2019 Performance Overview For Jeopardy

Matt Graham
SLAC National Accelerator Laboratory
May 14, 2020

U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Preliminaries

- This talk should really be called “Preliminary Track Efficiency and Trident MC/Data comparisons”
  - BIG emphasis on the “Preliminary” … we are not near understanding the data or the MC yet
  - Norman & PF have already talked about tracking & vertexing performance
- This work was done in the midst of Cameron and I trying to figure out some descrepancies in the 4.5 GeV reach (comparing with my old, mathematica parametric stuff)
  - Not to spoil Cameron’s talk but there are some issues….
  - In this talk, I’ll make some referenences to some rates I used as input to the old-style reach estimates

Basic Info

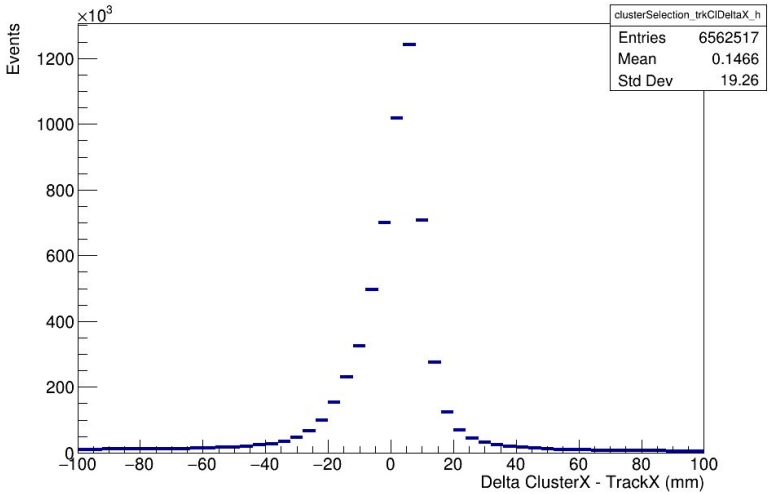
- I used data from run 10031: ~29% of the run or ~43/nb
- MC from pass0:
  - rad-beam: 8.7M @ 3.123e7 pb
  - tritrig-beam: 9.4M @ 4.566e8 pb
  - wab-beam : 98.7M @ 4.715e10 pb -- we need event weighting for WABs
  - This stuff lives at SLAC @ /nfs/slac/g/hps_data2/users/bravo/mc/det19
- Used hpstr to do this, but it's not committed yet (someday!)
  - Mostly ported over the functionality that was in my DST-based code...still a few things left to do

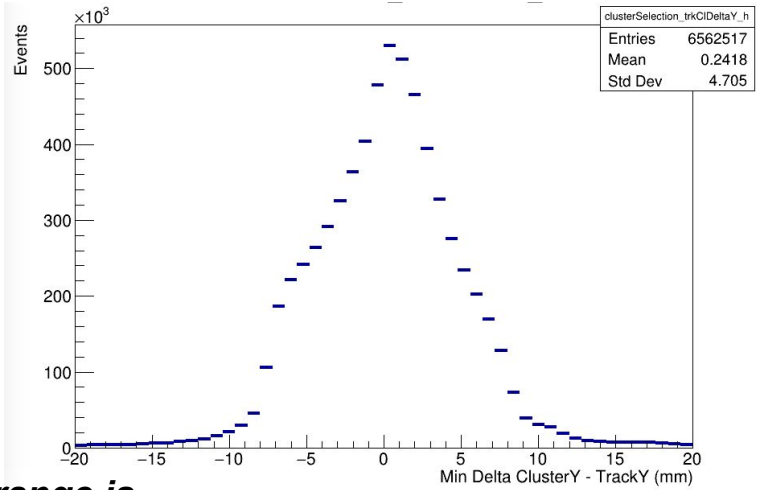
Track Efficiency for 2019 Data/MC

SLAC

- Use typical two cluster tag-and-probe method
  - Two clusters, top/bottom, left/right, positron track associated to positron-side cluster (tag), probe for electron track
- Cluster matching hasn't been tuned for 2019 yet, so rolled my own
- Somewhat loose timing cuts:
  - |cluster time - offset| <10 ns
  - |cluster time difference| <10ns
- This method only really works for electron tracks
  - Hope to use hodoscope+cluster tagging for positrons … someday

