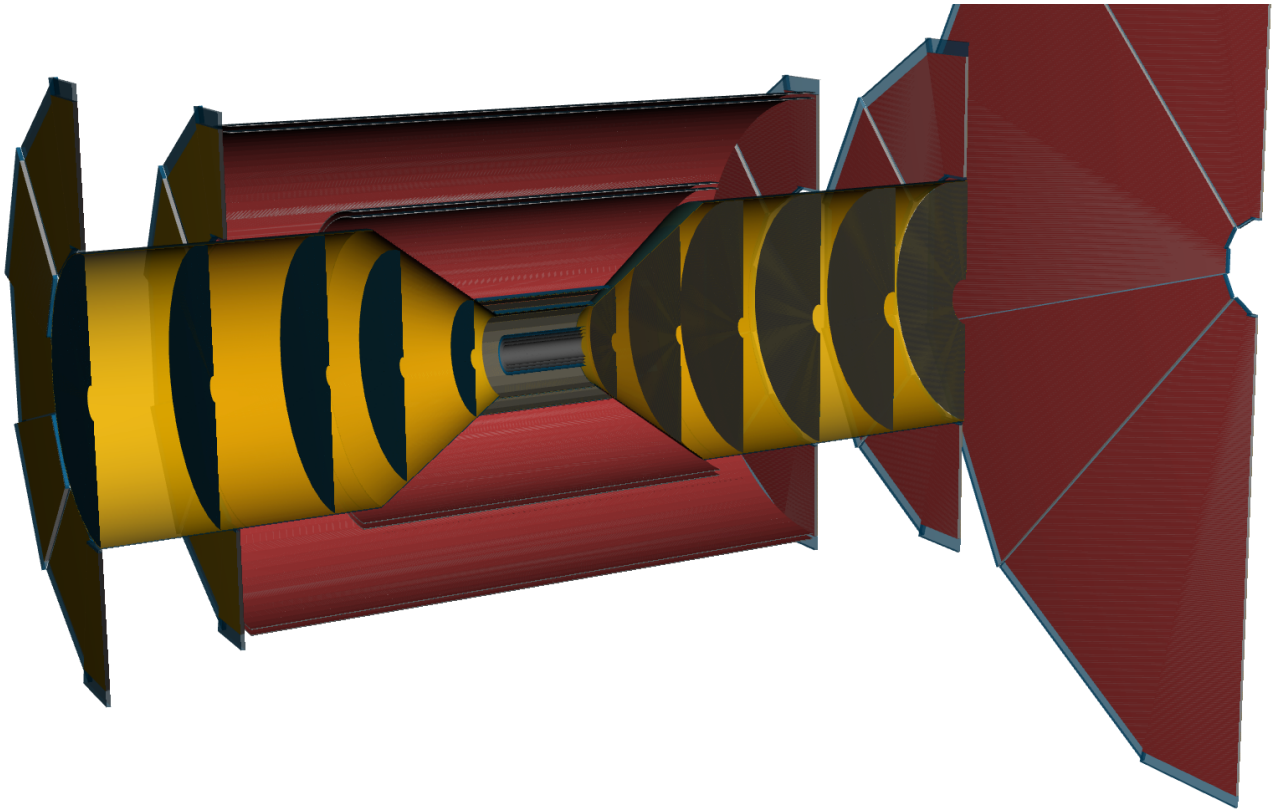
Efficiency extraction

- Tracking baseline-2 in dd4hep
  - Vertexing: 3 vertexing layers → up to 3 vertexing hits
  - Barrel tracking: 2 Si layers + 4 MM layers → up to 6 tracking hits
  - Forward tracking: 6 Si disks + 3 GEM disks → up to 7 tracking hits
  - Backward tracking: 5 Si disks + 2 GEM disks → up to 5 tracking hits



Currenly saving a 12-bit string to store the measurements at different vertexing/ tracking/PID/calorimter layers per reconstructed track

ECal vertexing

0 1 0111111 111

PID tracking

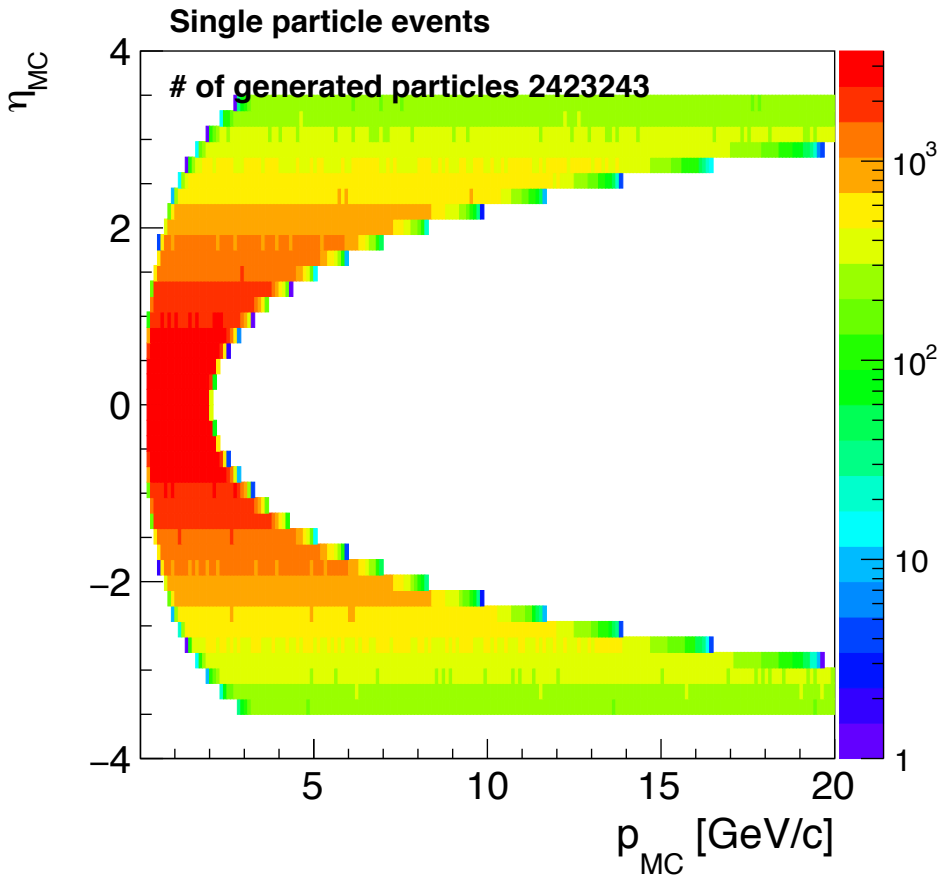
Efficiency extraction

- Good track definition for efficiency extraction
  - ☑ Minimum # of hits
  - ☑ χ^2 cut
  - ☐ Reconstructed momentum in reasonble range from the truth momentum
  - ☐ Other requirements (e.g. at least 2 vertexing hits and 2 tracking hits, particles reach calorimeter surface, etc.)

