Electron Seeding with Silicon Strips

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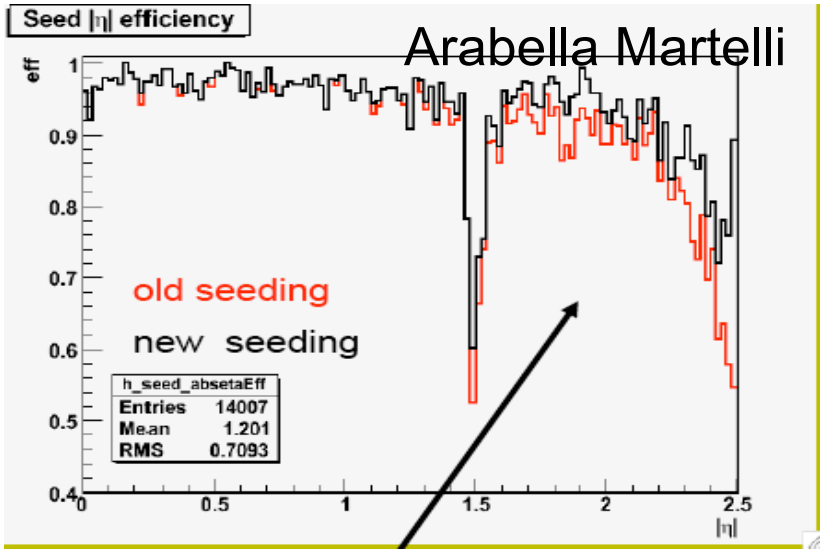
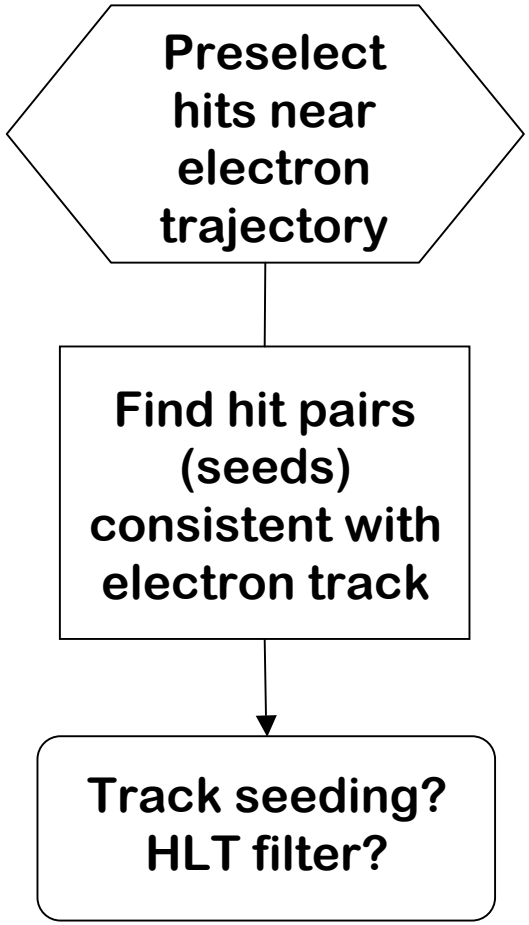
Motivation

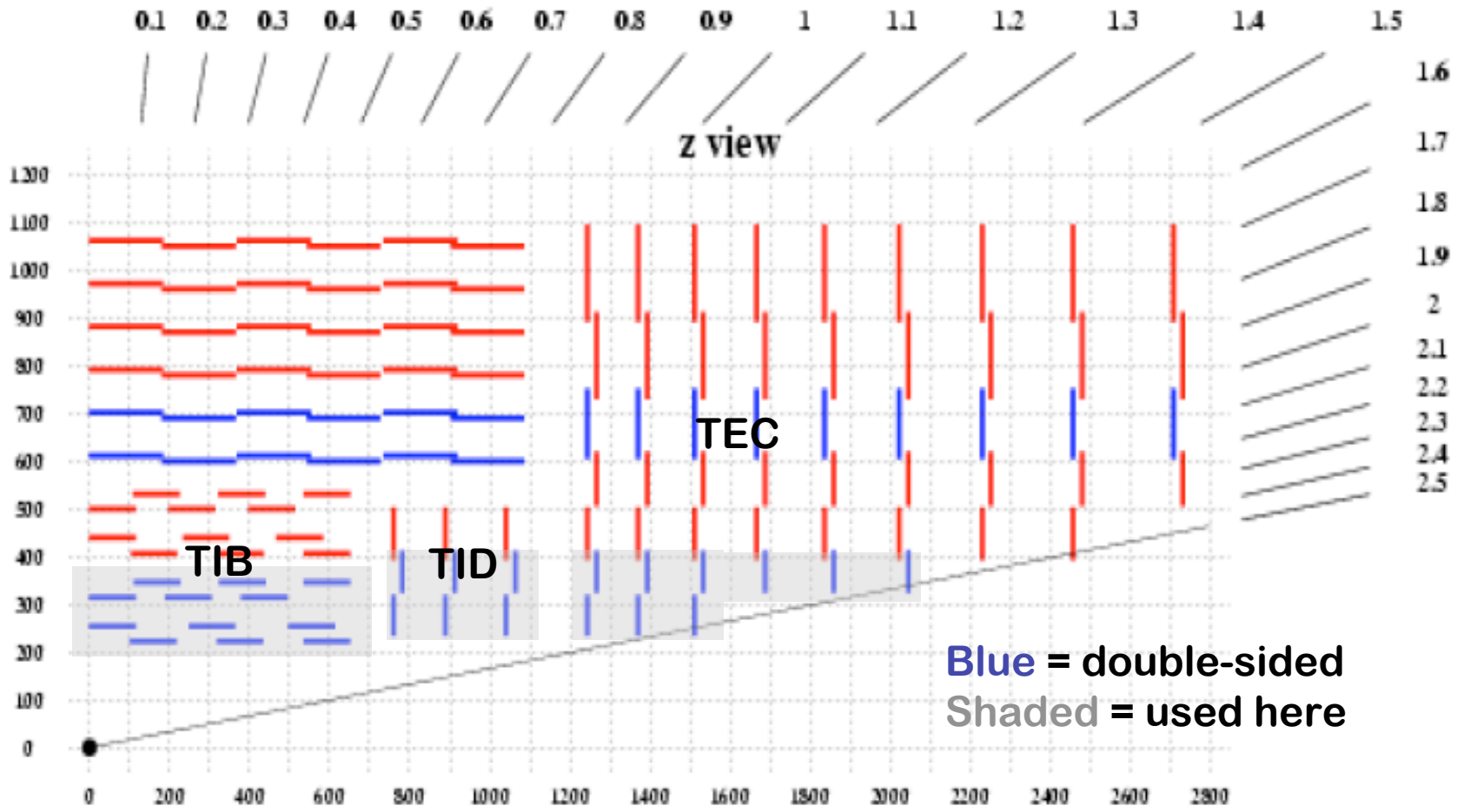
- Increase efficiency of electron seeding, especially at large η.
  Complements pixel based matching.
- Provide redundancy
  Having both Pixel and SiStrip seeding could be valuable, especially in early days of running when the devices are still being understood.