Track Matching Kludge: Data



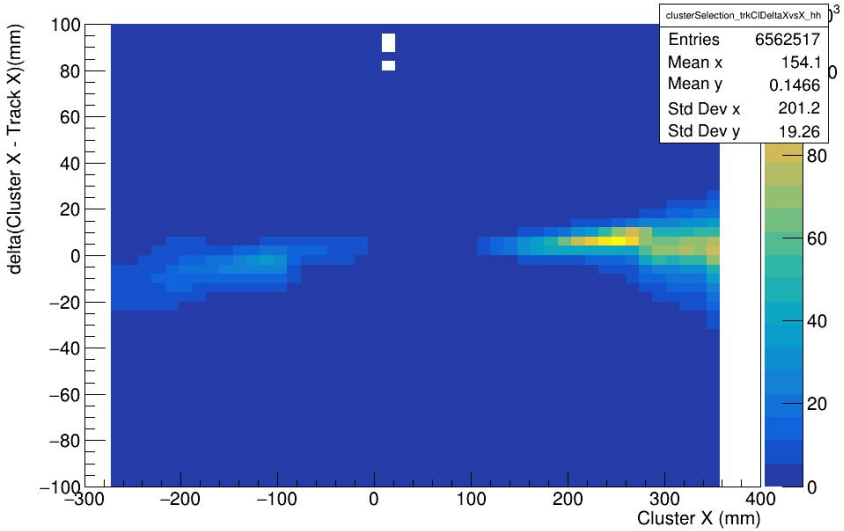


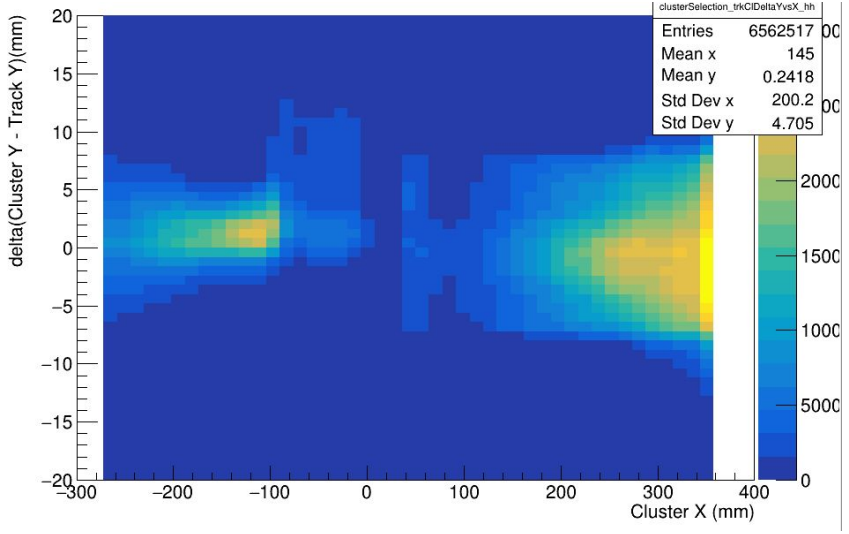
Note axis range is different for X and Y!

Very simplistic matching...select cluster with track projection closest in deltaY