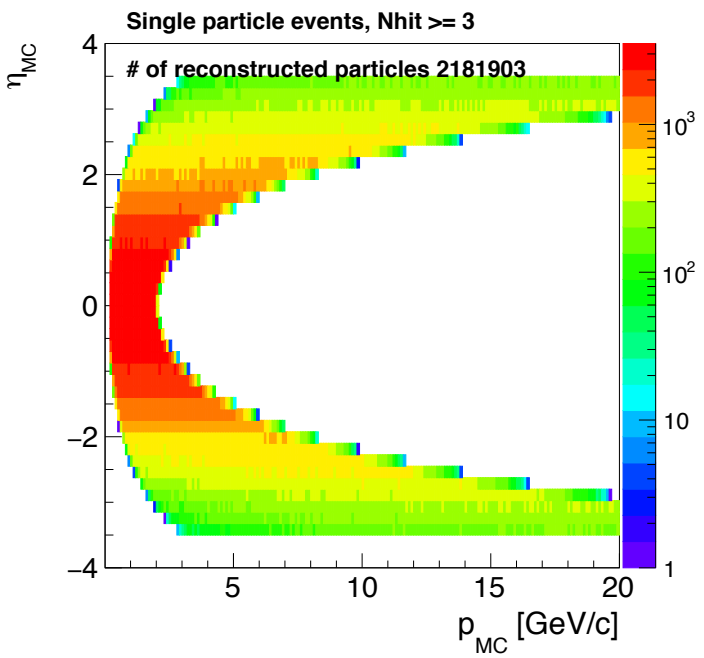
- Efficiency definition
  - Loop through all the reconstructed particles which are matched to generated particles (charged, stable) → # of reconstructed particles
  - Loop through all the generated particles (charged, stable) → # of generated particles
  - Efficiency = # reconstructed particles / # gen particles

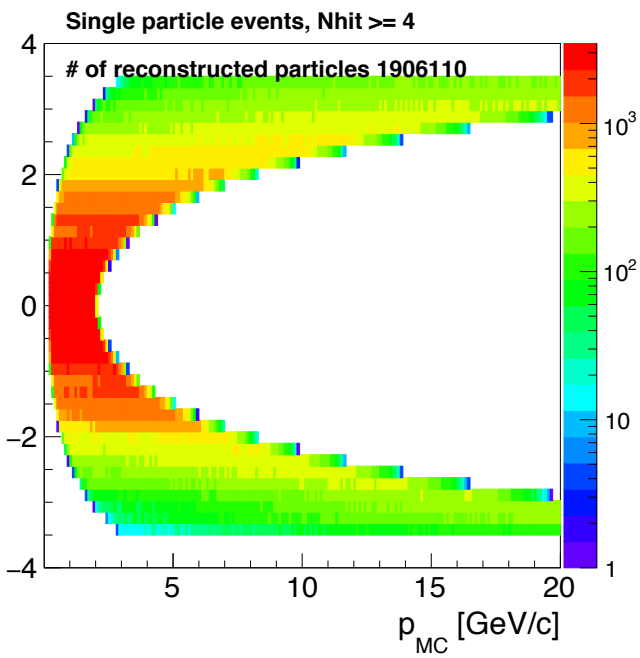
Single particle events

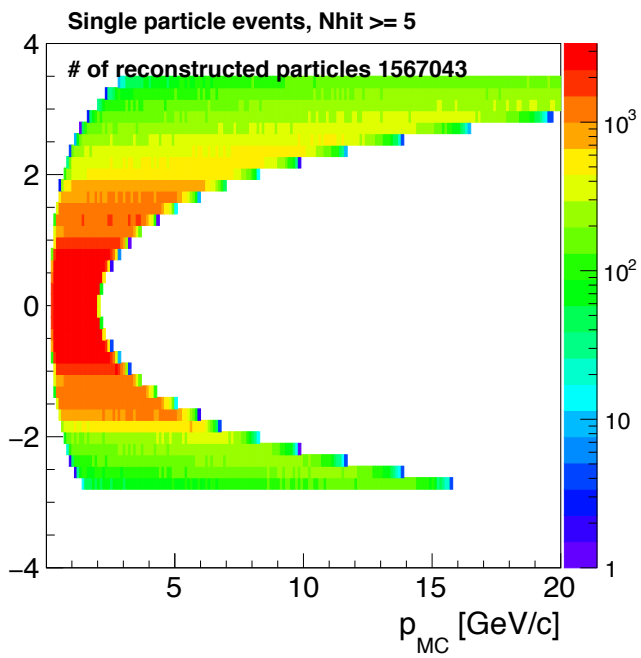
- Single particle
  - Uniform p_T, ϕ, η distribution
- Generate separately for low p range and high p range
  - 0.2-2GeV: 100MeV bin size
  - 2-5GeV: 200MeV bin size
  - 5-30GeV: 1GeV bin size
  - -3.5 to 3.5: 0.1 bin size
- Baseline-2, full detector on
- Currenly only low momentum, will generate higher momenum range
- Will probably switch to uniform p rather than p_T

