Charged Pions and Taus in MAIA

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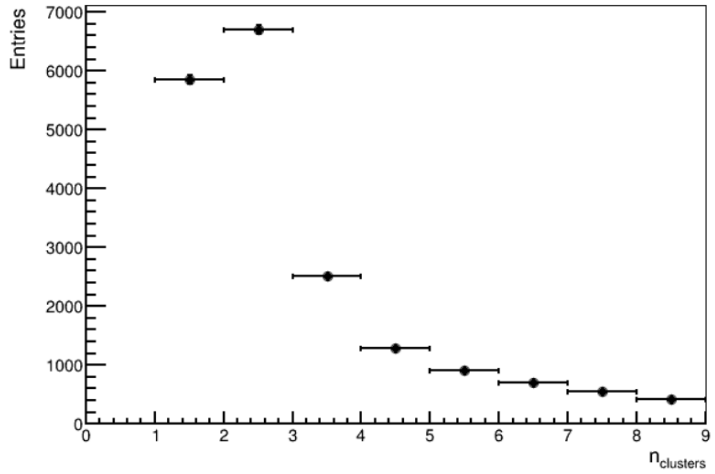
Recap of Last Week

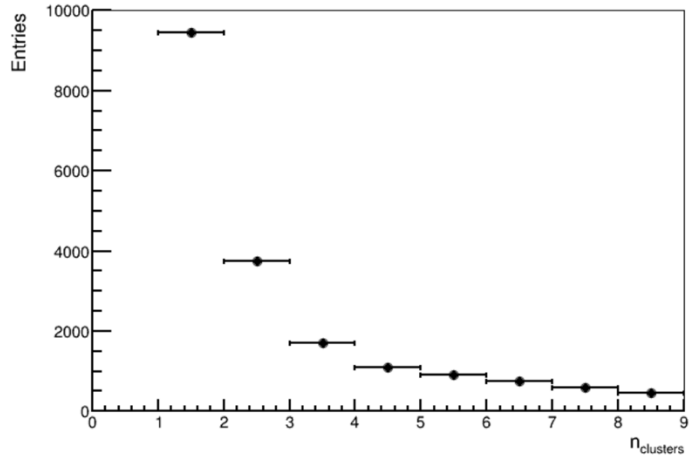
- W/ pion gun: found that track "refit" greatly improved pion reconstruction efficiency (slides)
  - In particular, the track-cluster matching performance improved

