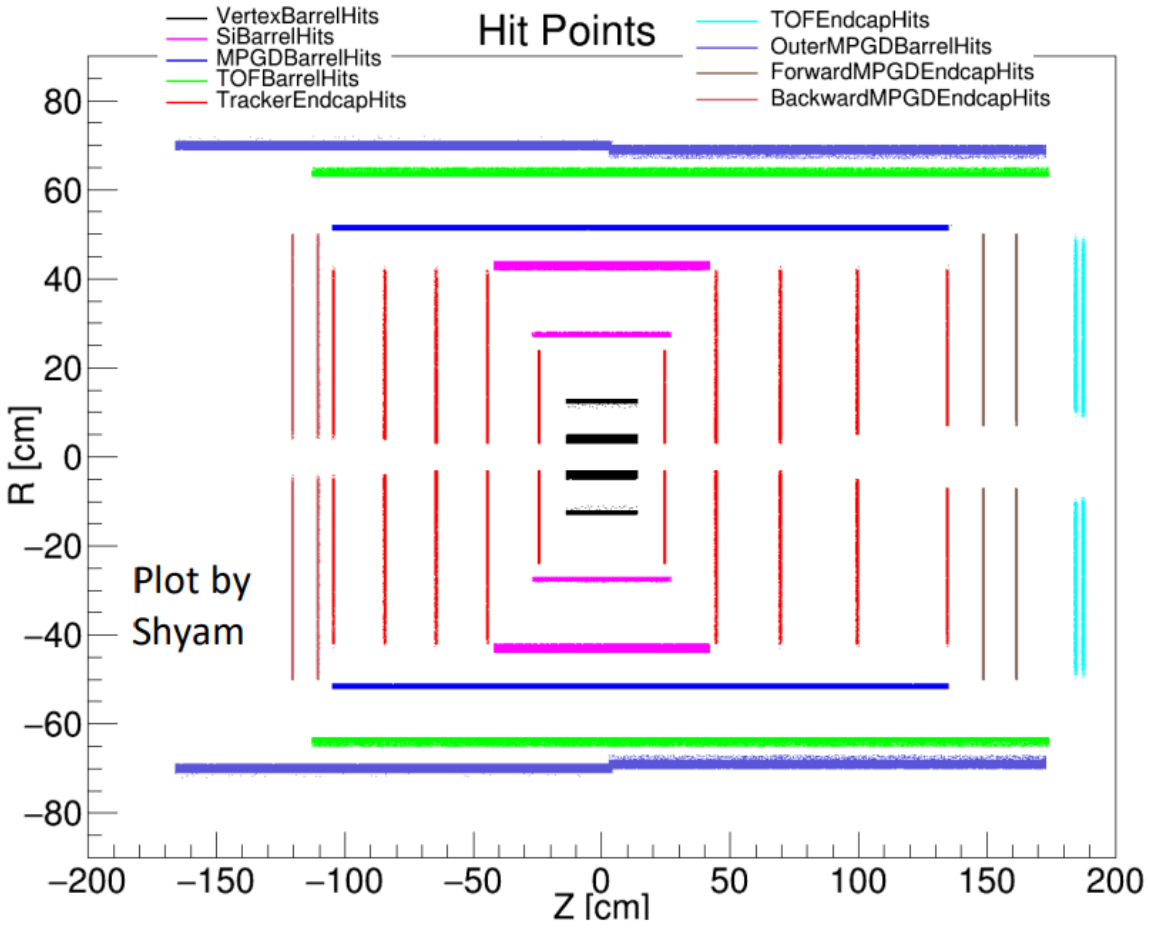
Realistic seeding in the *CraterLake* configuration

Barak Schmookler

Outline

- Single-particle seeding results with updated tracking configuration
- First look at seeding with single-particle + background. Thank you to Kolja for helping create the mixed event files!
- Ongoing work

Seed finding in updated tracking configuration



ACTS seed finder and filter parameters

Parameter	Description	Value
bFieldInZ	z component of magnetic field	1.7 T
rMax	Maximum r value to look for seeds	440 mm
rMin	Minimum r value to look for seeds	33 mm
zMin	Minimum z value to look for seeds	-1500 mm
zMax	Maximum z value to look for seeds	1700 mm
beamPosX	Beam offset in x	0
beamPosY	Beam offset in y	0
deltaRMinTopSP	Min distance in r between middle and top SP in one seed	**10 mm**
deltaRMinBottomSP	Min distance in r between middle and bottom SP in one seed	**10 mm**
deltaRMaxTopSP	Max distance in r between middle and top SP in one seed	**200 mm**
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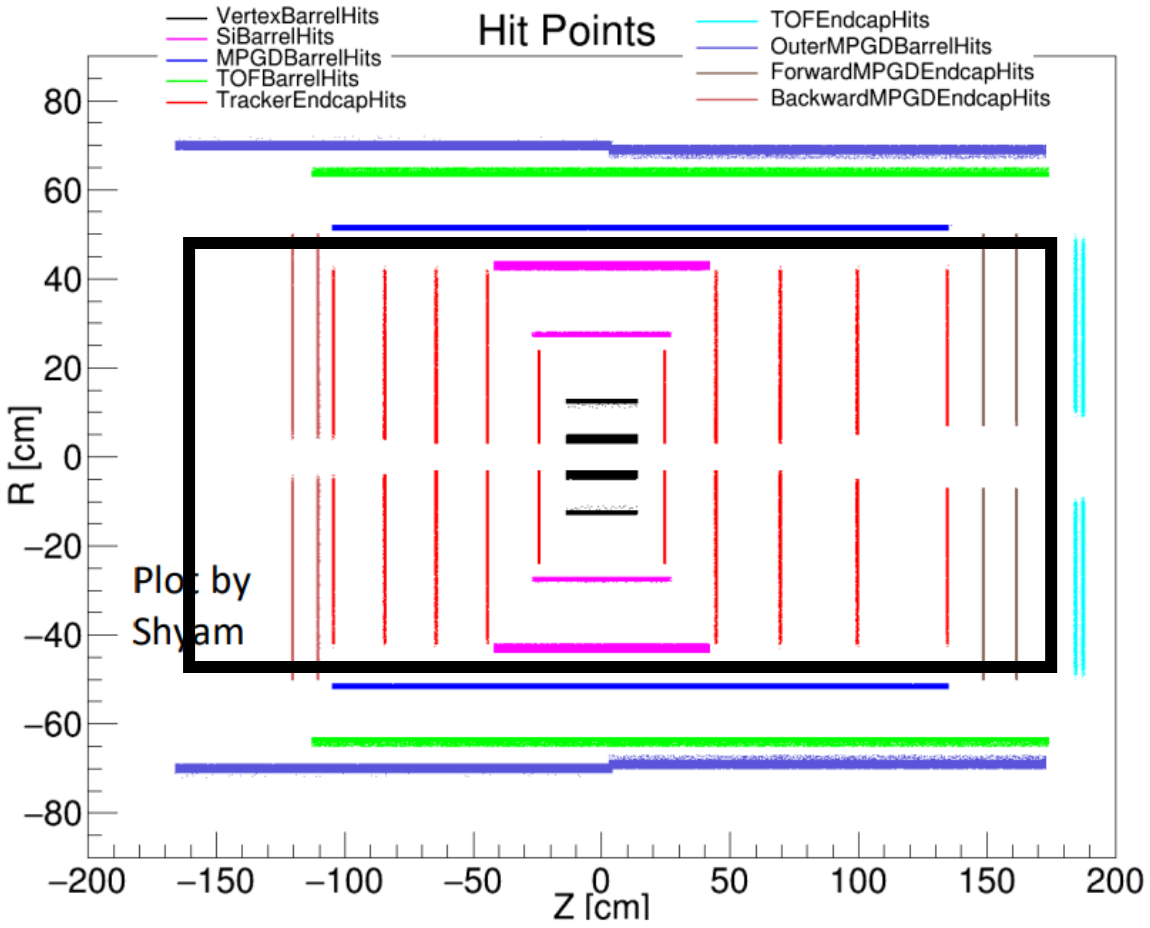
collisionRegionMin	Min z for primary vertex	-250 mm
collisionRegionMax	Max z for primary vertex	250 mm
cotThetaMax	Cotangent of max theta angle	**27.29**
minPt	Min transverse momentum	100 MeV/cotThetaMax
maxSeedsPerSpM	Max number of seeds a single middle space point can belong to - 1	0
sigmaScattering	How many standard devs of scattering angles to consider	5
radLengthPerSeed	Average radiation lengths of material on the length of a seed	0.1
impactMax	Max transverse PCA allowed	3 mm
rMinMiddle	Min R for middle space point	20 mm
rMaxMiddle	Max R for middle space point	400 mm
bFieldMin	min B field	0.1

