Pre-preliminary 2019 Data Analysis

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Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Introduction

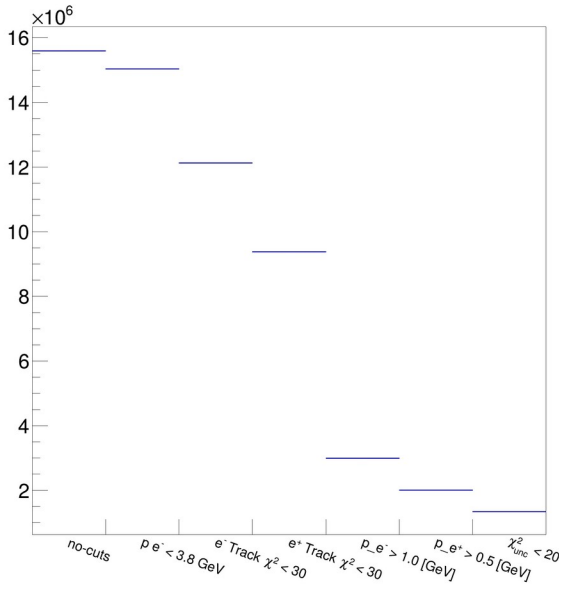
- New types of jobs in hps-mc
    - Generate physics processes with MadGraph and process up to right before running detector sim (slic/geant)
    - Simulate passage of particles through the detector separately for each component of the backgrounds (tritrig, wab, beam) while also merging and running readout and reconstruction
    - Run analysis with hpstr on this reconstructed MC as well as data
- Focusing on run 10031 which was with an 8 um W target and 100 nA beam current, for which the MC software was configured to simulate
- Exclusively looking at Kalman tracks and vertices
- Comparison of data and MC scaled to the expected rate
- What's next?

Small Local MC Samples

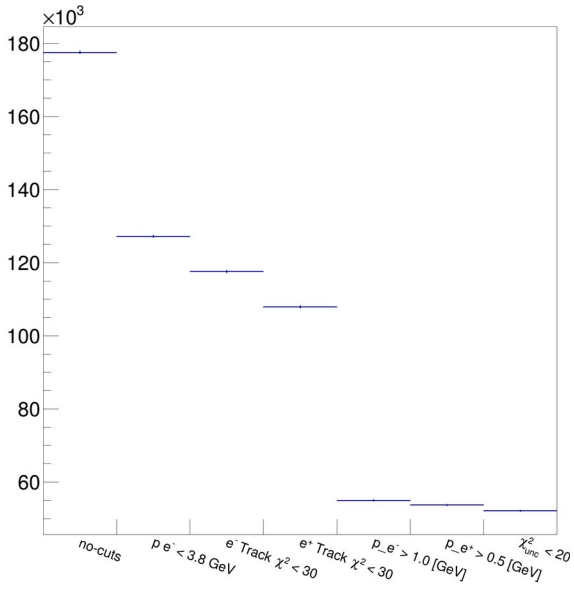
- Made a small set of MC samples locally to compare to the run hps_010031
  - 200 files of tritrig+beam each with 10,000 tritrig events
  - 2000 files of wab+beam each with 30,000 wab events
  - Done with conditions used for hps_010031 which has an integrated luminosity of 0.1525 pb^{-1} based on Maurik's lumi script
- All relevant steps use detector HPS_TY_iter4
  - Slightly stale branch of hps-java used, but shouldn't matter that much
  - Special branch of lcsim from PF used