SiTrack

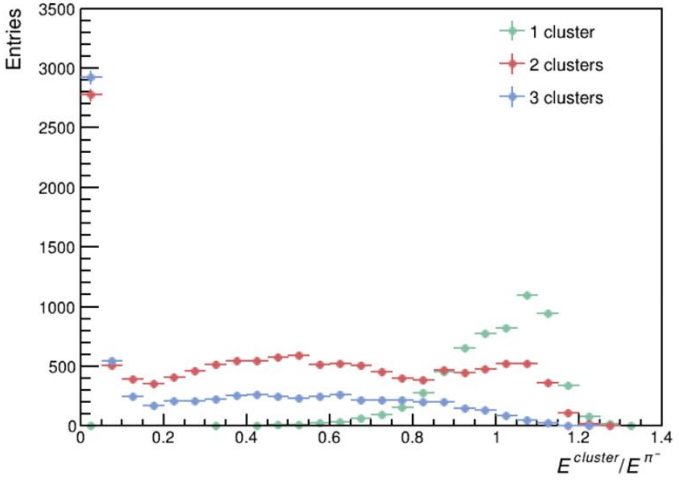
clusters less split up

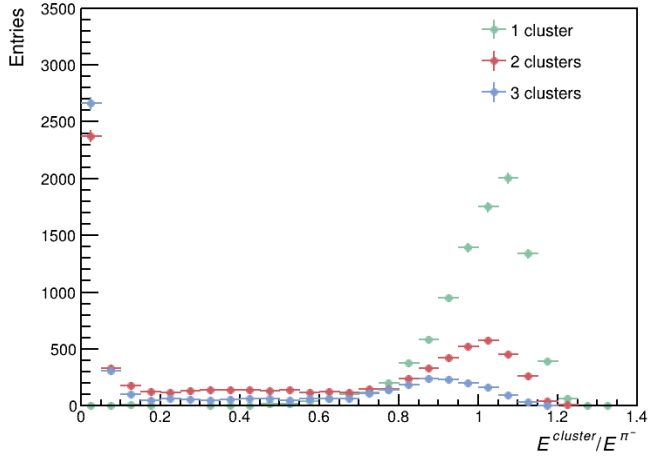
SiTrack_Refitted





one cluster more often captures all $\pi^{\pm}$ E





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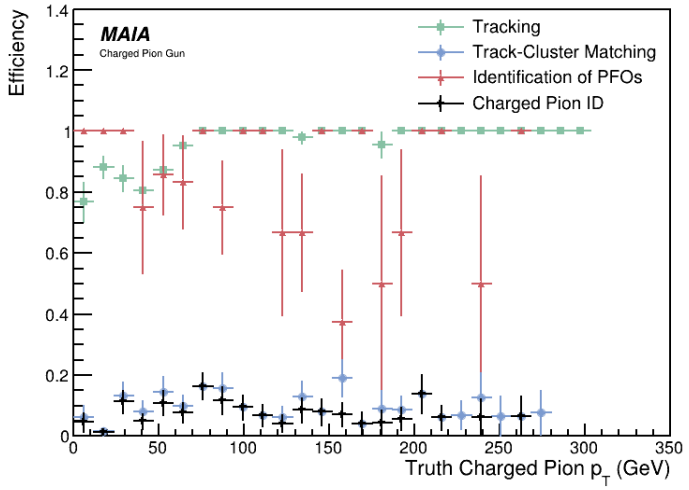
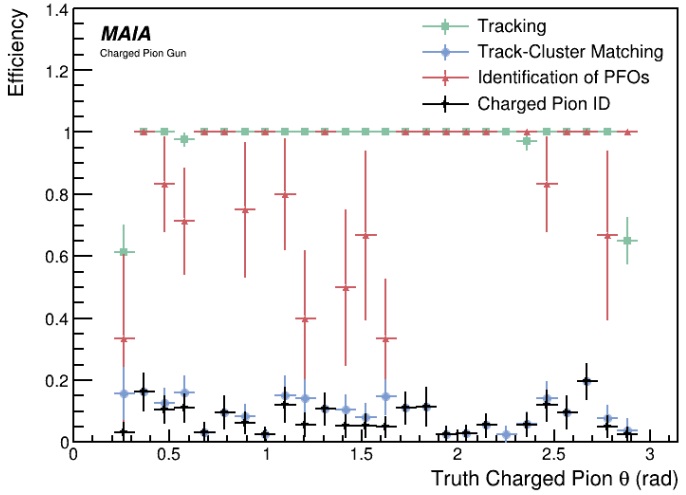
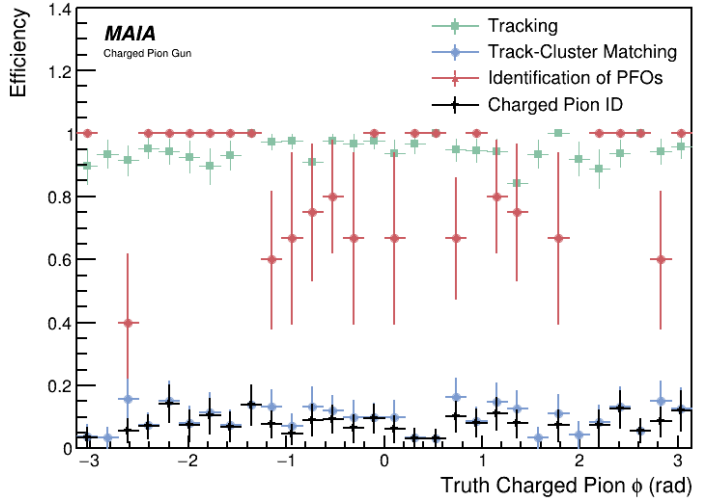
- This propagates down reconstruction in the form of improved track-cluster matching efficiency:

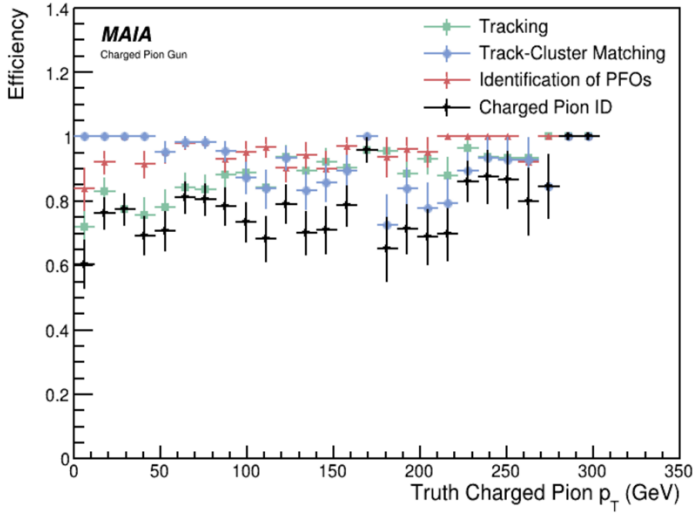
Si Track

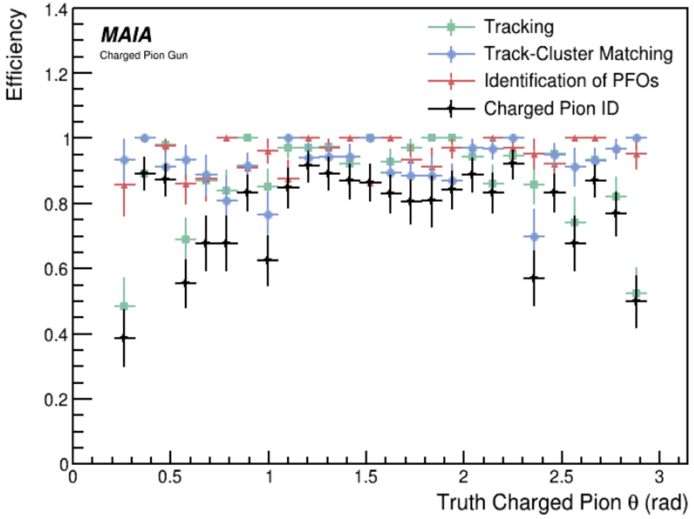


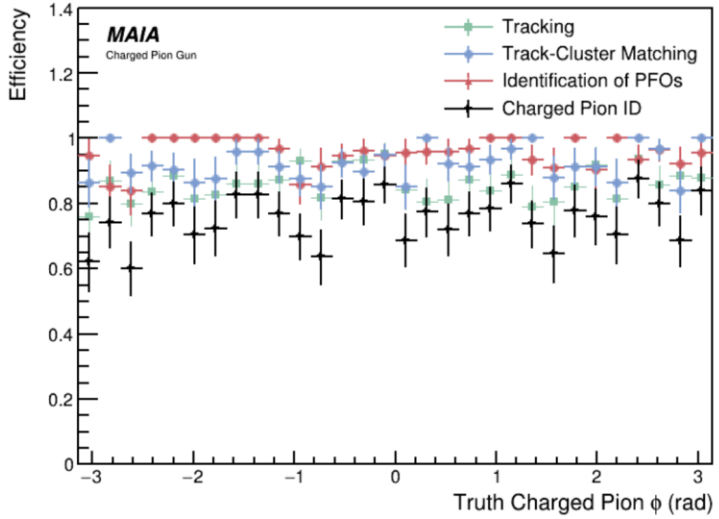




Si Track
_Refitted







Recap of Last Week

Loose summary: parameters and exact details yet to be understood (by me) and checked against code

- This could make sense given how Pandora clustering / PFO creation works :
    1. Clusters are seeded with tracks @ ECal face
    2. “Typical” clustering, beginning from the ECal face to the HCal end
        1. Pandora will tend to split clusters
    3. Clusters are then merged, according to several algorithms
    4. Attempt to match cluster to track. If cluster energy inconsistent w/ track pT, *do not associate*. Instead, try to combine that cluster with another to see if the energy becomes consistent w/ trk pT.
    5. Run fragment removal, i.e., merging neutral clusters nearby charged clusters
    6. Form PFOs
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this could explain previous slides - clusters being split with ~even energy leads to none being consistent with track p_T