Overview


Preselect hits near electron trajectory
Find hit pairs (seeds) consistent with electron track
Track seeding? HLT filter?

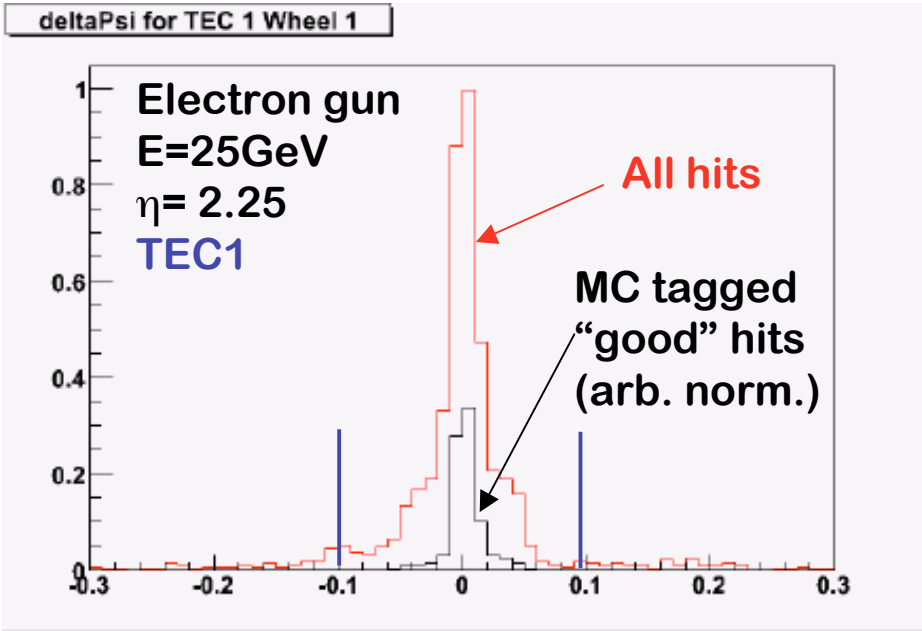
Tracker layout

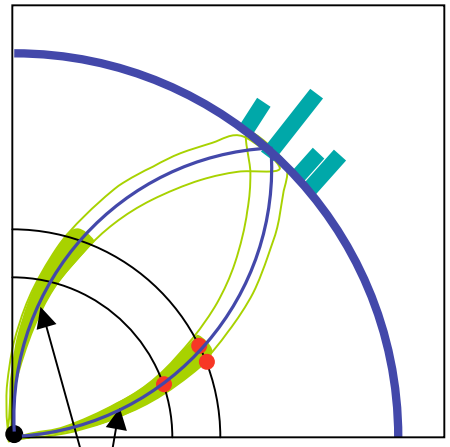


Hit preselection: r-ϕ

r-ϕ: $|\Delta\phi| < 0.1$ rad

Driven by SC position resolution

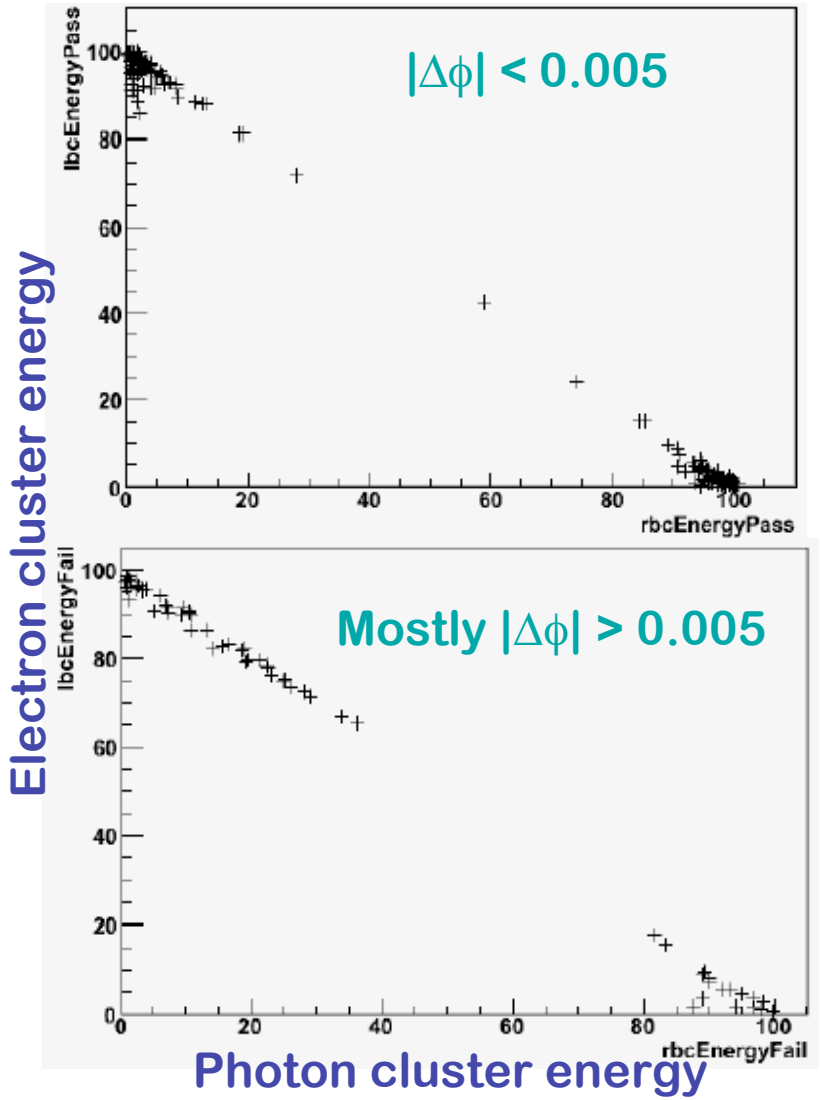




Two charges
Curvature from SC E_T

Distributions
in other layers
are similar

Aside on showers and roads



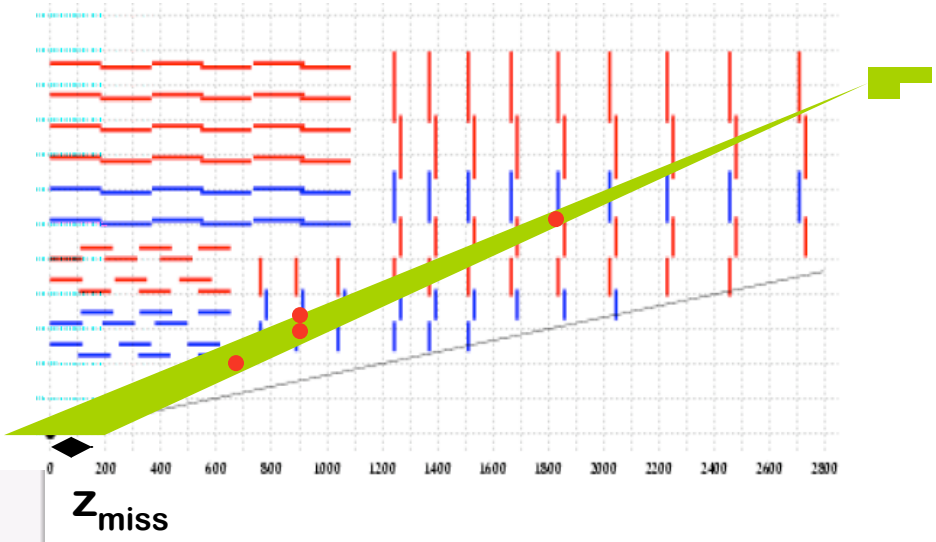
Case:

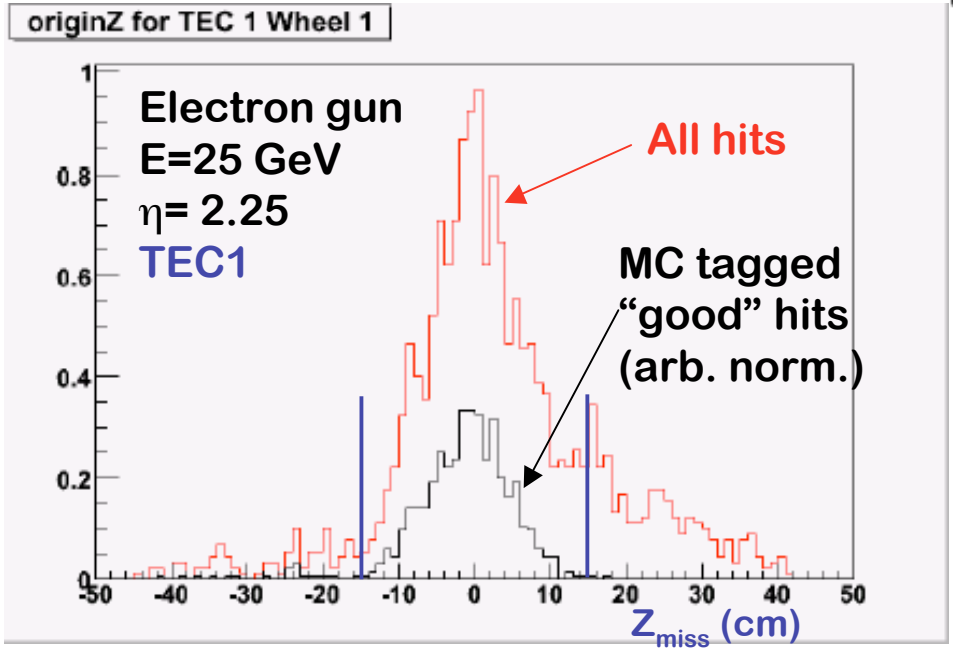
- 100 GeV electrons, $\eta = 0.75$
- 2 basic clusters in SC, presumably 1 electron, 1 radiated photon