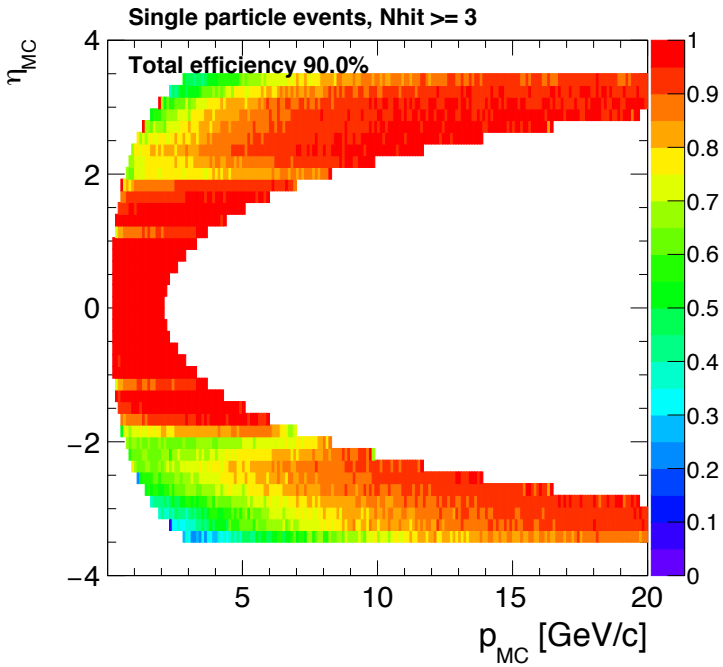


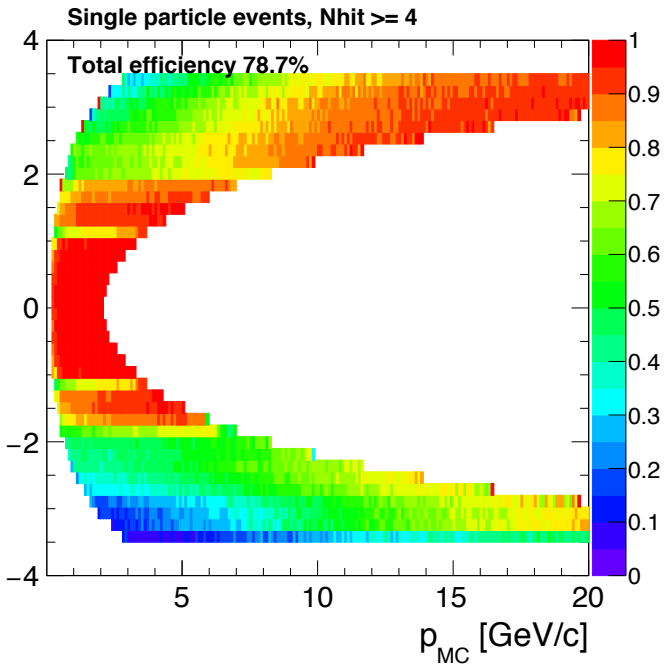
Efficiency extraction

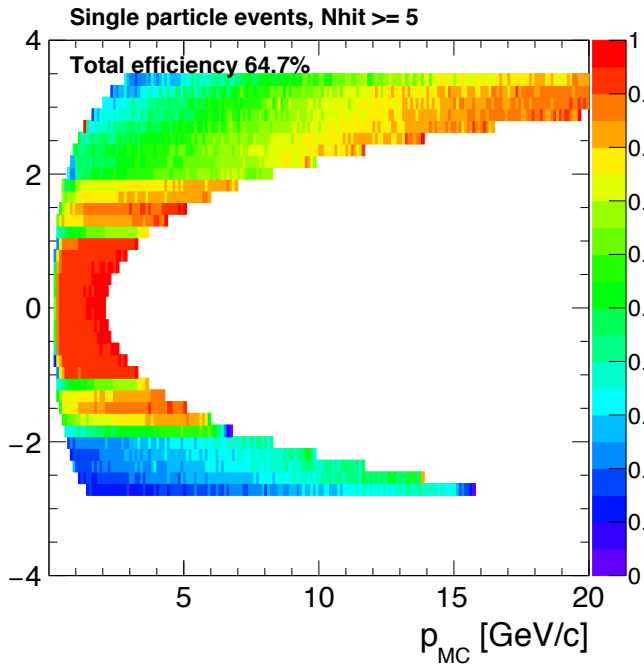






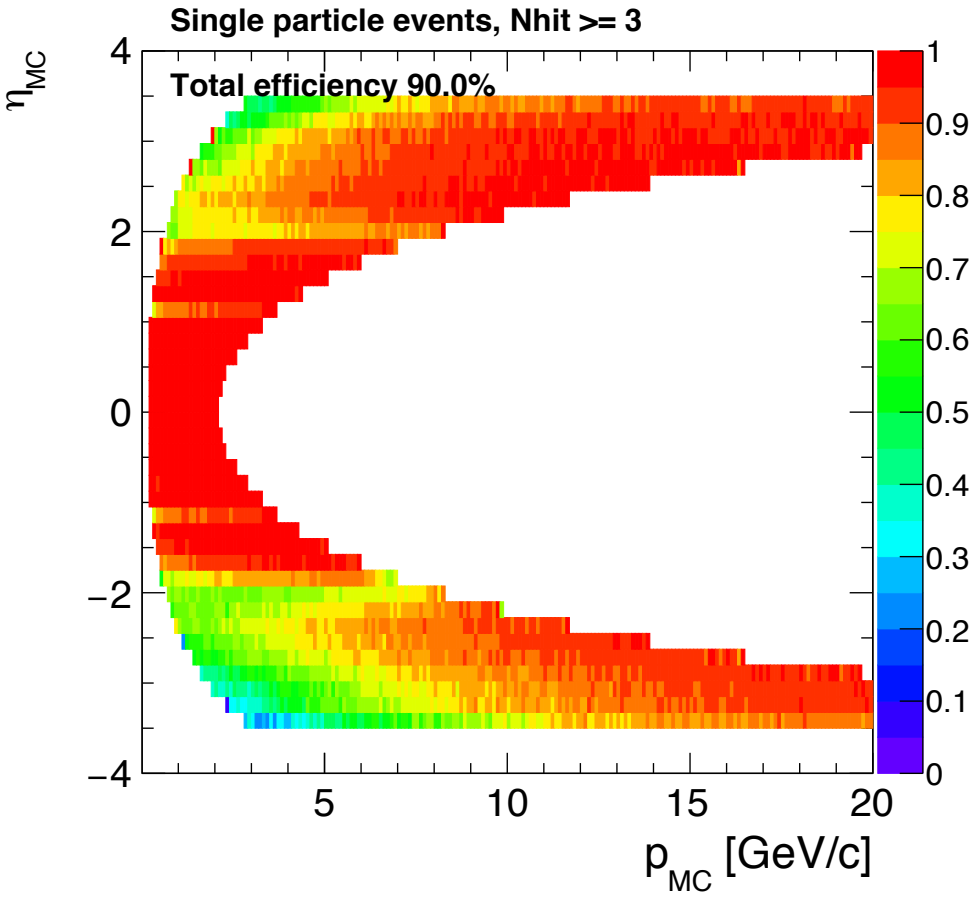




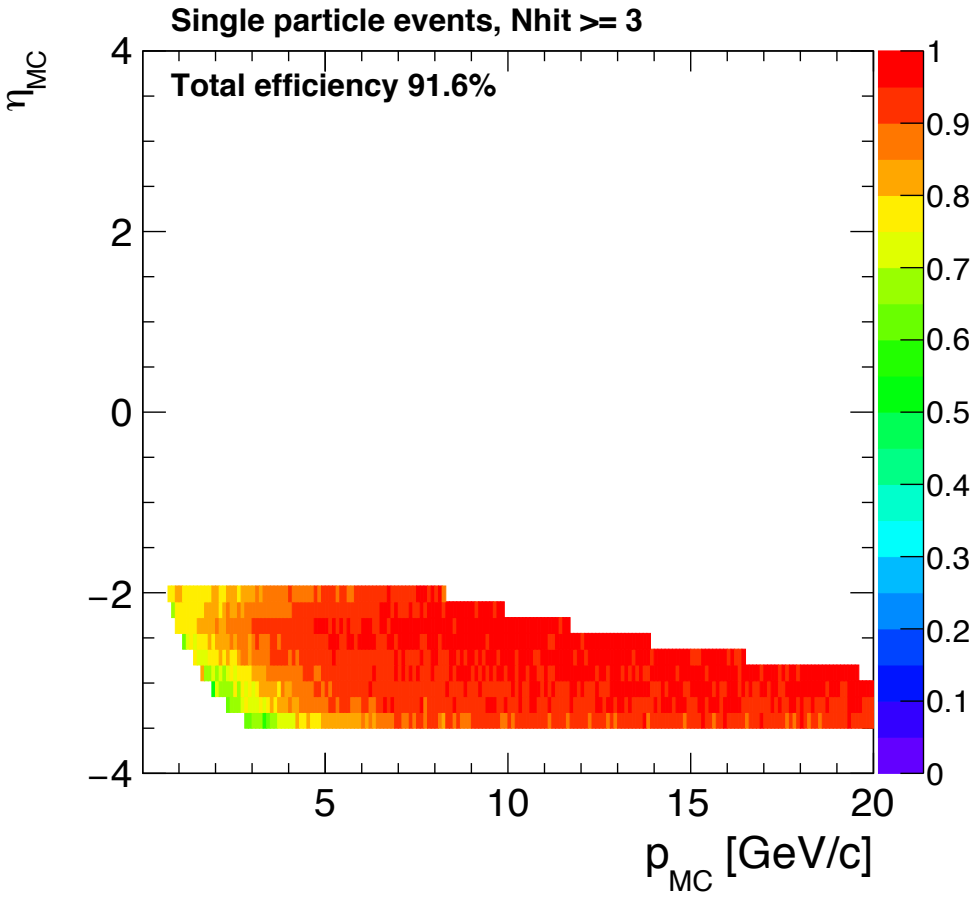


In-efficiency at backward

$\chi^2 < 15$