Preselection Cutflows

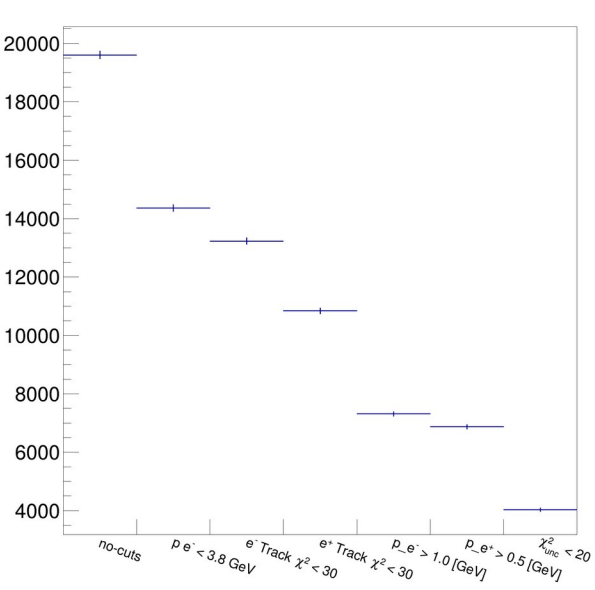
hps_010031



Tritrig+Beam

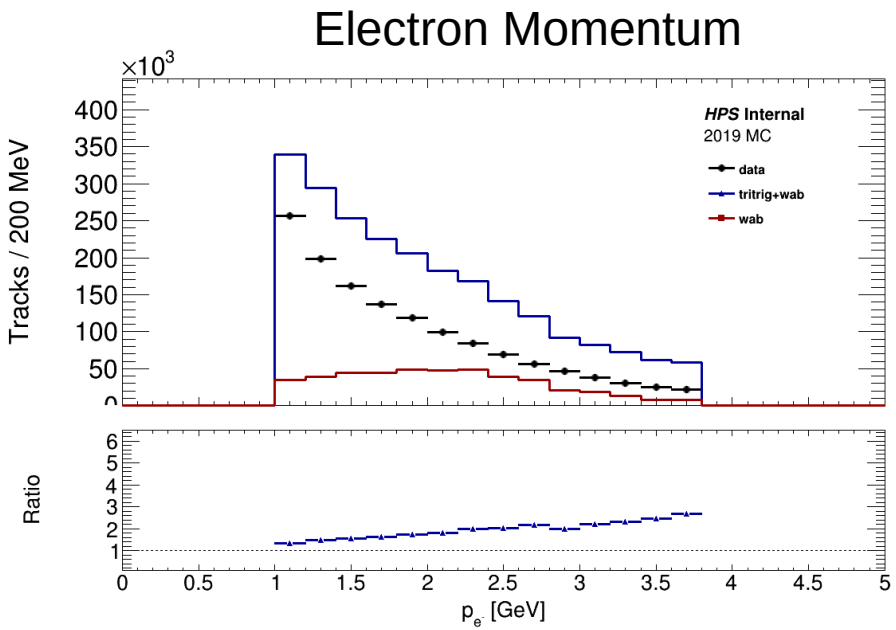


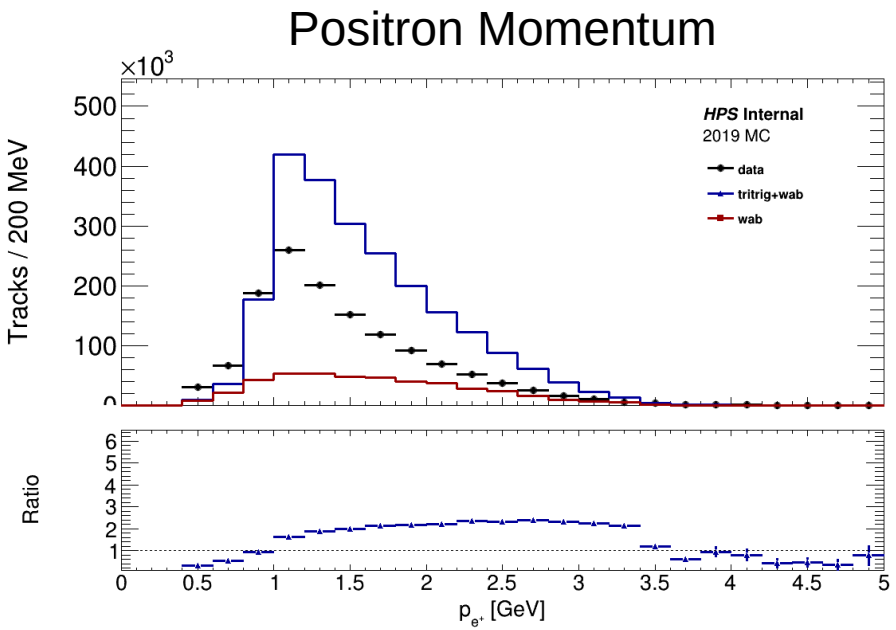
WAB+Beam



- Data includes all triggers while MC readout exclusively uses Singles1 trigger (Ecal Cluster + Hodo Hit)
- FEE cut seems to remove less data than MC

