Track efficiency from 2-prong “tridents”

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HPS Collaboration Meeting
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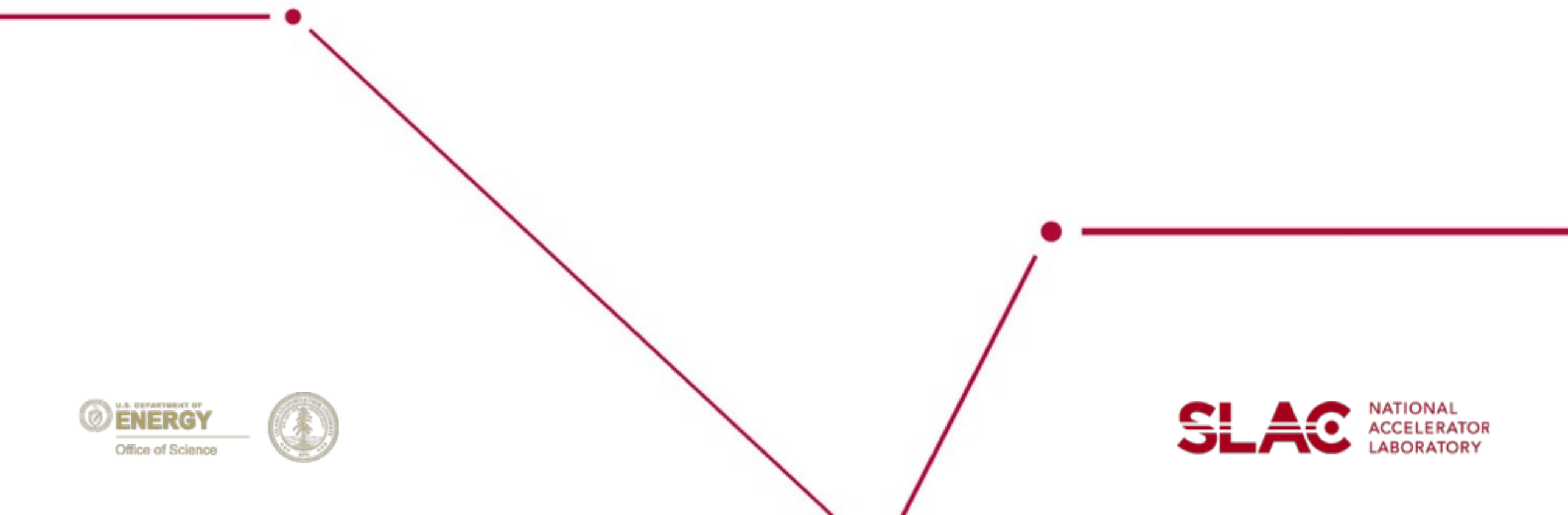

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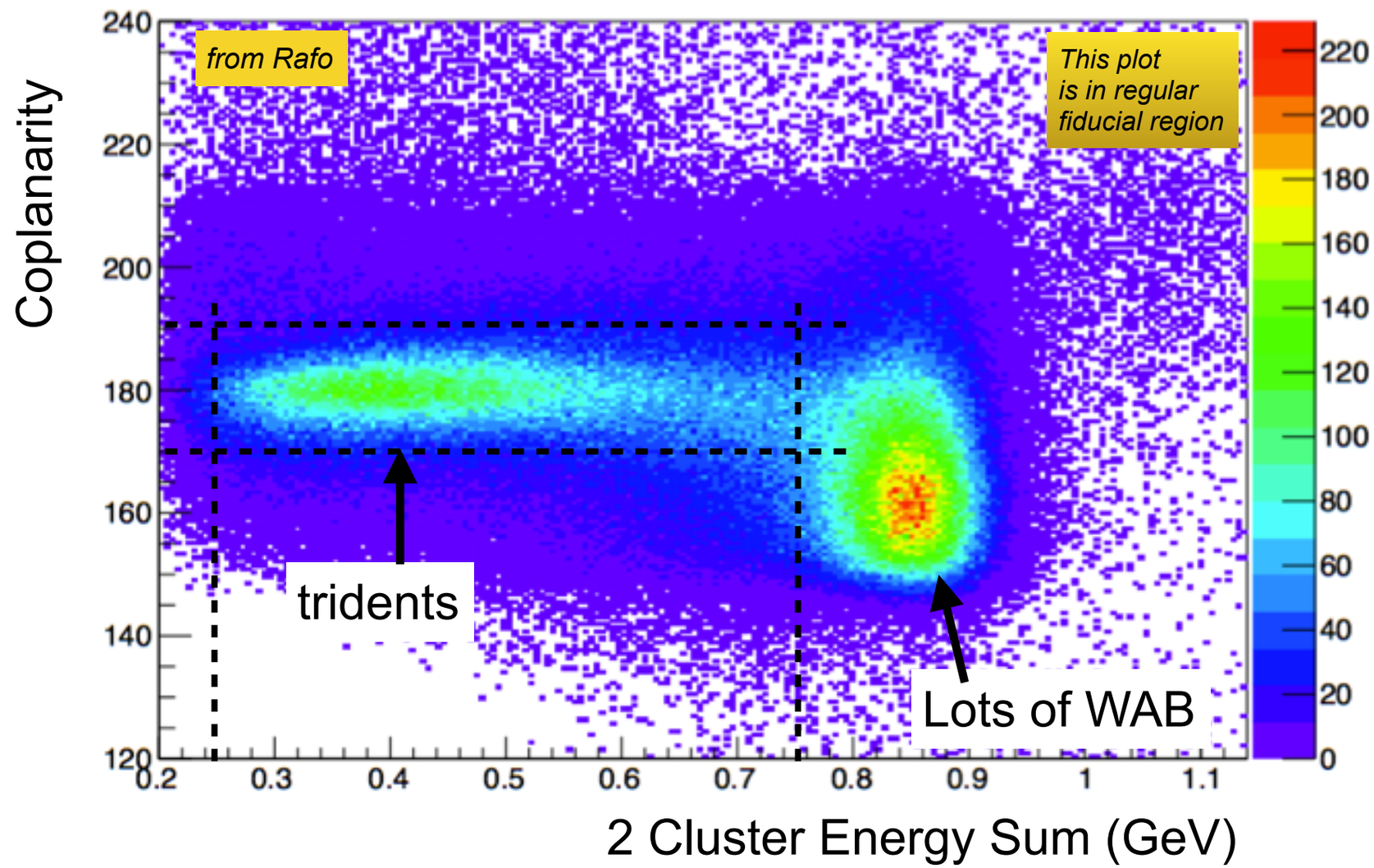
Cluster pairs

Rafo made a nice, simple ntuple and a few cuts set up to select events based on clusters in the ECal…

…this plot shows all pairs with cuts on individual cluster times and |Δt|. No tracking requirements.