- Must be in correct quadrant
- delta(Y) required to by <20mm

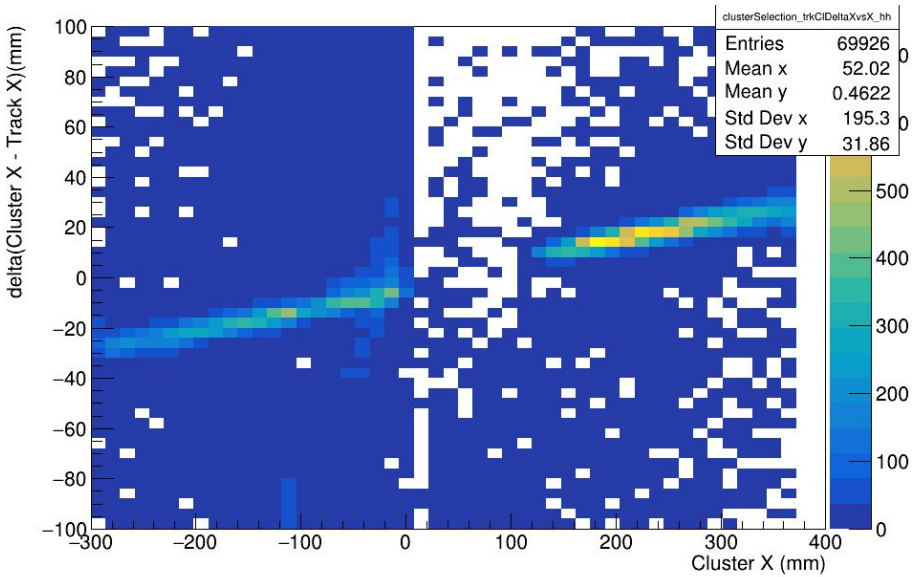
Track Matching Kludge: Data

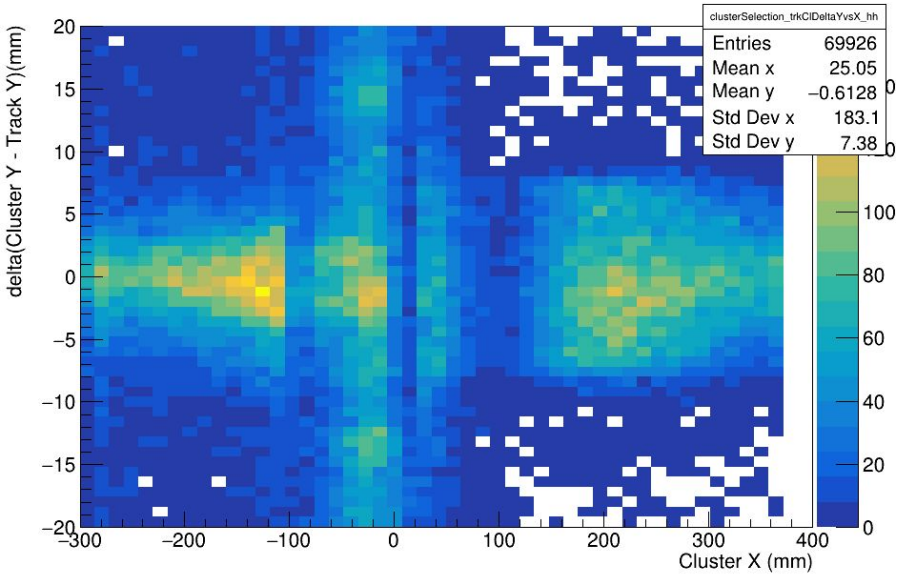




This doesn't look too terrible!

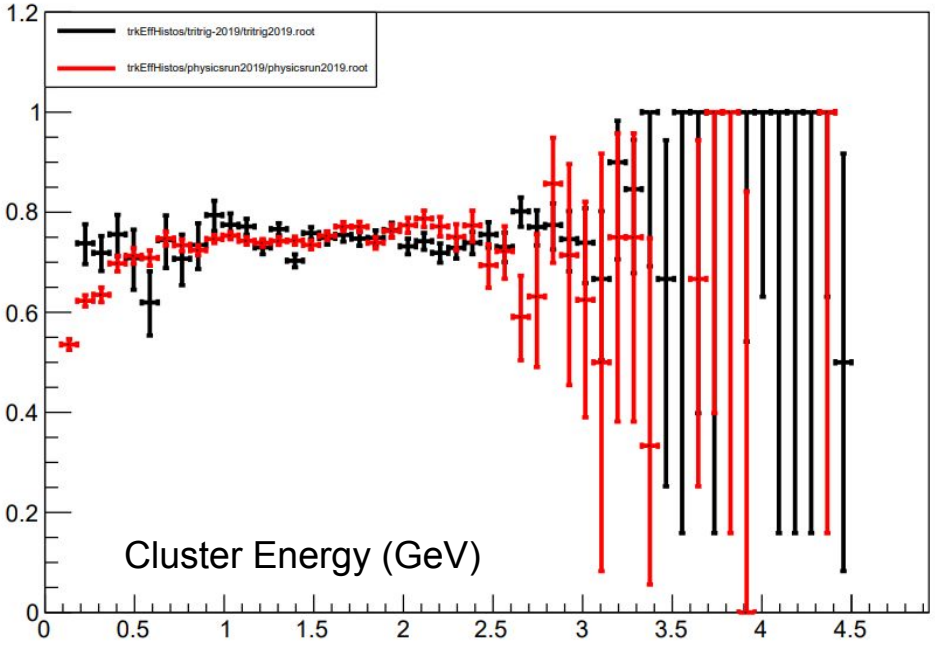
Track Matching Kludge: MC





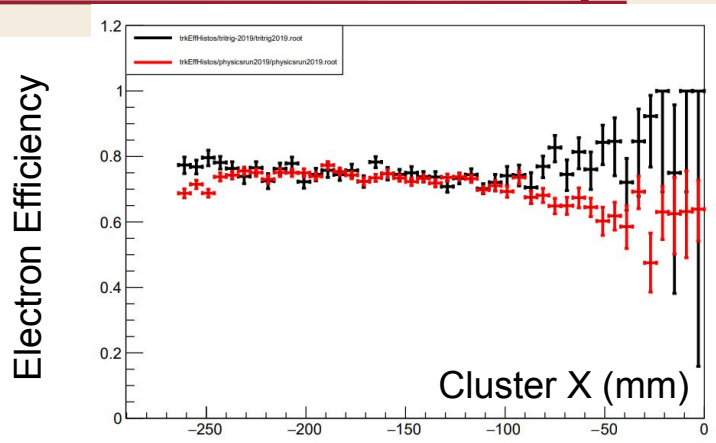
…not great….fixing the matching for 2019 is on ECal groups list

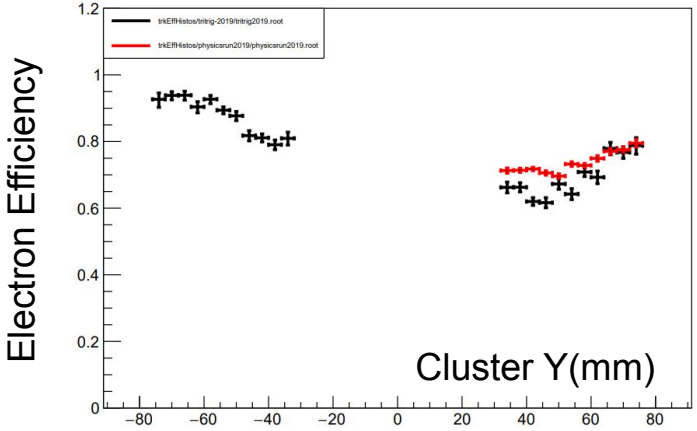
Electron Track Efficiency: Fiducial Region



