Initial Quick Peak at HPS Acceptance

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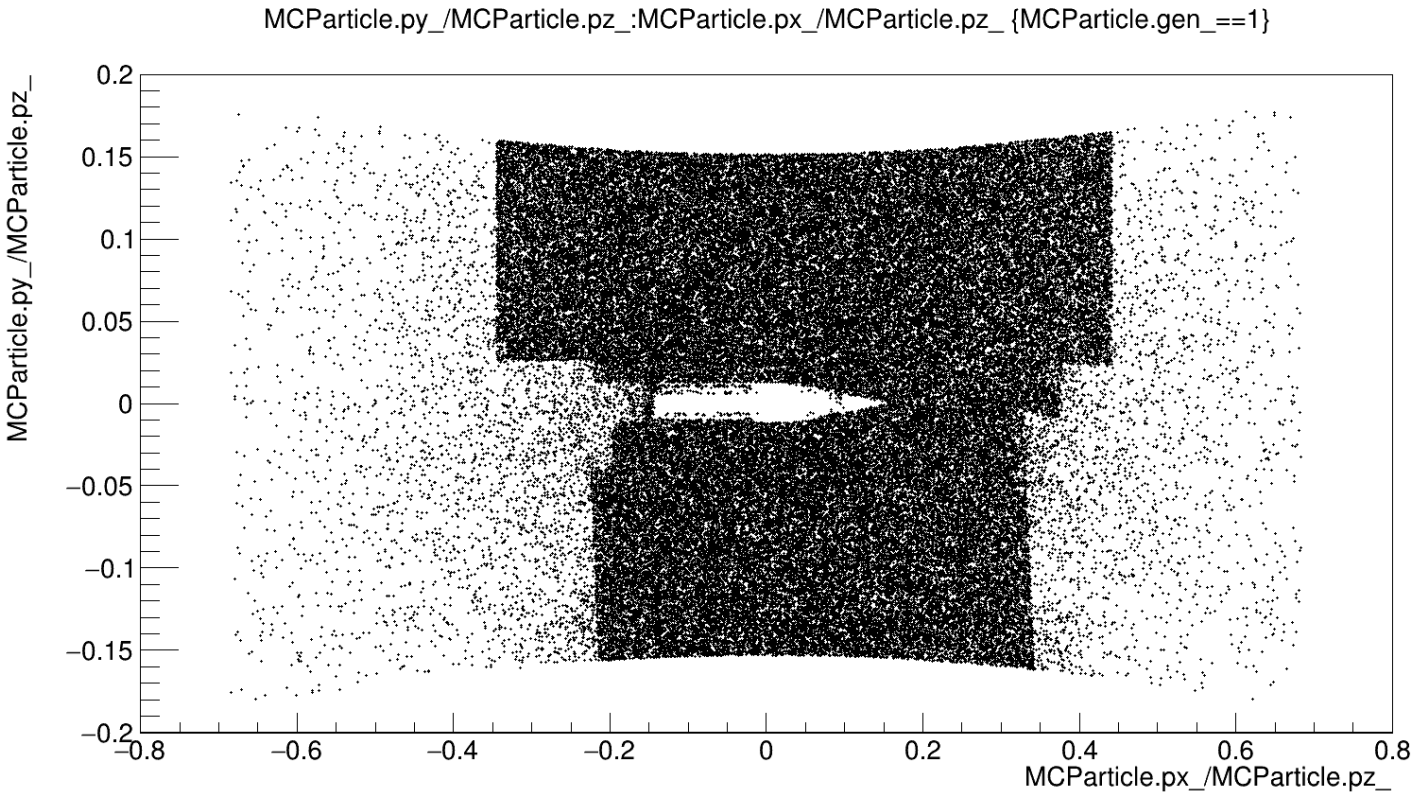
Introduction