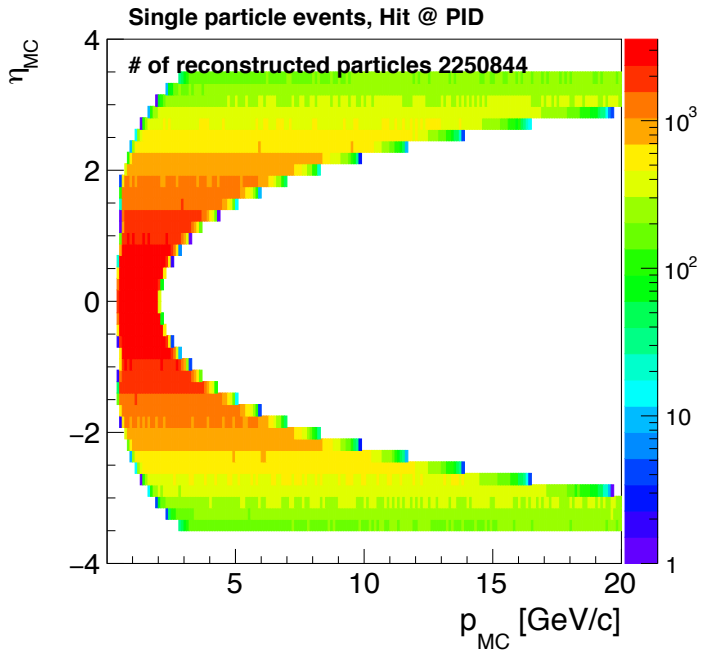


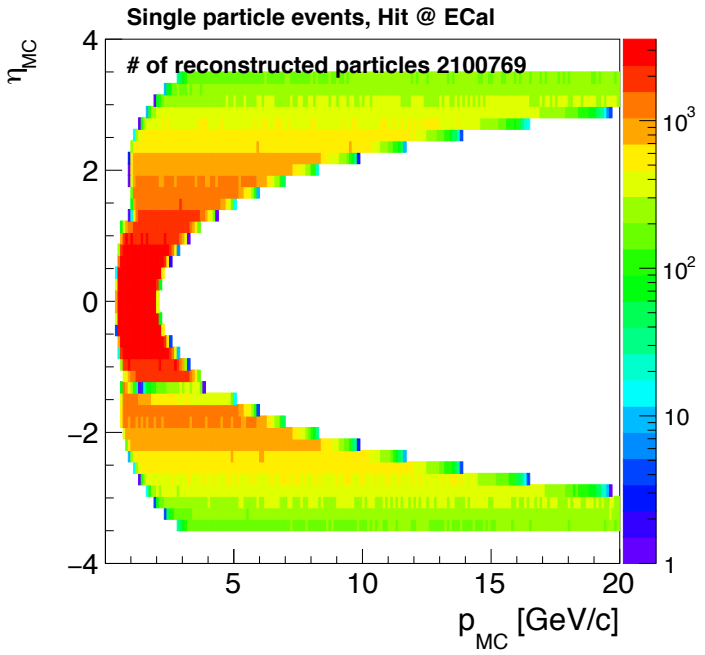
$\chi^2 < 100$

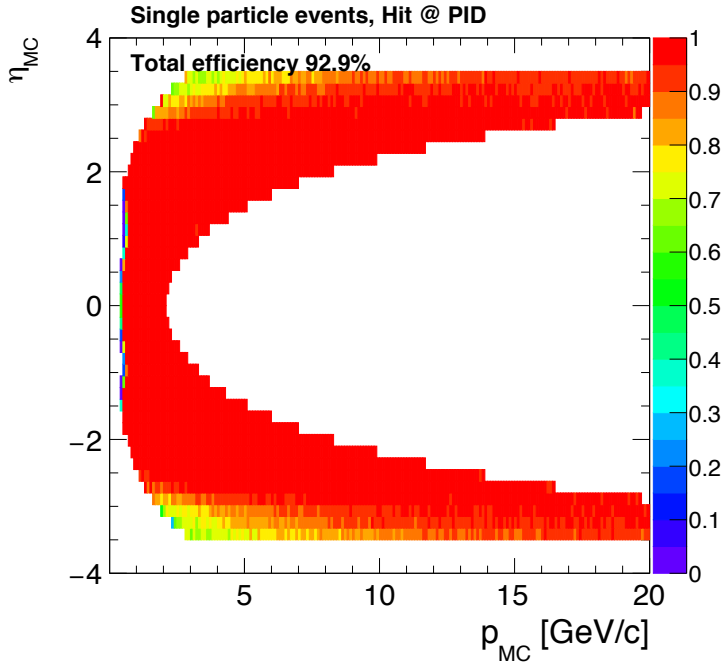


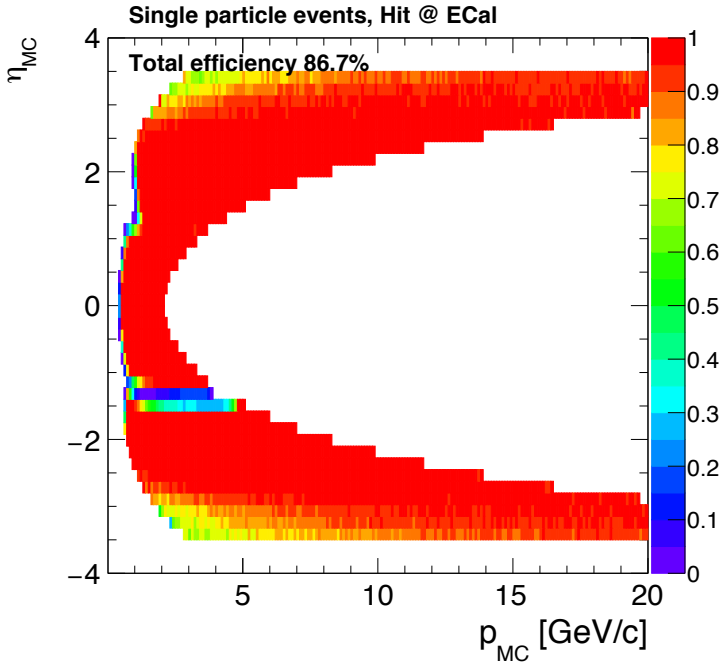
Expecting better performance (smaller χ^2 for all the hits) with the updated material map