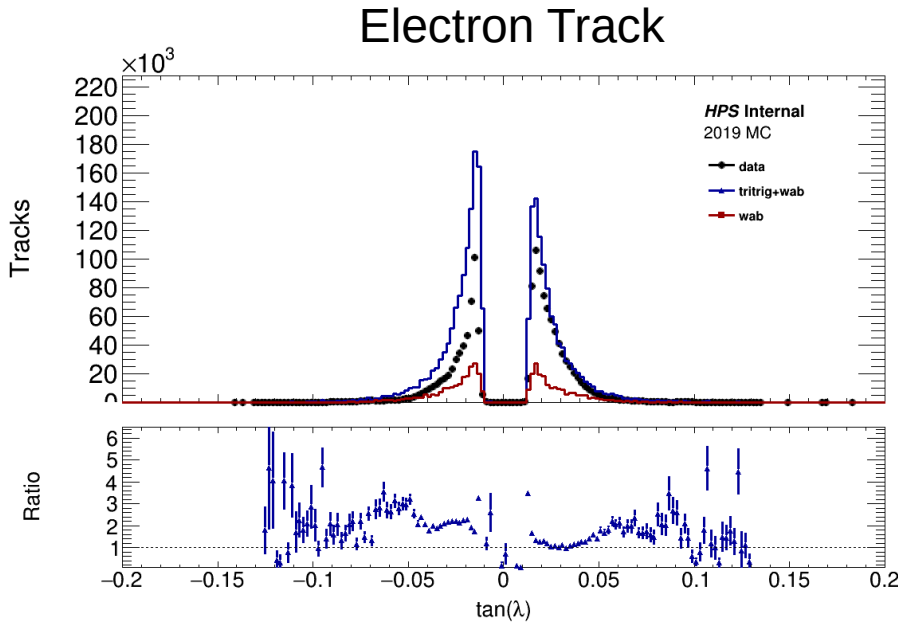
Preselection Track Momentum

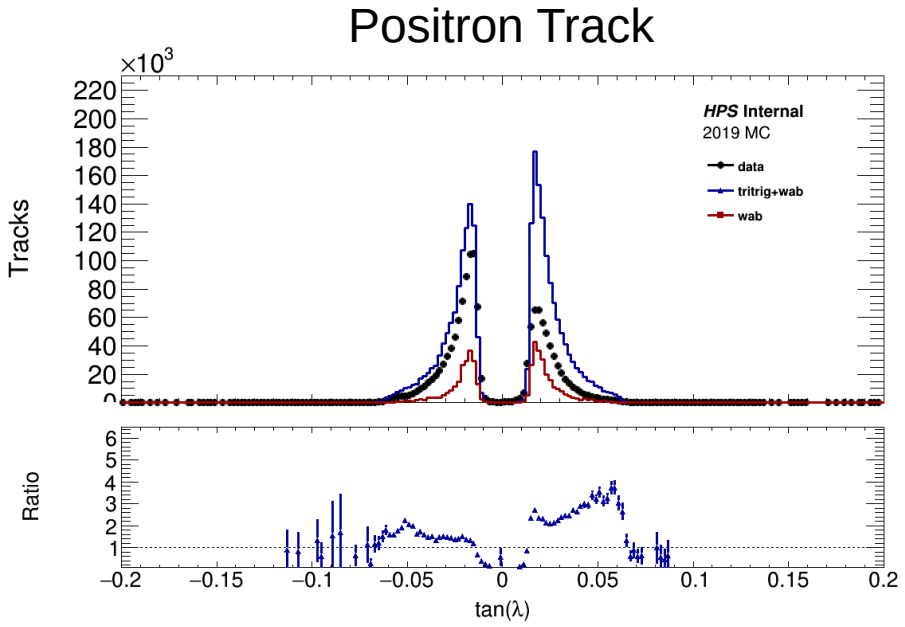




- MC is normalized to expected rate for 10031 luminosity
- Expected rate in MC is roughly 2x the data rate

Preselection Track Directions