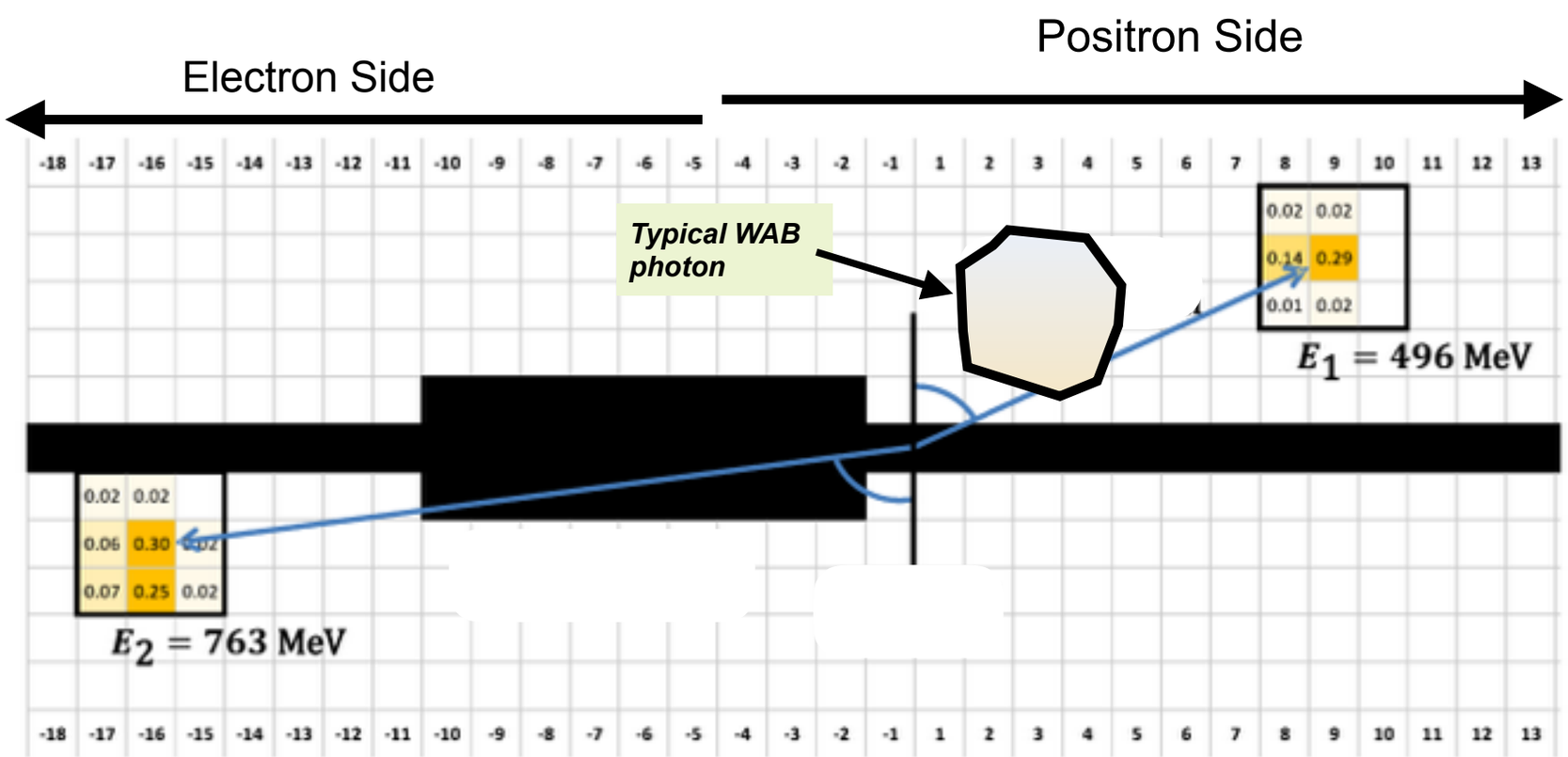


Even though the WAB peaks at beam energy (minus sampling fraction here) and 160°, there is a long tail that leaks into the tridents…

These WABs are a pain! I'd like to use this sample to get track efficiency from tridents. For electrons it's ok (since even if it's a WAB, the electron is still an electron), but for positrons it will dilute the sample.

Tag & Probe of 2-prong tridents to get efficiency

- Pass the Tag:
  - 2 clusters, top/bottom & left/right
  - 30ns<t_{CL}<50ns; $|\Delta t(E_{sum})|<3\sigma$ (Rafo's parameterization)
  - a track matched (loosely) to positron/electron cluster (depending which tag)
    - includes all of the cuts used to define a "track" and a "cluster match"
    - track charge must match the "charge" of the side (i.e. left-side cluster must be +ive)
- Pass the Probe:
  - a track matched to the electron/positron cluster
- Efficiency = N(tag+probe)/N(tag)

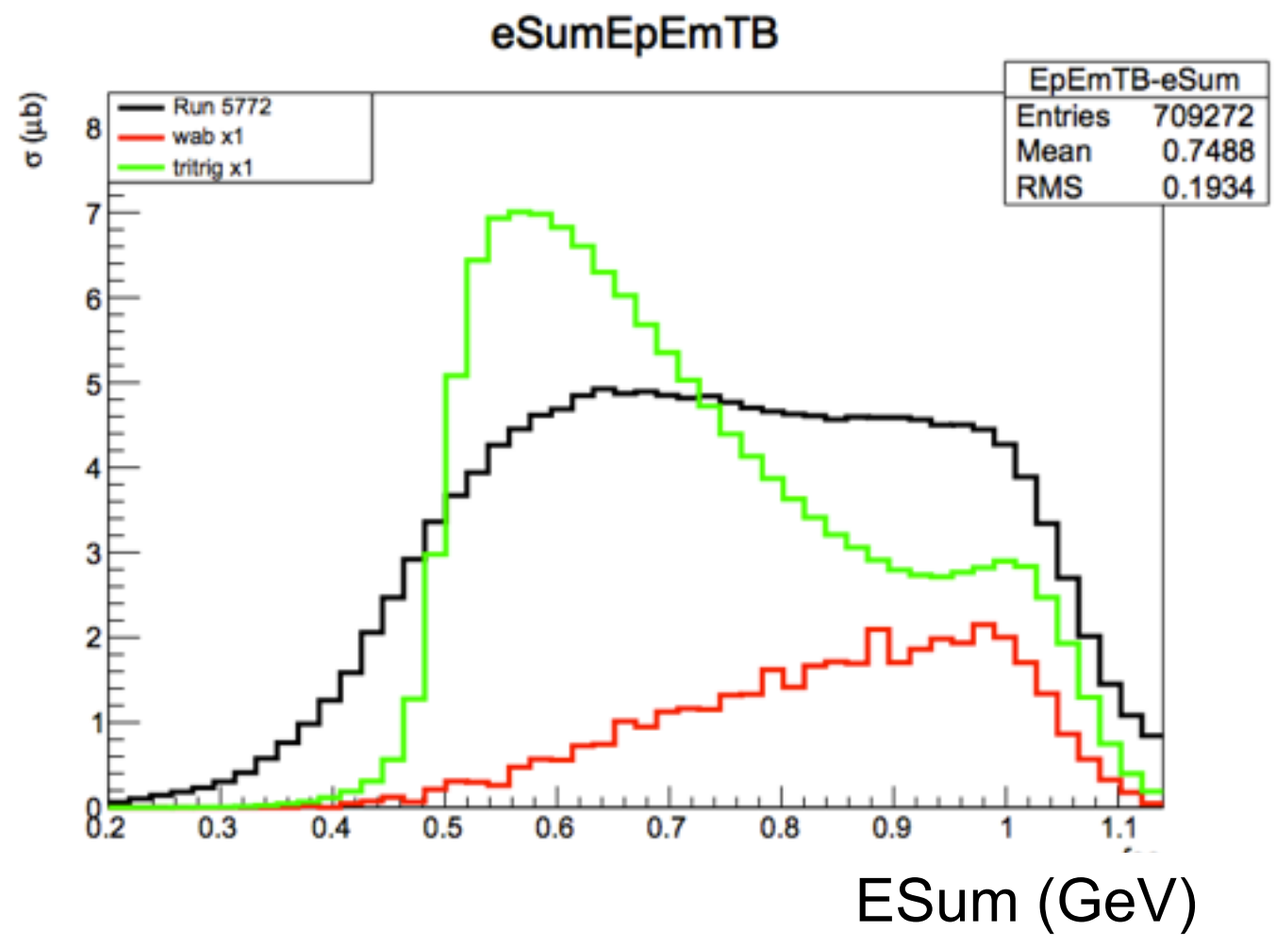


Tracking efficiency from 2-prongs

- for the tag-and-probe, require that the cluster-side matches that charge (i.e. a cluster on the positron side is matched to a positron)…gets rid of large θ_x WAB electrons!

Other than this, still require top/bottom + left/right clusters with tight relative-timing cut

