Track reconstruction plots for the TDR

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What we have done – single-particle studies

- Tracking benchmark for momentum resolution and DCA resolutions. Work by Shyam Kumar.
- Track theta and phi resolutions. Not yet in benchmark
- Single-particle efficiency as a function of eta and momentum. Not yet in benchmark.

- Studies have been repeated for different particle creation locations (i.e. not just (x,y,z) = (0,0,0)) and for various charged-particle types. What sets of plots are necessary to include in the TDR?

- These plots can be made in benchmarks or using the reconstructed campaign output. For the campaigns, we may need to add single-particle steering files for generating particles away from (x,y,z) = (0,0,0).

Work in progress – single-particle studies

- Track residuals (unbiased) at various detector layers.
- Track ‘purity’: how often are track hits from the generated categorized as good track measurements – rather than holes or outliers.
- Understanding degradation of real-seeding performance at lower Pt (< 400 MeV/c) and when the particle is generated far (> 1cm) from (x,y) = (0,0).
- Tracking redundancy – what happens if we remove a given tracking layer?

Tracking studies with DIS events

- Track reconstruction for NC DIS events (and minimum bias signal events) – comparison of eta and momentum spectrum of generated, charged particles and reconstructed tracks. Benchmark in progress.
- Track purity – how often the hits used for a given track come from a single MC particle. This has been done in analysis codes using the hit *cellid*. Update based on additional relations between hit collections.

- Ongoing studies with embedded background. We have 3 types of events generated with 2us time frames:
  1. Each time frame has 1 signal event with the signal at a fixed time in the time frame. Only 1 type of background (e.g. proton-gas) is mixed in.
  2. Each time frame has 1 signal event with the signal at a random time in the time frame. All backgrounds are included at their realistic rates.
  3. Both signals and backgrounds are mixed in at realistic rates.

Some things to understand

In single-particle simulations, some Geant hits associated with the generated particle are missing from the fitted track

Two example events:

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Event statistics:
SimHits associated with primary particle = 6 / 6
RecHits associated with primary particle = 6
Number of correctly-identified measurement hits = 4 / 4
Number of outlier hits that should be measurement hits = 1 / 1
Number of RecHits associated with primary particle completely missing from track = 1 / 6