- $|\Delta\phi|$ is narrow when the energy sharing is asymmetric.
- $|\Delta\phi|$ can be large when the energy sharing is more balanced.

  Does this reflect difficulty in determining the SC position when the basic clusters overlap?
- Led to widening the cut to $|\Delta\phi| > 0.1$

Hit preselection: r-z

- Road width is driven by beam luminous region
- z_{miss} = z at beam axis of line through SC and hit.
- $|z_{miss}| < 15$ cm

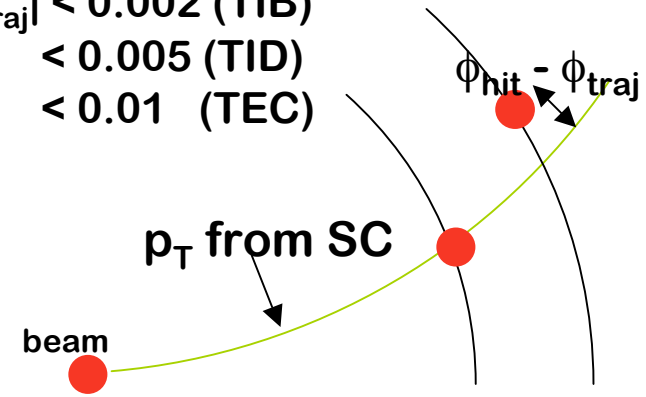


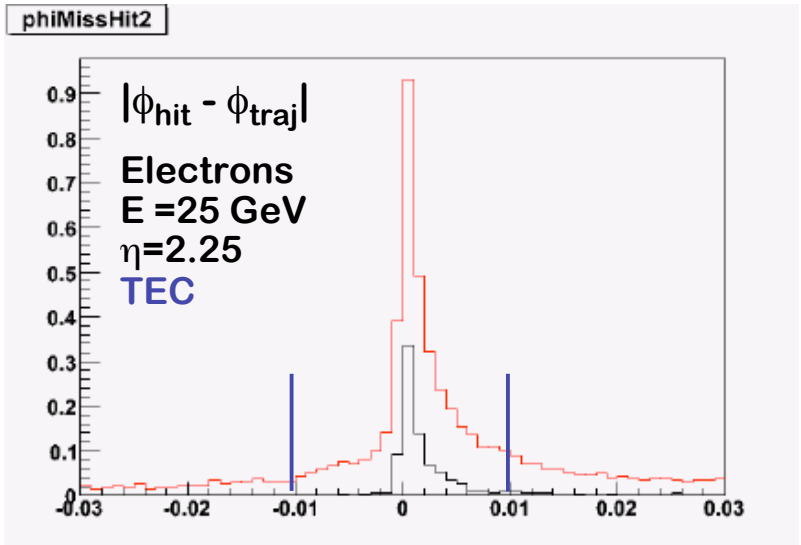


Step 2: Form seeds

r-ϕ view

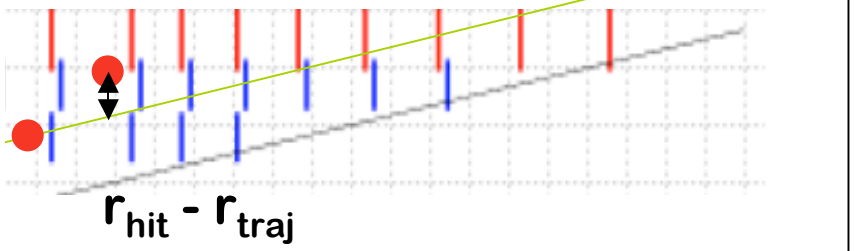
$|\phi_{hit} - \phi_{traj}| < 0.002$ (TIB)
< 0.005 (TID)
< 0.01 (TEC)