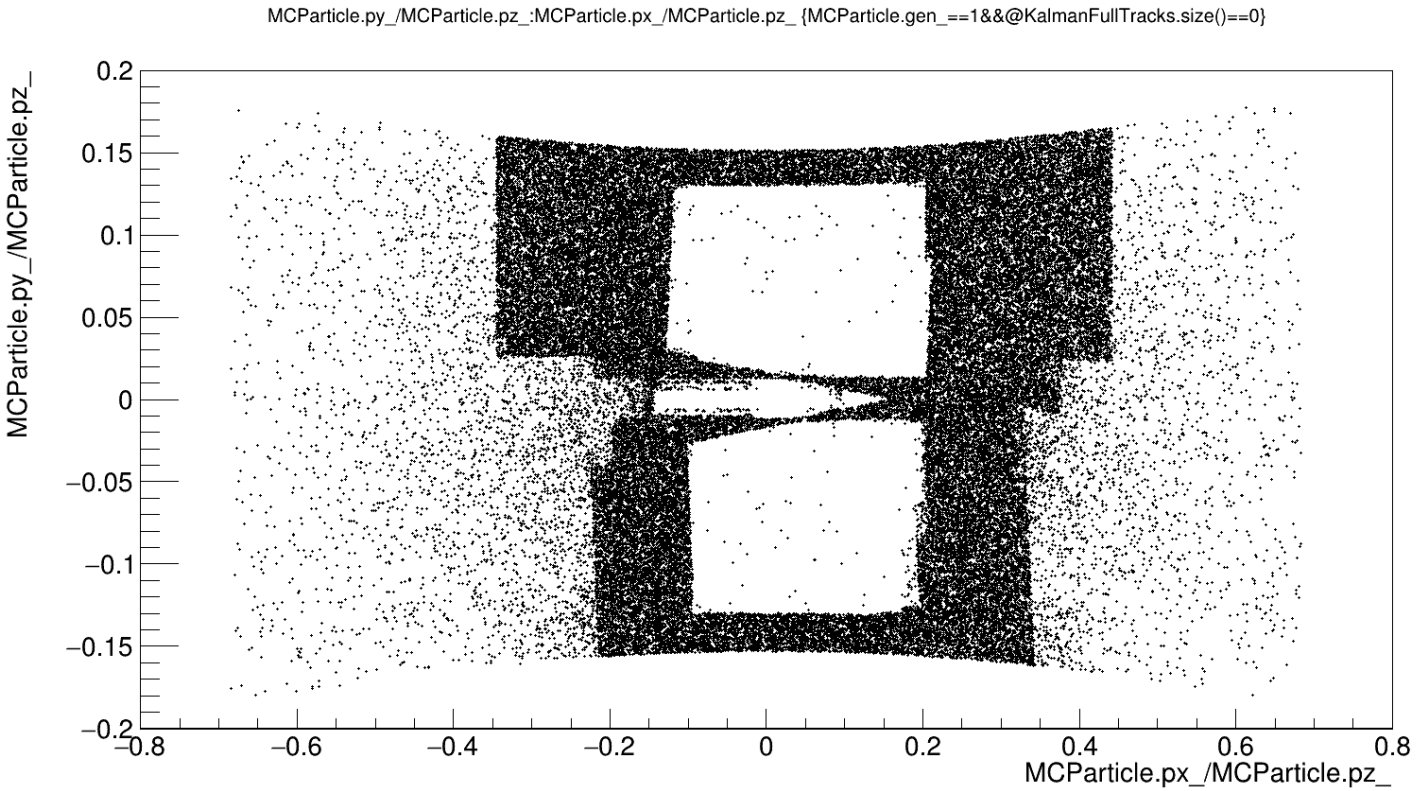
- After some trial and error (some GPS documentation had a typo) managed to get isotropic point source of electrons with angular distribution that covers full HPS acceptance
  - Angular distribution used goes a bit further out than acceptance so we know we have the FULL acceptance
  - Example of coordinate rotation and angle constraints in example: https://github.com/JeffersonLab/hps-mc/blob/master/examples/slic_gps_to_ana/gps.mac
- This is an initial study of “as surveyed” detector with 2021 bfield and using dead channel list recently uploaded to db (realistic conditions)
  - Each event has 1 primary electron at origin with energy 3.73 GeV
  - Isotropic distribution, abs(tanλ) < 150 mrad & abs(phi0) < 600 mrad
  - This goes somewhat beyond the acceptance of ECal and SVT
- Let’s start by looking at some high level stuff and then dig a bit for this first little peak