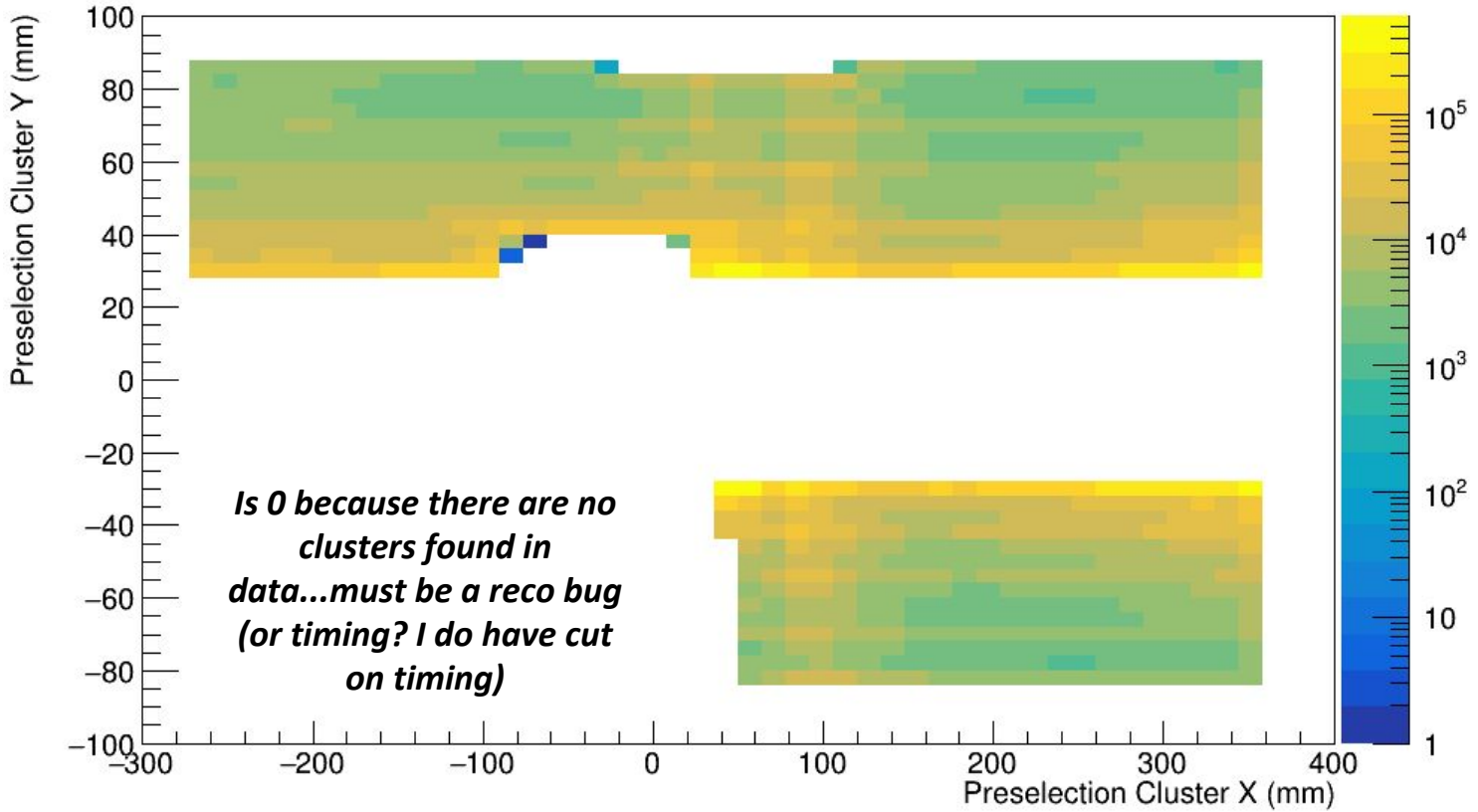
Black: tritrig-beam
Red: Run 10031

No top-positron+bottom electrons in data???