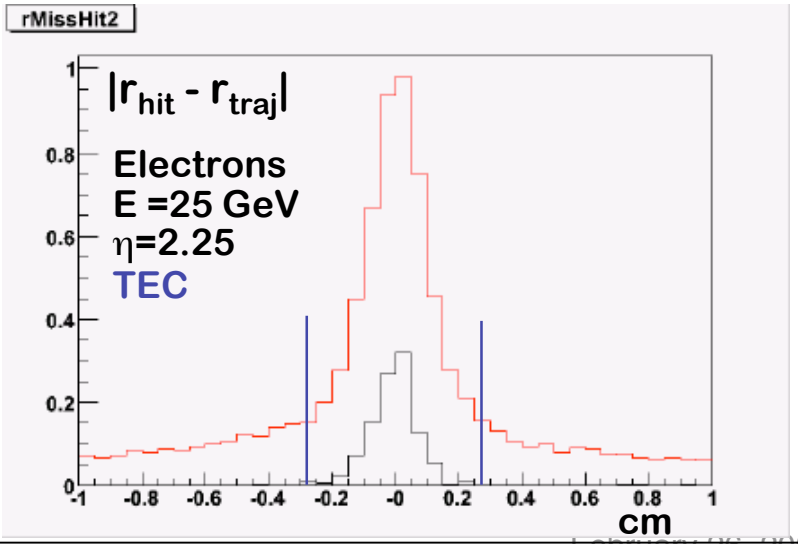




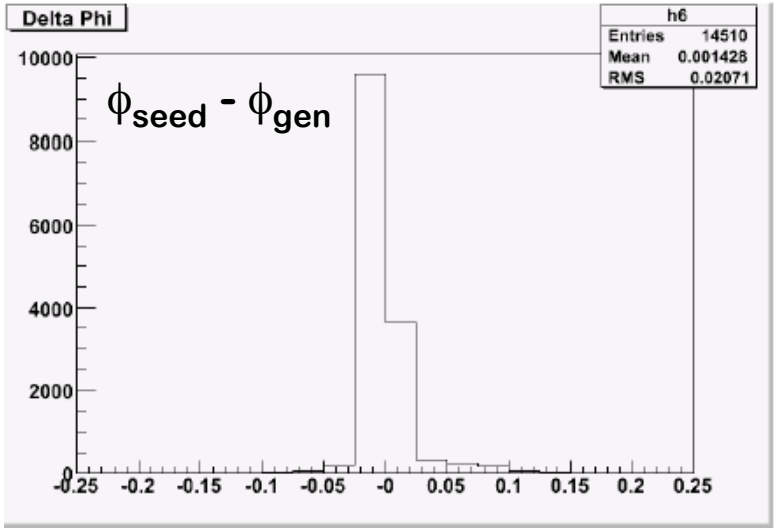
r-z view

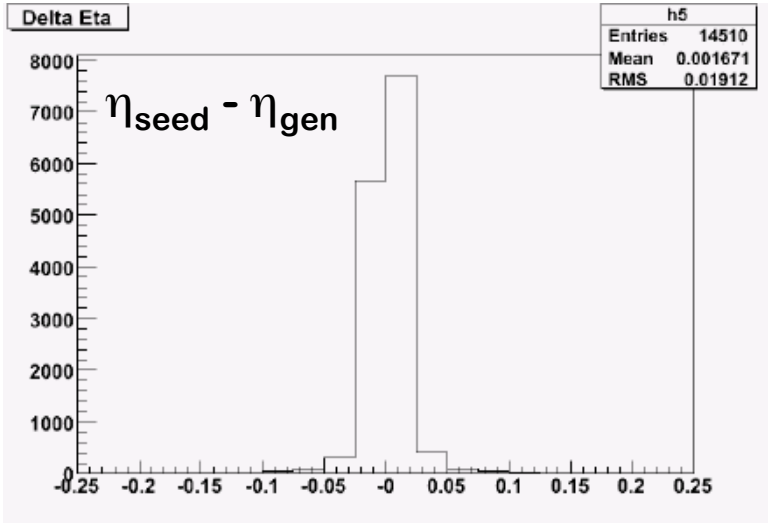
$|r_{hit} - r_{traj}| < 3$ mm
(in barrel, $|z_{hit} - z_{traj}| < 3$ mm)