Primary Electrons



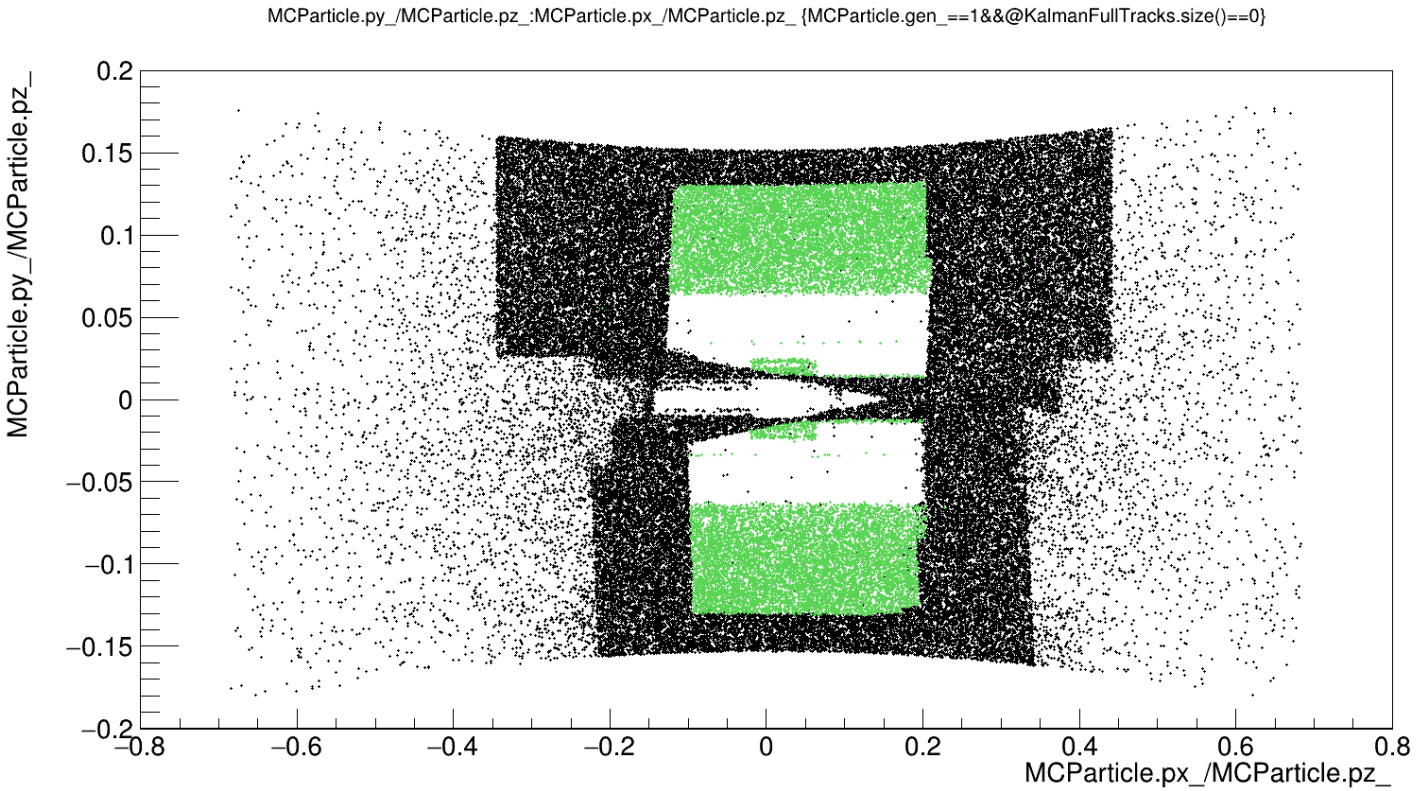
- Primary electron info saved in 106,829 of 200,000 events
  - SLIC only saves MC particles that deposit energy somewhere
- Clearly beyond detector in phi0, need to look at tracks to confirm we are beyond acceptance in tanλ