→ match failure

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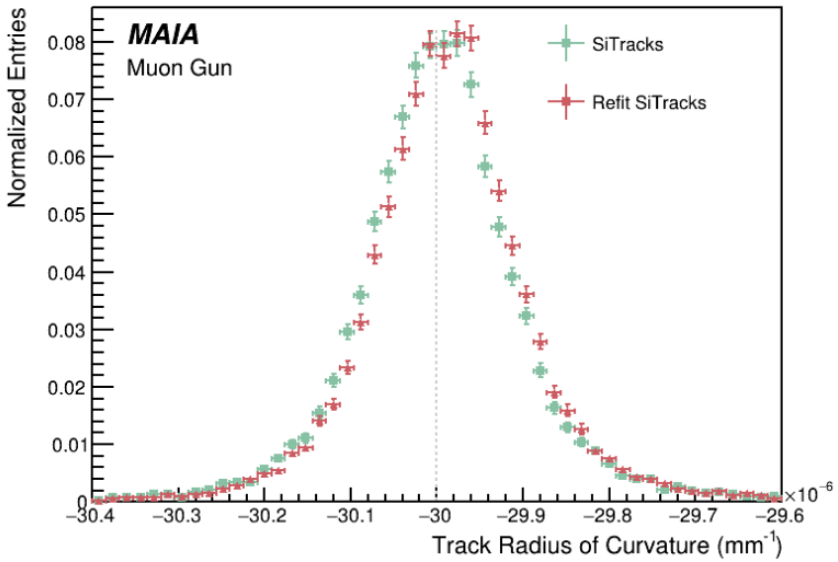
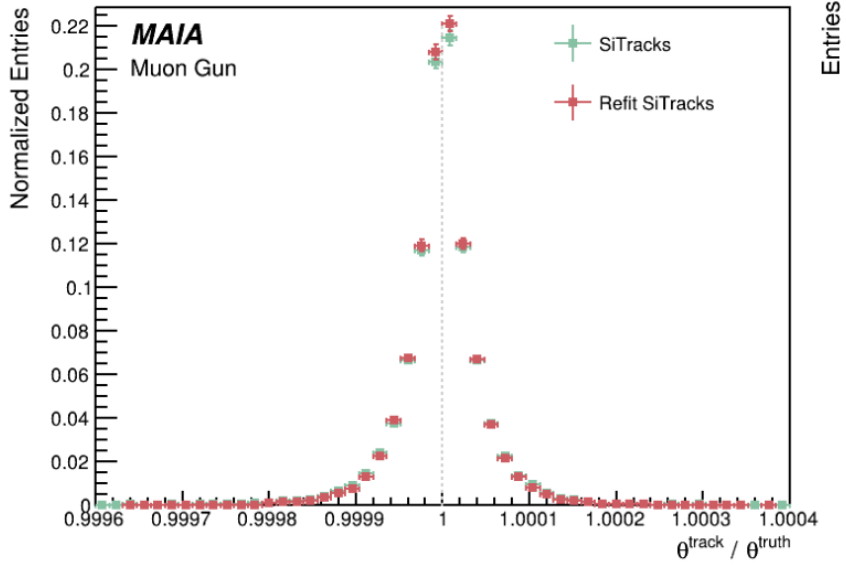
Main question from here:

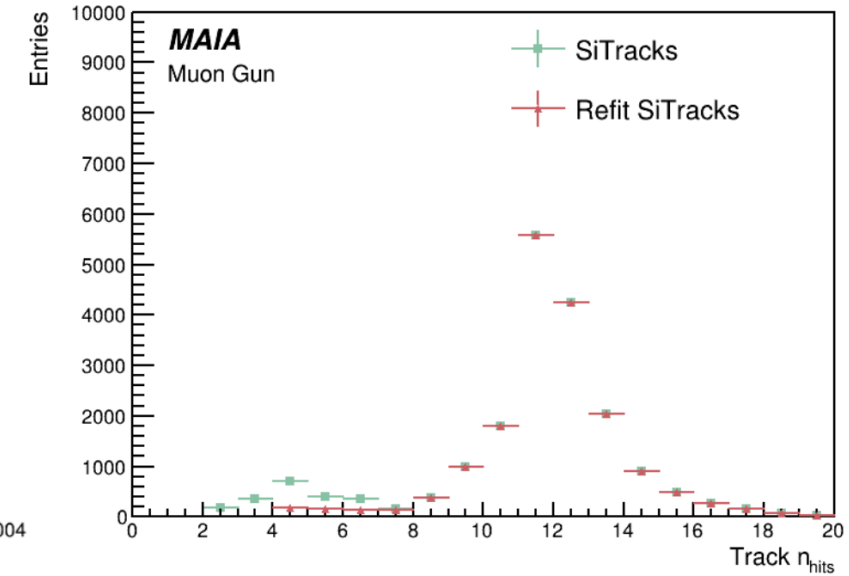
Why is one track container "better" than the other?

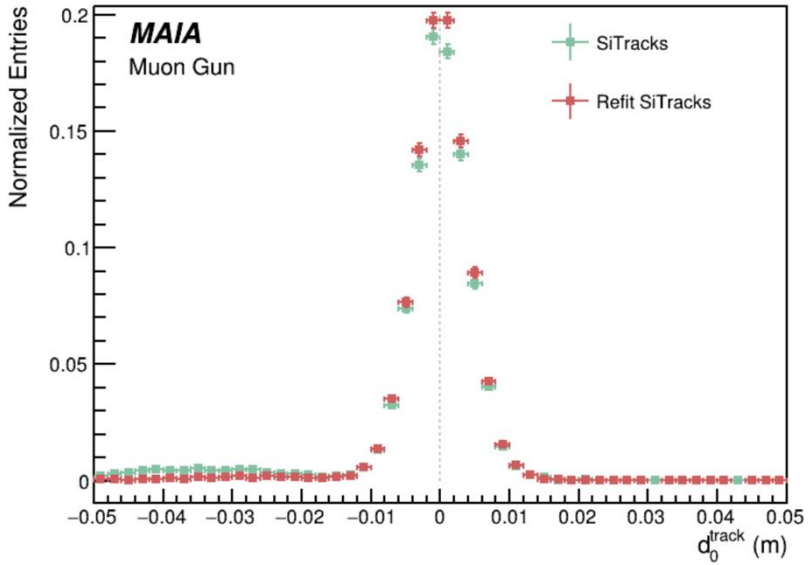
Are the tracks just different?