Reach to PID or ECal





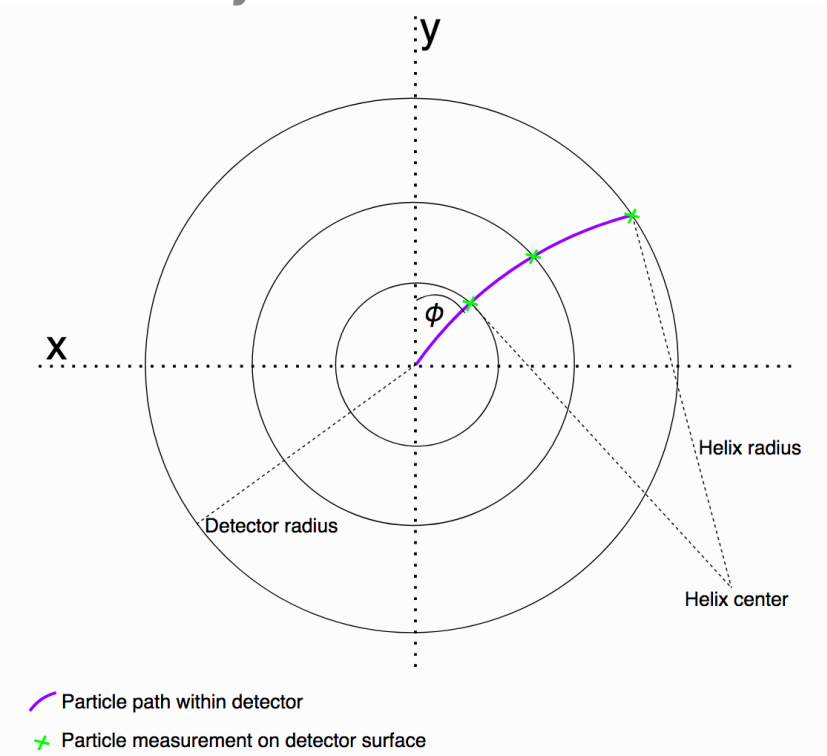


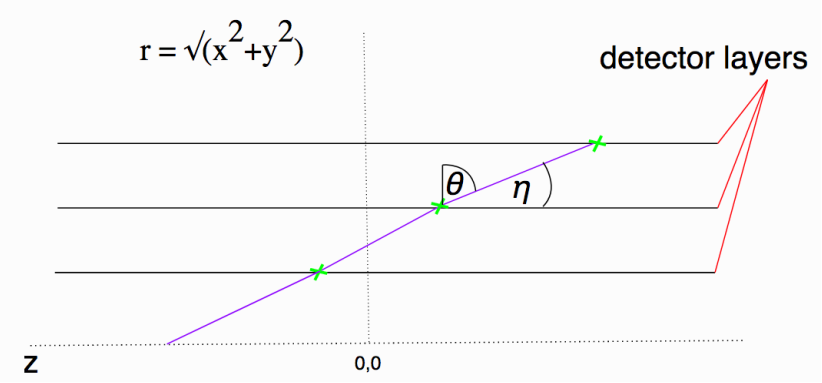


Summary

- Truth seeding
  - Good track definition
  - Magnetic field effect included by requiring # of hits per track
  - Use the most updated material map
  - Add the momentum selection

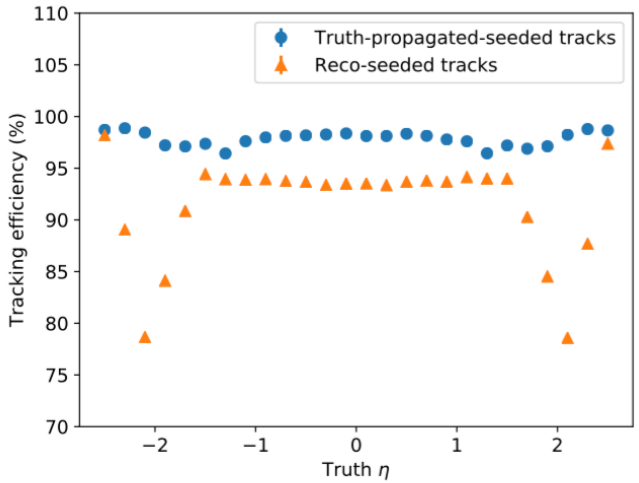
- A good seeding algorithm
  - It finds at least one seed for each particle that should be found
  - It doesn't find many seeds which do NOT correspond to particles
  - It doesn't find many seeds per particle
- ACTS seeding
  - Use triplet of hits for seed finding
  - Currently all hits used in ATHENA for seed finding

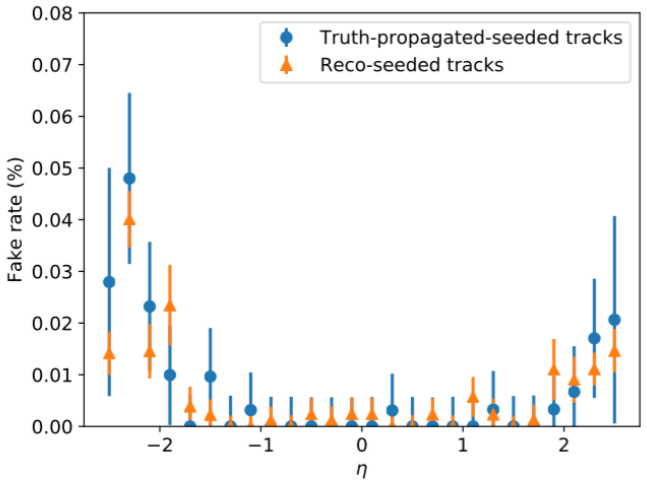


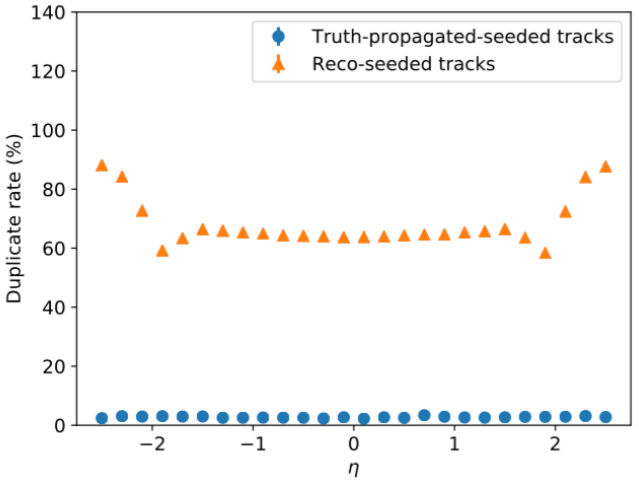


Efficiency, fake rate, duplicate rate

- A well **reconstructed track**: tracks can be associated to a generated particle by mathcing the momentum algorithm
- A track that is not associated to any simulated particle is considered to be a **fake track**.
- **Duplicate tracks** occur when multiple tracks are associated to the same generated particle.