Primary Electrons in Events w/o Track



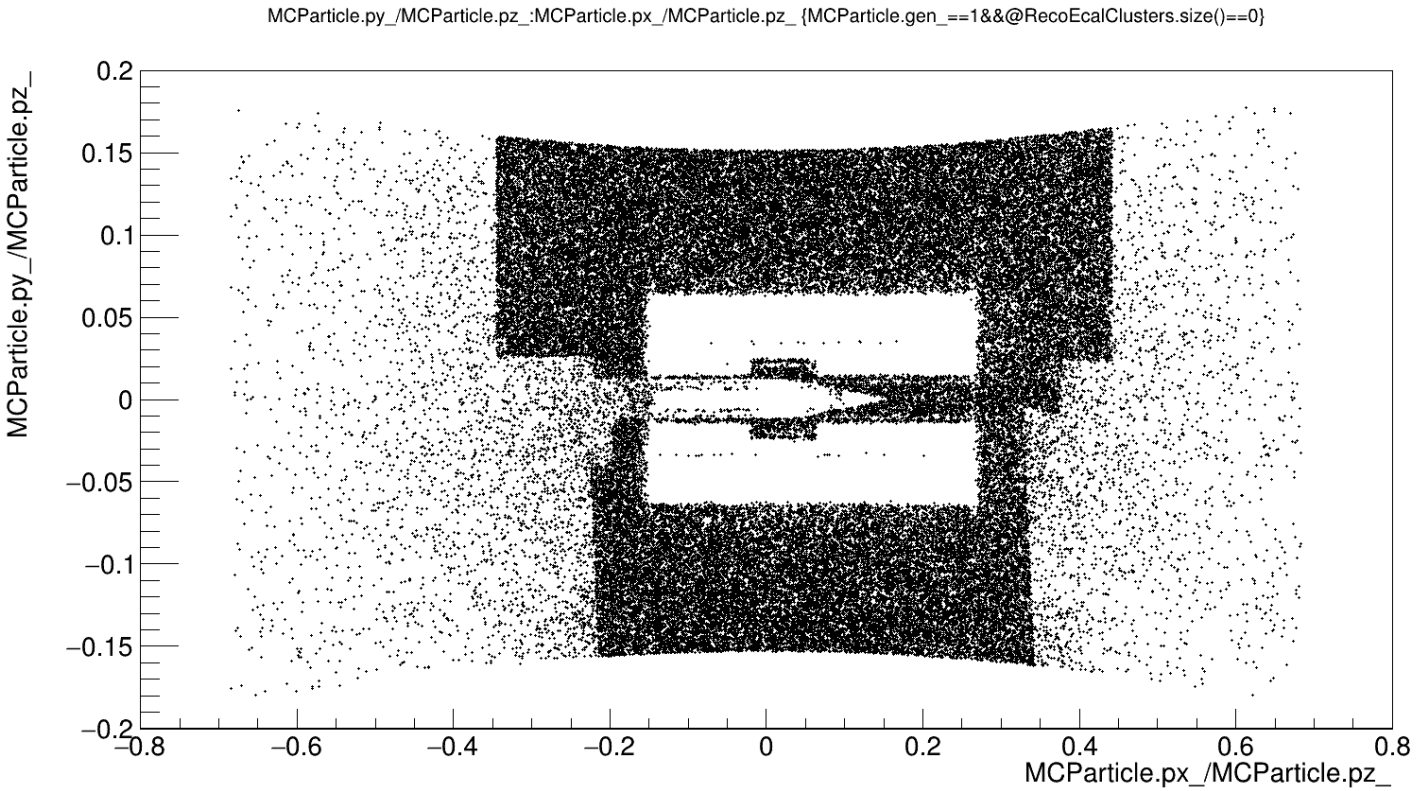
- Clearly angular distribution covers full tracking acceptance
  - KF tracks require at least 6 hits IIRC
- This is where the primary electrons are in events without a KF track