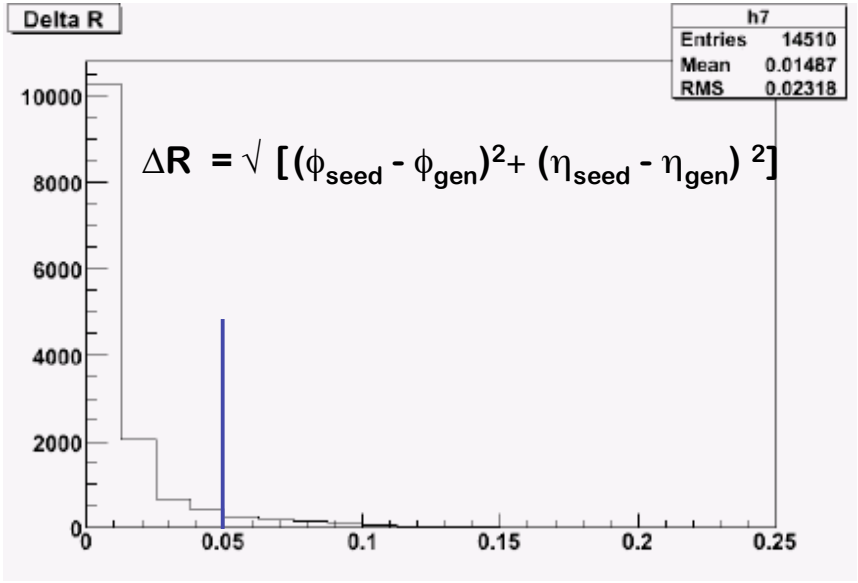




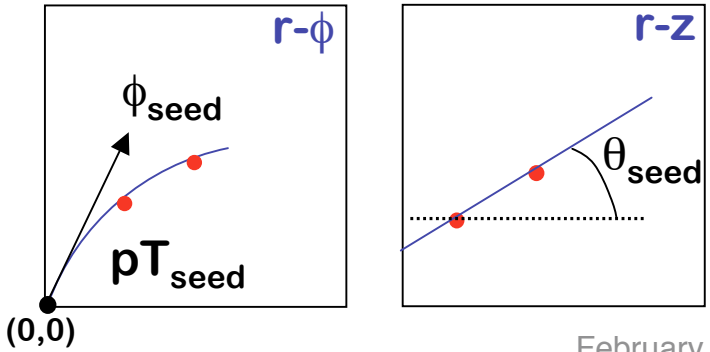
Reality checks



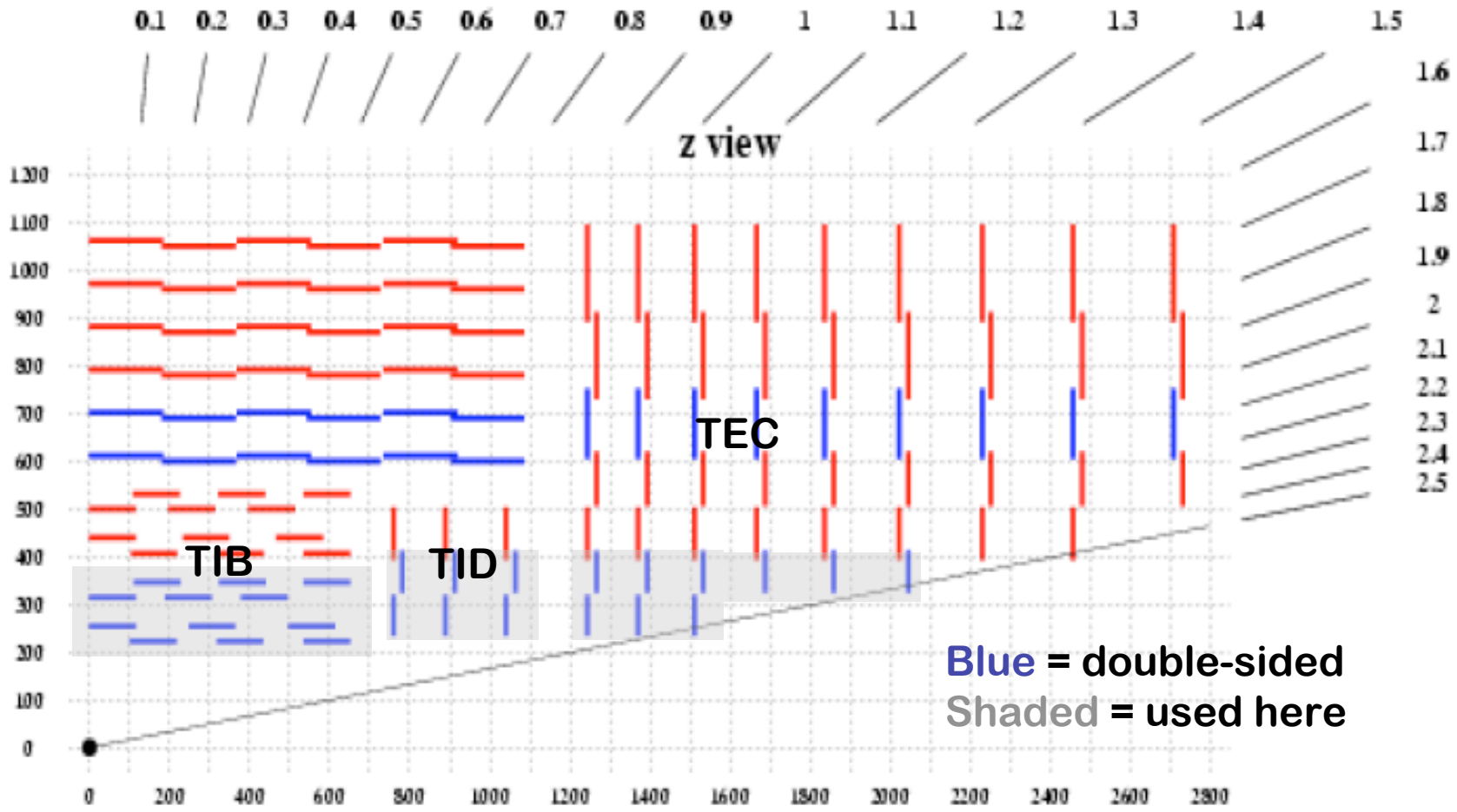




10,000 electron gun events
E = 25 GeV $0 < \eta < 2.5$