Event statistics:
SimHits associated with primary particle = 8 / 9
RecHits associated with primary particle = 8
Number of correctly-identified measurement hits = 7 / 7
Number of outlier hits that should be measurement hits = 0 / 0
Number of RecHits associated with primary particle completely missing from track = 1 / 8
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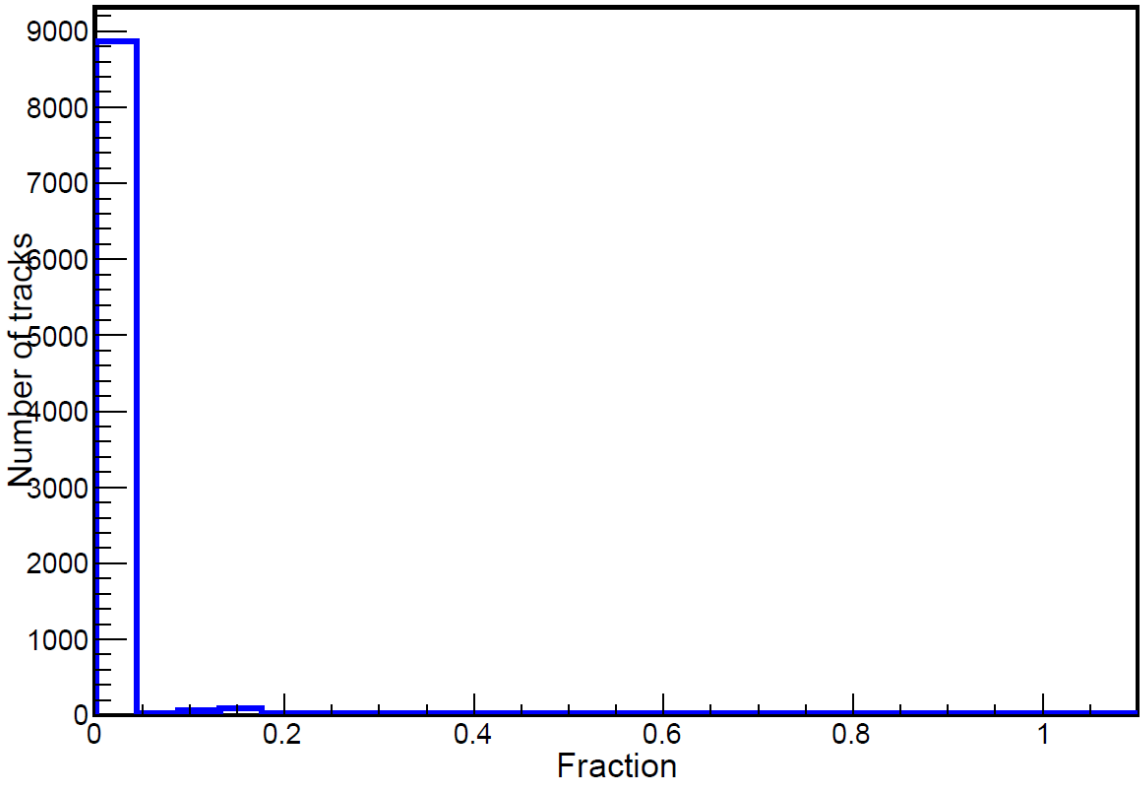
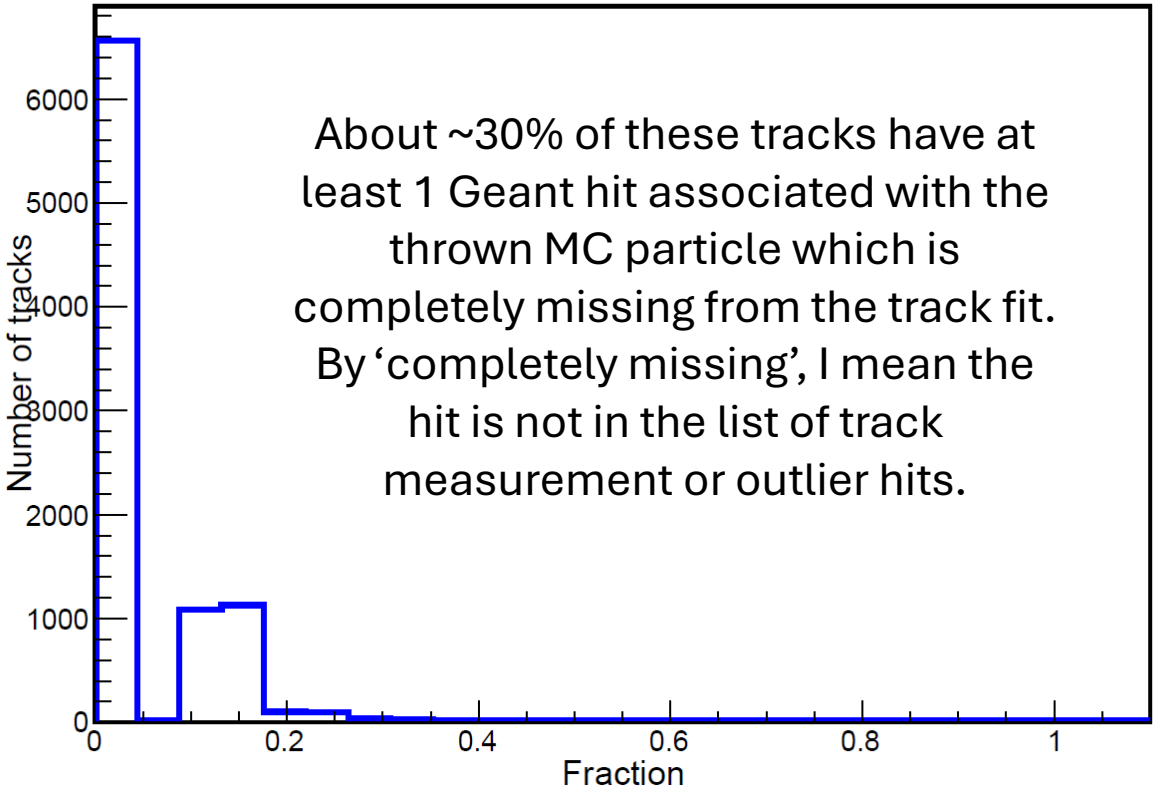
In single-particle simulations, some Geant hits associated with the generated particle are missing from the fitted track

10k single muon events simulated.