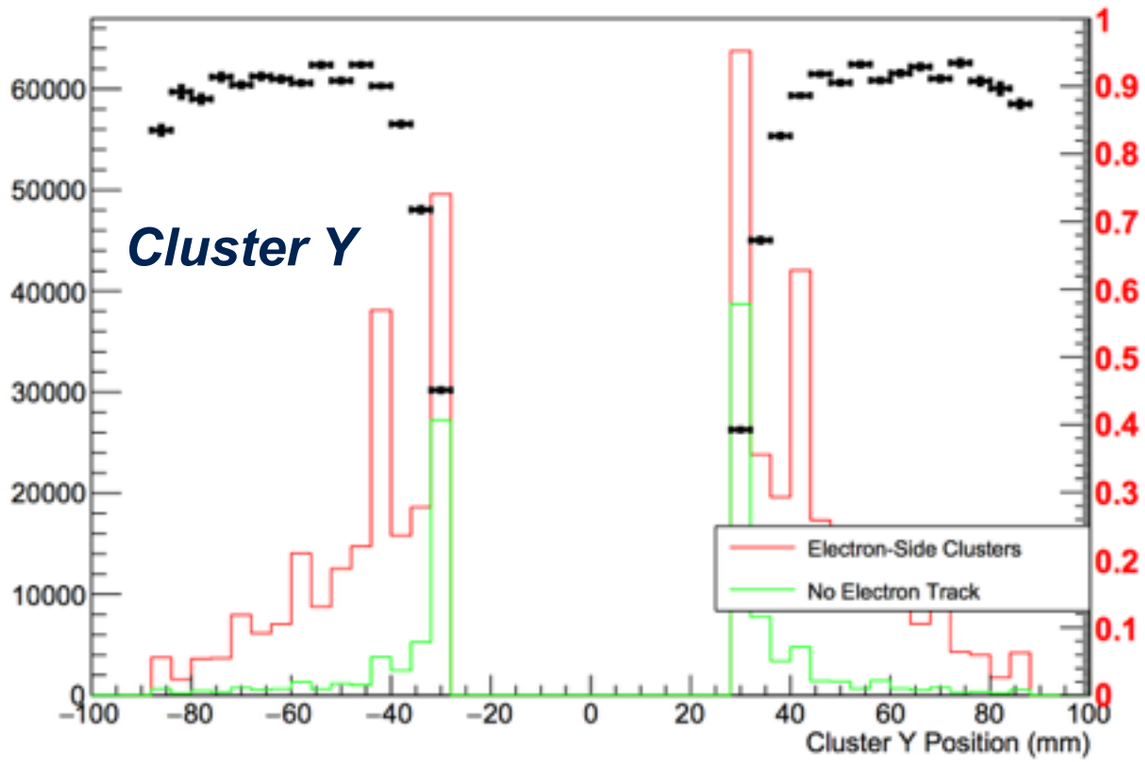
…everything I show will be in the full acceptance (unless marked)

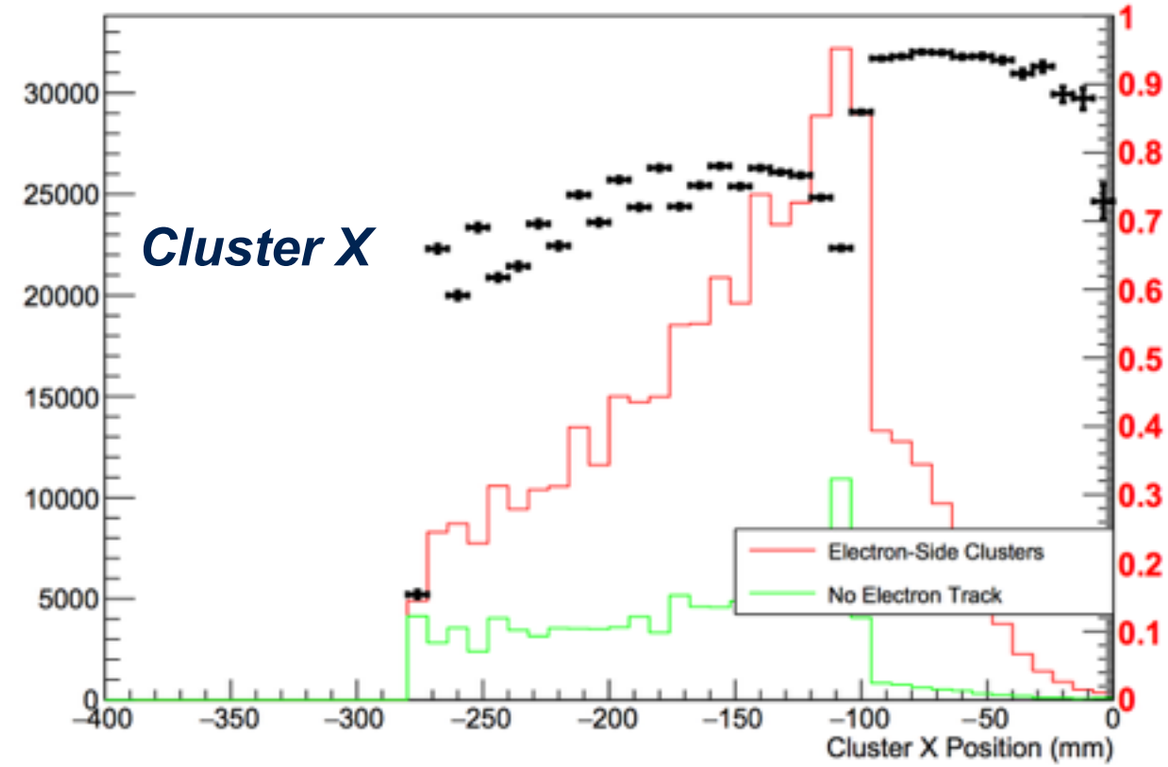


this is my version of this plot and I like it the best; not sure why other's disagree

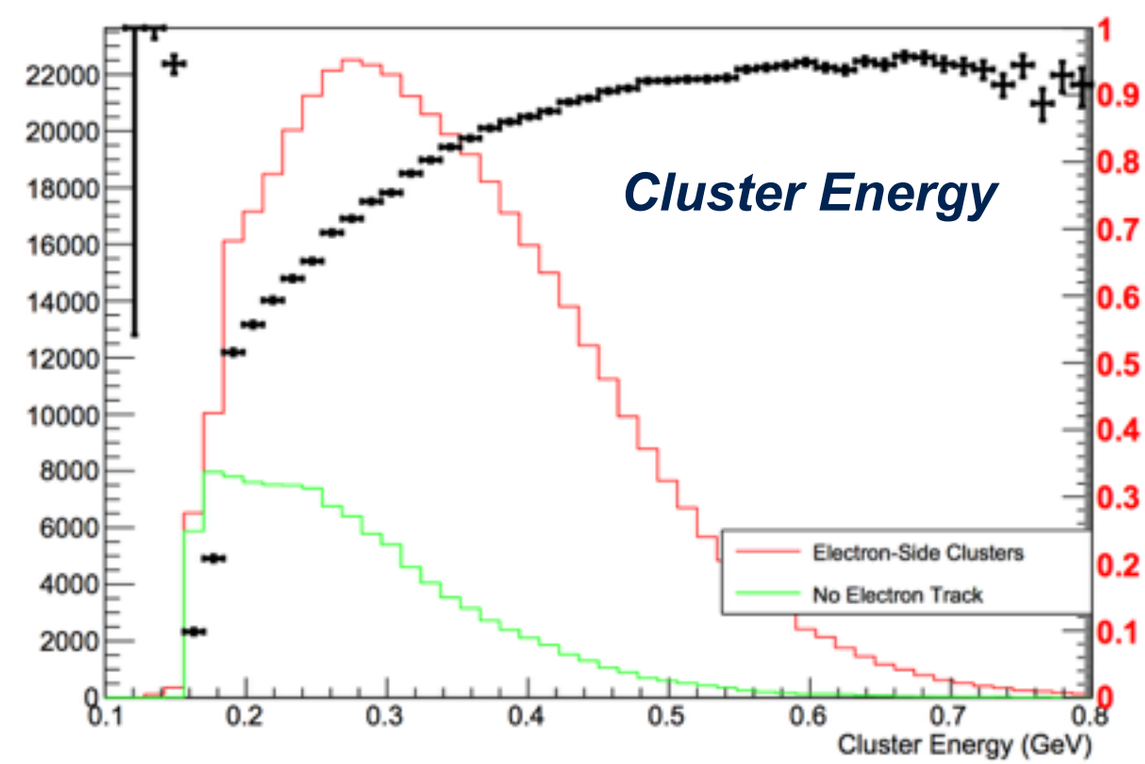
one thing…if 2 tracks have >1 overlapping hits, include track with most hits (or random is same number)