Primary Electrons in Events w/ Track and w/o ECal



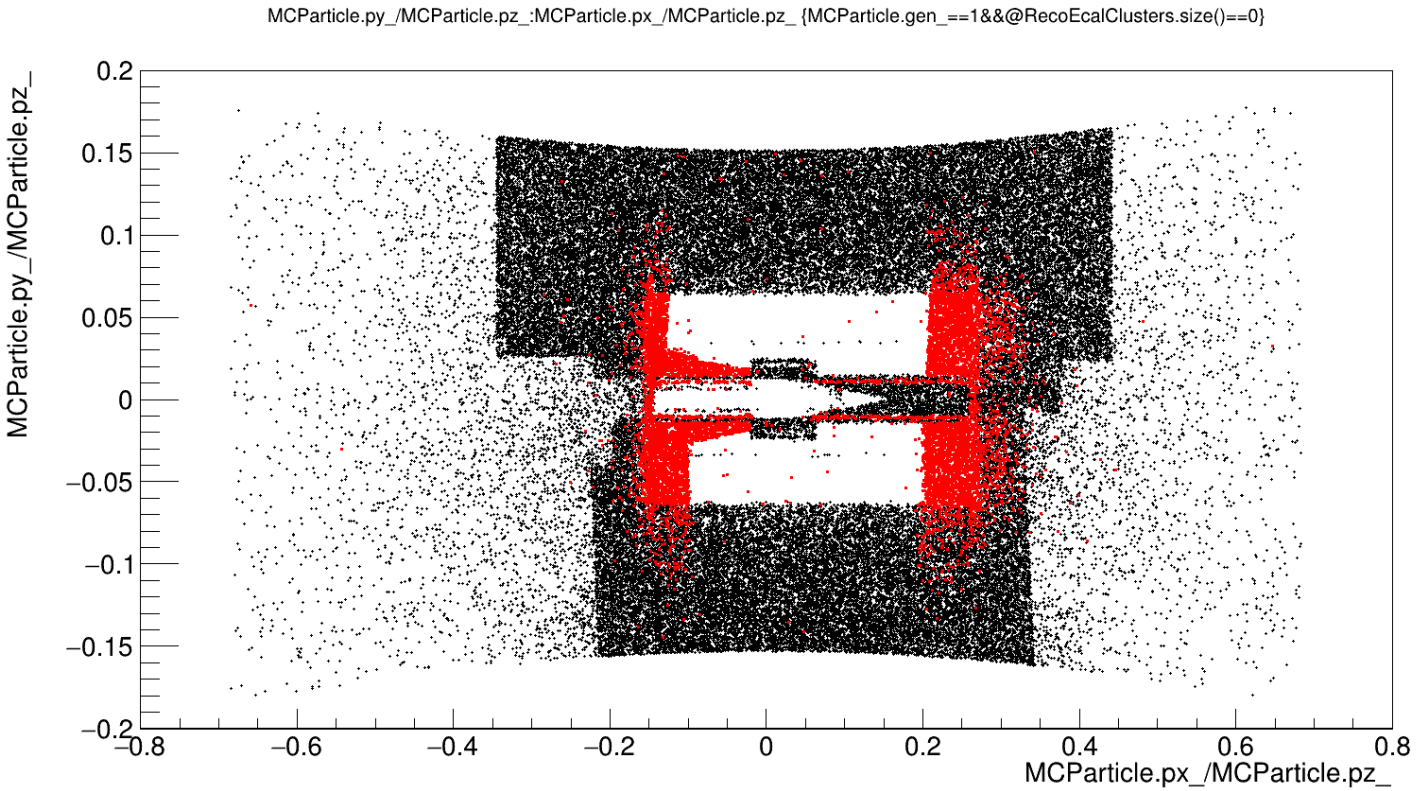
- Green points here are where primary electrons are that make a track but do not make an ECal cluster
- Now let's see where the ECal is

Primary Electrons in Events w/o ECal



- Sample also full covers acceptance of Ecal
- These are where primary electrons go that do not make an ECal cluster

Primary Electrons in Events w/ ECal w/o Track



- Red points on this plot are where we have primary electrons that make an ECal cluster, but do not make a track
  - Clearly extends into fiducial region of ECal
  - ~30% of events with an ECal cluster do not