Fraction of associated digitized hits classified as outlier hits



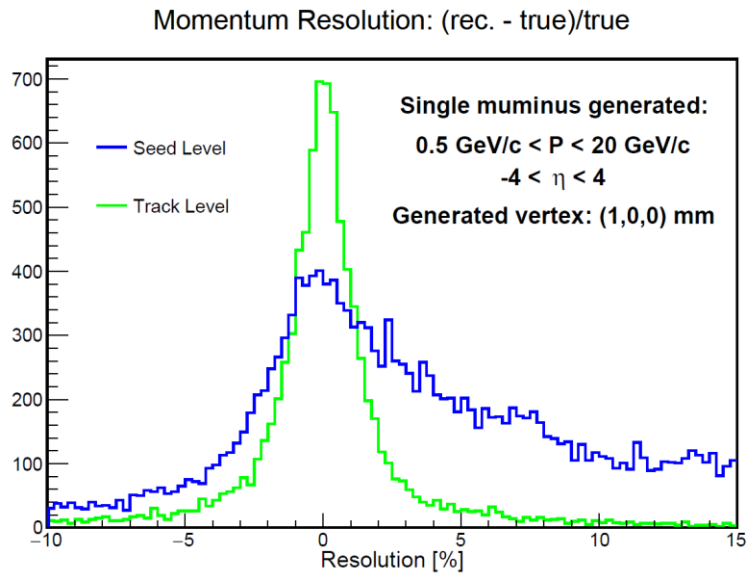
Fraction of associated digitized hits missing from track

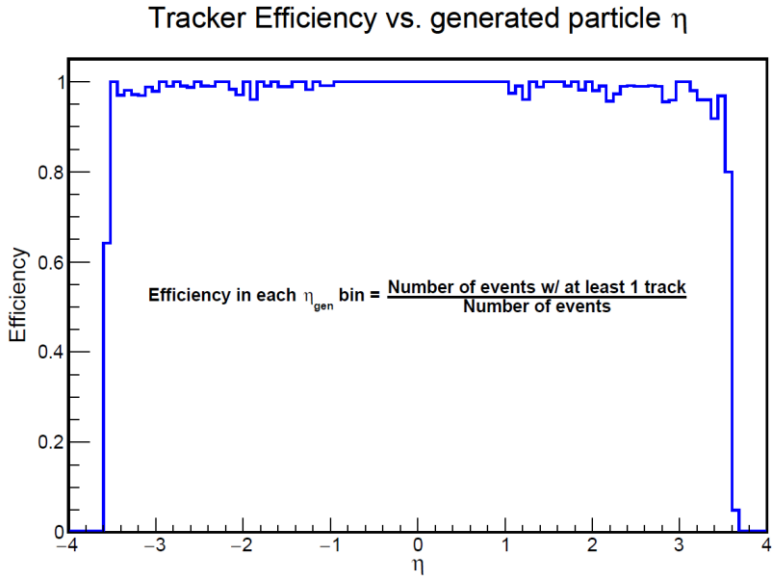


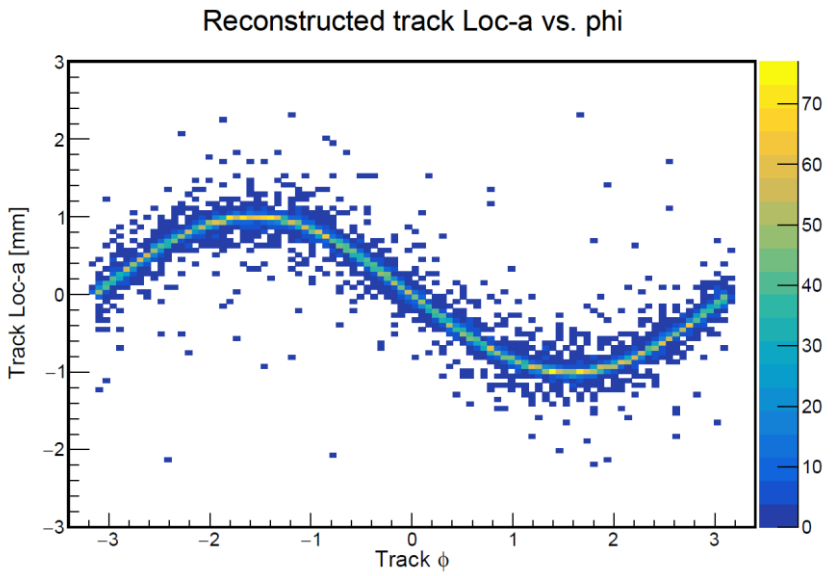
About ~30% of these tracks have at least 1 Geant hit associated with the thrown MC particle which is completely missing from the track fit. By ‘completely missing’, I mean the hit is not in the list of track measurement or outlier hits.

Real-seeded tracking for off-beamline particles

Default seeding parameters work well for 1mm offset.