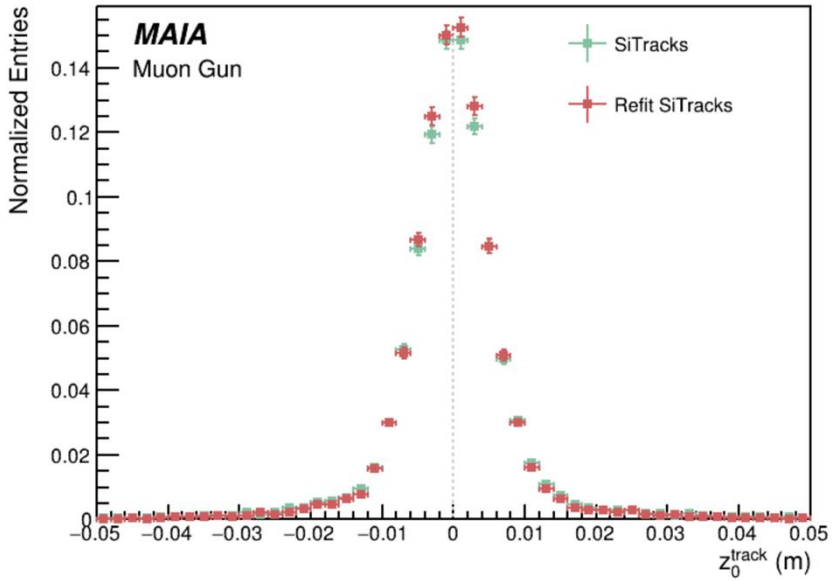
- Plots on this slide for muon gun, pT = 50 GeV, flat in theta and phi (comparison to pion gun soon to follow)

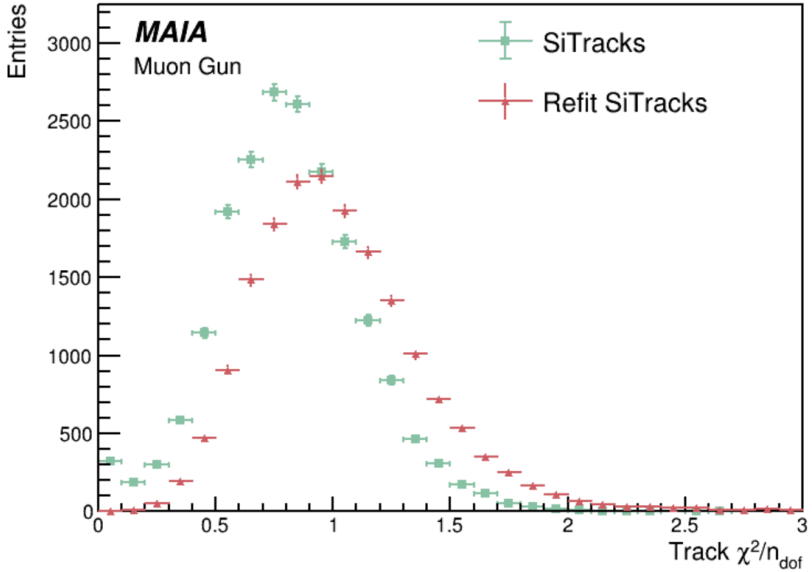












Is the track extrapolation behaving as expected?

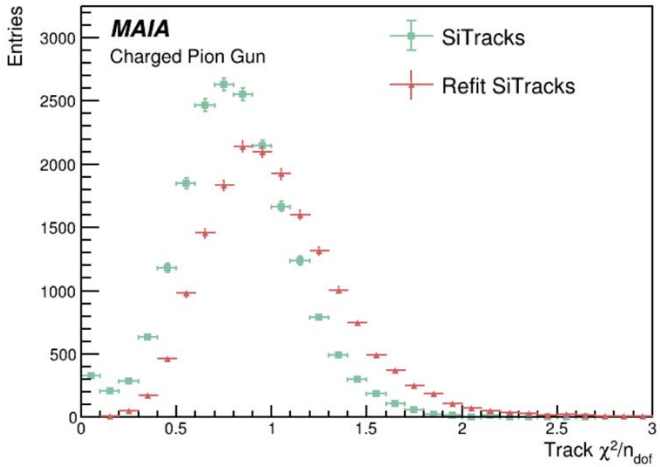
- Previous studies have found that SiTracks and SiTracksRefitted have similar track states at ECal “face”
- Reproducing this is crucial – improper extrapolation could impact clustering at the seeding step
- *Could track extrapolation be sensitive to using the MuColl_v1 ACTS material map, when MAIA geometry is used for simulation & digitization? It is difficult for me to estimate the impact of this.*

