Single-particle track reconstruction with embedded background

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Seeding and tracking

Seeding implementations

Truth (Ideal) seeding: For every generated, final-state (i.e. status = 1) charged particle, we use the true charge, q/p, theta, phi, and generation vertex to form the seed. Option to smear the initial parameters is included.

Real seeding: The ACTS orthogonal seeder outputs a set of seeds, with each seed consisting of 3 space points. The seeds need to fulfill certain expectations for a particle moving in a uniform magnetic field. The seed finder and seed filter settings configure the allowed search region and tolerances. We then fit the seed points to determine the charge, q/p, theta, phi, and the initial position coordinates.

A given seed is then passed into the ACTS CKF for track finding and fitting. At the acceptance edges, the truth-seeded tracks can sometimes have fewer than 3 hits. For real seeding, we can have seed duplicates.

We don't currently have an implementation where we separate track finding and fitting. For example, we don't use Geant information to send the true hits for a given particle to a KF.

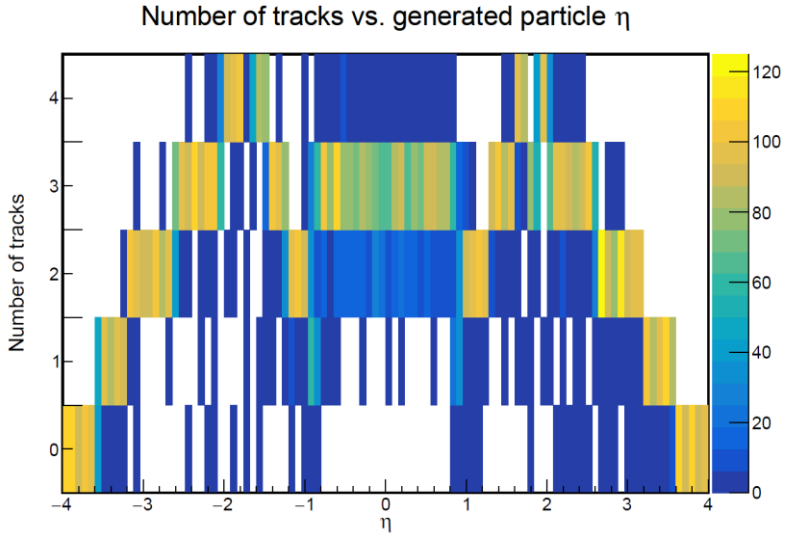
https://acts.readthedocs.io/en/latest/tracking.html
https://acts.readthedocs.io/en/latest/core/seeding.html#seeding-core

Studies done in September 2023

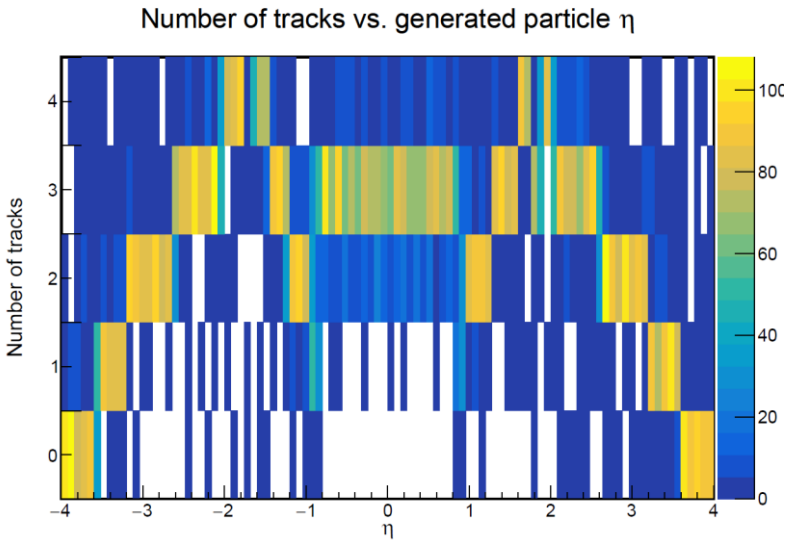
Single μ^- generated:
0.5 GeV/c < P < 20 GeV/c
-4 < η < 4
Generated vertex: (0,0,0) mm

- We have embedded background into single-particle (muon) events at the generator level. These events have been run through the default ePIC *Craterlake* simulation + EICRecon.
- We have studied the effect on the output of the ACTS seeder. More details can be found here.