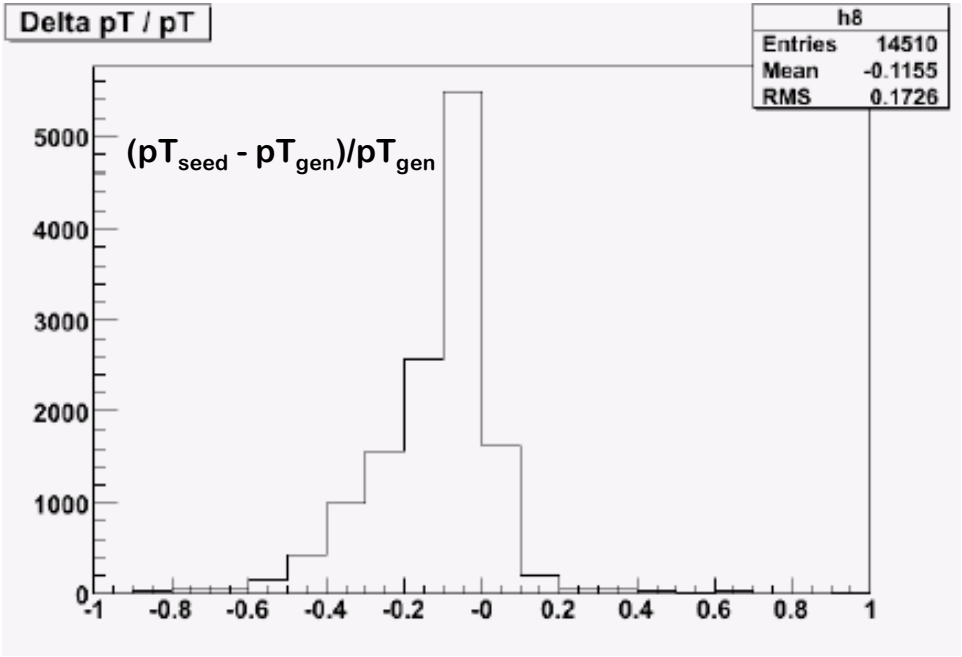


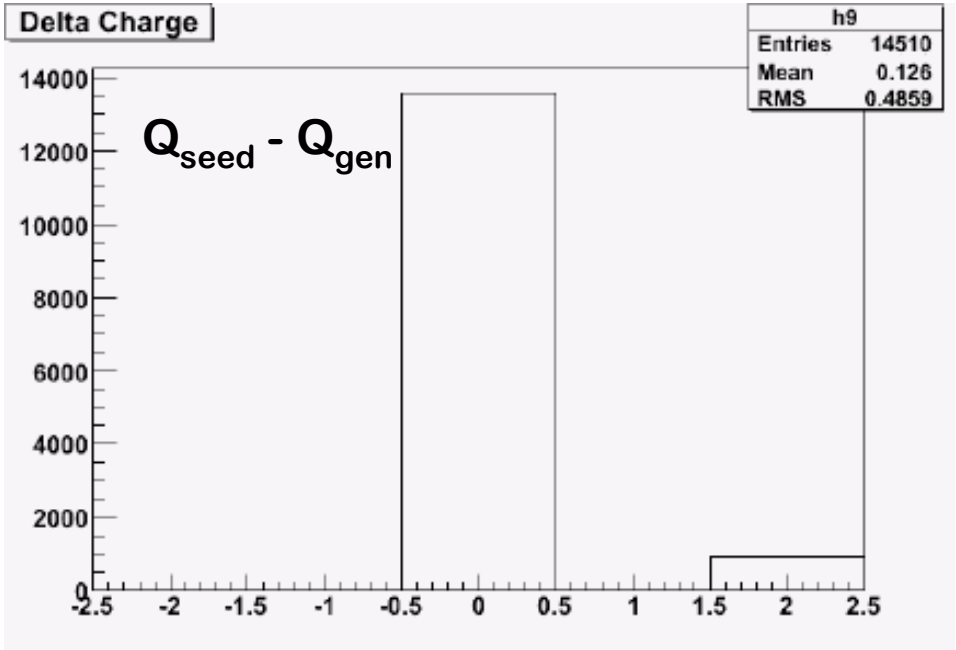
Tracker layout



More reality checks

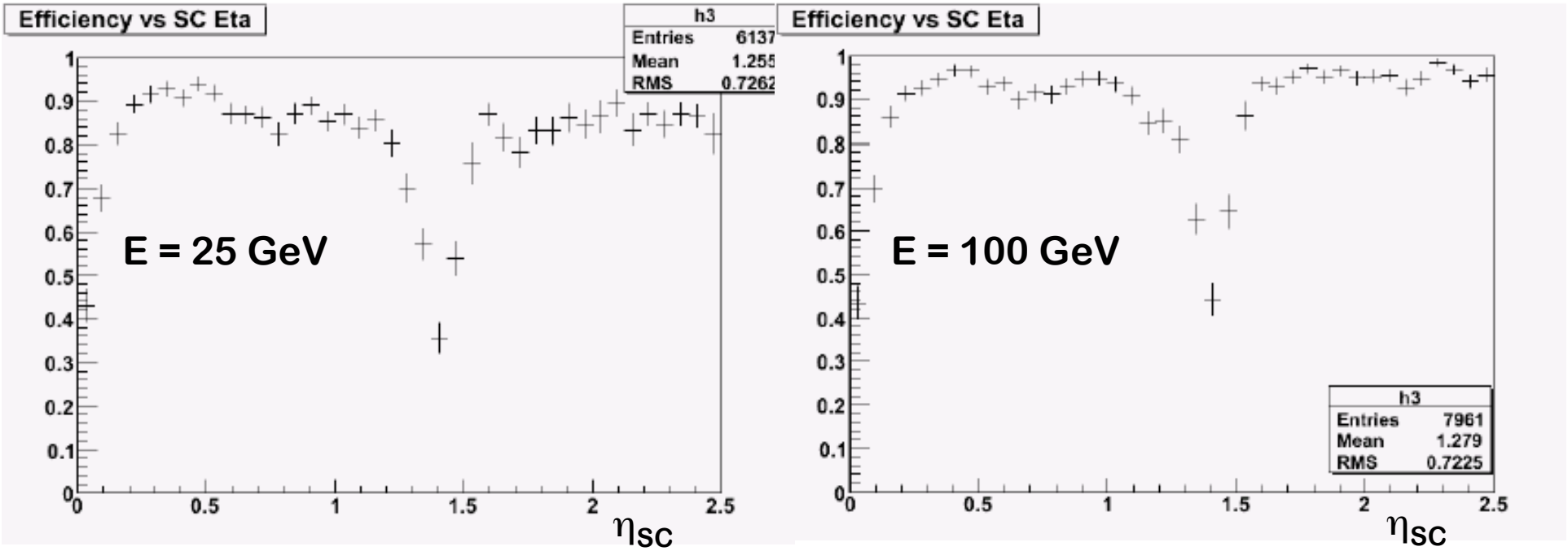
10,000 electron gun events
E = 25 GeV $0 < \eta < 2.5$