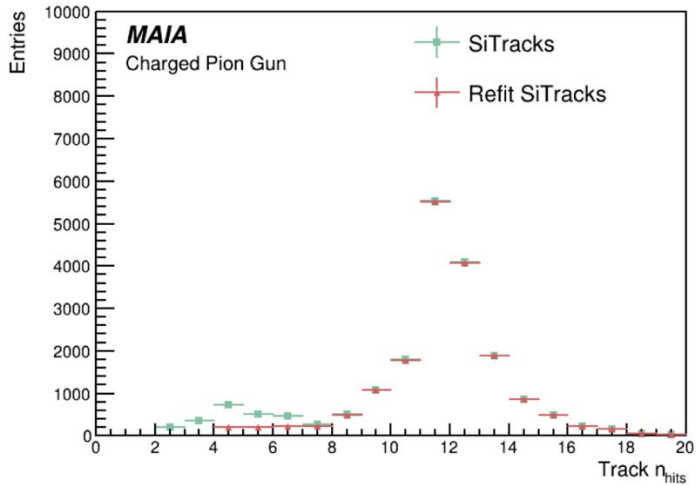
Work in progress.

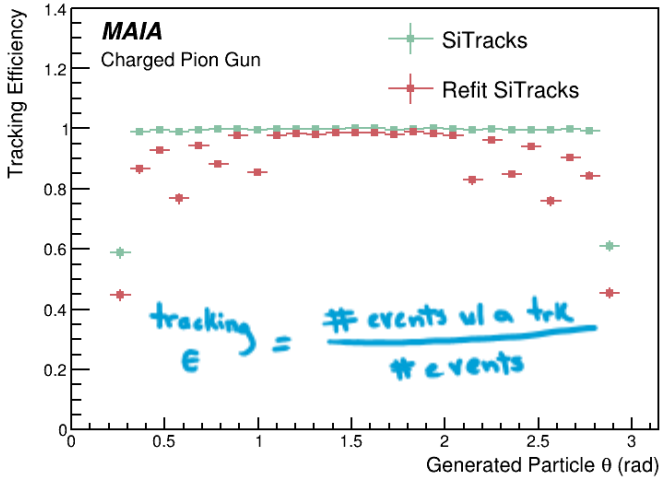
Muon vs. Charged Pion Tracks

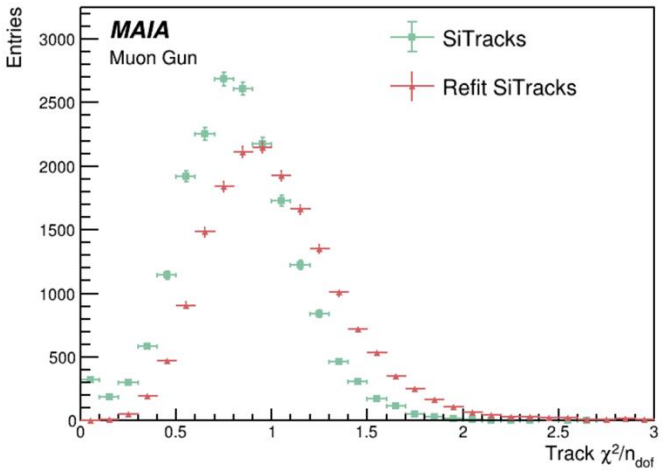
No significant differences in μ and $\pi^{\pm}$ tracks

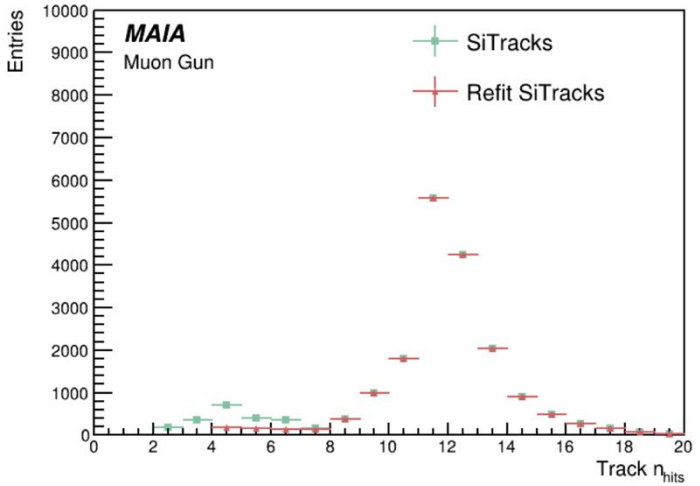
- Compare pion tracks to muon tracks, then establish baseline w/ paper results
- For just this tracking study, simplify further by generating pions or muons w/ pT = 50 GeV
  - Phi flat from 0 to 2Pi
  - Theta flat from 0 to Pi