Seed finding in updated tracking configuration



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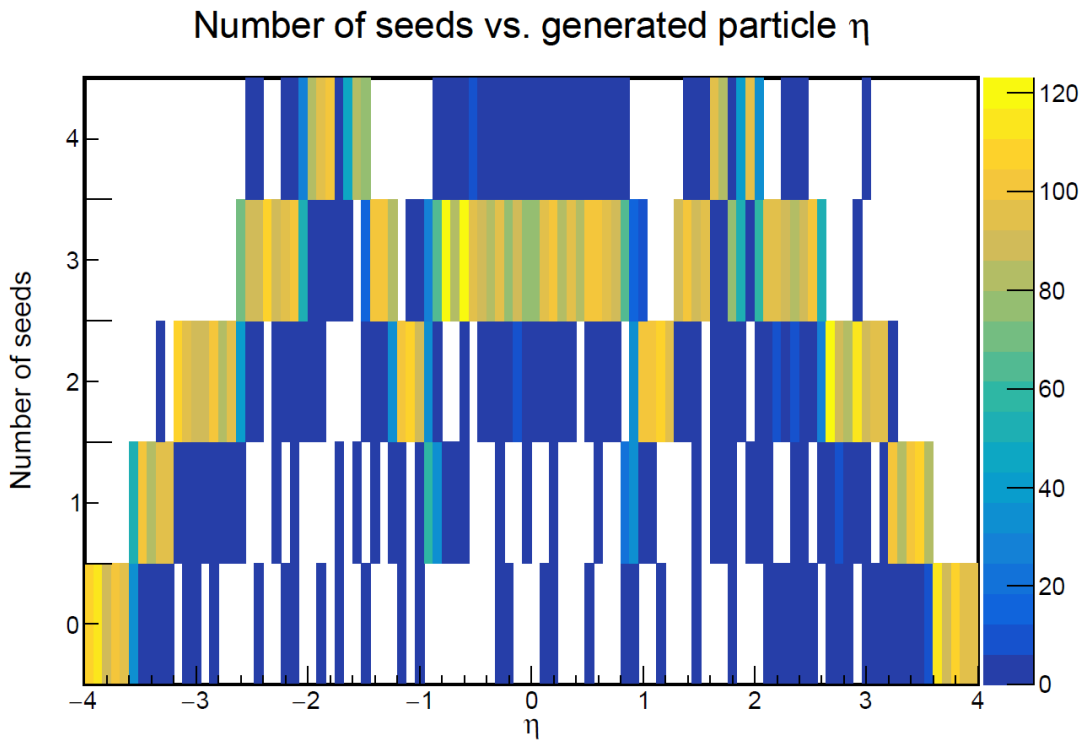
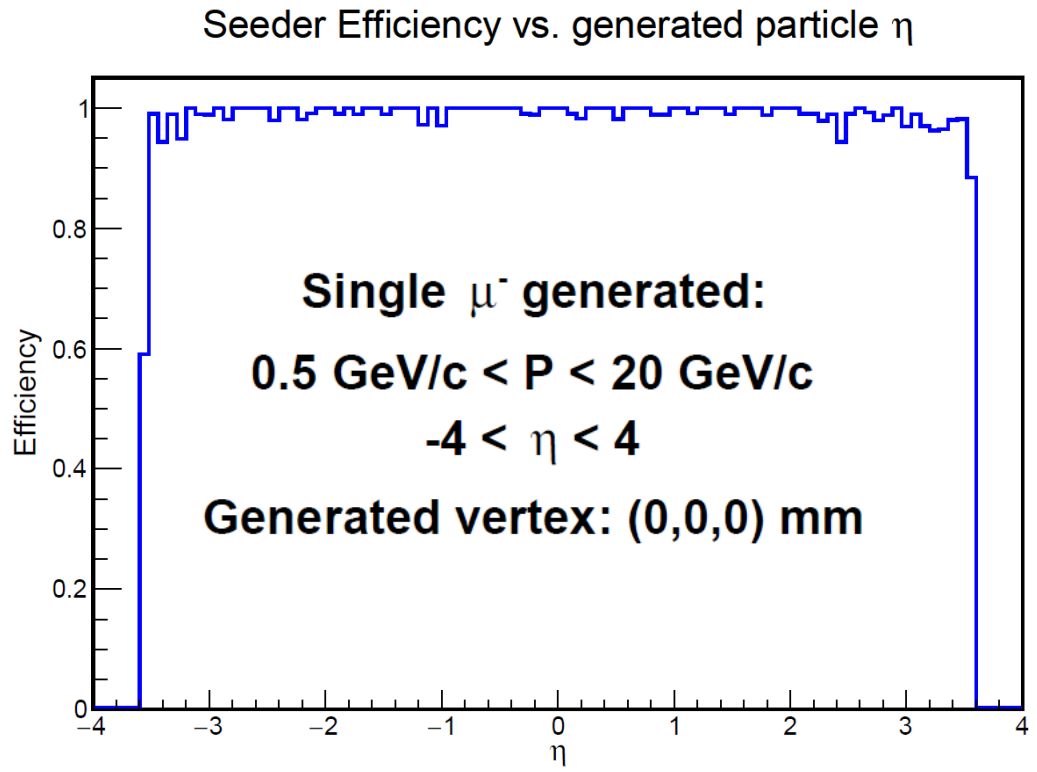
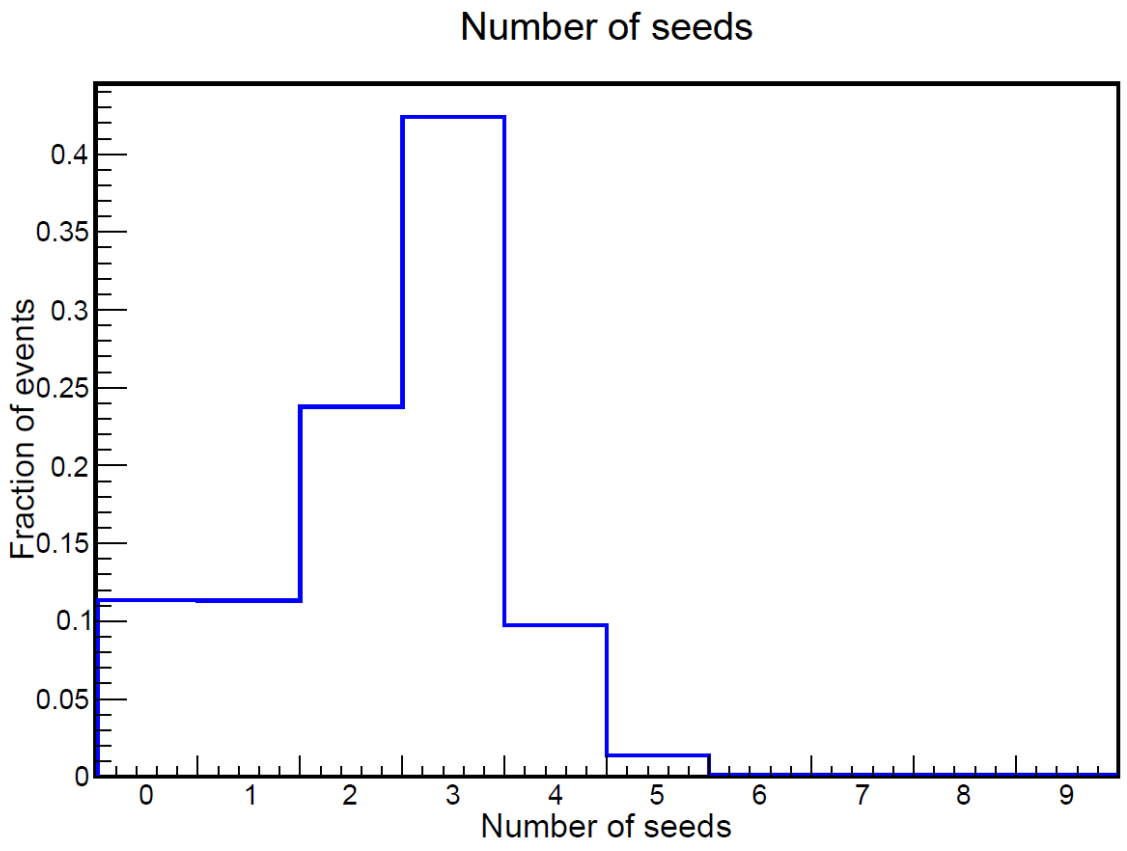
Seed efficiency/multiplicity





An efficient event is defined as one where at least one seed is found. We see high efficiency with a single particle simulation for -3.5 < η < 3.5.