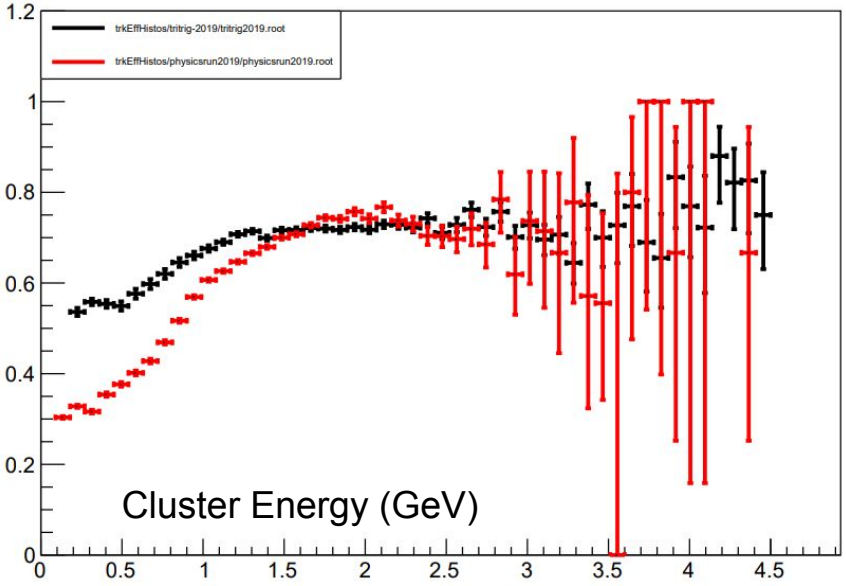




Bottom electron efficiency in data….

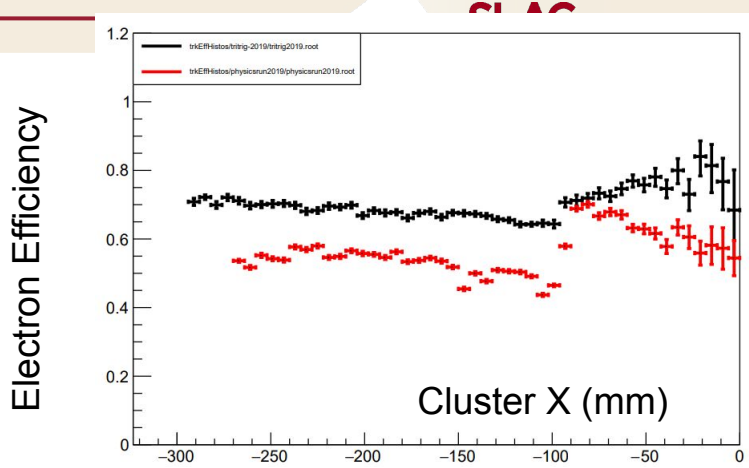


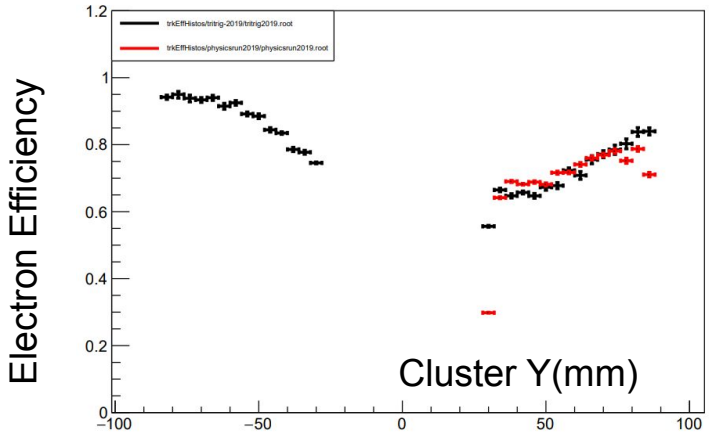
Electron Track Efficiency: All ECal Region



Black: tritrig-beam
Red: Run 10031

Big offset in X, consistent with E/Y? Need to show distributions...

