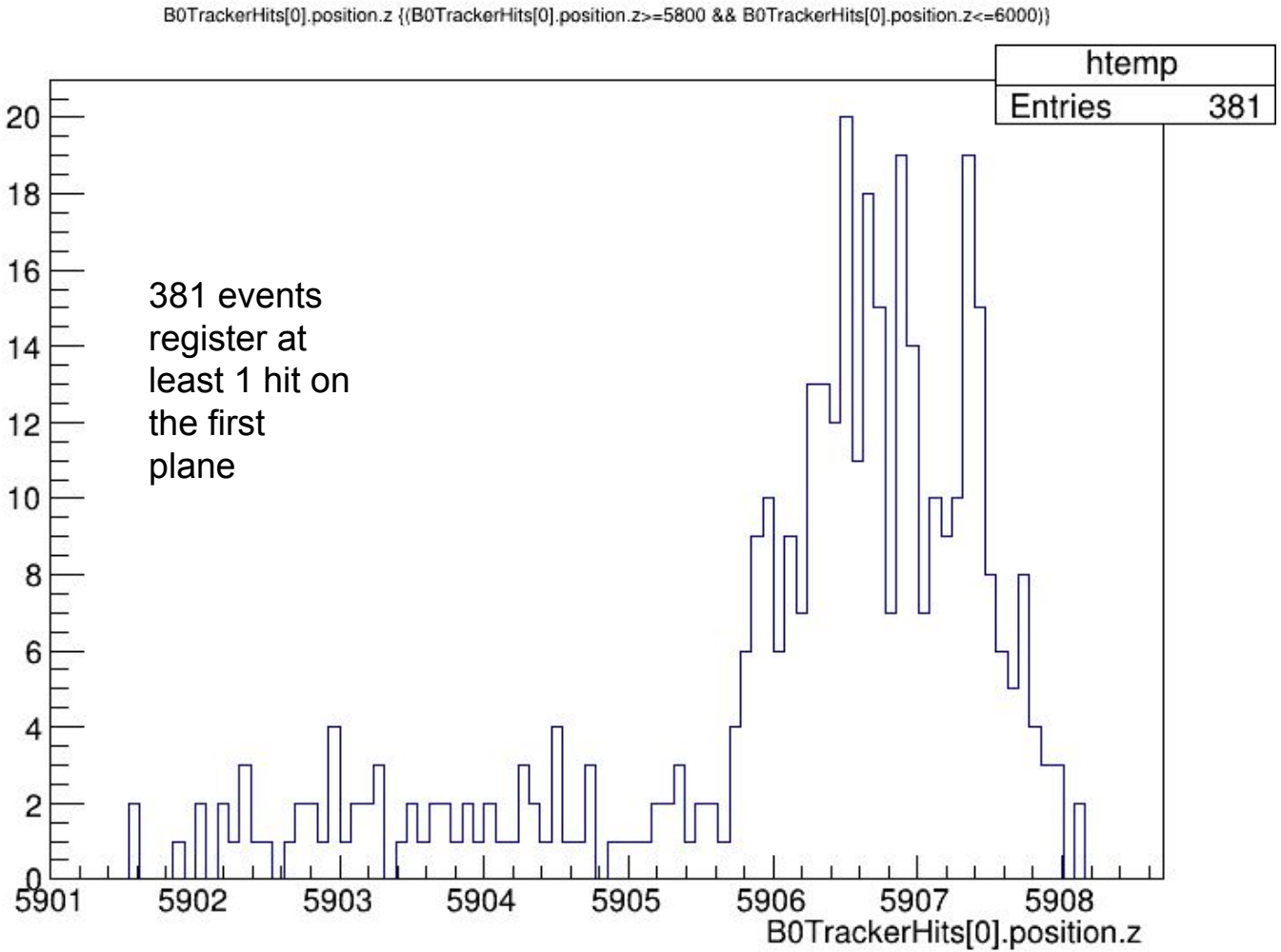


Transverse



206 events out of 1000 get reconstructed momentum

Study with 100 GeV protons
(Main magnetic field turned off)