Seed multiplicity – why do we see many events with 3 seeds?



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Seed multiplicity – why do we see many events with 3 seeds?

If we have a particle at mid-rapidity which hits layers L0, L1, L2, L3, and L4, then we can make the following combinations:

1. L0,L1,L2
2. L0,L2,L3
3. L0,L3,L4
4. ✖ L0,L1,L3
5. ✖ L0,L1,L4
6. ✖ L0,L2,L4
7. ✖ L1,L2,L3
8. ✖ L1,L2,L4
9. ✖ L1,L3,L4
10. ✖ L2,L3,L4

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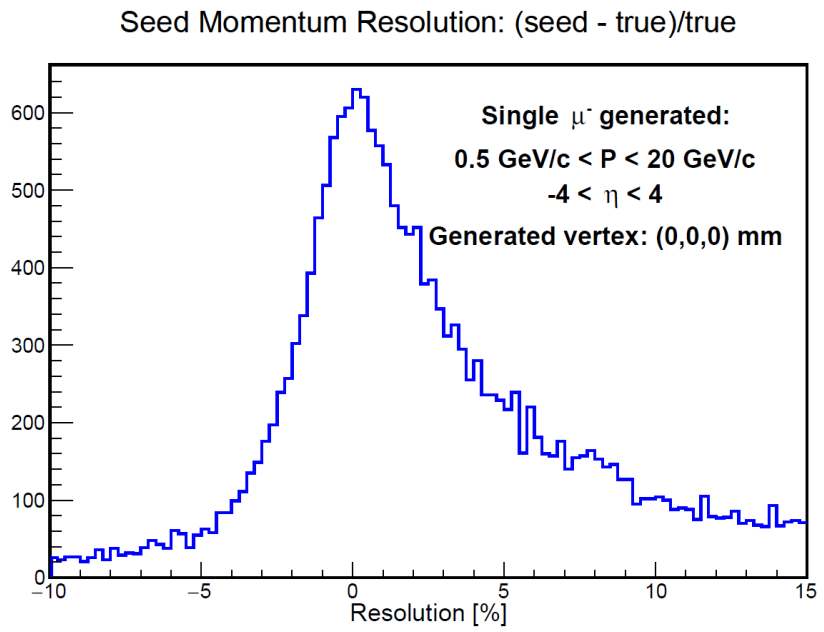
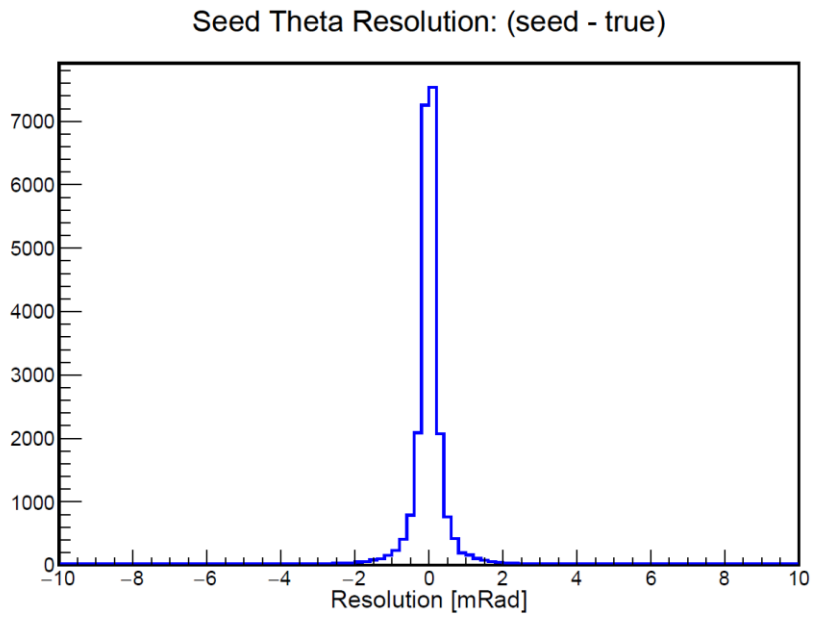
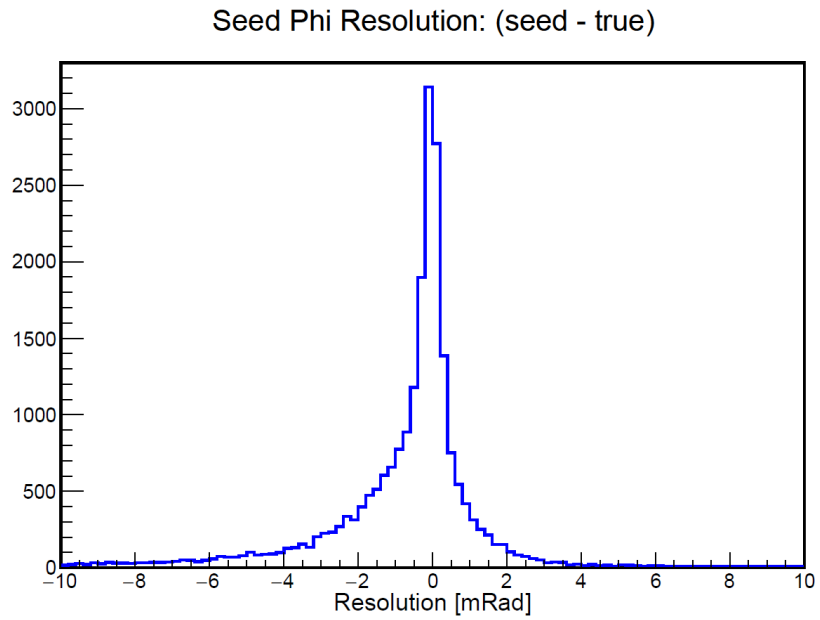
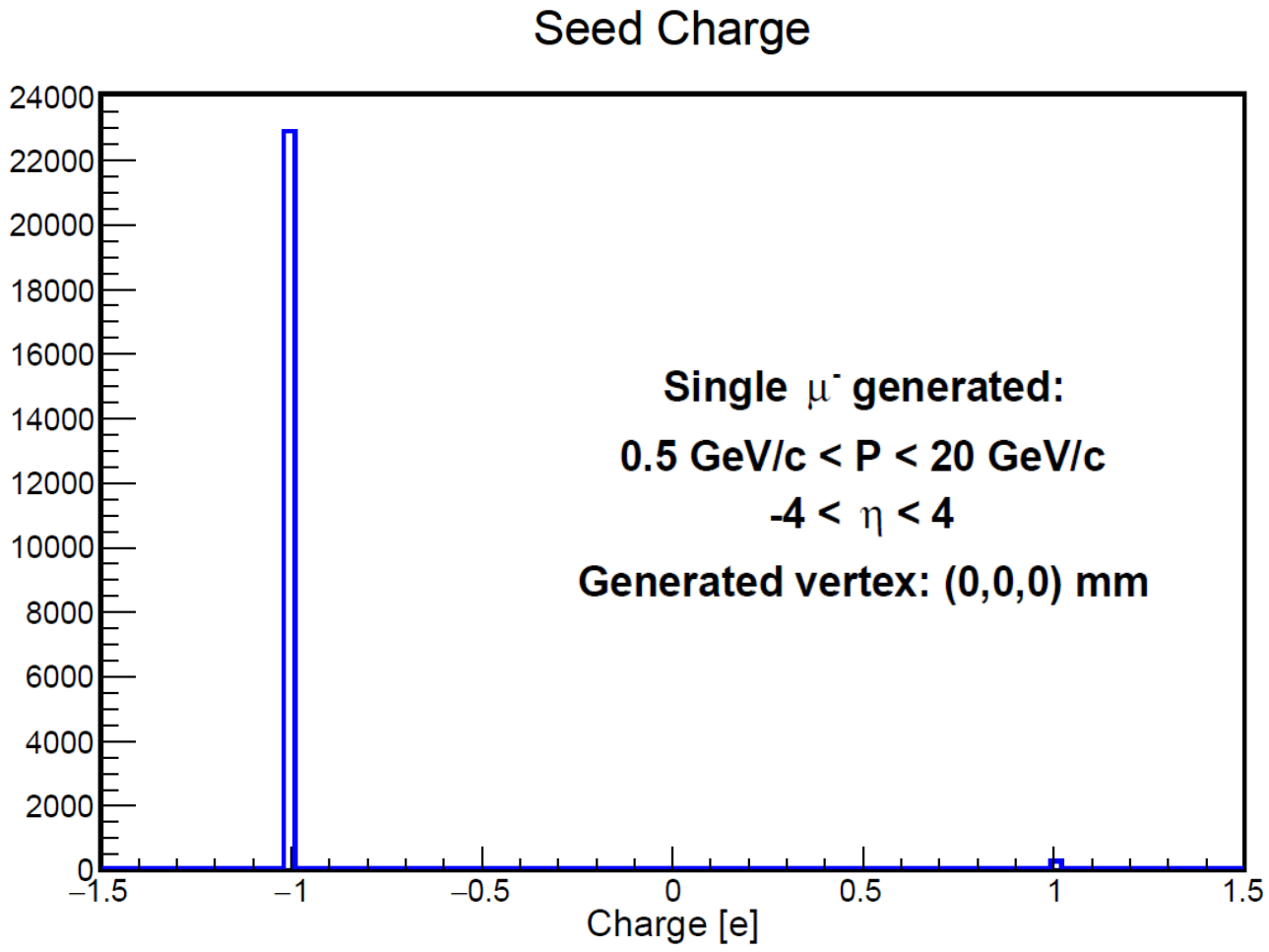
Seed angle and momentum reconstruction