- Asymmetry in top vs bottom not the same in data and MC

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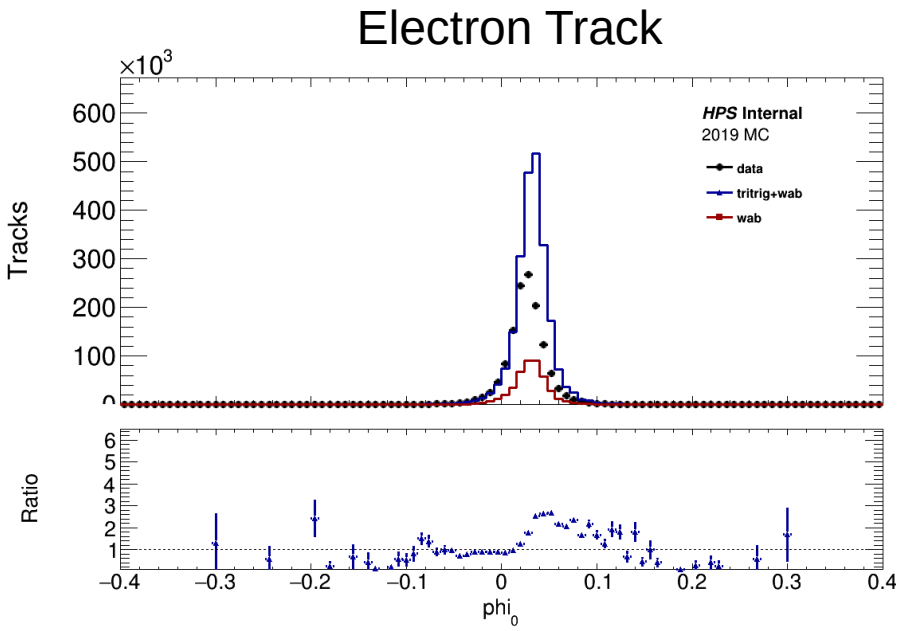
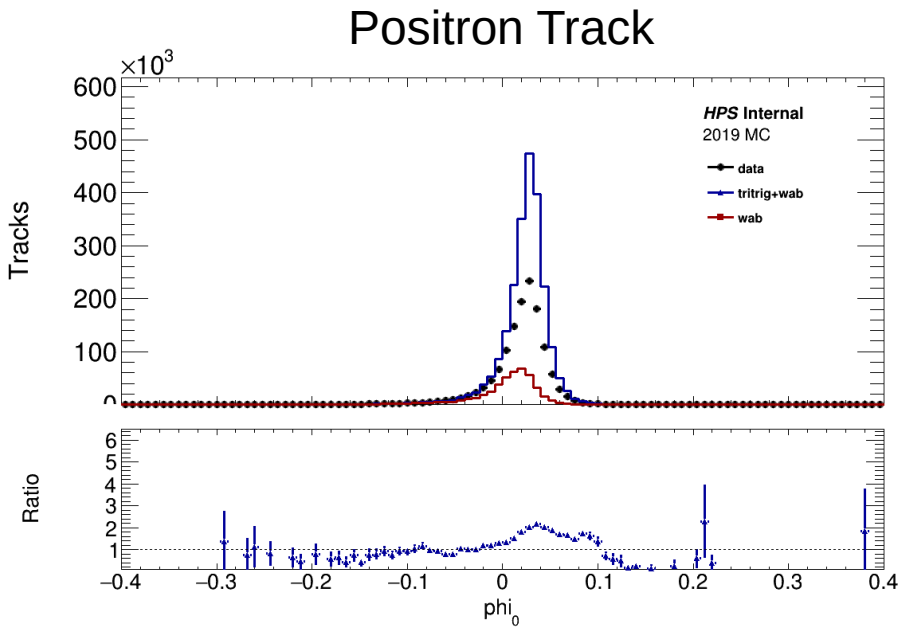
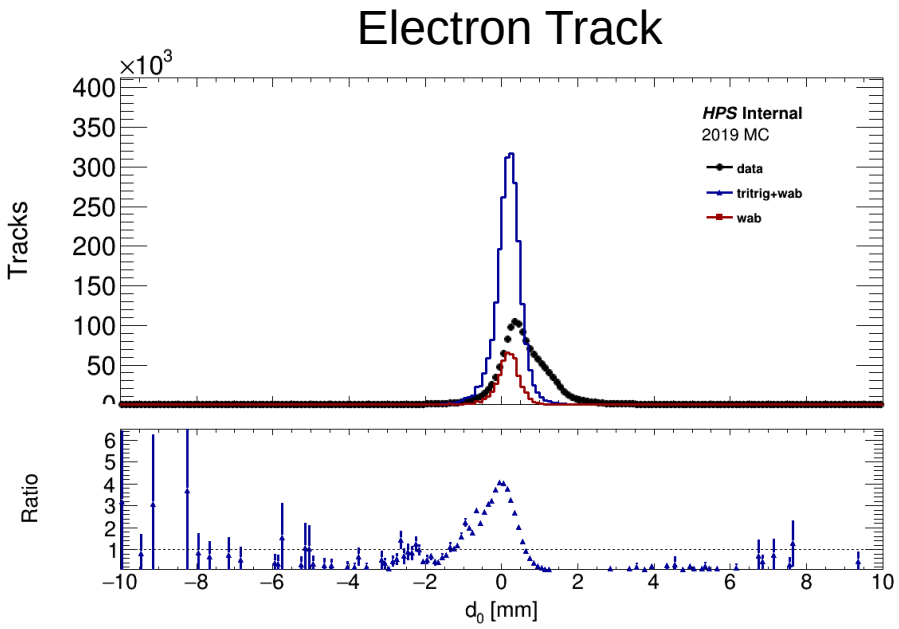
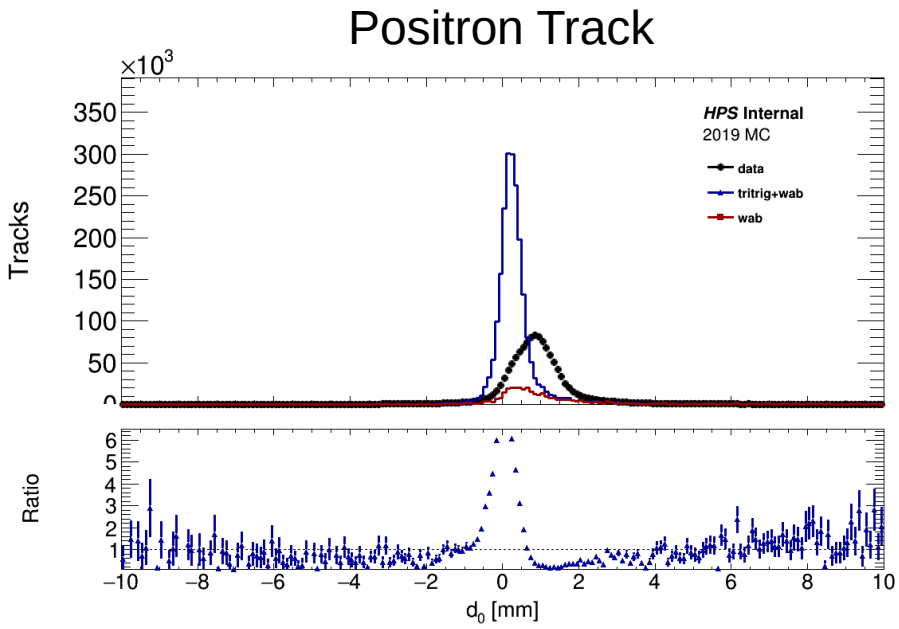