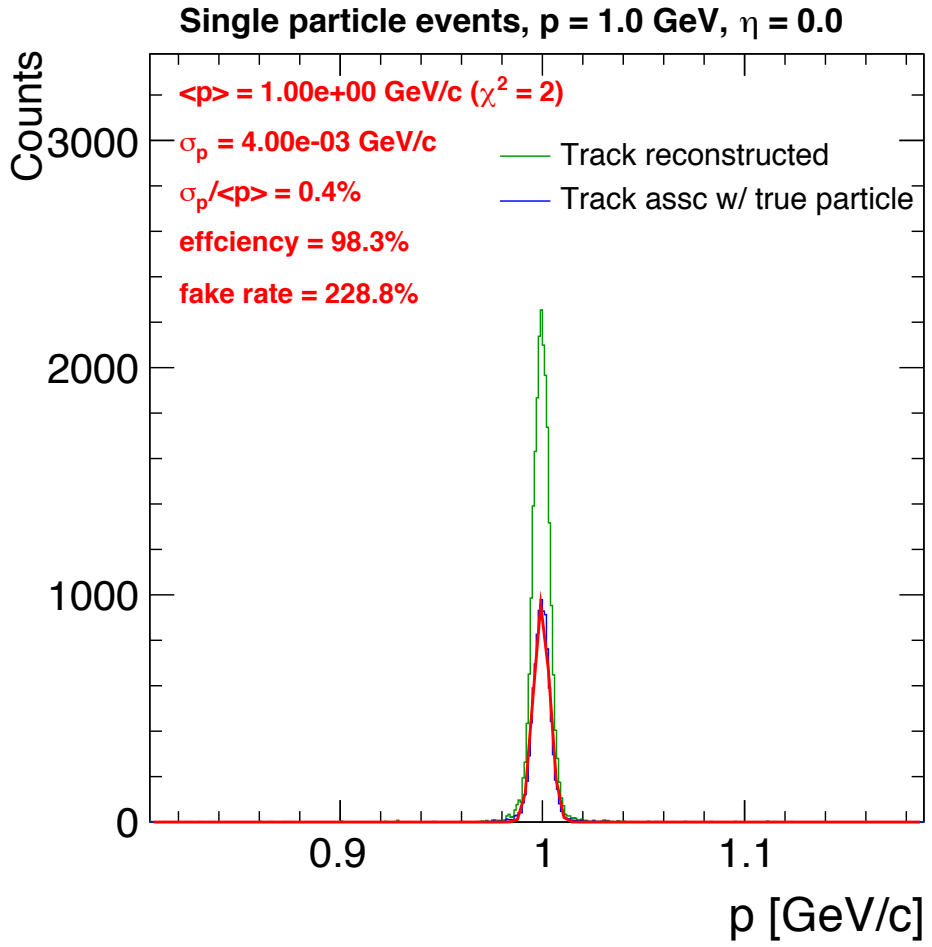






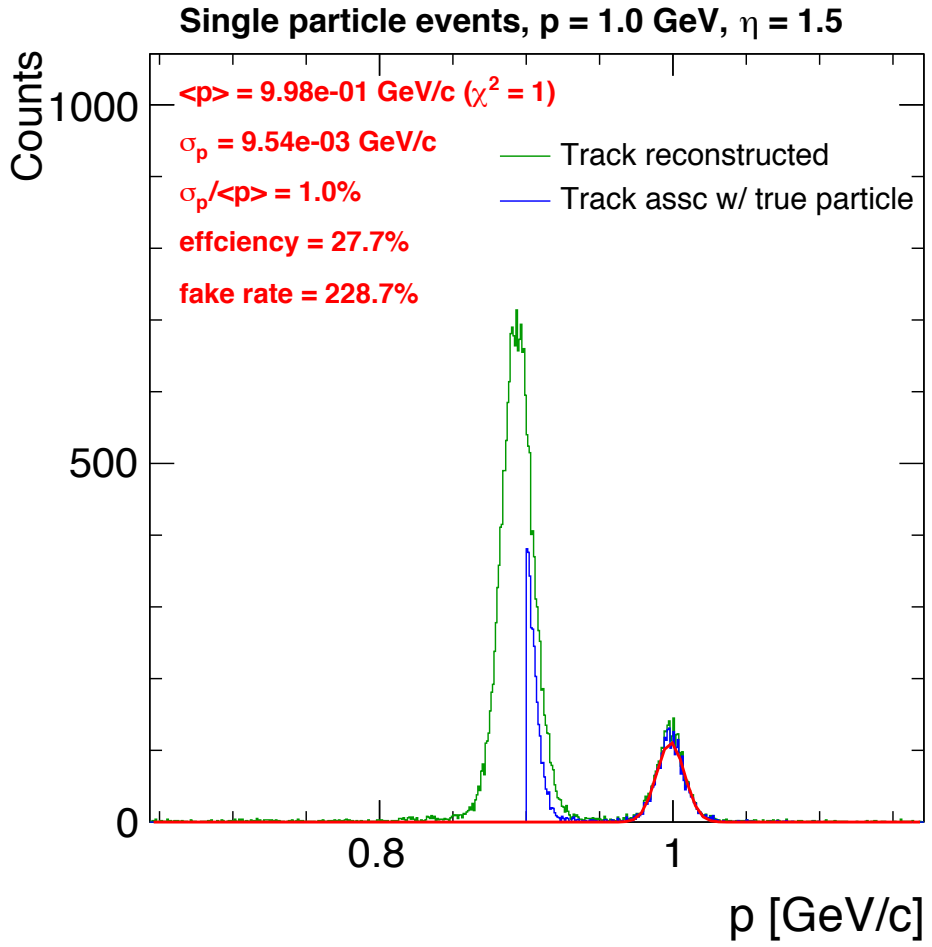
Realistic seeding

- Multiple seeds per generated particle with “correct” paramters
  - Hits from the same track used multiple times for seeding
  - Can be filtered at the seeding stage or tracking finding stage requiring the shared measuremnts between tracks