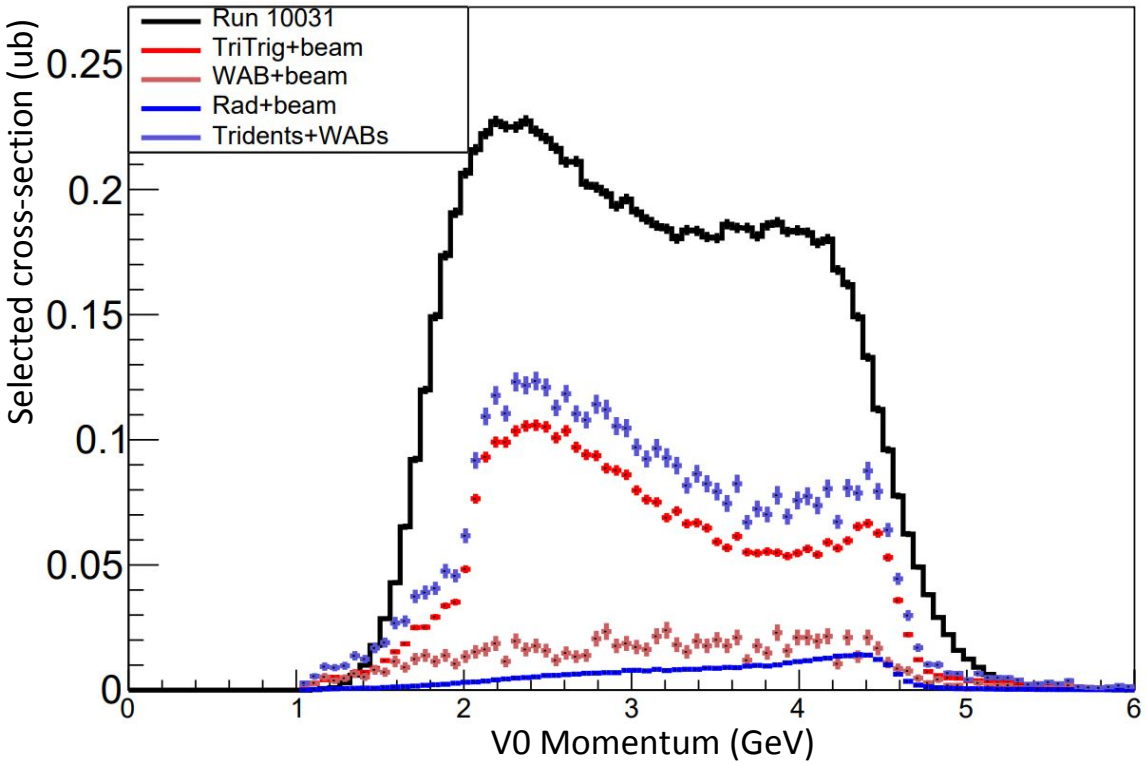




Tridents (and not yet WABs) for 2019

- Strategy is loose, loose, loose
  - Accidentals are not a major issue once we require two tracks
  - We do have some weird low-momentum tracks that especially show up in the MC for some reason
  - But generally, want open things up, look at a lot of angles, see what the MC is giving us, compare to what data is telling us and try to make the two get married
- Here are the basic cuts:
  - All track momentum > 0.5GeV, electrons <3.5 GeV (this is maybe a bit tight!)
  - Track chi^2<250 … this is crazy for MC, less crazy for data (but still loose)
  - Unconstrained vtx chi^2<(infinity) … keep all
- From these, I look at combinations of cluster-matched and layer requirements with and without PSum cuts (PSum>0.8*EBeam)

No Layer requirement, positron cluster matched

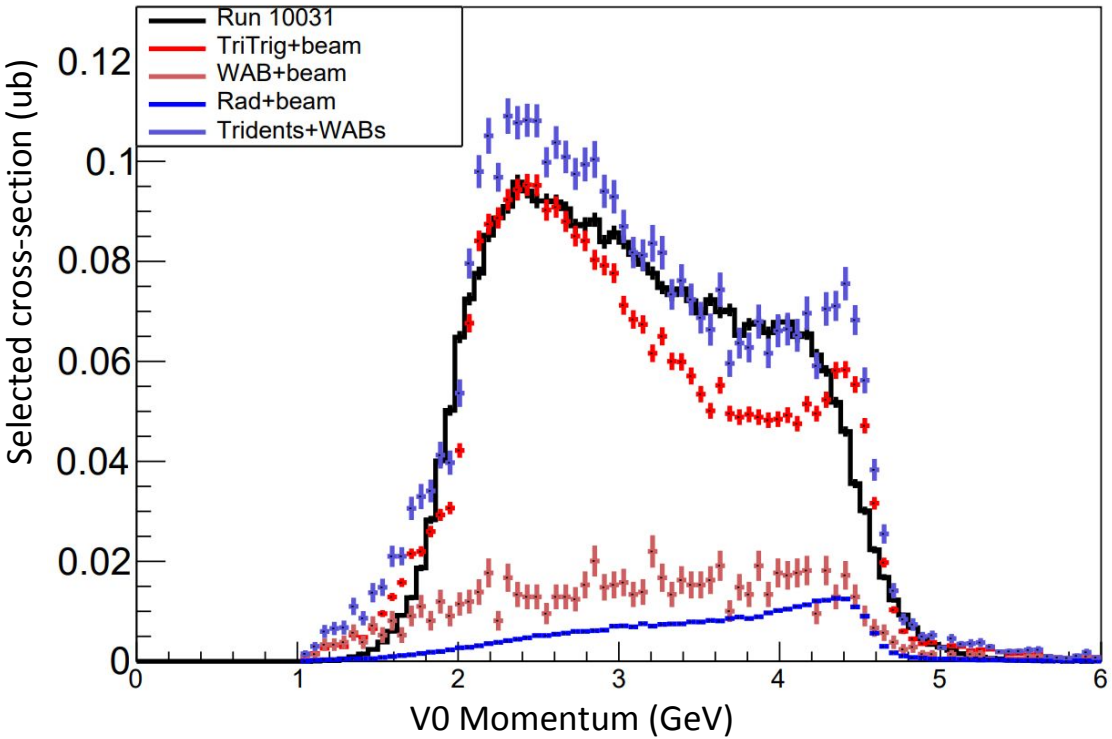


EVERY TIME WE'VE LOOKED AT THIS PLOT FOR A NEW RUN IT'S STANK

~2x higher rate in data than MC
(really this should be the other way around)
Shapes aren't terrible given we can do better with alignment