- Shape of Phi_0 of positron tracks is fairly close
- Shape of electron tracks is shifted away from zero a bit in MC

Preselection Track Extrapolations





- d_0 is much higher on average in data for positrons and electrons
- Do we need to use a different beam spot in MC?

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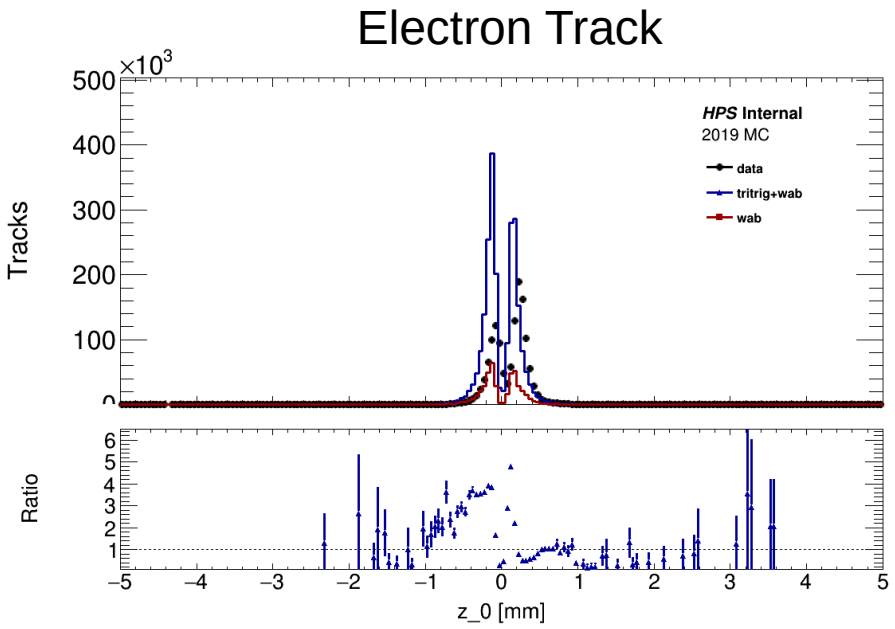
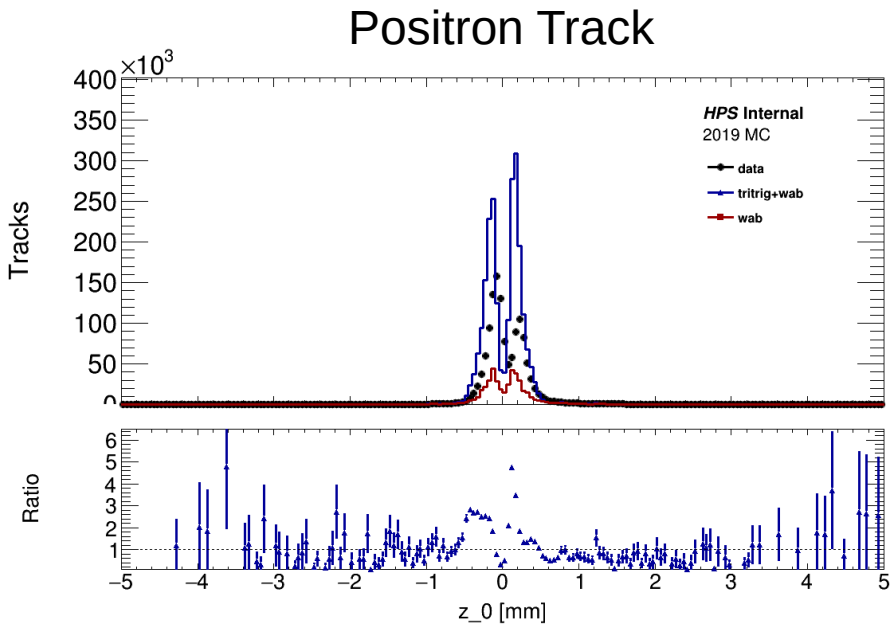
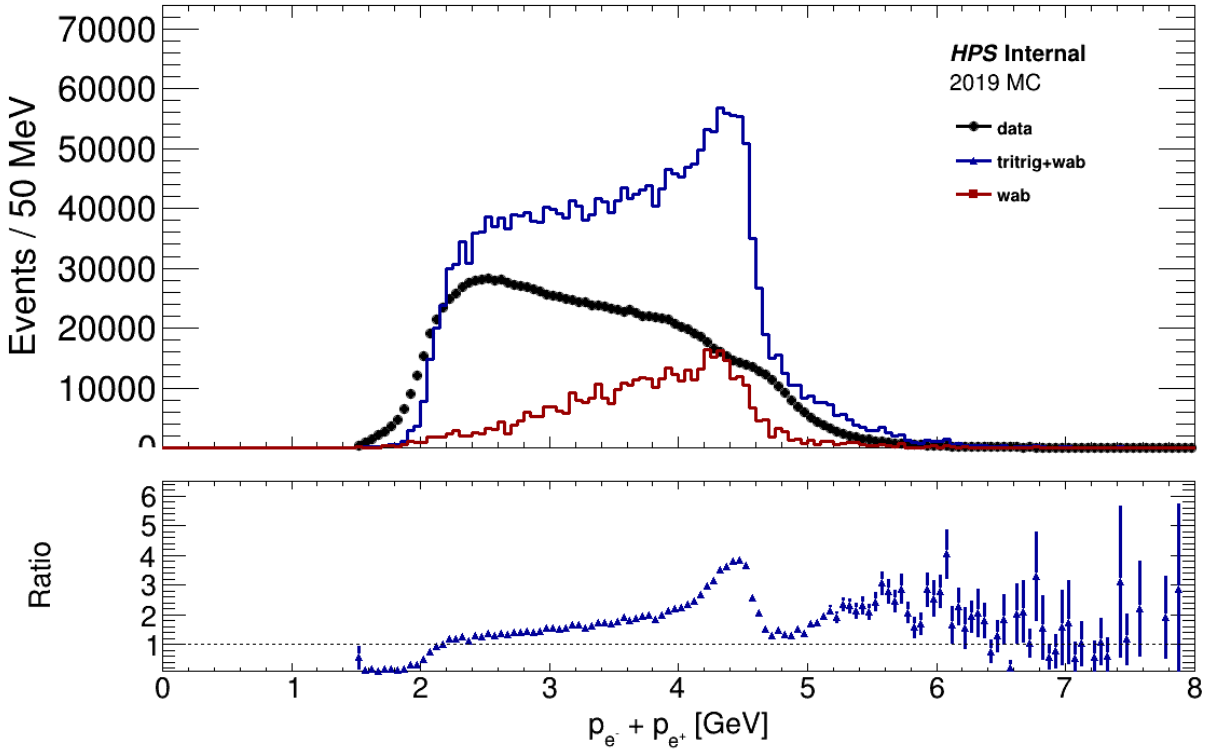




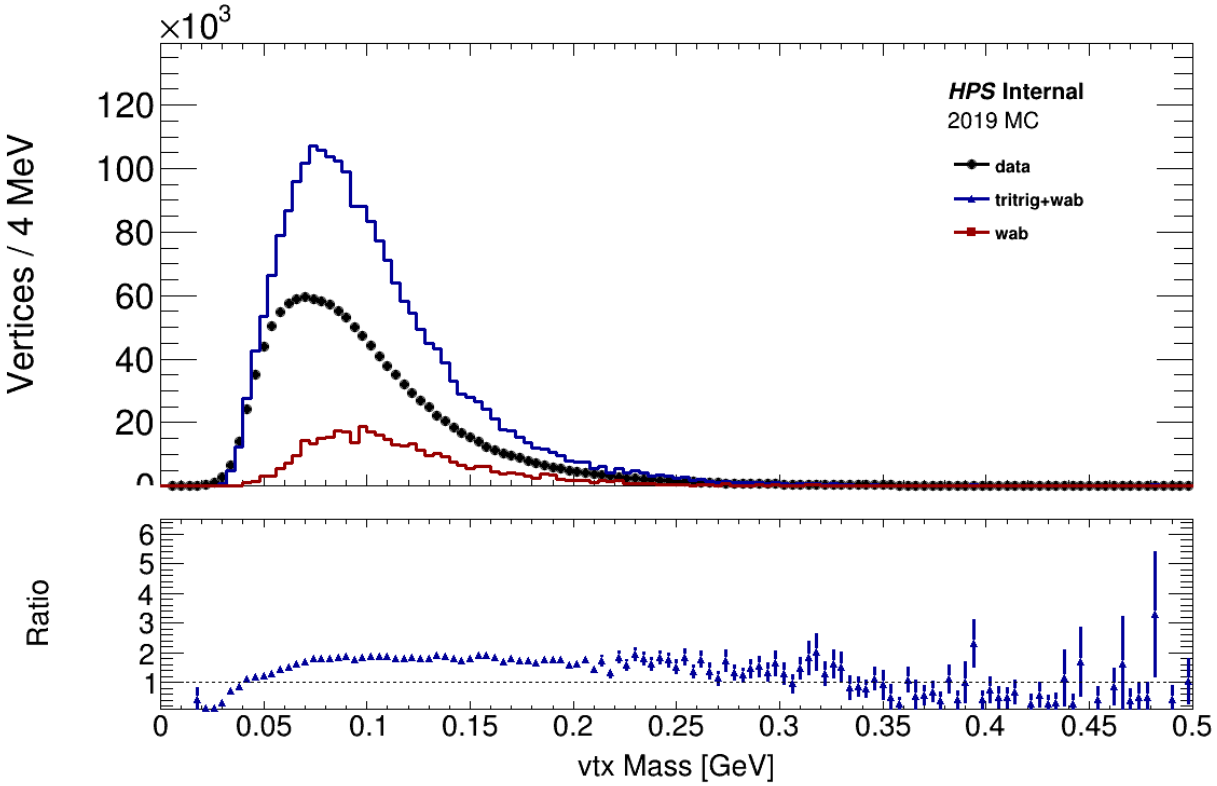
- The shape of z_0 is clearly off for both tracks
- Electrons are maybe worse than positrons?