FEEs are more complicated than we thought

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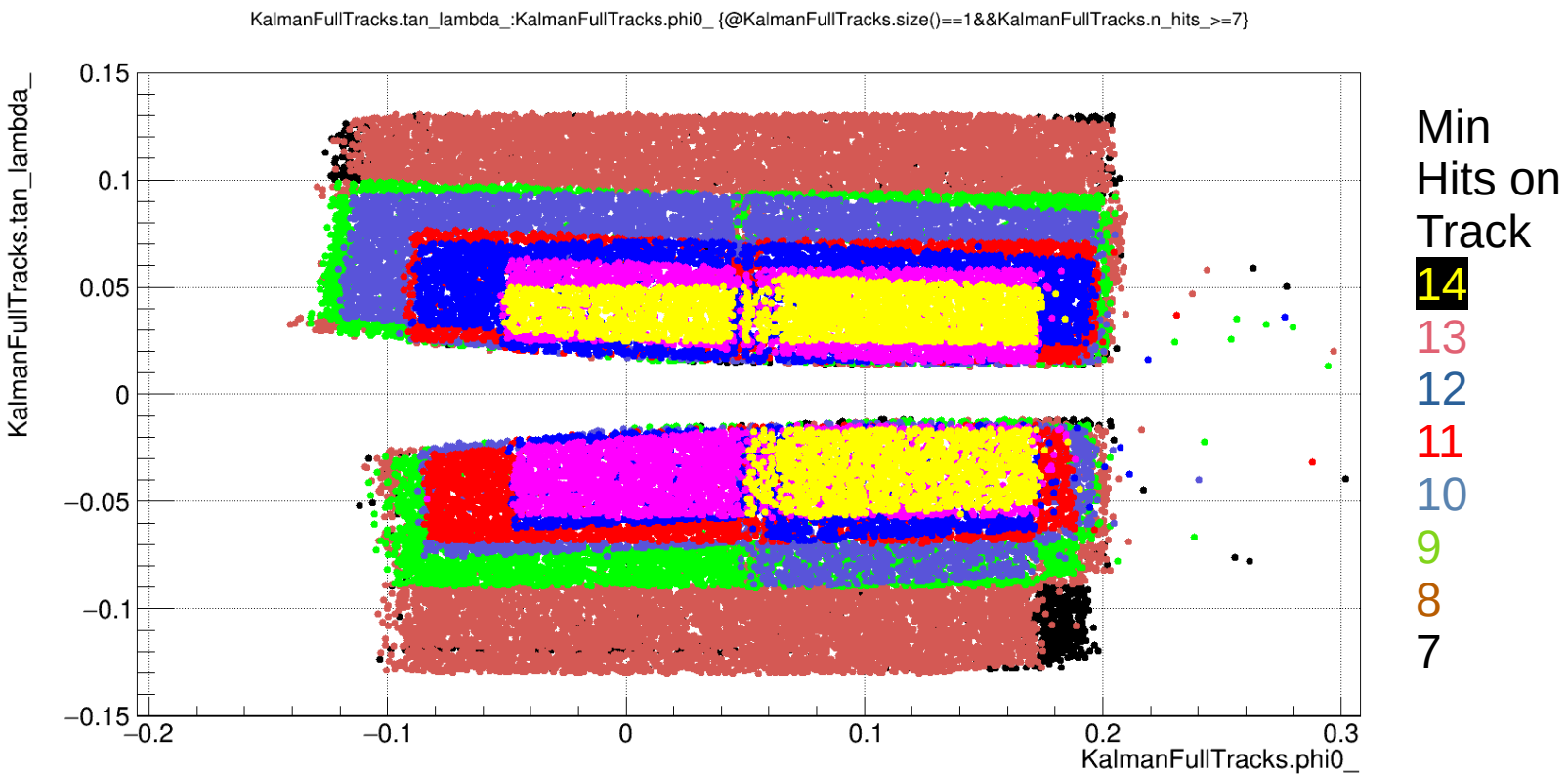
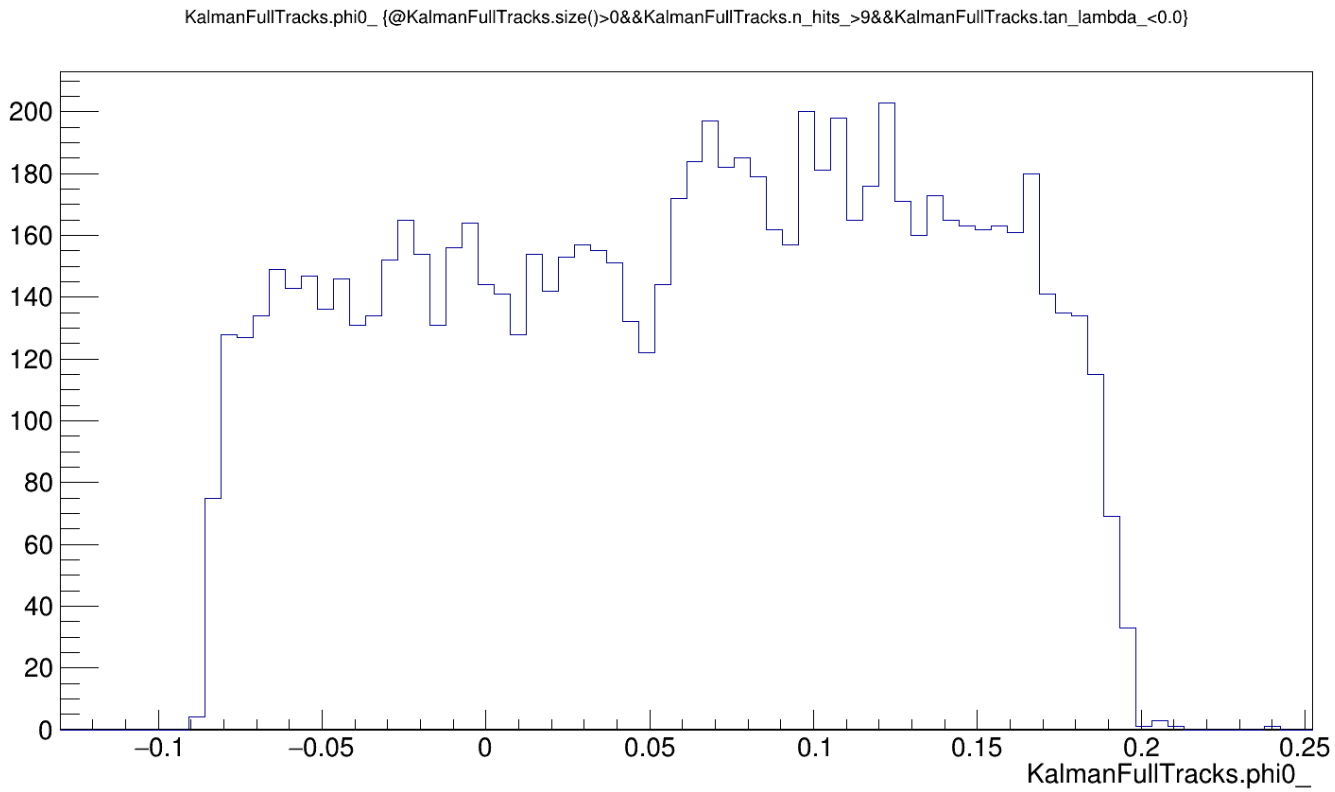
- Okay so, at the beam energy we have parts of our acceptance where we expect a track and no ECal and other places where we expect an ECal cluster but no track
  - Any track efficiency analysis that assumes every electron that makes an ECal cluster should make a track is expected to be off by tens of %
  - We need to be careful about having oversimplifying assumptions
  - This only gets more complicated as you decrease the energy
- Impossible to make track and cluster efficiency in MC based on this sample because SLIC throws away any primary particle info if particle does not deposit energy, should be easily changed though
- Lets take a look at our acceptance a bit in the variables we are usually looking at now that we are convinced we are fully covering it in the sample we are looking at