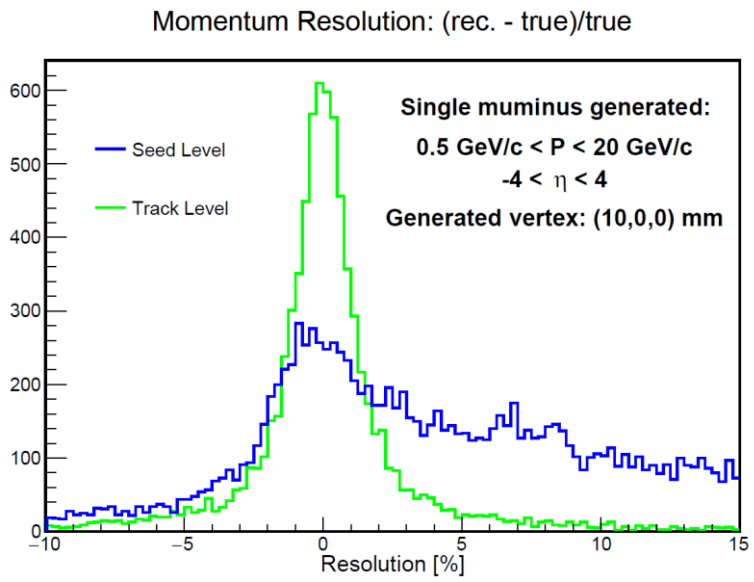


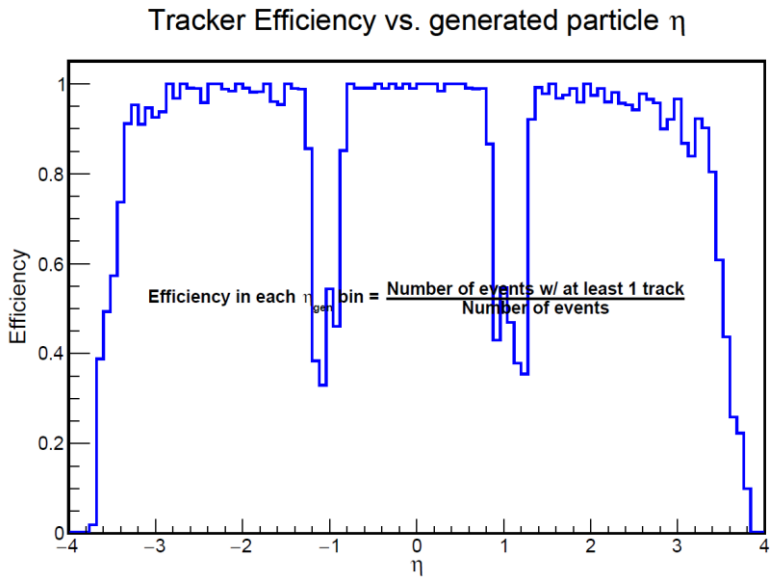


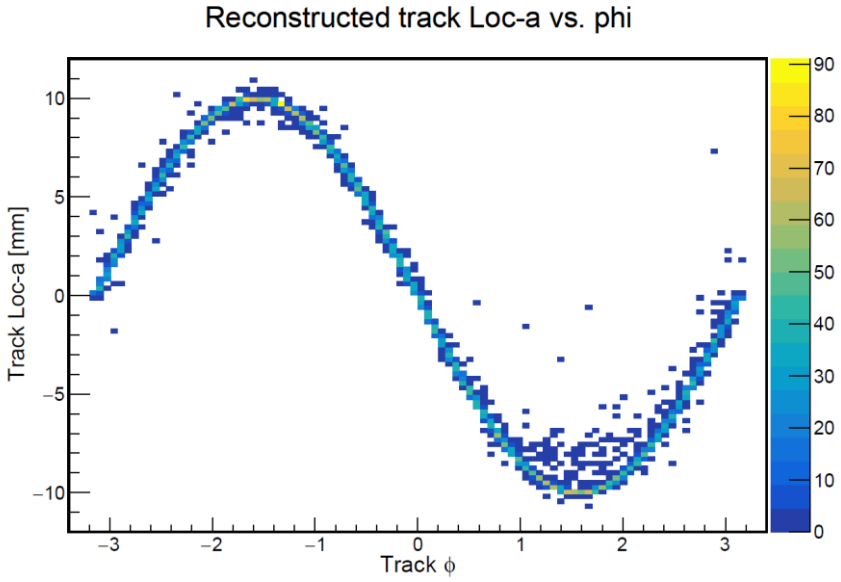


Real-seeded tracking for off-beamline particles

Updating seeder beamline DCA cut gives reasonable results for 10mm.







Real-seeded tracking for off-beamline particles

Efficiency results look poor when particle is generated outside first barrel vertex layer. (Some generated kinematics are unreasonable.)