Preselection Psum



- Psum does not peak nearly as much in data

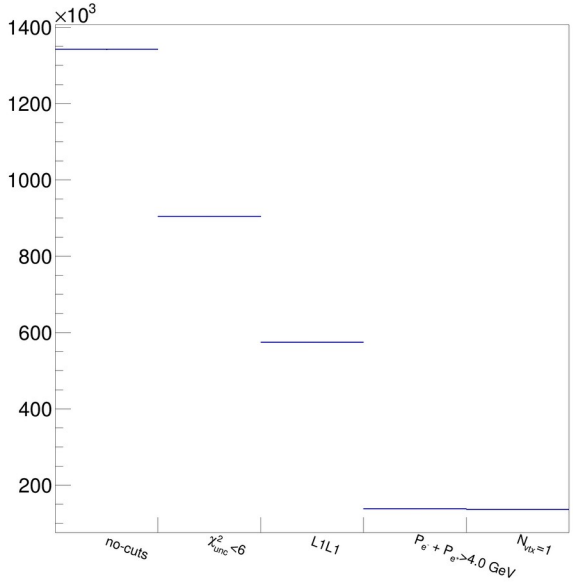
Preselection Vertex Mass



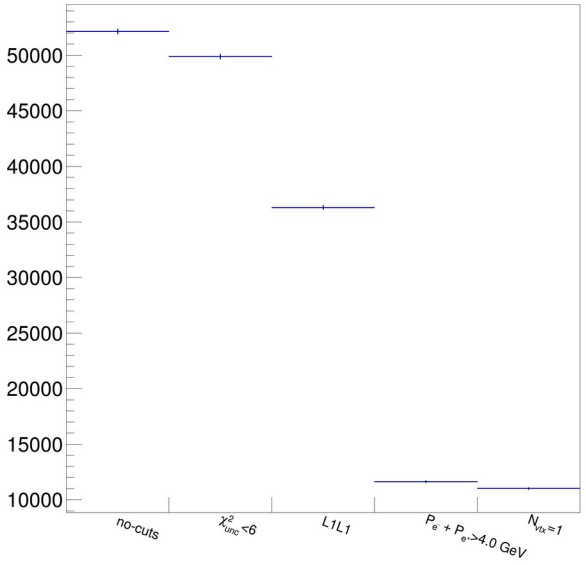
- Still need to spin up a rad+beam sample to be able to calculate the radiative fraction