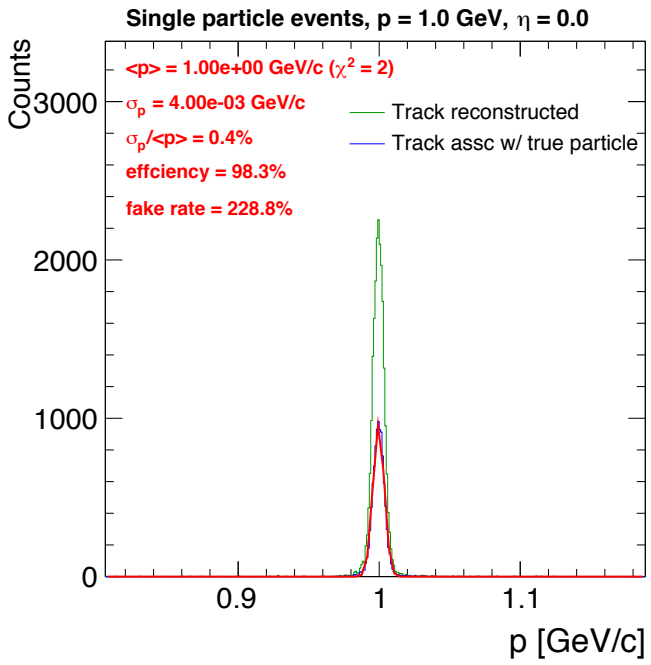


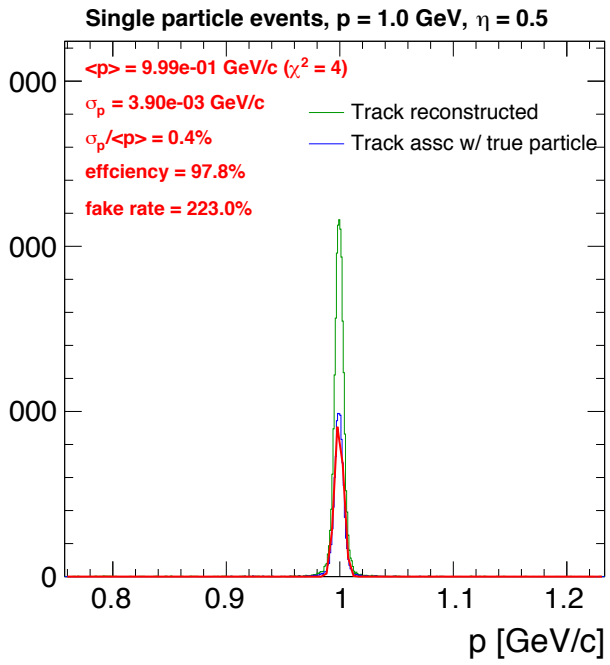
Realistic seeding

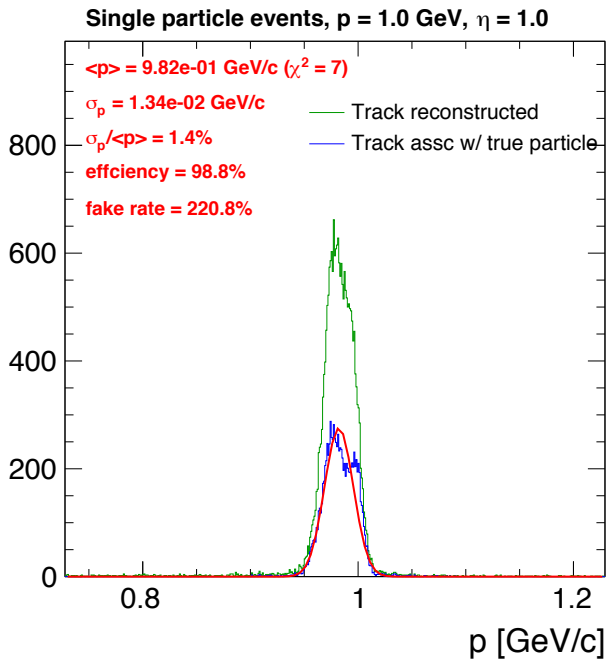
- Some seeds with “wrong” paramters
  - Reconstructed p very off the true p
  - Low efficiency for well-reonstructed particles
  - Needs to check what caused the biased-seeds

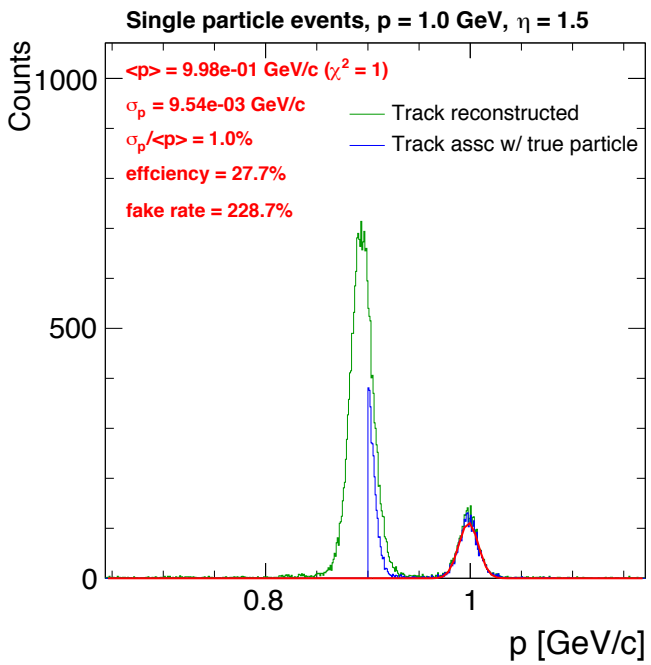


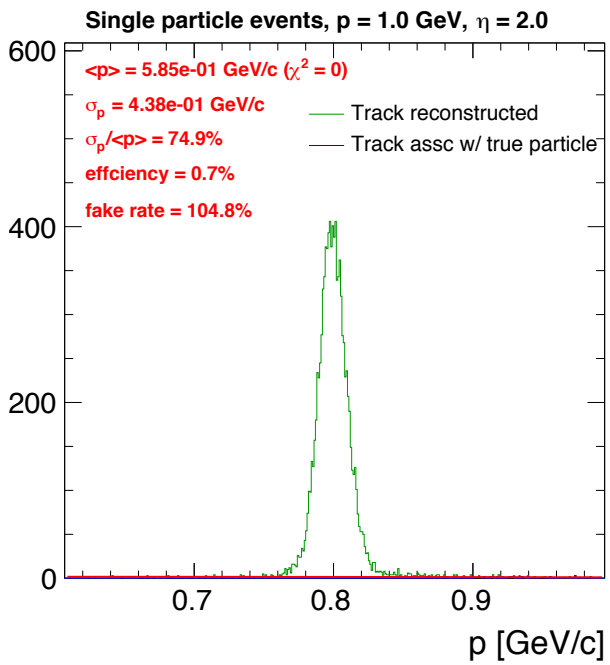
Realistic seeding (p=10GeV)