SVT FEE Acceptance at 3.74 GeV



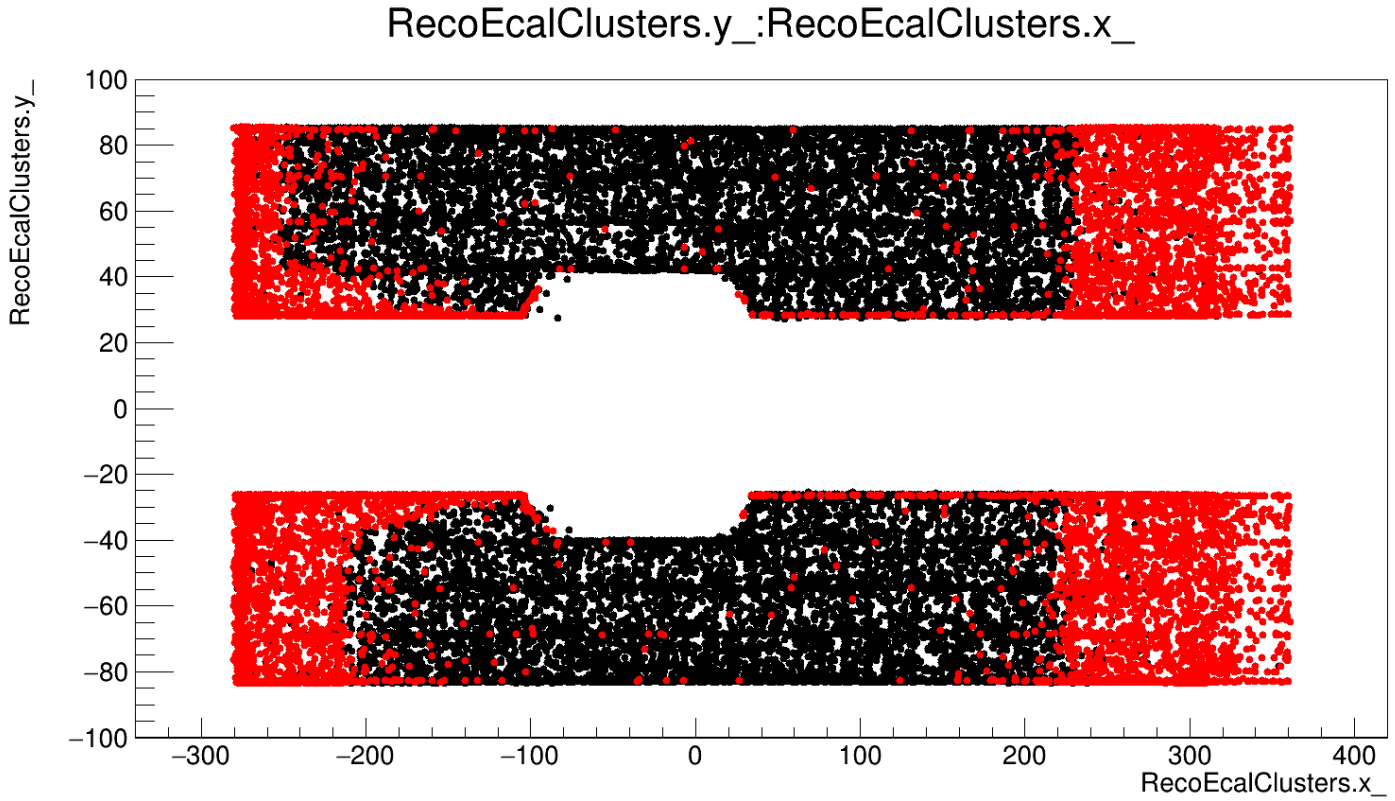
- This shows how the acceptance changes as you change the hit multiplicity requirement of the tracks
  - Using tracks with 12 or more hits pretty limited acceptance
- Phi0 cut based on acceptance can for sure clean some bad track fits

Bottom SVT FEE Phi0 “Acceptance” with >= 10 Track Hits



- Gotta keep these shapes in mind when look at single variables
  - Just keep in mind how full acceptance looks with that hit requirement
- This also seems to be insight into top/bottom asymmetries

ECal Clusters without a Track



Red points are Ecal Clusters in events without a track

- Significant portion of Ecal has a cluster and track is out of SVT acceptance
- This shape will change as we lower electron energy
  - Also different when we start looking at positrons

Discussion and Plans

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- Tried to also look at 4.55 GeV FEEs, but slic keeps seg faulting at around the 700th event
  - Could just make a ton of files and hadd, haven't gotten around to this
  - Also could go try to squash bug causing seg fault
  - Did notice events we do get sometimes have huge number of MC particles in them
- Abhisek will help keep pushing this effort
  - Look at all energies up to beam energy
  - Look at positrons
- After we are done characterizing the detector acceptance we will move on to understanding the physical distributions of the phase space. Stay tuned!