2-prong track efficiency: electrons, from data

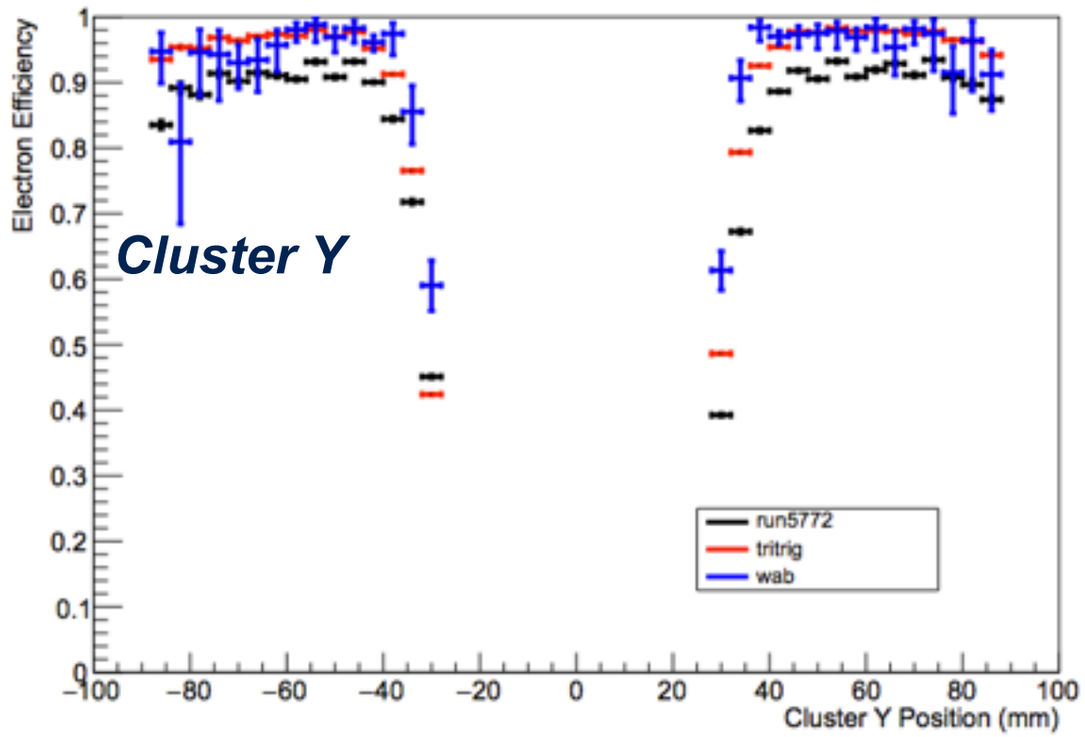


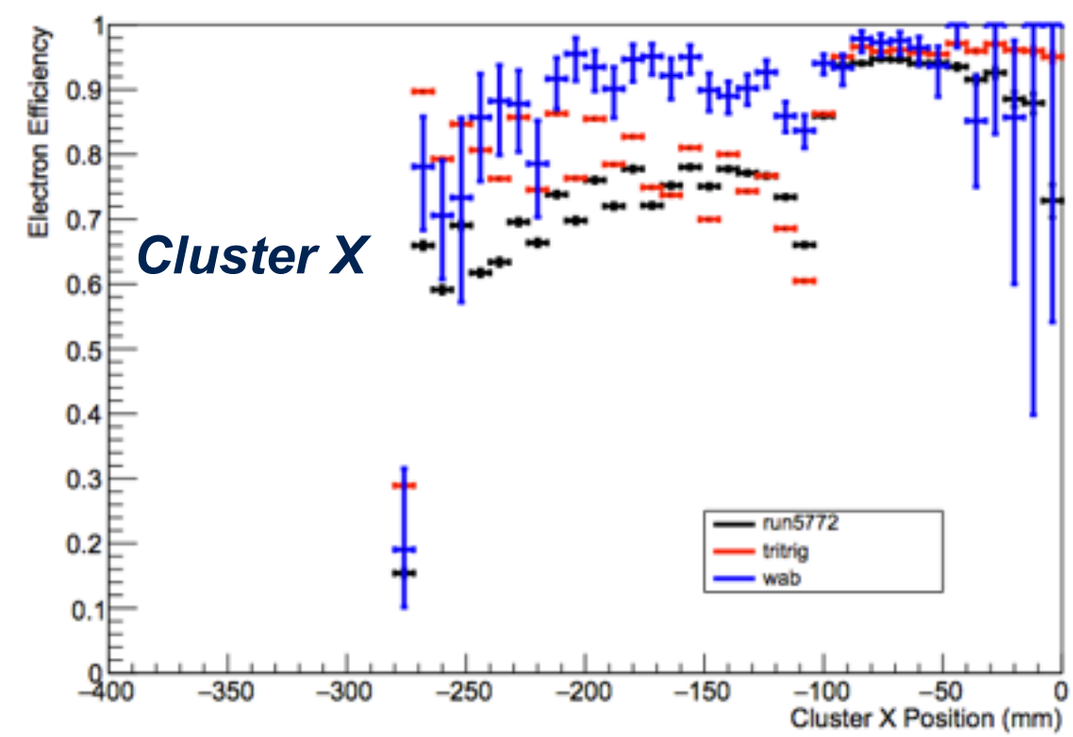


- lose most tracks as low y-angle
- there's a kink in the x-efficiency around where the hole is (??)
- gradual fall-off with lower momentum… we've seen this before but with bigger bins