Tight Selection Cutflows

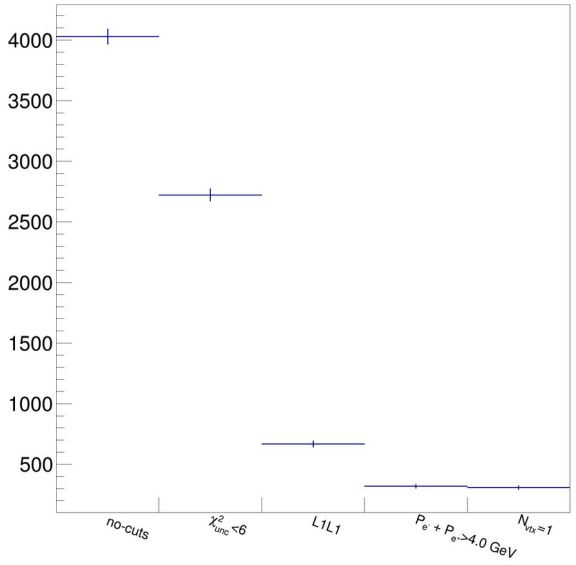
hps_010031



Tritrig+Beam



WAB+Beam



- Data includes all triggers while MC readout exclusively uses Singles1 trigger (Ecal Cluster + Hodo Hit)
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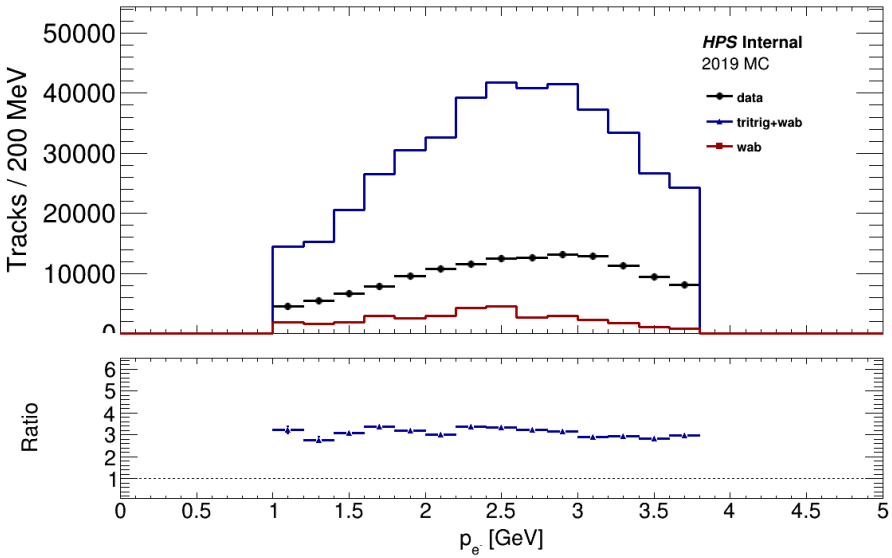
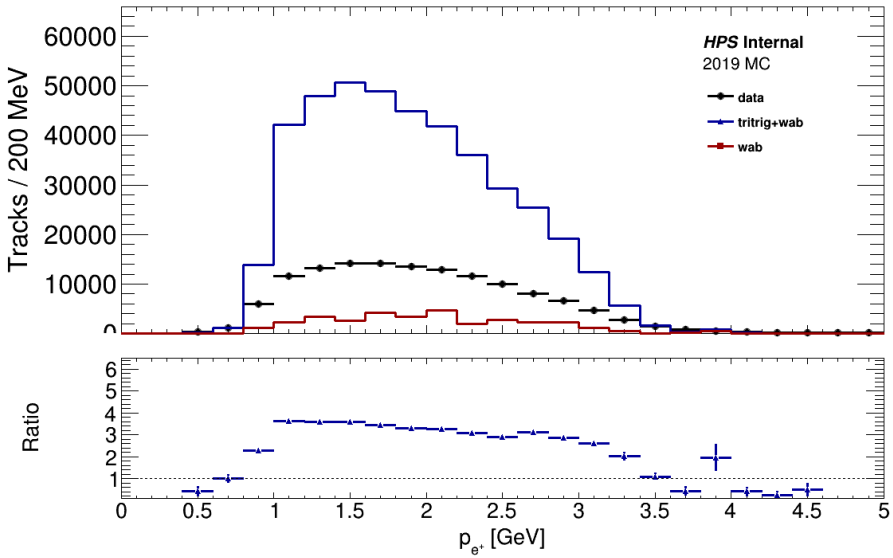
Tight Selection Track Momentum

Electron Momentum



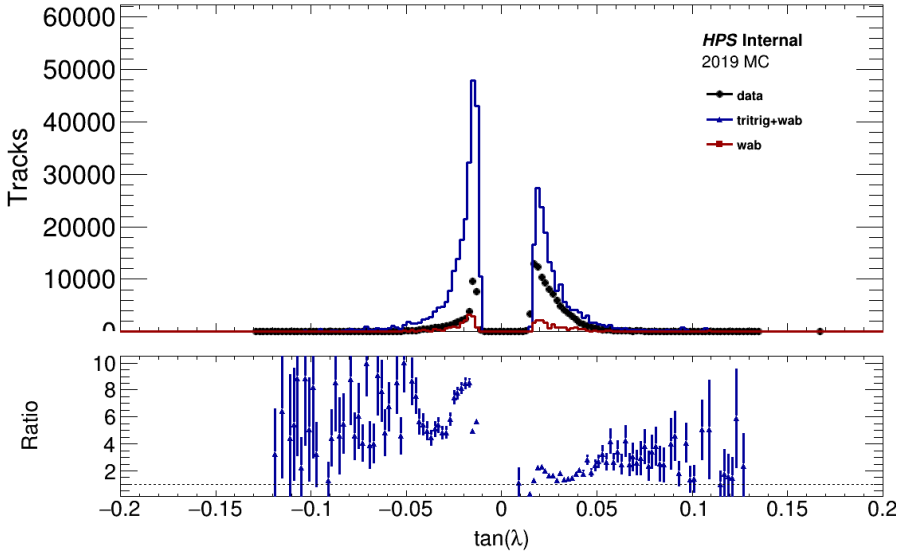
Positron Momentum



- Shapes match much better with Tight selection
- Rate is off by roughly a factor of 3 to 4