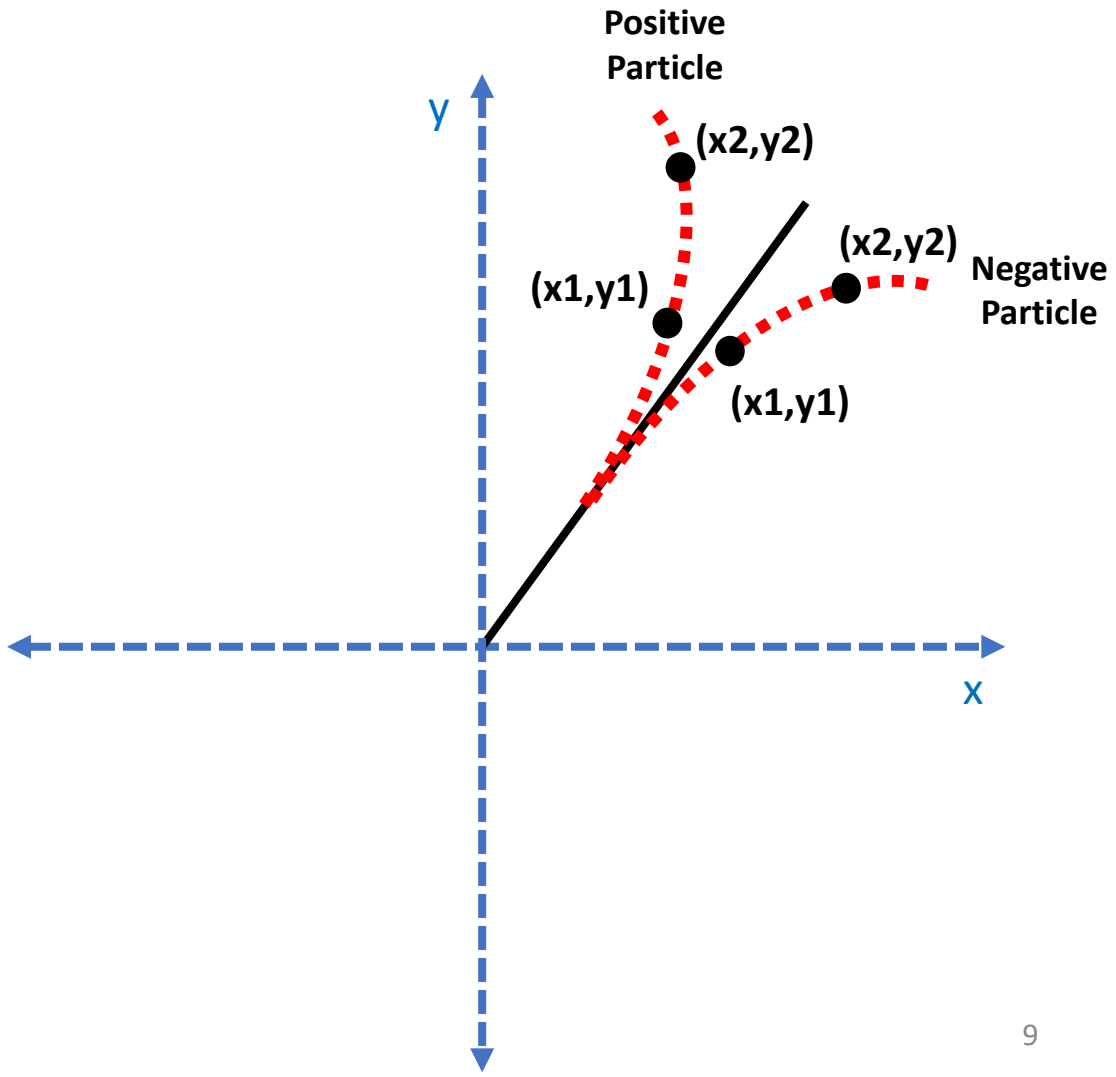






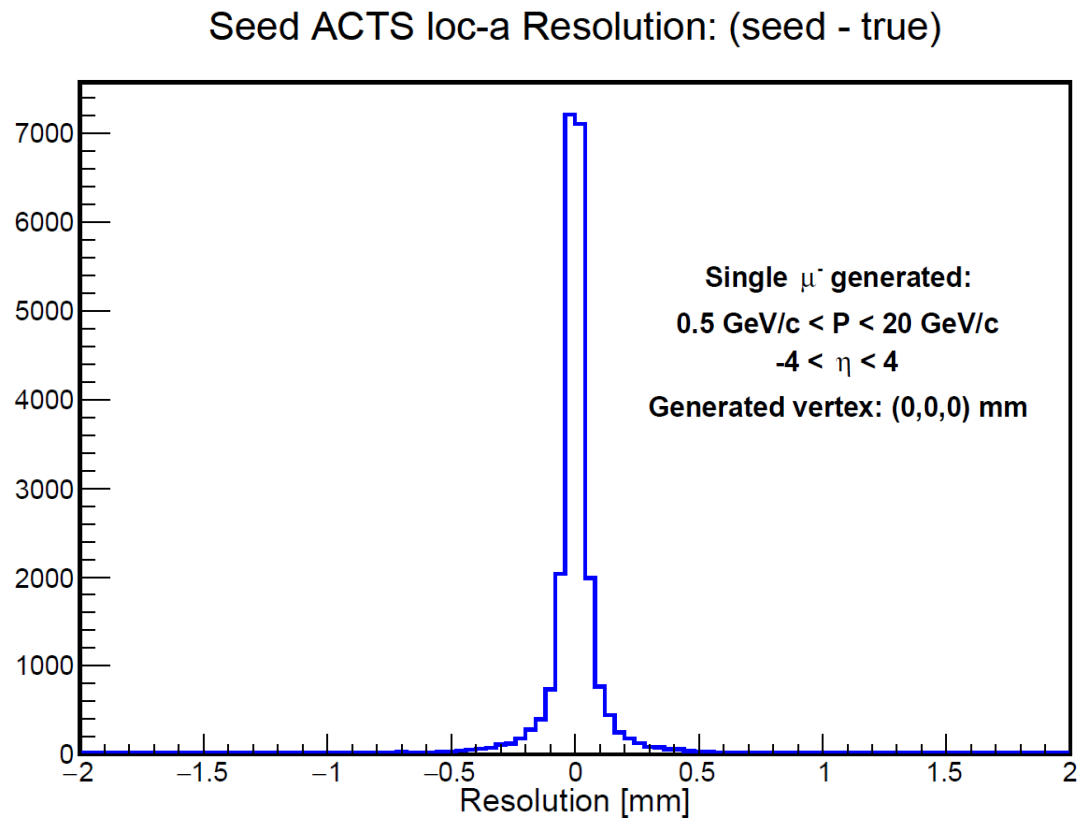
Seed charge reconstruction



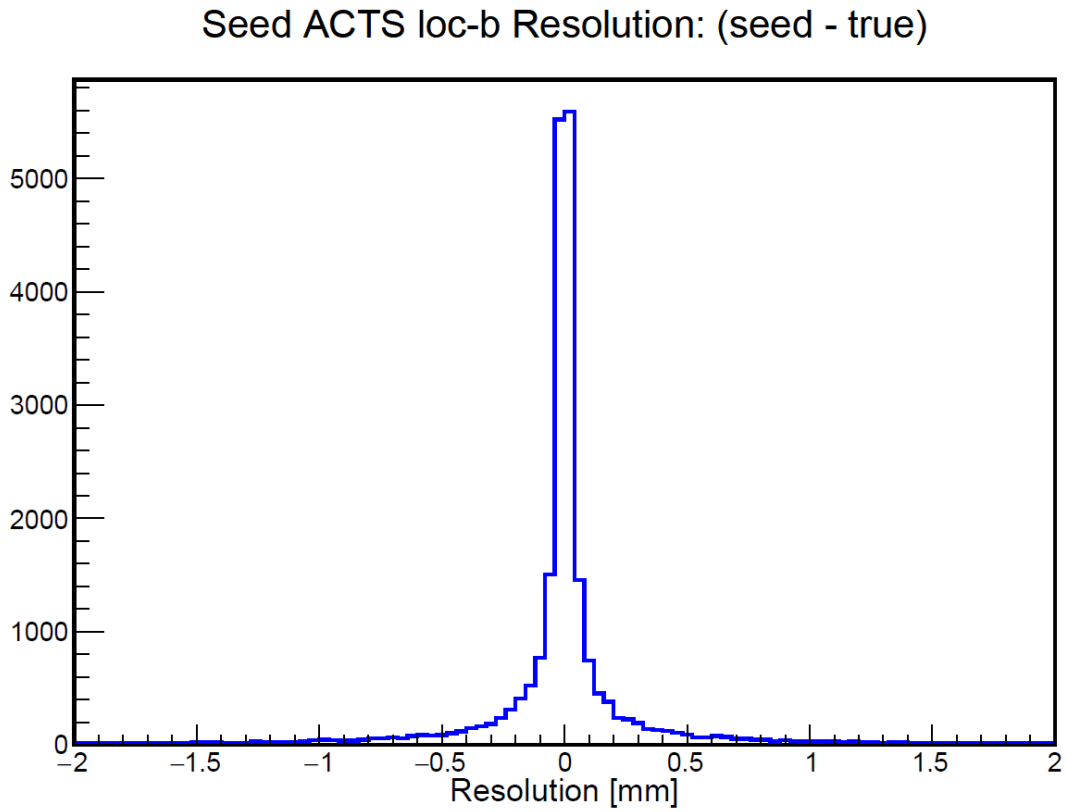


Seed position reconstruction

ACTS loc-a is the point of closest approach to the origin in the x-y plane.



ACTS loc-b is the z intercept (i.e. at r = 0) of linear fit in the r-z plane.

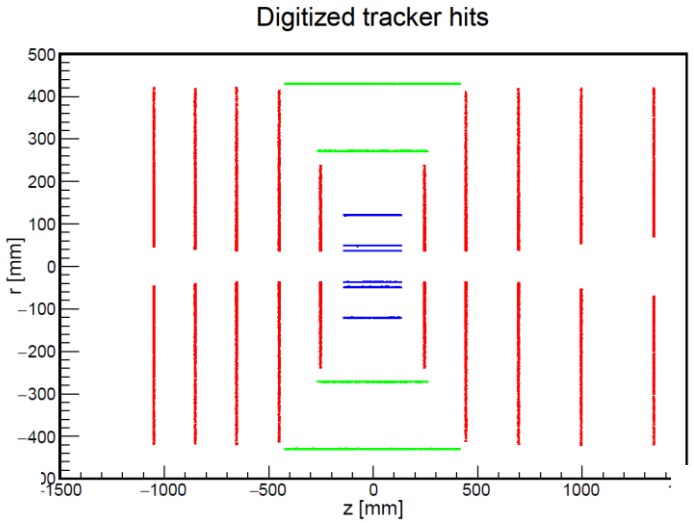


Background mixing

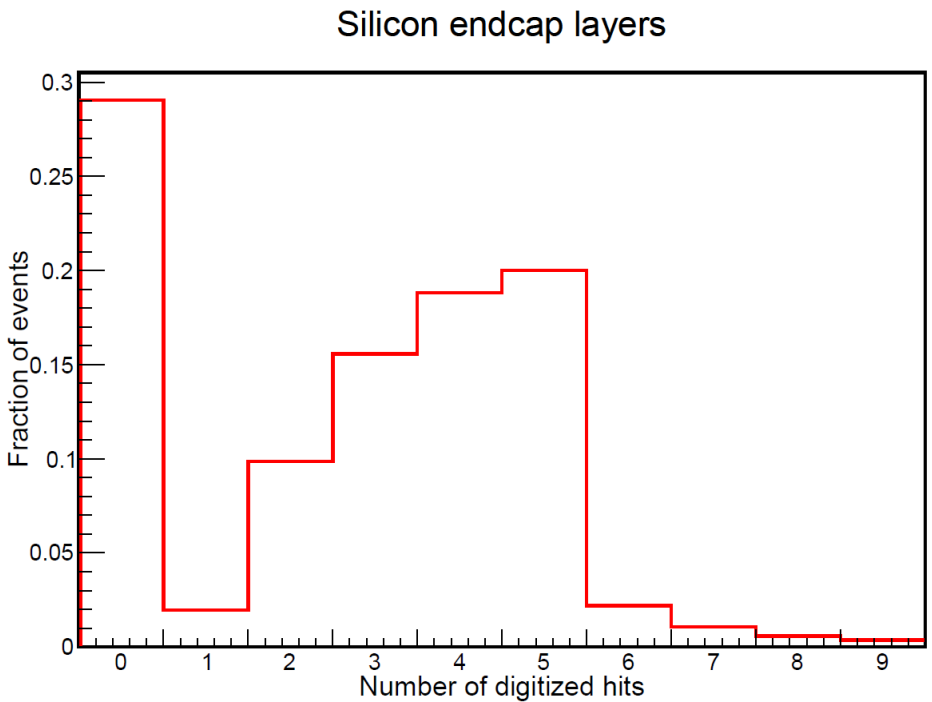
- For each of the 10,000 single-particle events shown above, we mix in three backgrounds – synchrotron radiation (SR), hadron-gas (h-gas), and electron-gas (e-gas) events – and run the mixed HepMC3 file through our detector simulation and reconstruction.
- We use a 2us time slice and take the background rates for the 10x100 eP beam energy setting. Details on the backgrounds can be found here: https://wiki.bnl.gov/EPIC/index.php?title=Background
- The SR can add 5-20k particles per slice; there will be an h-gas event once every three slices on average; and there will be 6 e-gas events per slice on average.