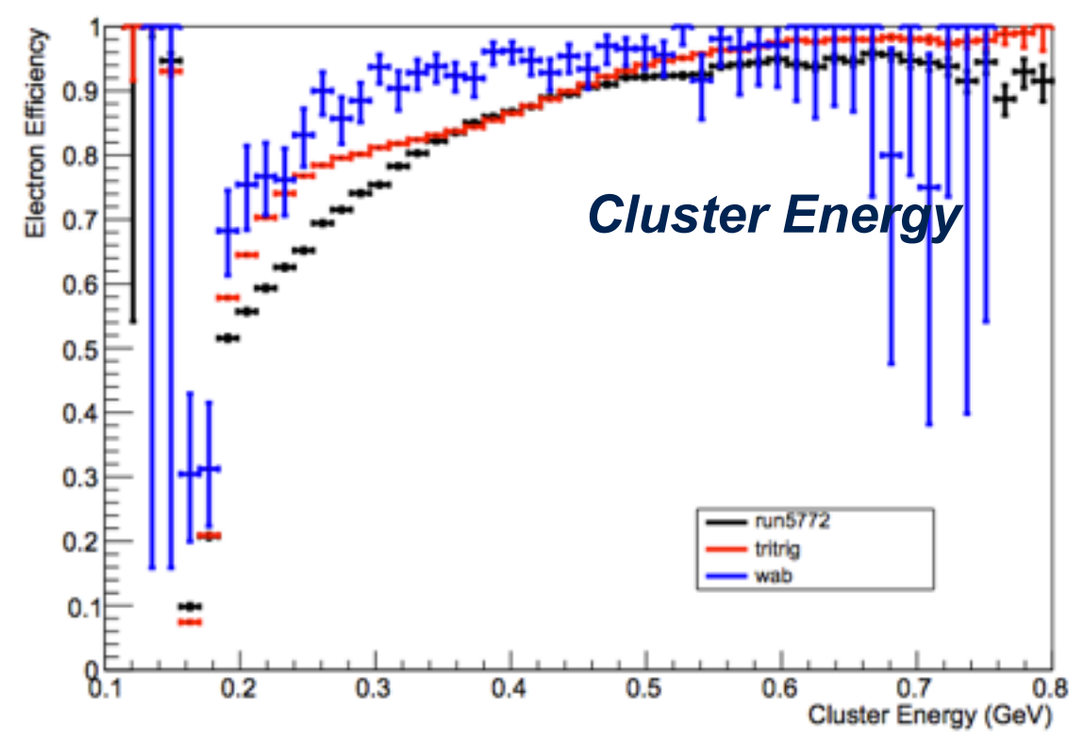


2-prong track efficiency: electrons data vs. MC





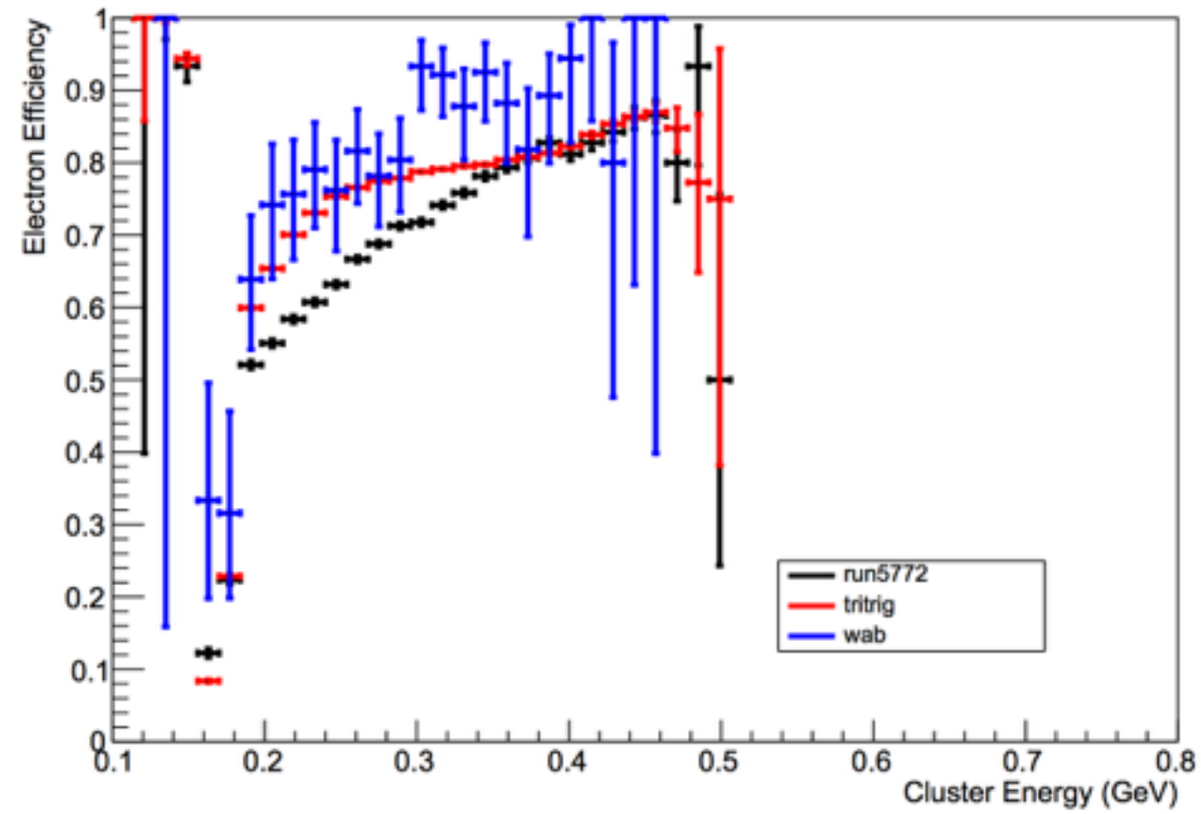
- converted WABs have higher electron efficiency
- does data die off faster than MC at small y-angle?
- there is a low-energy hump in the efficiency vs energy from tridents…or maybe it's losing tracks at mid-energy? Something looks funny here.



2-prong track efficiency: mid-ESum & superFid

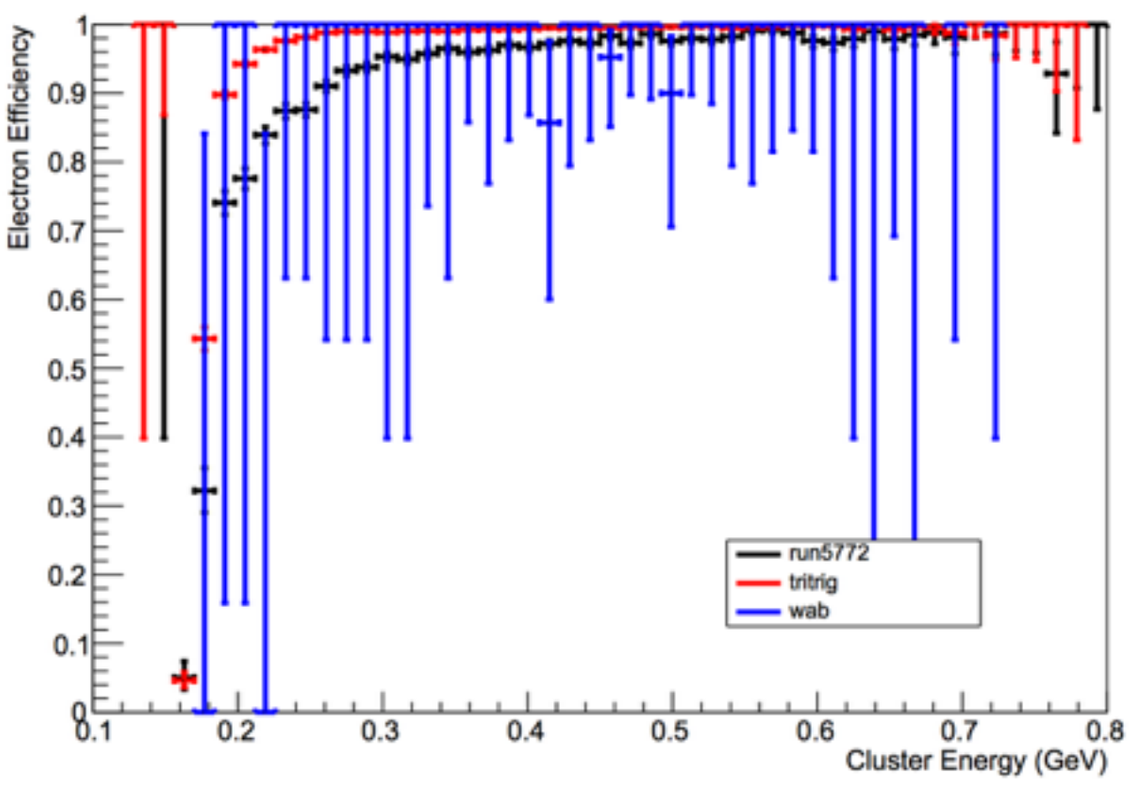
require 0.45<ESum<0.65…gets rid of a lot of the WAB conversions

…looks like a hump!