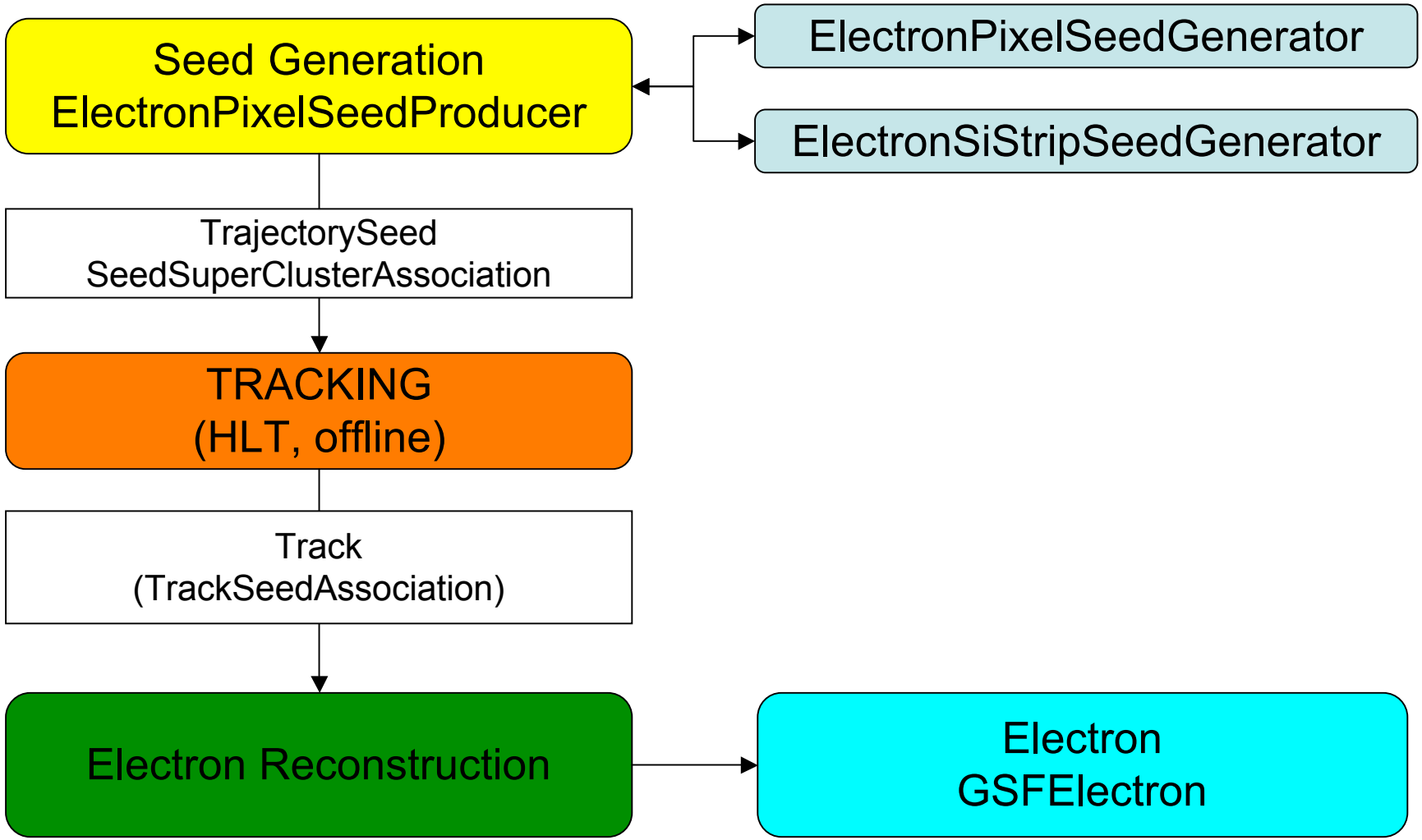
Seeding Efficiency

- Electron gun events
  - E_{SC} > 15 GeV
  - L1 energy > 15 GeV
  - "found" = seed with $\Delta R > 0.05$ and $\Delta Q = 0$



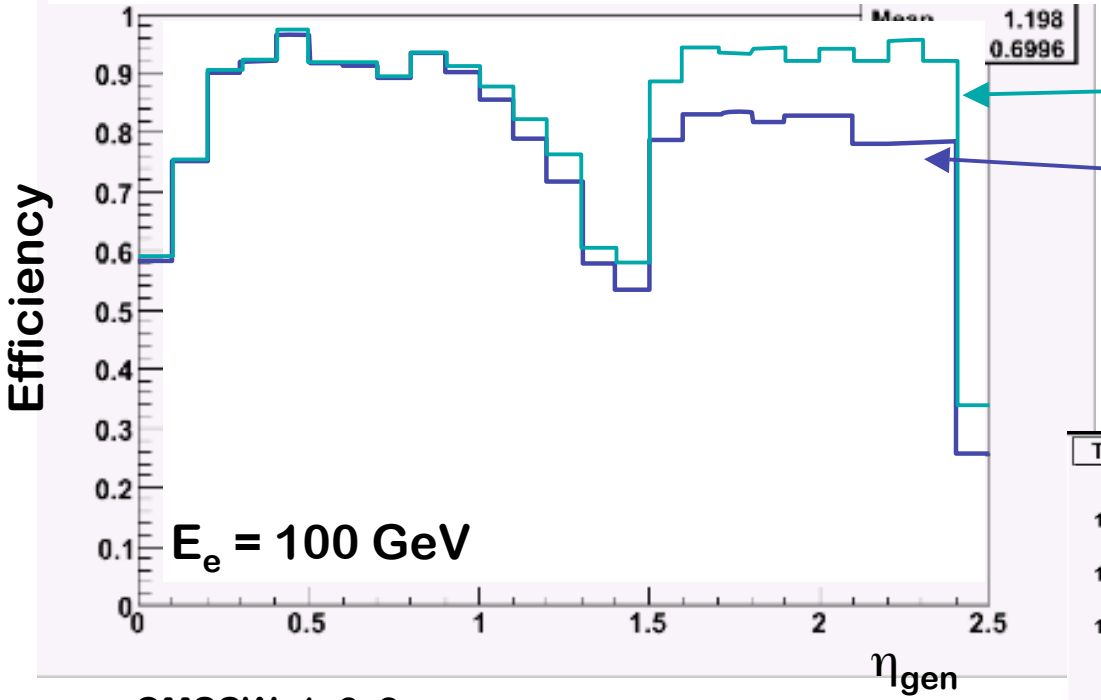
Software Structure

C. Macklin



Track efficiency

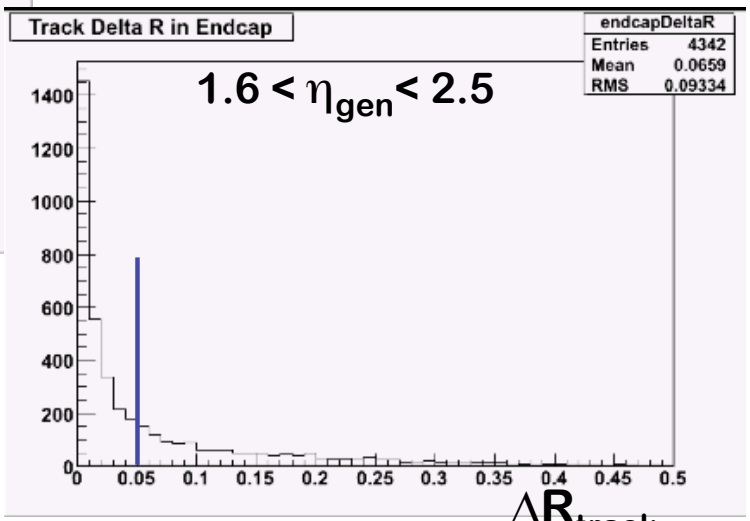
Efficiency = Fraction of good SC with at least one track found (includes seeding efficiency)



$\Delta R_{track} < 0.5$

$\Delta R_{track} < 0.05$

Tracks at large η seem to have degraded ΔR, even though the ΔR of seeds is good.