Work in Progress

Digitized hits in the silicon tracking detectors

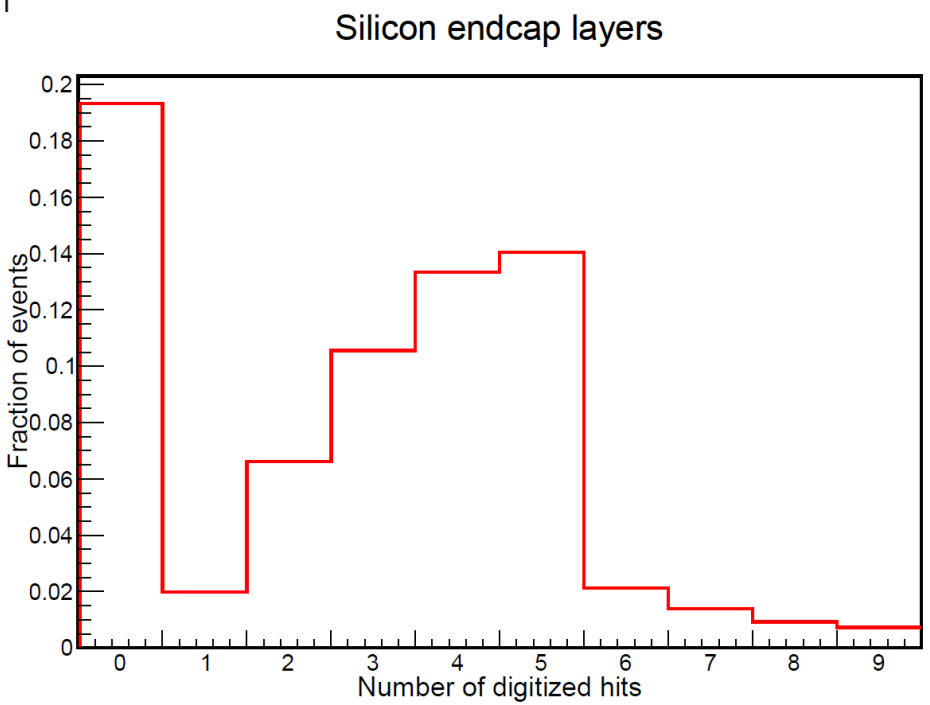


Single muon only



Note: a threshold of 5 KeV is applied in EICRecon for the silicon tracker hits

Single muon + background



Work in Progress

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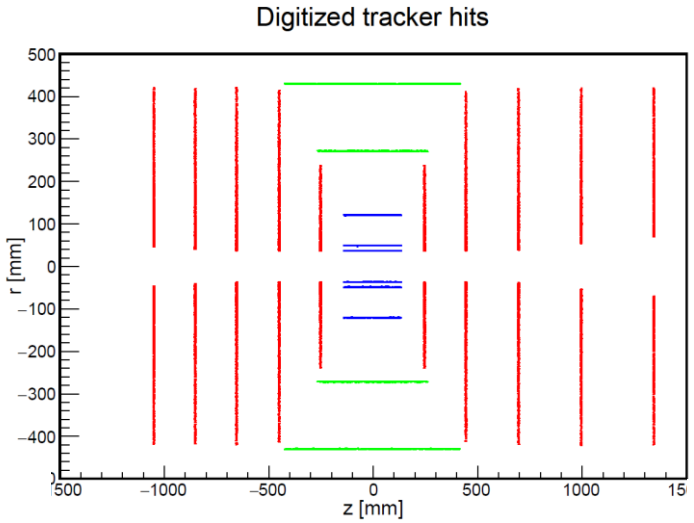
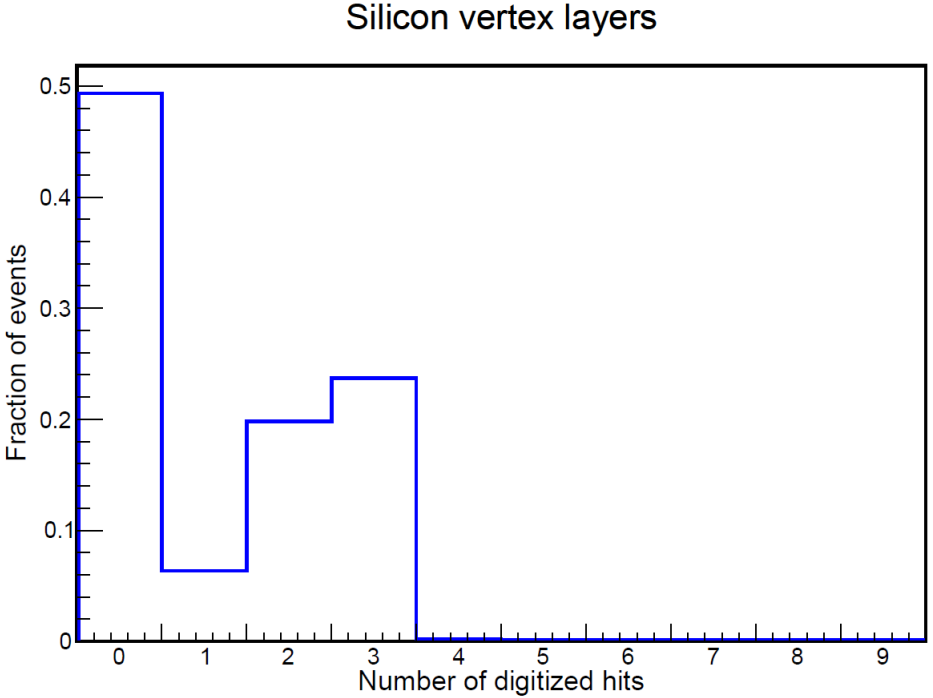


Single muon only



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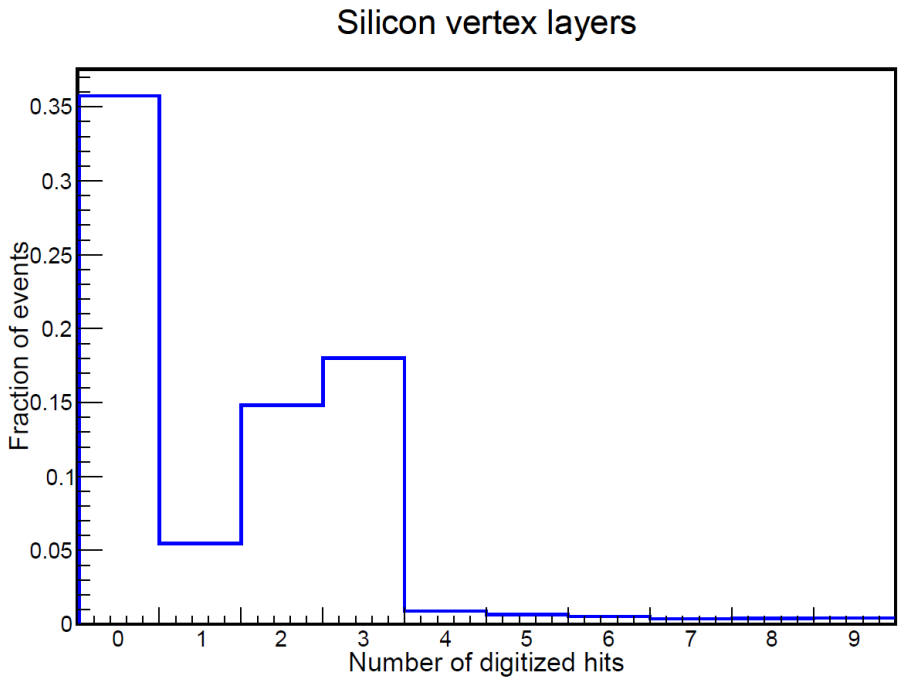
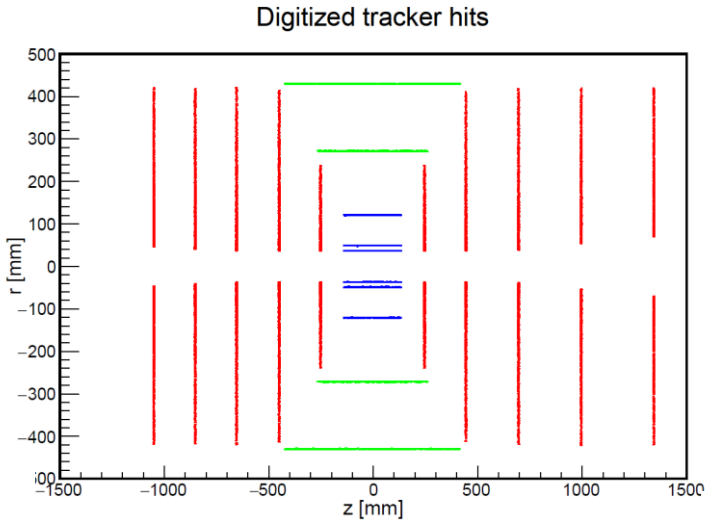