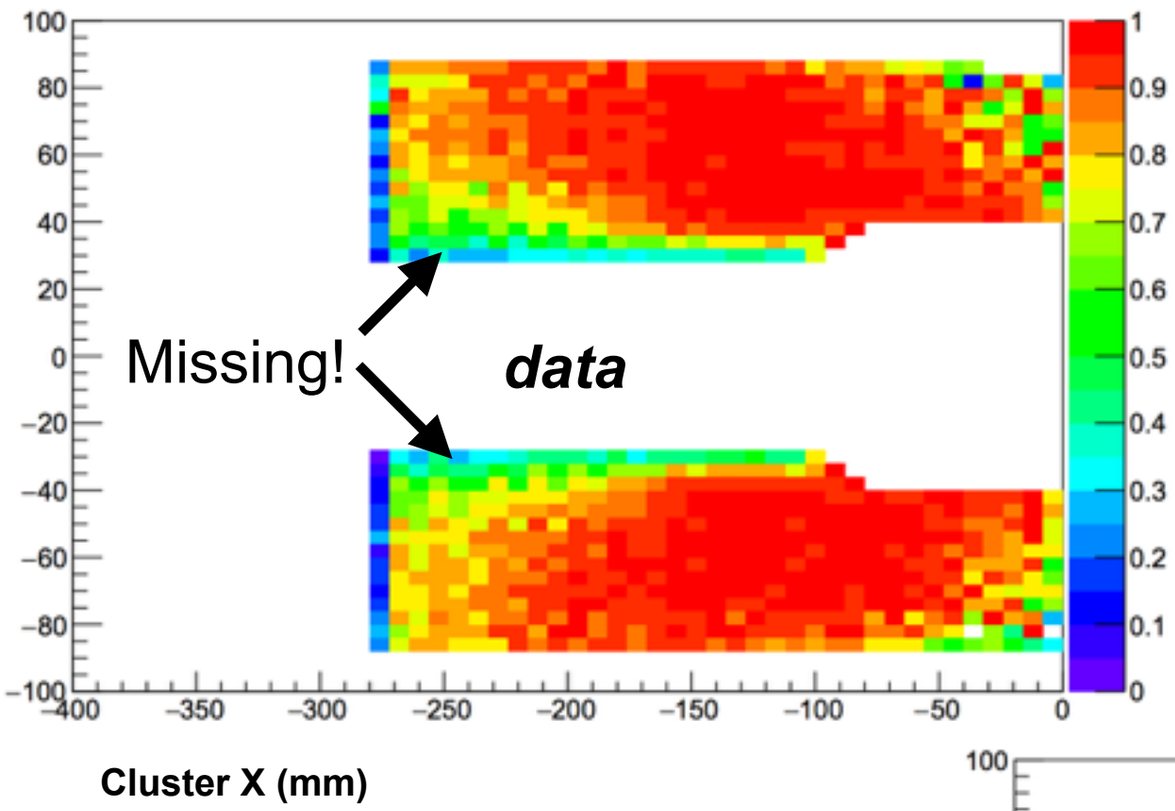


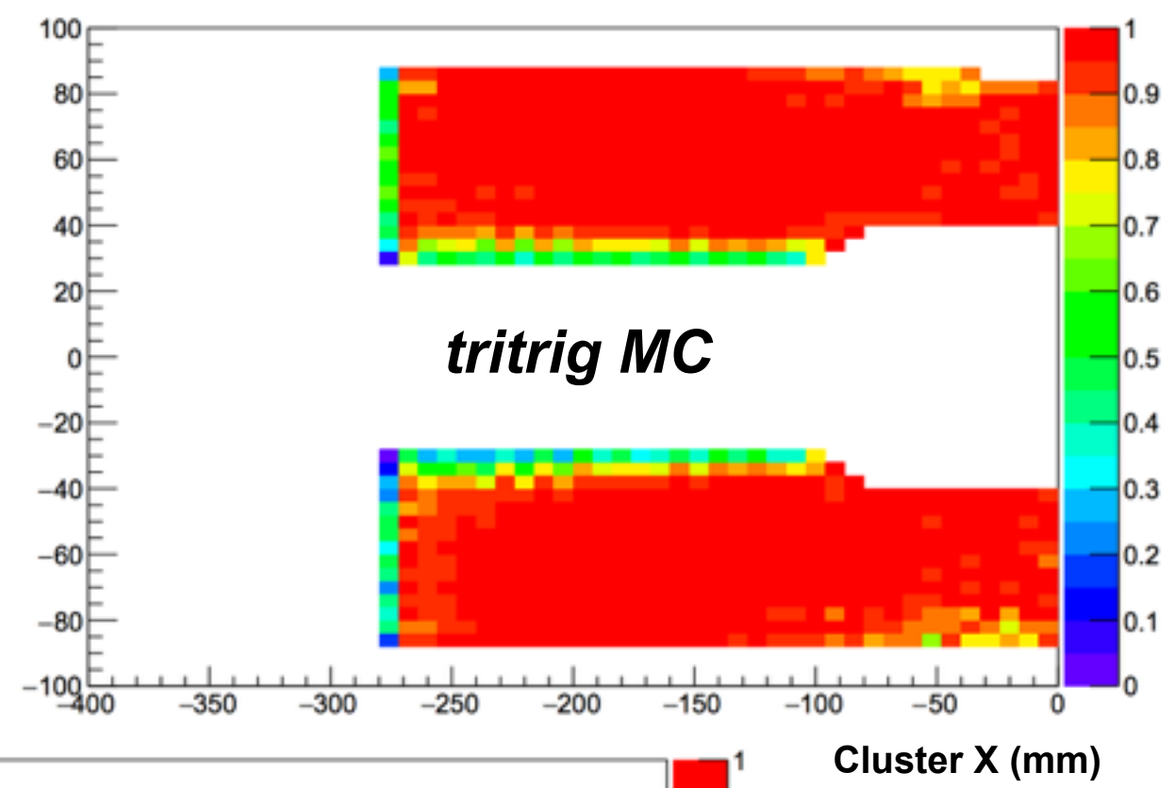
require superFid

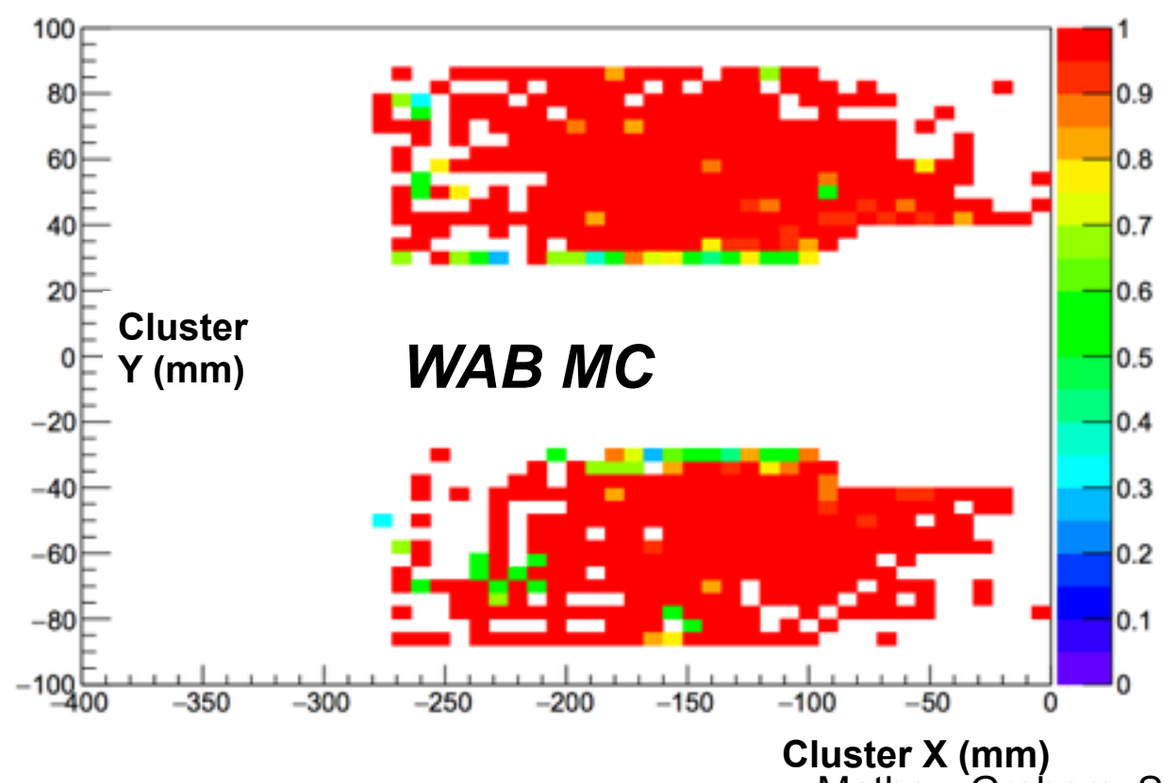
maybe not a hump, but fall off quicker in data than MC.