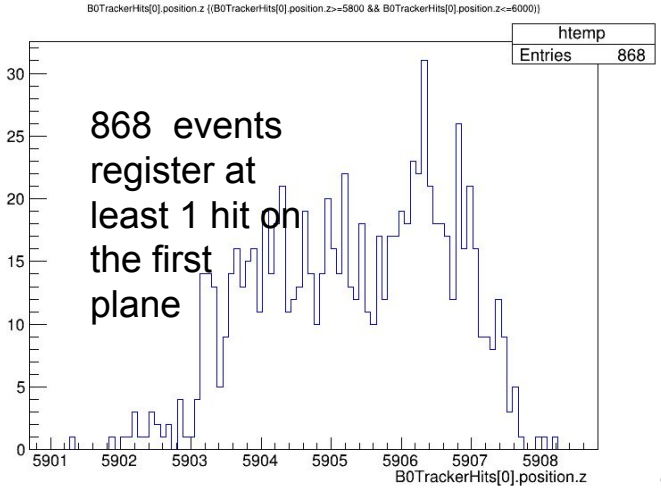


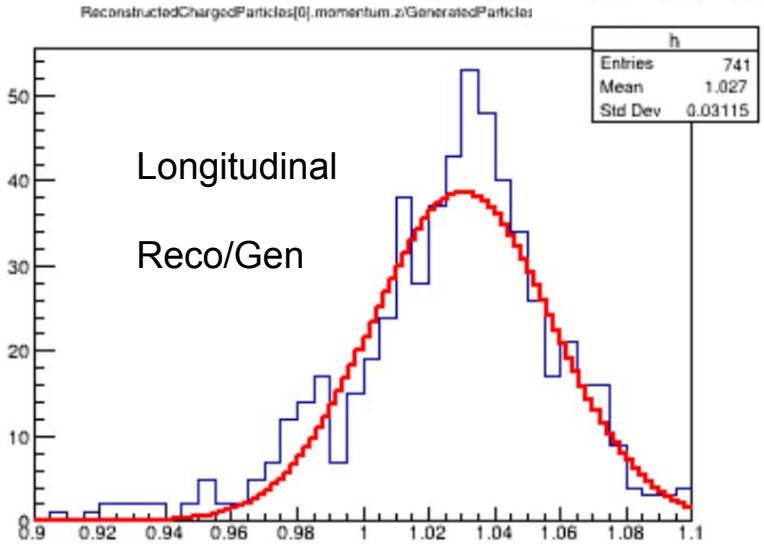
No better than the case with the main field on

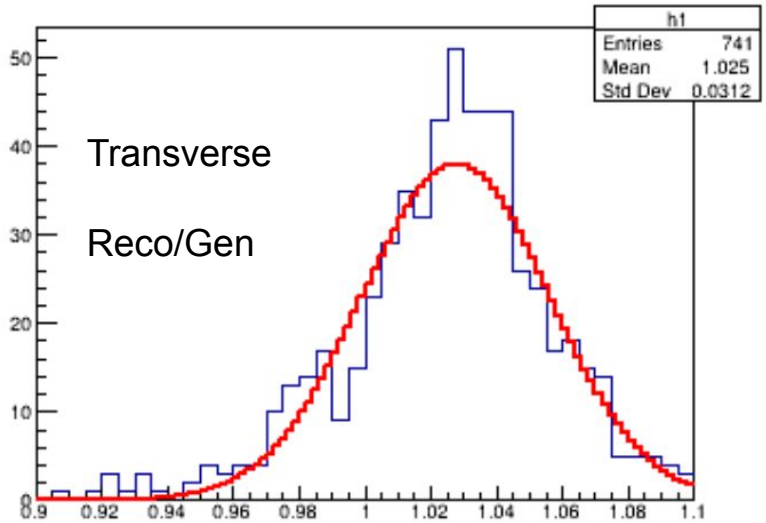
Study with 100 GeV protons
(central magnetic field turned off+apply 25 mrad crossing angle boost)

```
from DDSim.DD4hepSimulation import
DD4hepSimulation
from g4units import mm, GeV, MeV, mrad
SIM = DD4hepSimulation()

SIM.enableGun = True
SIM.gun.thetaMin = 6*mrad
SIM.gun.thetaMax = 22*mrad
SIM.gun.momentumMin = 100*GeV
SIM.gun.momentumMax = 100*GeV
SIM.gun.distribution = 'uniform'
SIM.gun.particle = 'proton'
SIM.outputFile = 'result.edm4hep.root'
SIM.crossingAngleBoost = -25*mrad
```







To Do

1) Understand the skew in the reconstructed/generated momentum distribution plots. Skews left when central magnetic field on and right when central magnetic field off. Could be a DD4hep related issue (https://github.com/AIDASoft/DD4hep/pull/1080) but needs more investigation.
2) Test with full tracking geometry and crossing angle boost applied.
3) The axis range in reco/gen momentum plots is restricted. Check how badly the outliers fail.
4) Test with realistic seeder
5) Check B0Tracker has reasonable default thresholds in eicrecon.
6) Understand the effect of track quality cuts
7) Understand what changed that's making acts navigation to B0 work now compared to a few months ago.