Note: not sure I trust WABs, or maybe my analysis...usually (and Cameron sees) much more high-ESum peaked distro

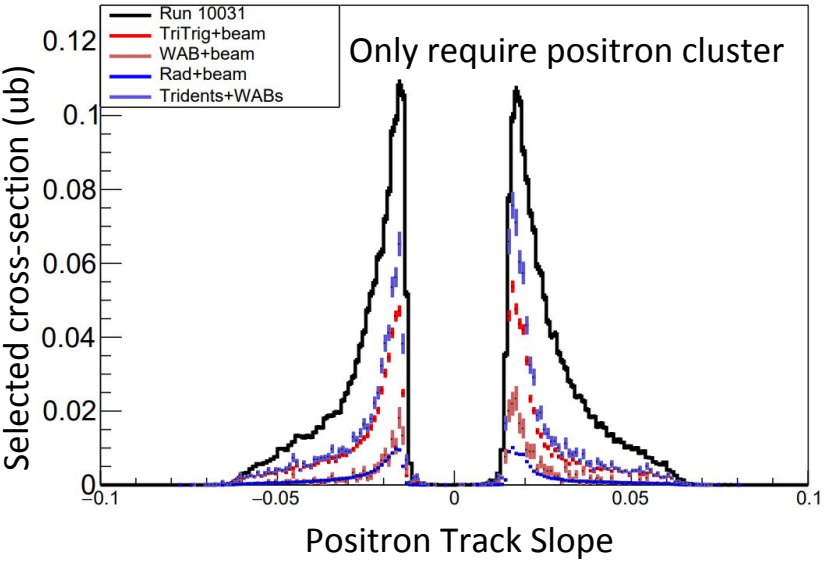
No Layer requirement, Both clusters matched



Not so bad...let's be done!

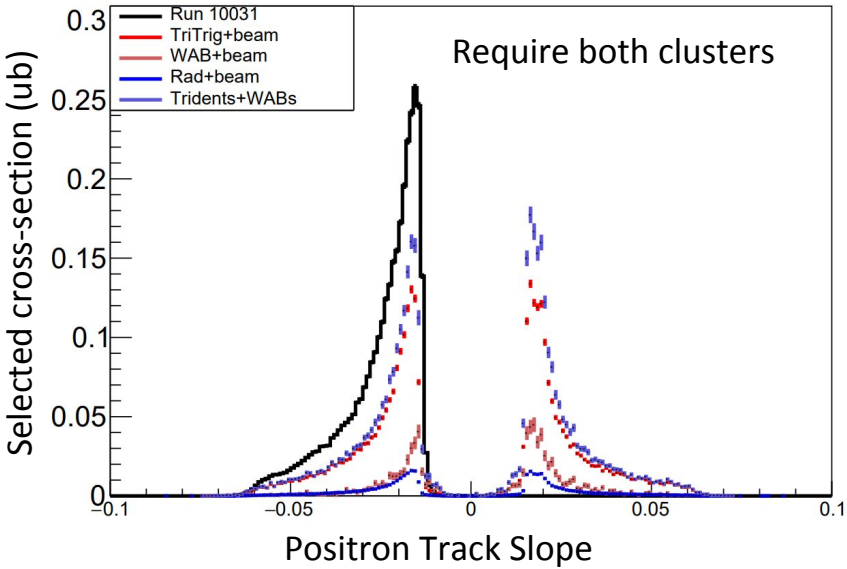
...remember slide 9?

No Layer requirement, Track Slopes

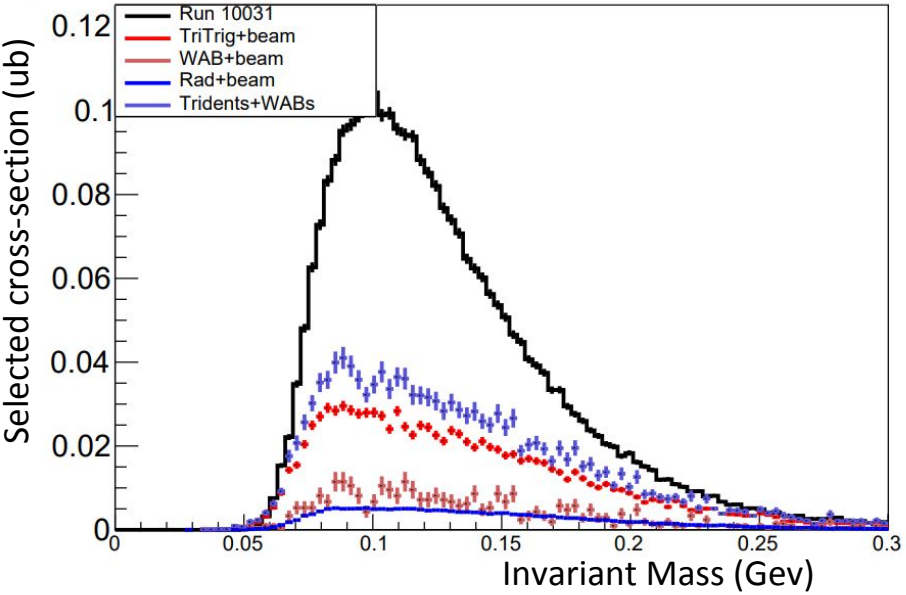


Take away: if we require both e+e- clusters, data is artificially dropped by roughly 2…"agreement" in last slide is artificial.