electron track efficiency vs X vs Y of ECal Cluster

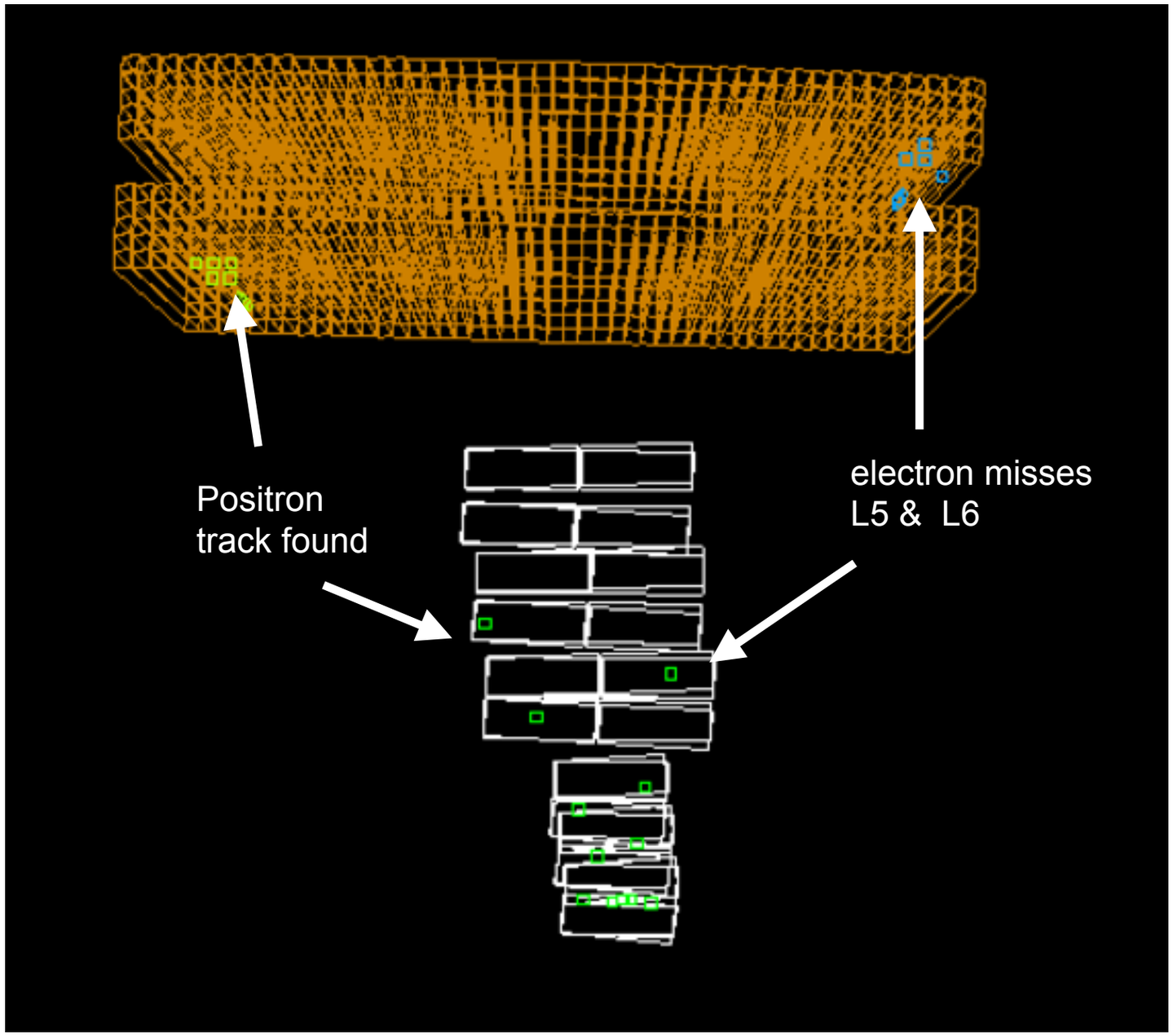






- again, definitely looks like there's some inefficiency in data (compared to MC) at higher-|X| (=~lower momentum)…locally, ~10-20% difference

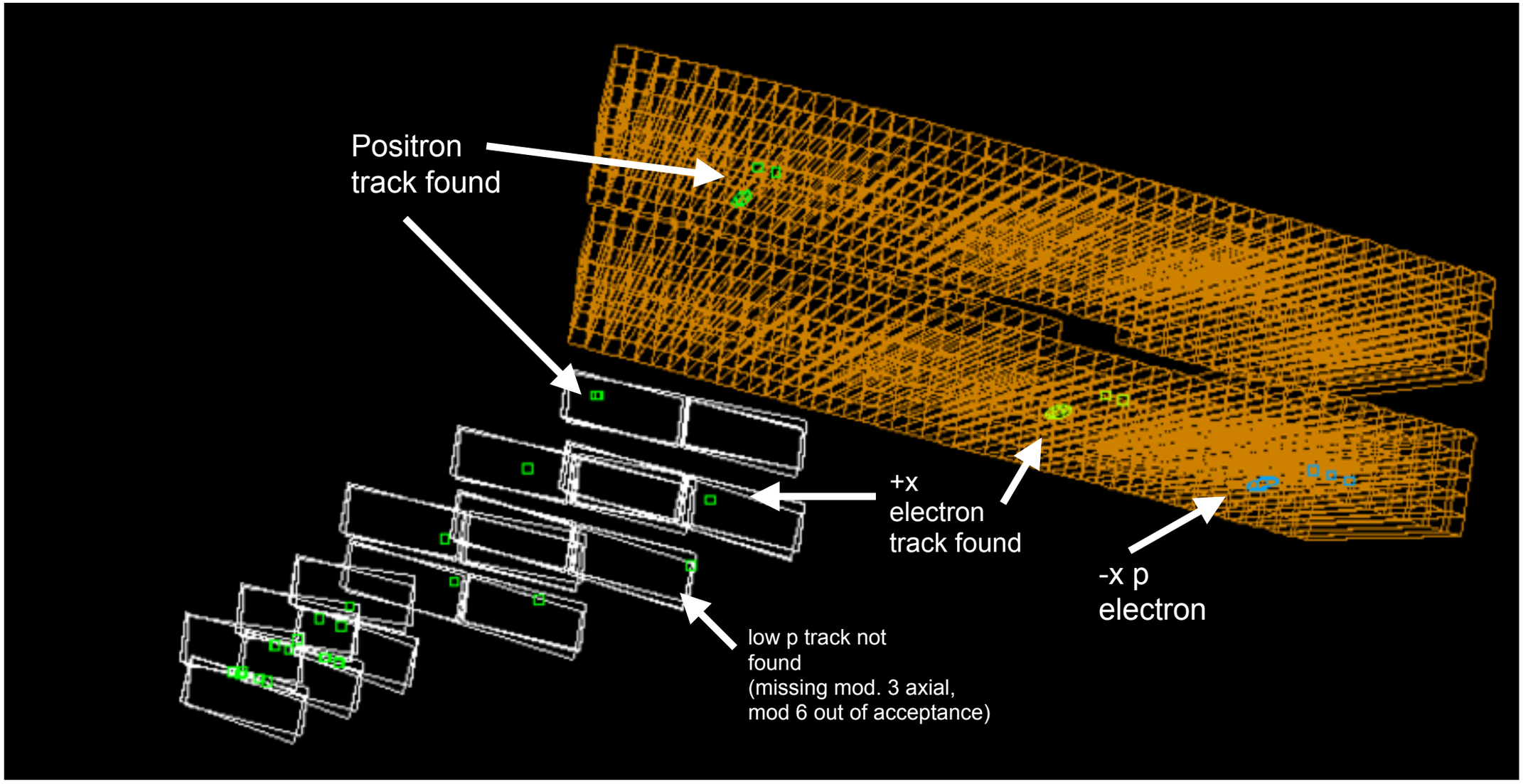
Hand scanning: typical case



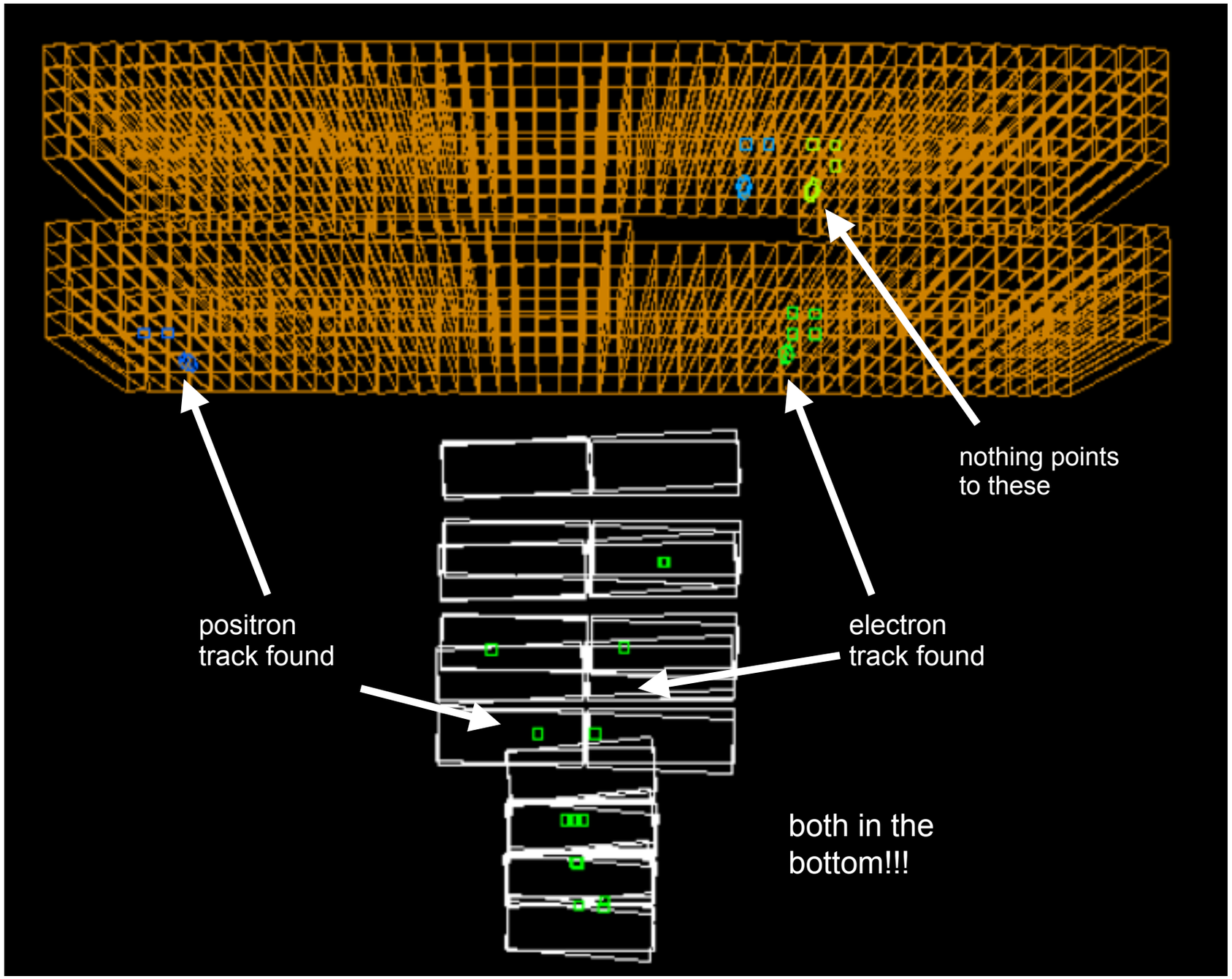
did some hand-scanning on events that failed the electron probe…