Single muon only



Single muon + background



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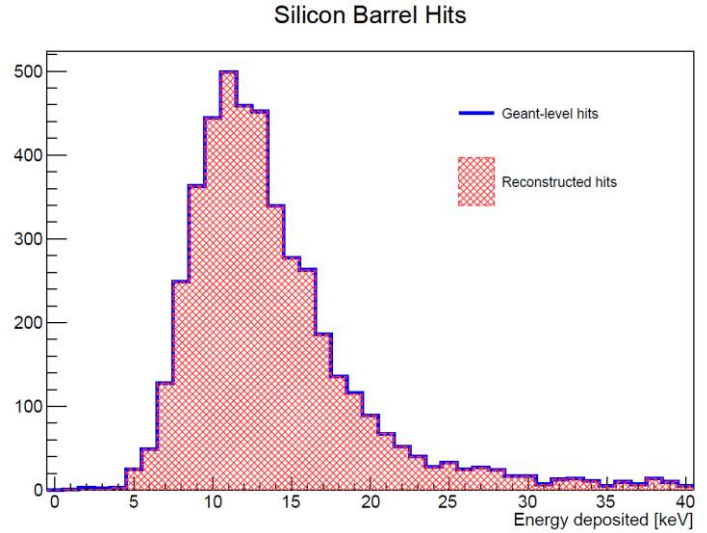
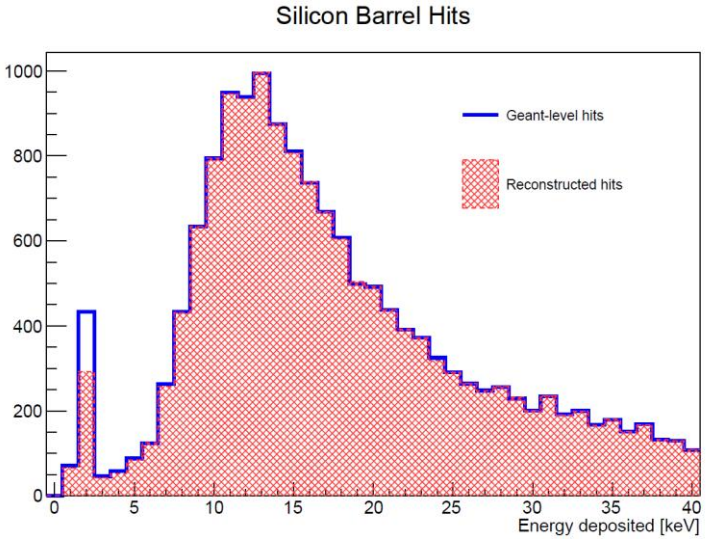
- We have embedded background into single-particle (muon) events at the generator level. These events have been run through the default ePIC *Craterlake* simulation + EICRecon.
- We have studied the effect on the output of the real-seeded tracking. More details can be found here.

Single muon only



Single muon + background



Recent updates to real-seeded tracking

- We plan to repeat the above studies incorporating recent changes to the real seeded tracking.
- These changes include:
  1. **Update of ACTS version**
  2. **Fix to globalToLocal seed conversion.** EICRecon PR #1185
  3. **Fix to seed charge calculation.** EICRecon PRs #1213, #1214
  4. **Updates to seed covariance matrix.** In progress.
  5. **Removal of seed duplicates.** In progress; see Minjung's talk.