Work in Progress

Digitized hits in the silicon tracking detectors



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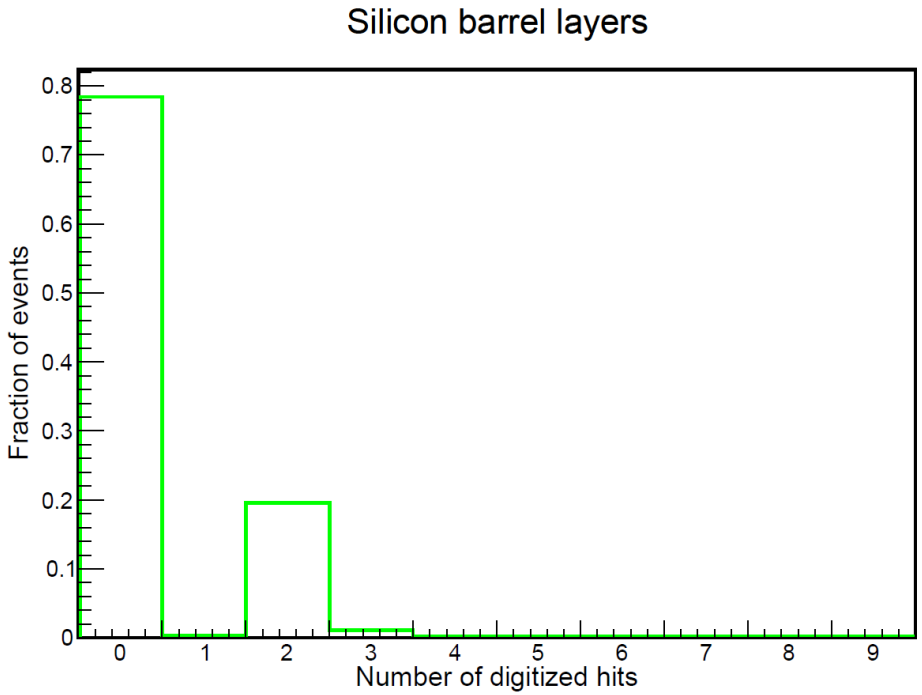

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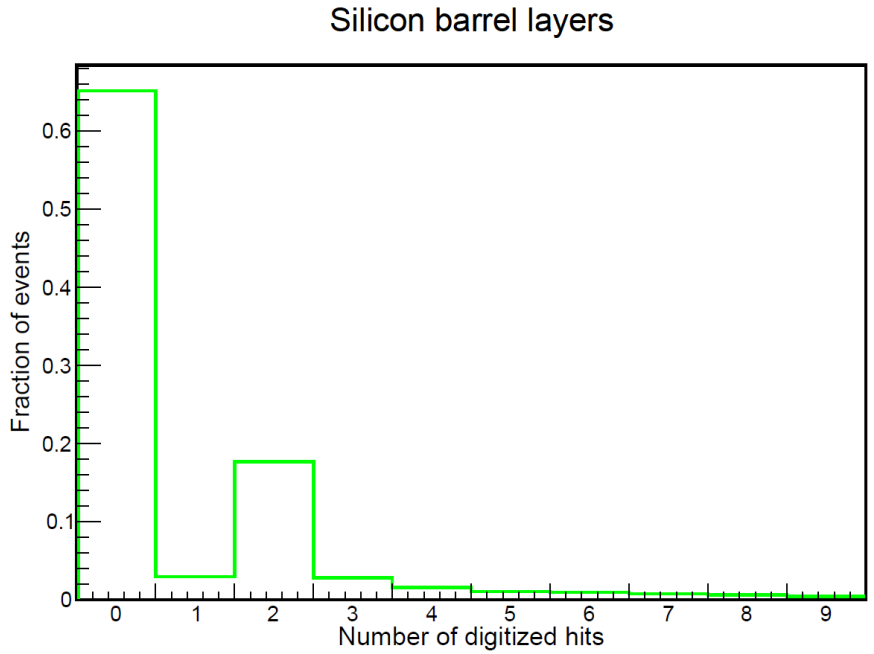
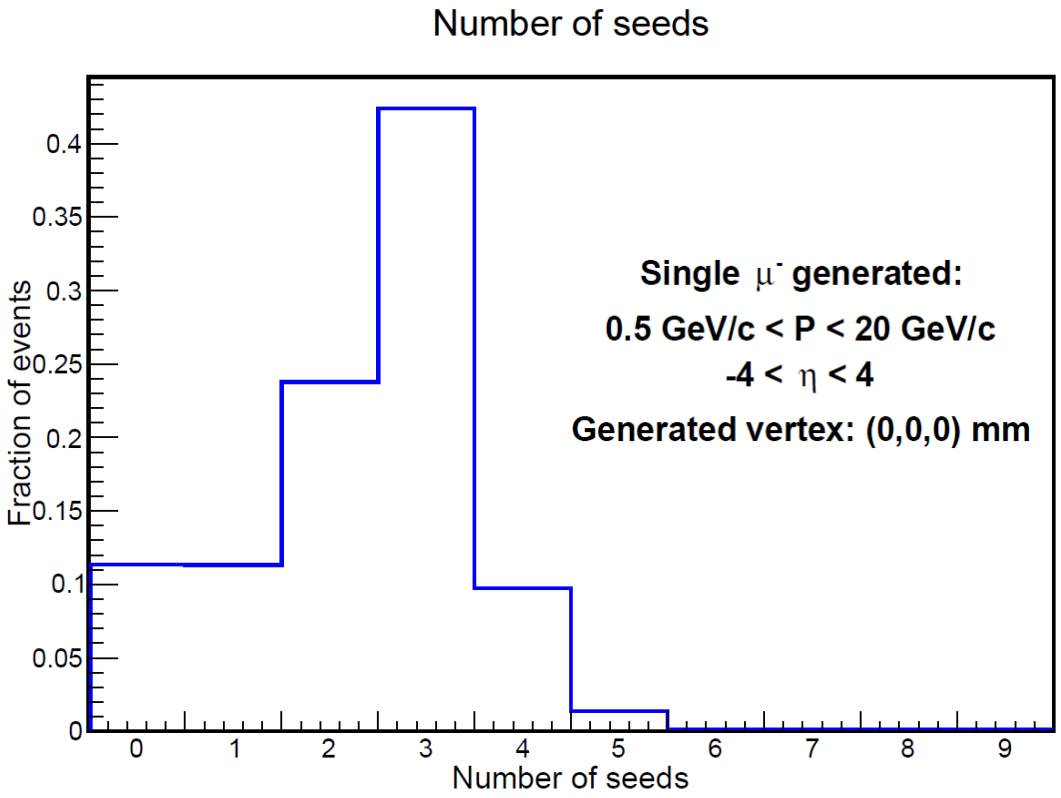