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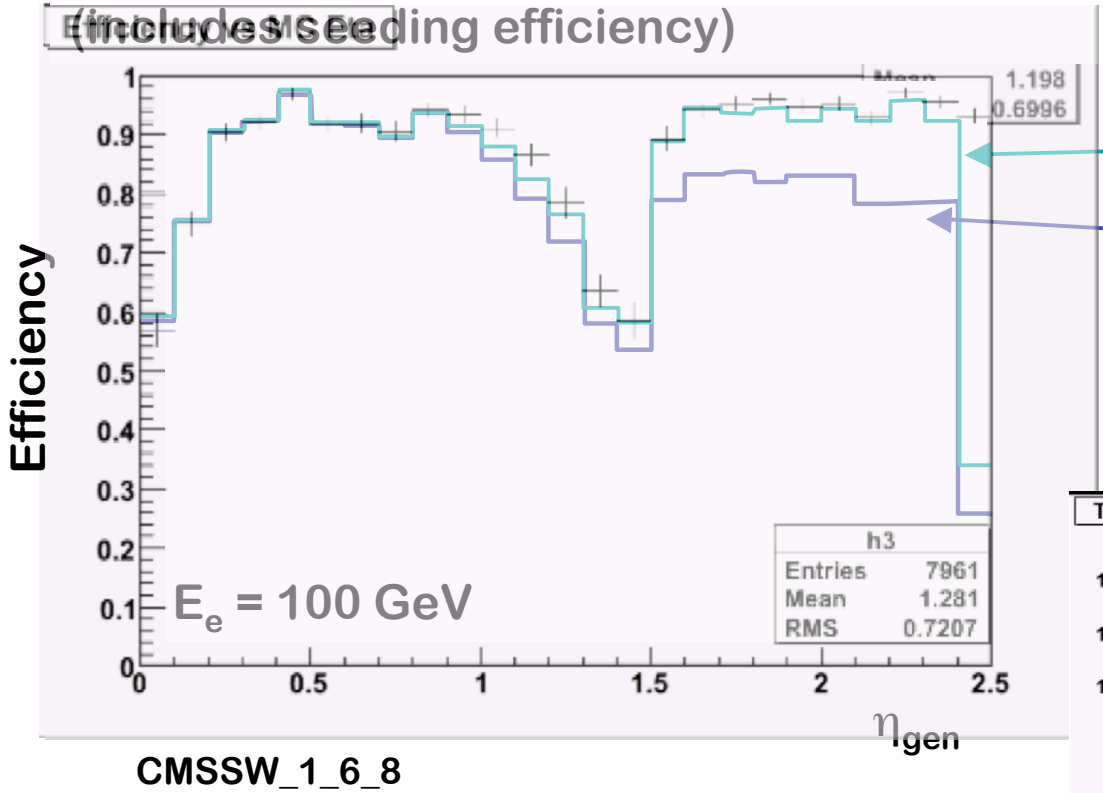
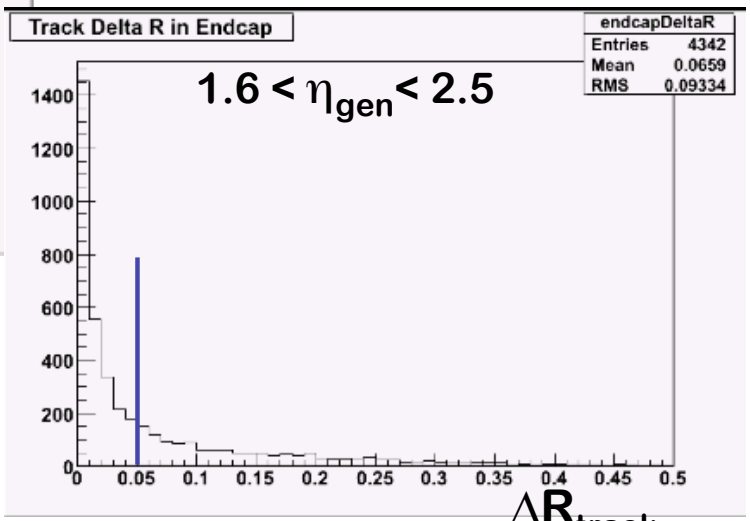


CMSSW_1_6_8

$\Delta R_{track} < 0.5$

$\Delta R_{track} < 0.05$

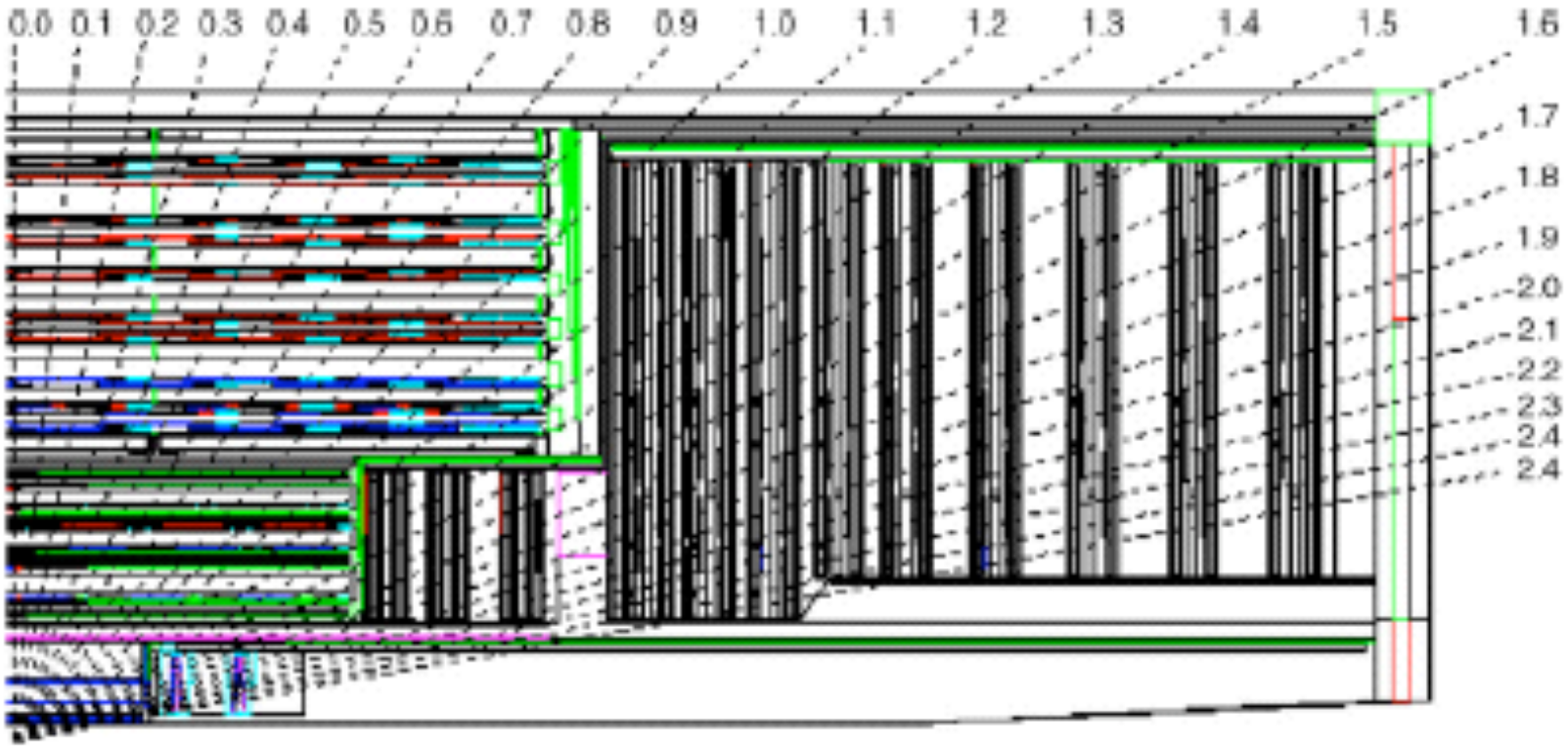
Tracks at large η seem to have degraded ΔR, even though there are seeds with good ΔR.



Conclusions

- Silicon strip seeding achieves efficiencies of 88% (25 GeV) to 96% (100 GeV) at large η.
- Looks encouraging (at least to me), BUT, there are things that need to be studied that could reduce this:
  - Fake rates - may require tightening cuts
  - Timing - may require tightening cuts
  - Multiple seed rejection - may throw out some good seeds with the bad

Backup Slides



Endcap seed ΔR