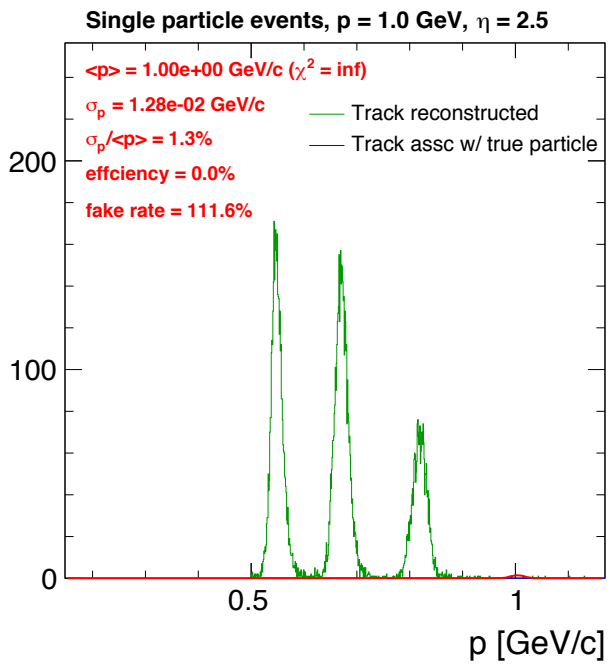




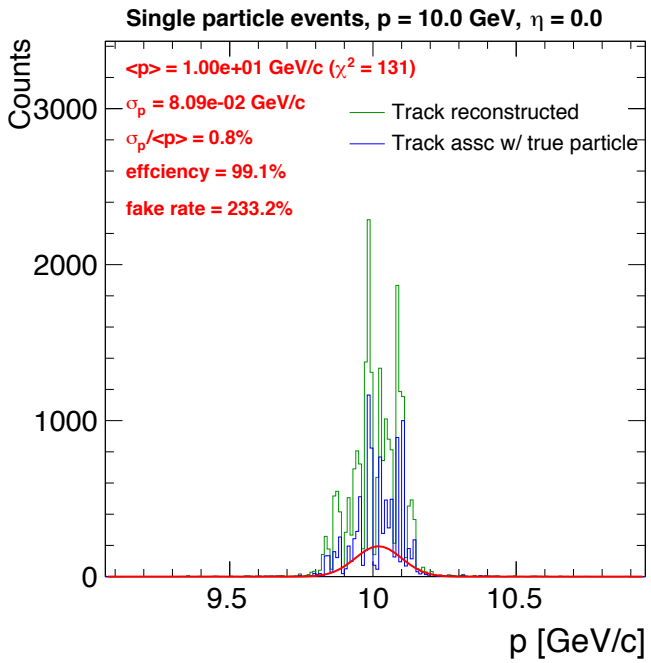


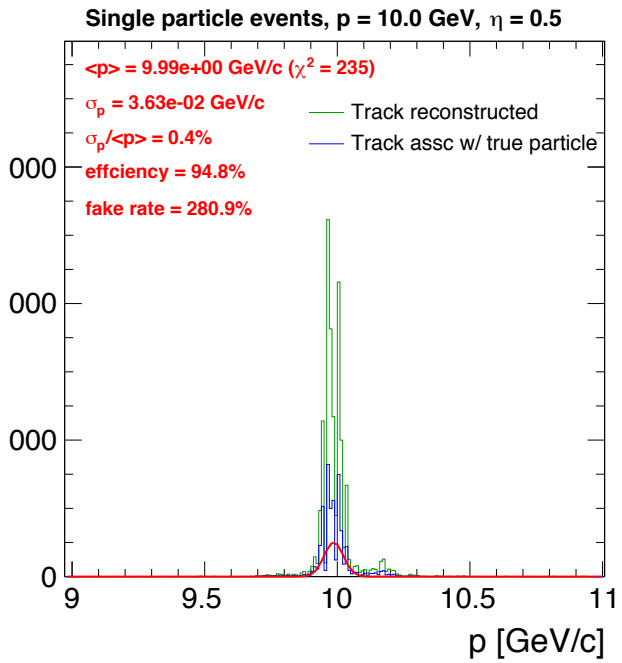


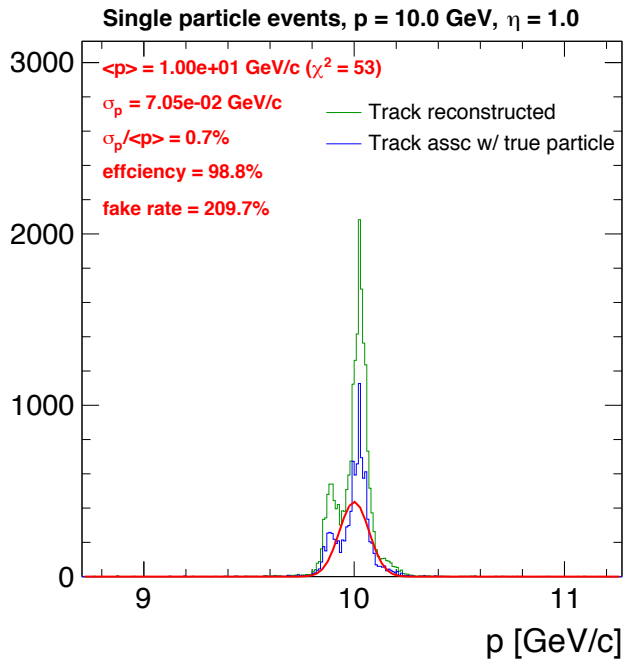


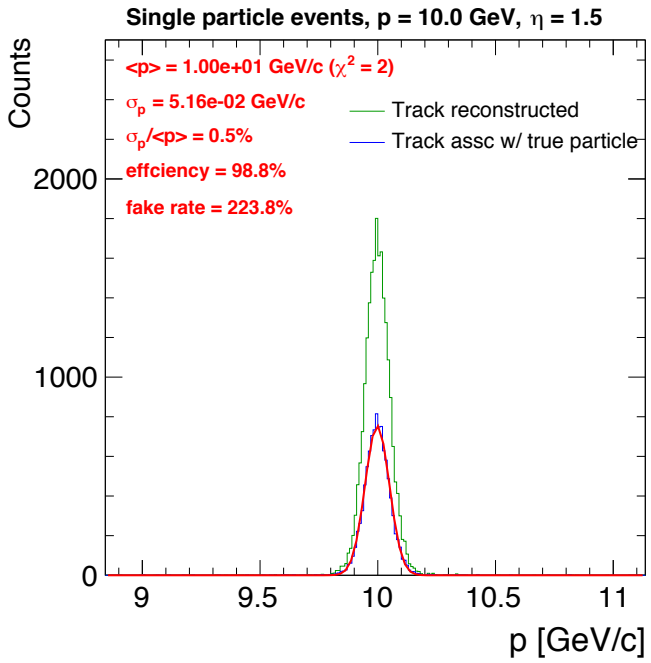


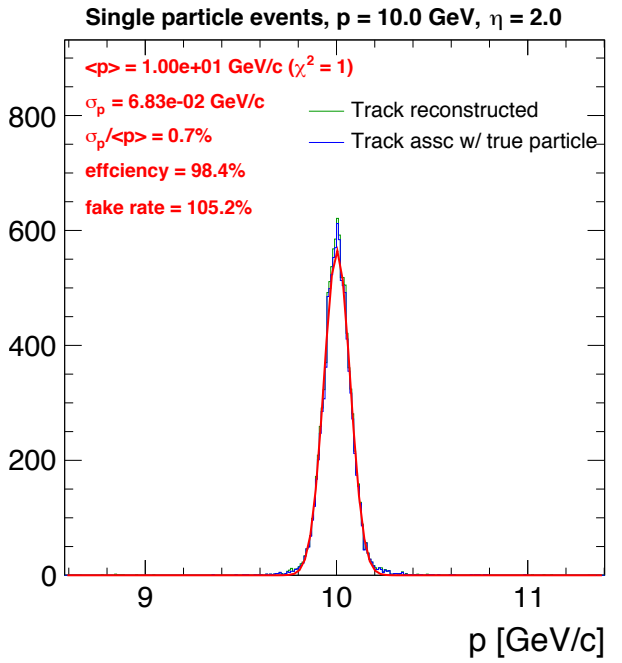
Realistic seeding (p=10GeV)

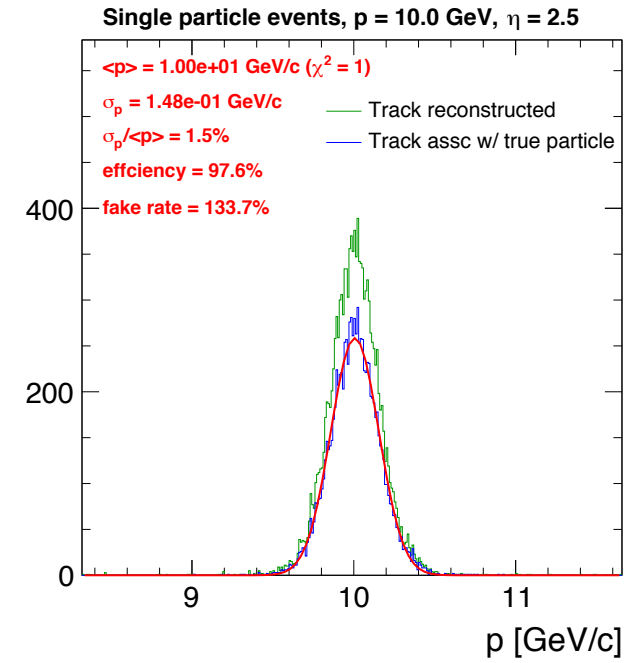












Summary

- Truth seeding
  - Good track definition
  - Magnetic field effect included by requiring # of hits per track
  - Use the most updated material map
  - Add the momentum selection

- Realistic seeding
  - Currently looking at single particle events (p distribution shown, will also check ϕ, θ, # of hits and χ^2)
  - Filter duplicate tracks and diagnose the cause for fake tracks
  - Move on to more realistic enviornment: DIS events, events+background