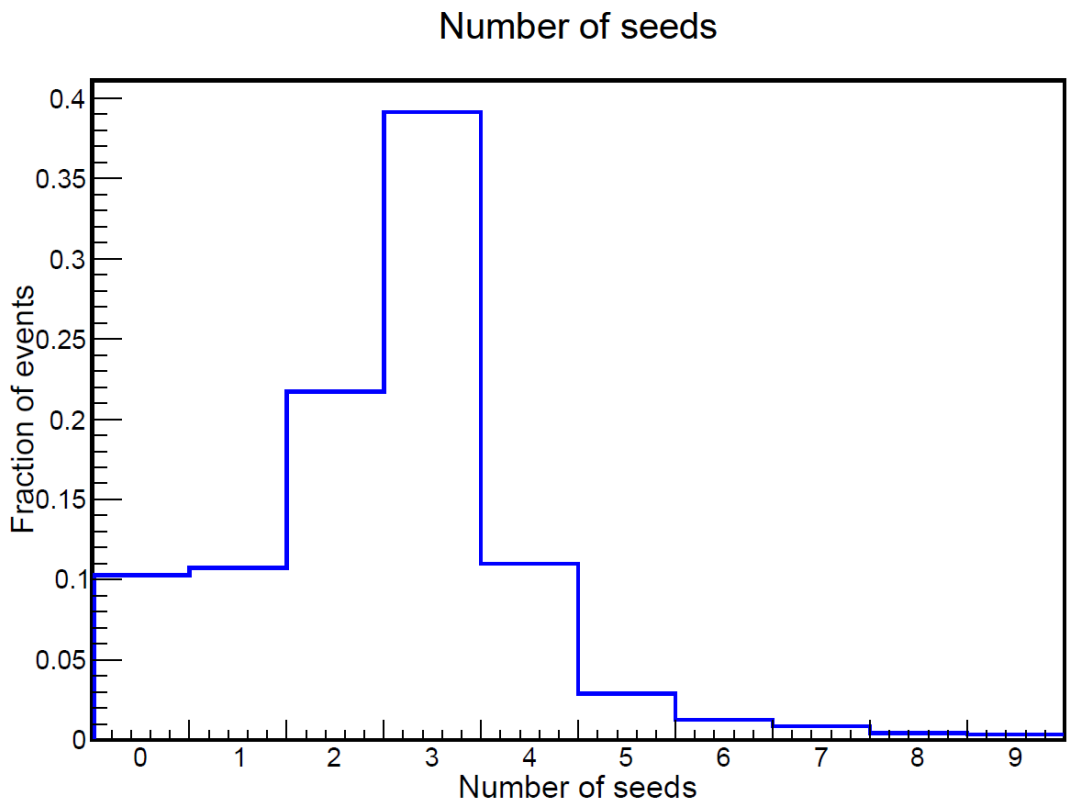
Work in Progress

Seed multiplicity

Single muon only



Single muon + background



Work in Progress

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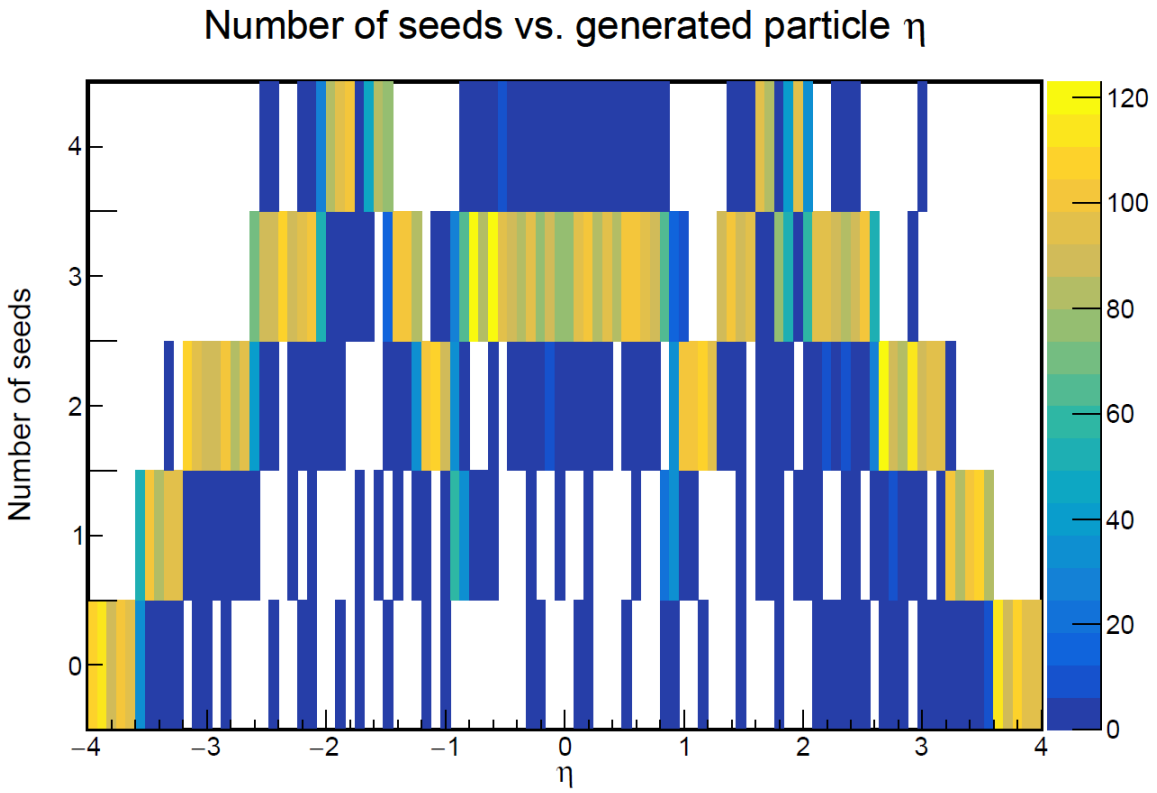

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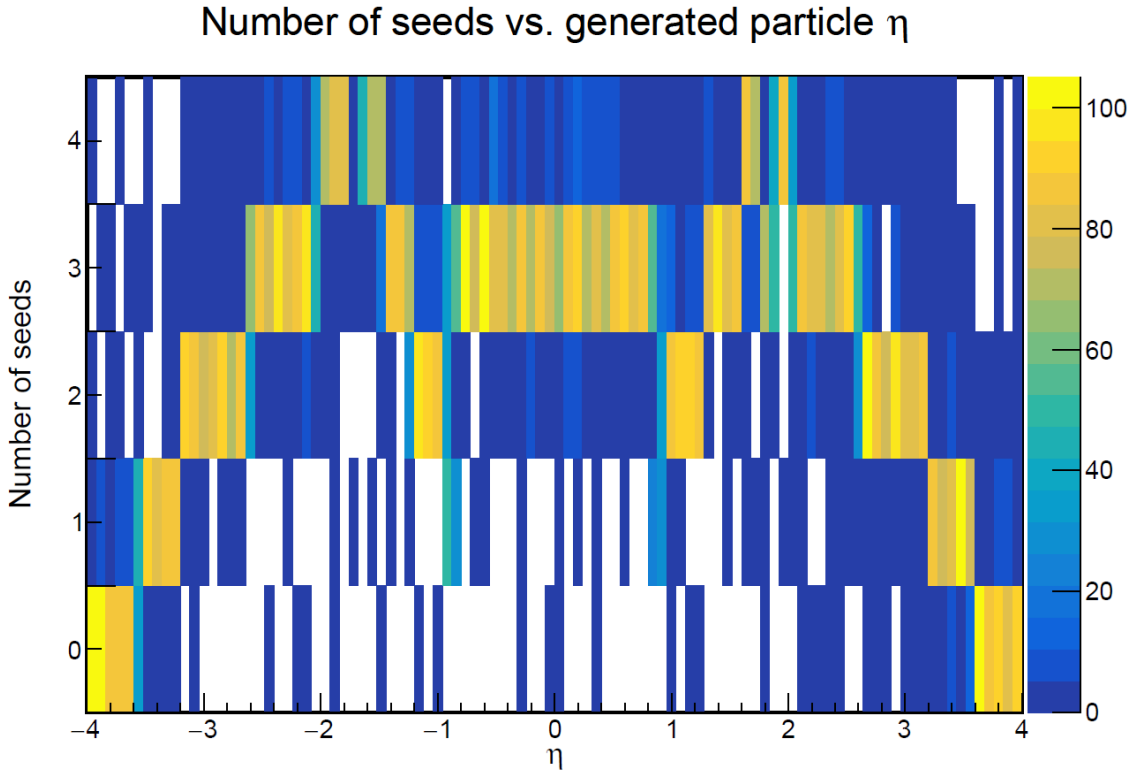

Summary / Ongoing efforts

- Single-particle seeding results are very similar in the updated and prior tracking configurations.
- Seeding results – for a single-particle simulation at least – appear robust when backgrounds are included. We need to perform more checks and also study these single-particle results after the CKF step (i.e. at the track level).
- Ongoing work is to start looking at DIS events (no background) with real seeding. This will require us to think of a way to handle the duplicate seeds/tracks. We probably want to get track quality information into the output ROOT file.