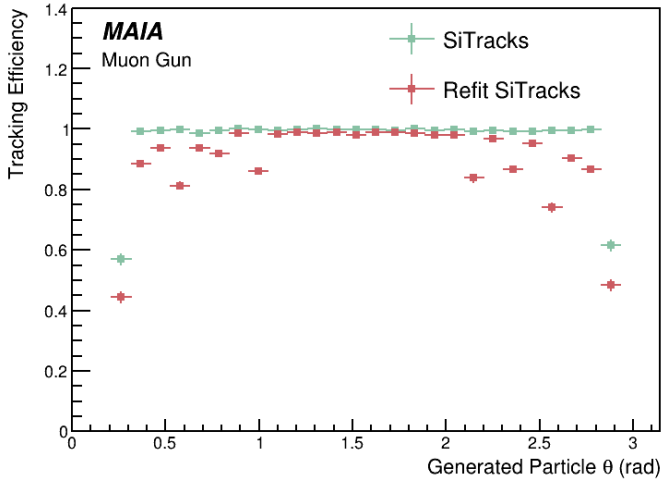






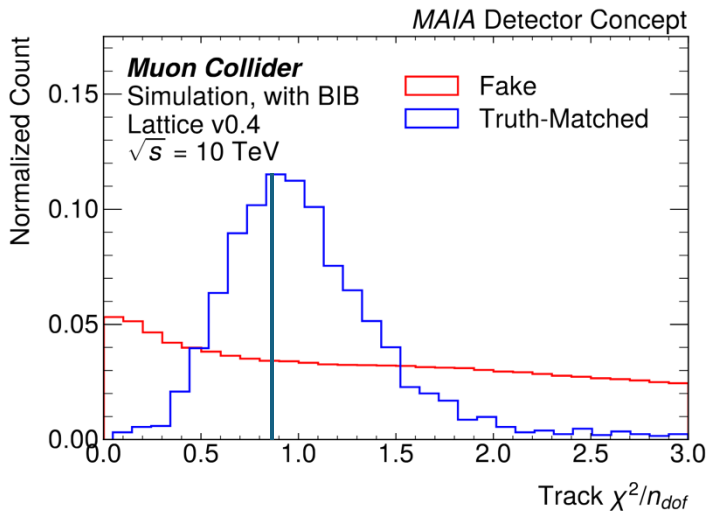


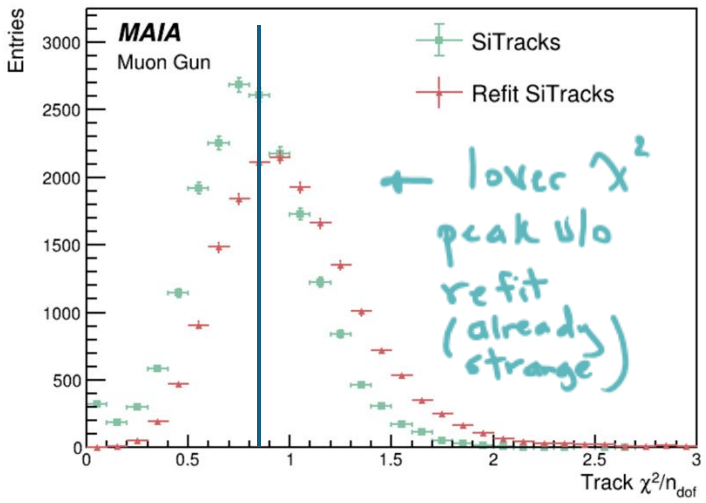


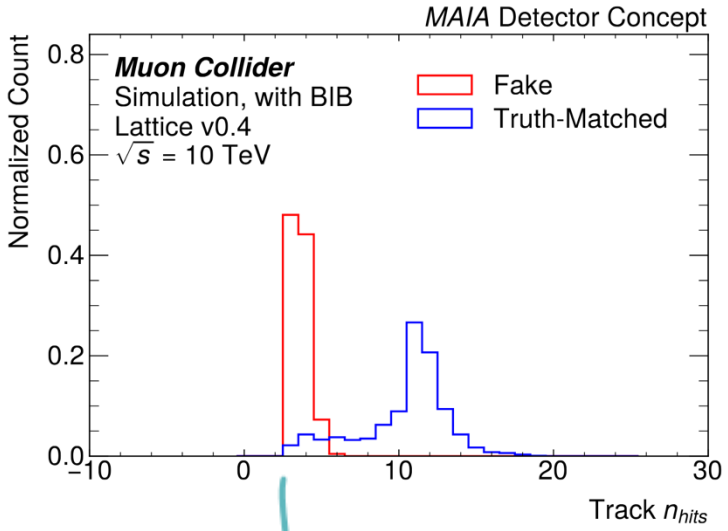


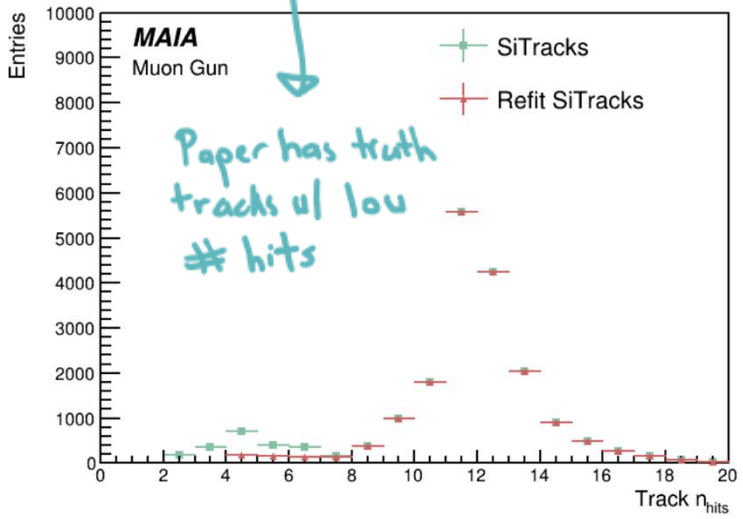
Comparison of Muon Tracks to Paper

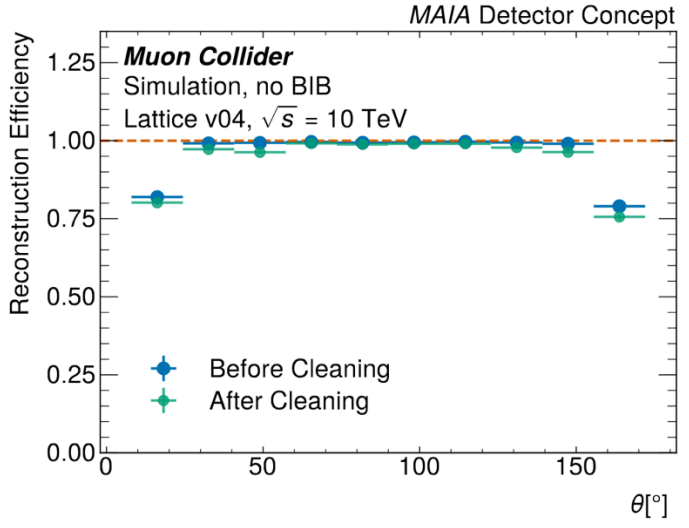
- Overall, SiTracks look more consistent with paper results than SiTracksRefitted

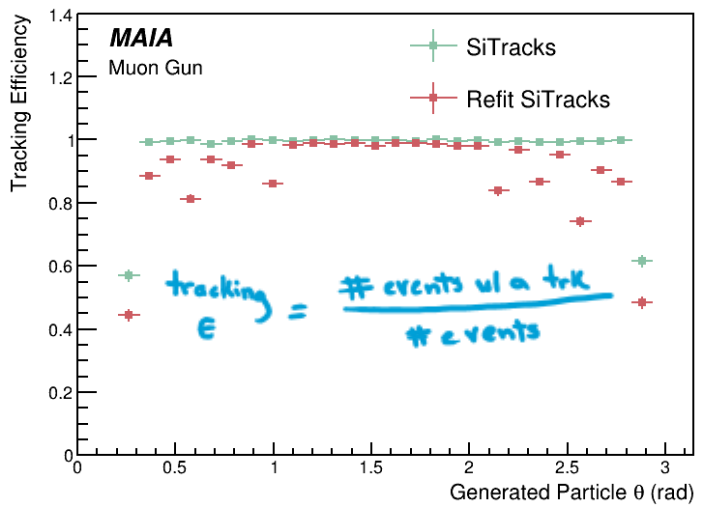












Summary

- Pion clustering performance highly sensitive to tracking container used in Pandora
- Parameters of SiTracks and SiTracksRefitted look similar
- Extrapolation of track to ECal surface could be going wrong → checking this next
- Muon gun used to validate pion tracks, closer match to paper results with SiTracks

- A few questions:
  - Could we have a second look for the ACTS material map / geometry for MAIA?
    - Can the wrong files impact track extrapolation?
  - ACTS tracking config used in paper?
    - There are other parameters that I've left untouched
  - Definition of track matching to truth objects?
    - Comparing efficiencies difficult without any truth-matching on our side

- Next (short-term) steps:
  1. Comparing state of SiTracks and SiTracksRefitted at ECal face
  2. Still parsing code to confirm purpose & details of track refit

- A few words on taus:
  - We have a version of "TauFinder" algorithm working on top of Pandora
  - Currently implementing truth matching