…many of the events were like this one: lowish momentum/high θ_x electron that miss last 2 layers

Hand scanning: less typical case



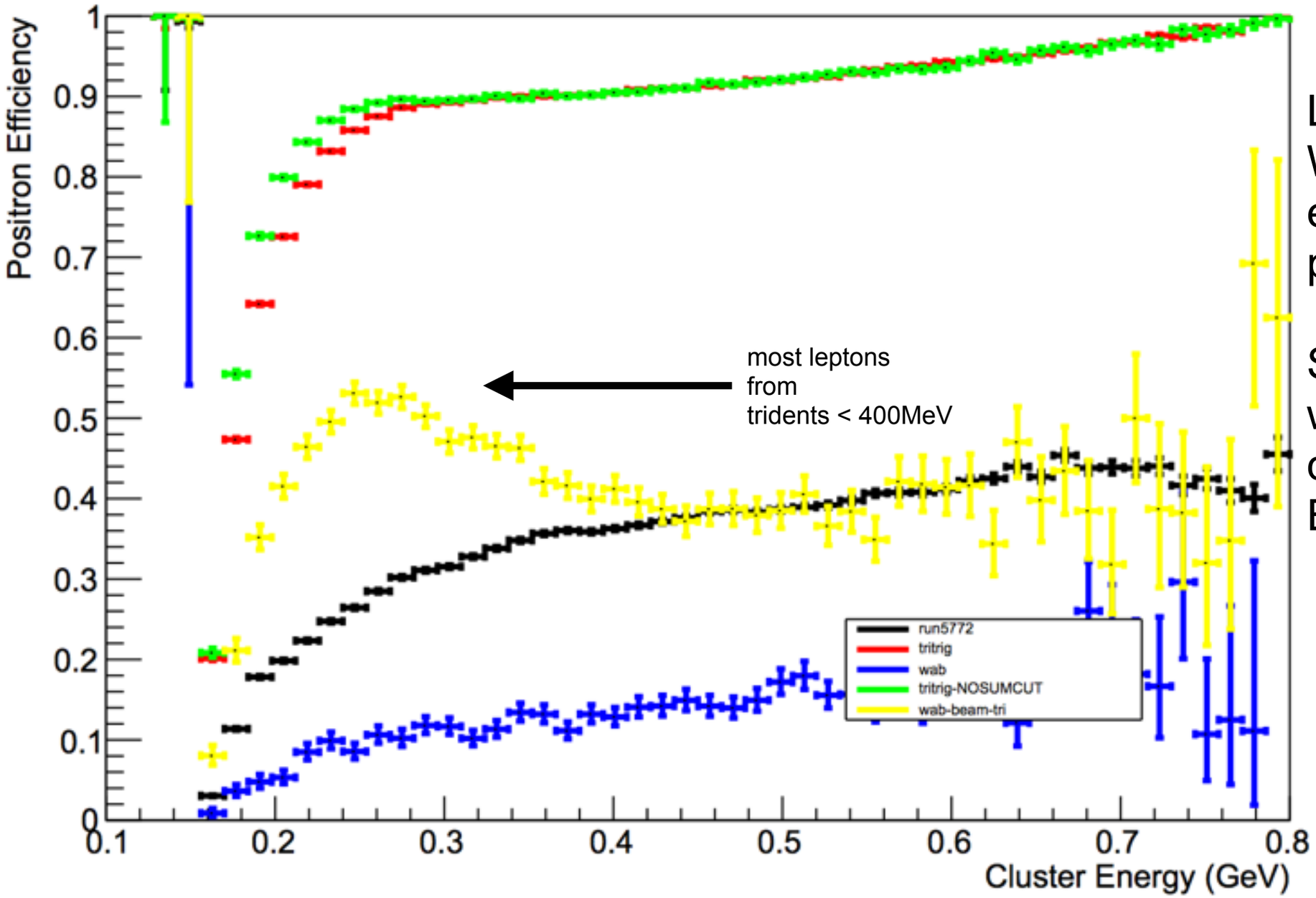
Hand scanning: garbage case



…this one has nice e^+e^- tracks in the bottom and 0 SVT hits in the top…

- triggered because of in-time photon in top-electron side
- *this shouldn't be counted as an inefficiency,* ***but in my tag/probe it is***
- fortunately, didn't see this very often

2-prong track "efficiency": positrons



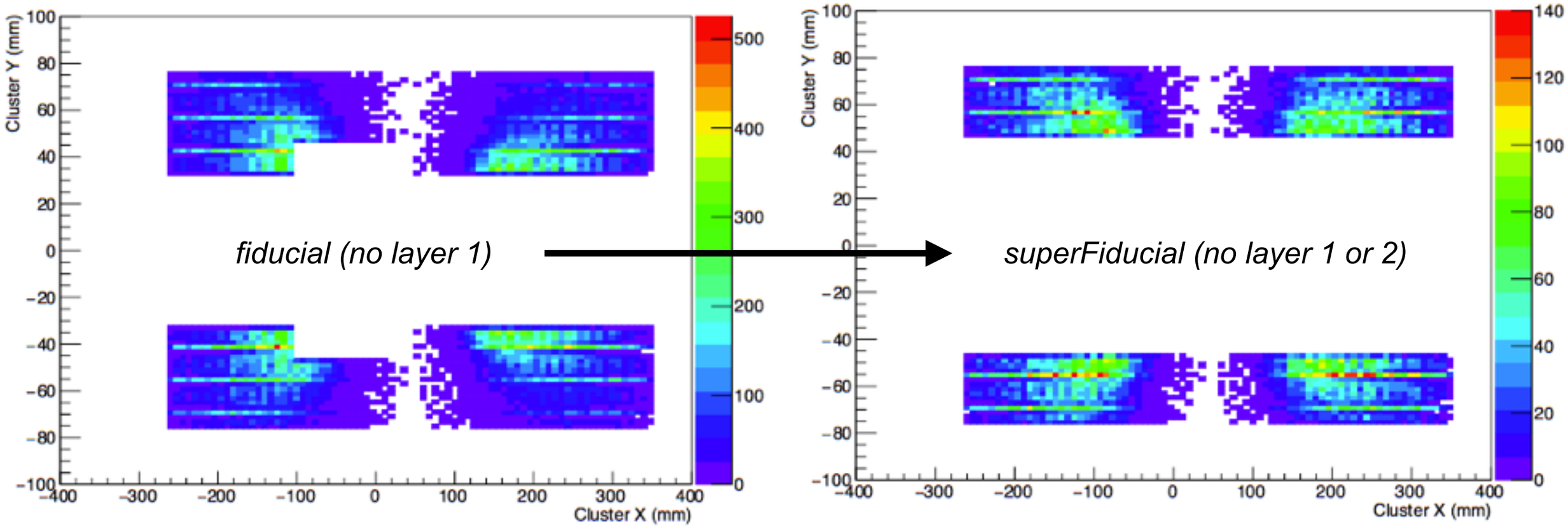
Lots of (non-converted) WABs in data so positron efficiency looks quite poor…don't be fooled!

Still, it's a bit troubling that wab-beam-tri efficiency doesn't match data at low E…

Conclusions

- Tracking inefficiency isn't a yuge problem
  - data/MC disagreement looks to be ~0 - 20% depending on momentum/trajectory
  - still should try to understand this discrepancy
- Can really only check the electron efficiency with the 2-prongs… positrons are too contaminated by WABs
  - electron result is pretty solid though…we have the best electrons
- From event display, our inefficiencies mostly make sense…
  - particles that don't get tracked typically are missing hits because they are out of tracker acceptance
- We should probably measure data/MC differences wrt p/θ/ϕ and apply some sort of correction to MC
  - this will be a tremendous job!

Super fiducial region



The ECal electron hole really confuses the issue…it makes distributions look weird even when they are correct and is sensitive to alignment & material data/ MC differences.

My solution is to take out layers 1 & 2 == superFiducial region…this gives a nice uniform area that is definitely well covered by the tracker