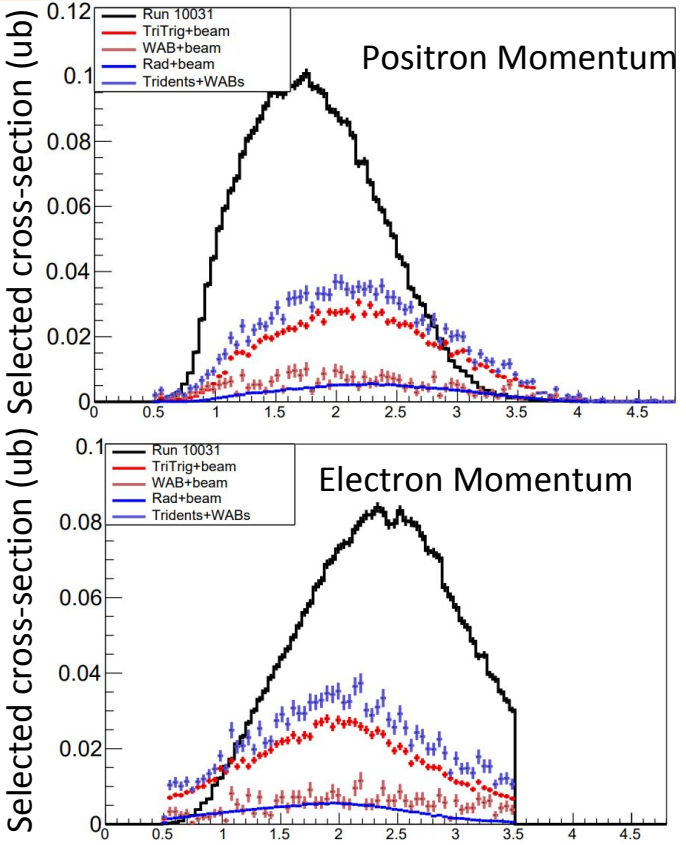
...something screwy with electron-side bottom cluster for this data set; must be (better be!) a bug



No Layer requirement, positron cluster matched: Radiative Cuts & Rates



These plots are after a cut of PSum>3.6 GeV...I don't show that because it's boring.
Apart from the obvious offset, the shapes don't look too great.



Let's talk about rates

Absolute rates mean not much at this point. BUT relative rates mean...something..more? I think so. Maybe?

	Rad TM (ub)	Tritrig+WAB(ub)	Data (ub)
Positron Cluster/All Layers/All ESum	----	4.5	9.4
Both Clusters/All Layers/All ESum	----	3.9	3.4
Positron Cluster/All Layers/ESum>3.6 GeV	0.07	1.4	3.0
Both Cluster/All Layers/ESum>3.6 GeV	0.06	1.2	1.0

Mult by ~ x2!

- Data rates seems to be ~ 2x MC (once accounting for missing electron clusters)
- The MC is getting ~15% more tridents by not requiring electrons cluster; data is ~40% (that's very rough)
- For what it's worth, in reach calculation in 2017(?) I used ***3.8 ub for accepted background*** rate and ***0.2 ub for the truth matched radiative*** rate

Requiring L0L0 hits

	Rad TM (ub)	Tritrig+WAB(ub)	Data (ub)
Positron Cluster/All Layers/All ESum	----	4.5	9.4
Both Clusters/All Layers/All ESum	----	3.9	3.4
Positron Cluster/All Layers/ESum>3.6 GeV	0.07	1.4	3.0
Both Cluster/All Layers/ESum>3.6 GeV	0.06	1.2	1.0
Positron Cluster/L0L0/All ESum	-----	3.7	5.1
Positron Cluster/L0L0/ESum>3.6 GeV	----	1.1	1.6

- Requiring both tracks to have L0 hits drops data rate by ~50%....MC only by 20% (though this is bigger than we've seen before...geometry?)

What Next

- Reprocess data with fix for electron-side bottom clusters
- Is the low overall track efficiency (for MC and data) just an artifact of the method + positron trigger? Could be.
  - Use MC to find efficiency for “findable tracks”...if that’s low, its a real problem with tracking
- The MC is giving us a factor of ~2x lower rate than data and we need to figure out why
  - I’m biased that the data is right because...it’s data AND it’s giving me comparable rates to what I estimated for reach
  - The fraction of events with electron going down hole is much lower in MC than I’d thought (although to be fair I thought it would be more in data too)
- Hopefully redo this with first-pass SVT alignment
- Also like to redo this using Kalman tracks

Track Momentum: All ESum