Tight Selection Track Directions

Electron Track



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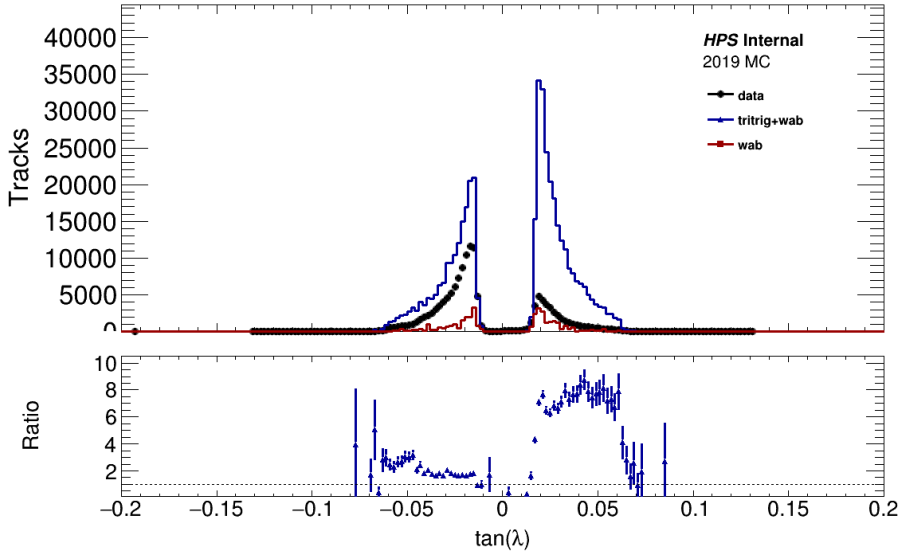
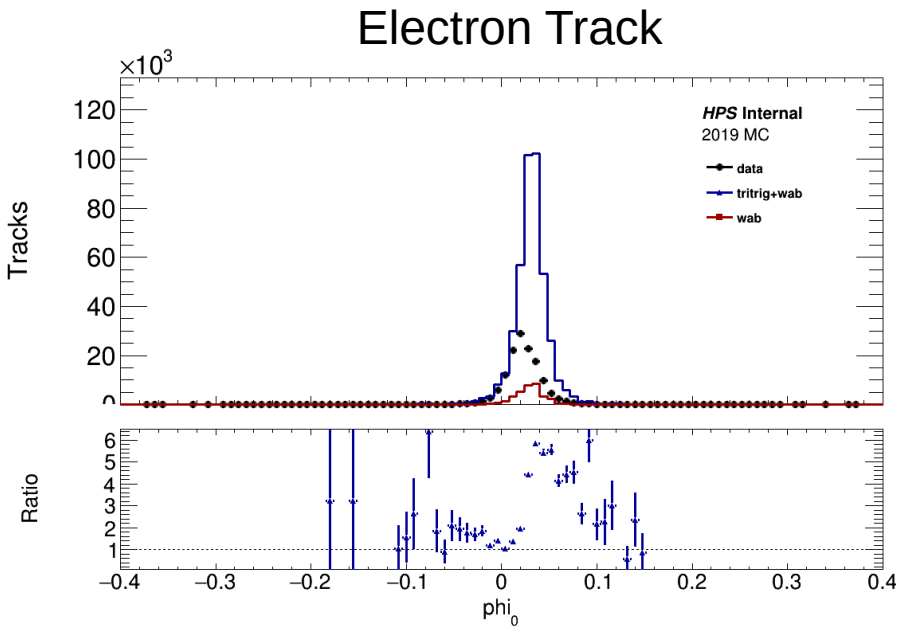
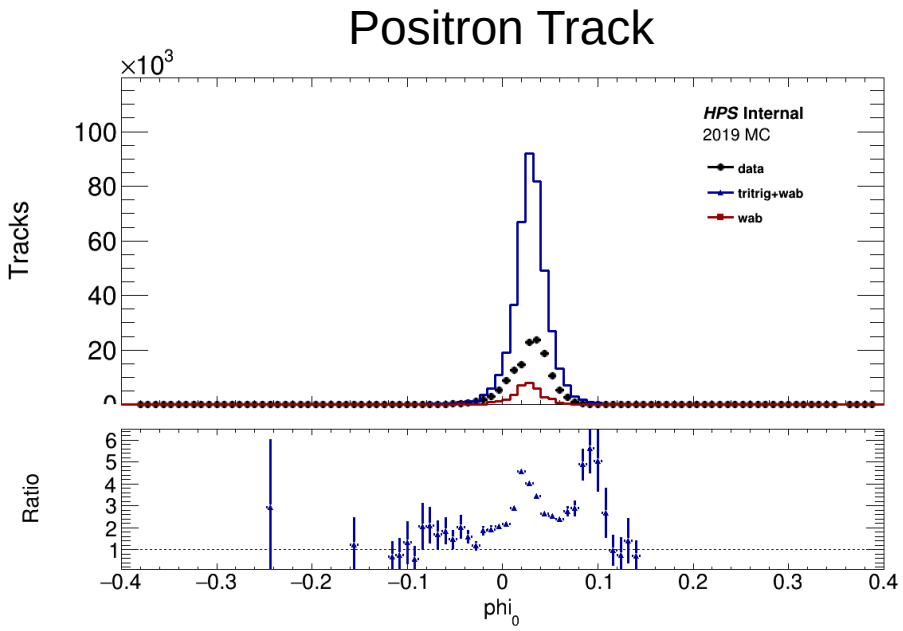


- Asymmetry in top vs bottom not the same in data and MC
- Shapes don’t look so bad

Tight Selection Track Directions

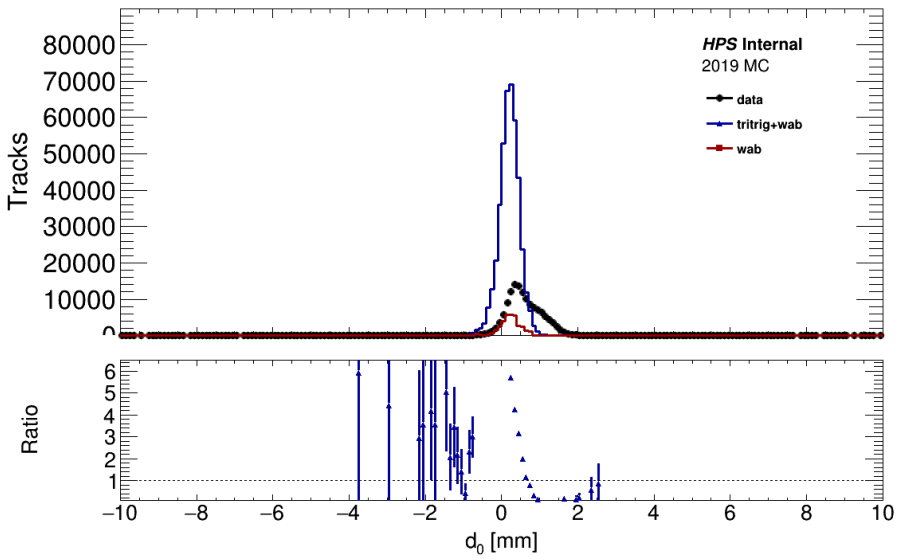




- Shape of electron tracks is shifted away from zero a bit in MC
- Shape of positron tracks seems funny to me

Tight Selection Track Extrapolations

Electron Track



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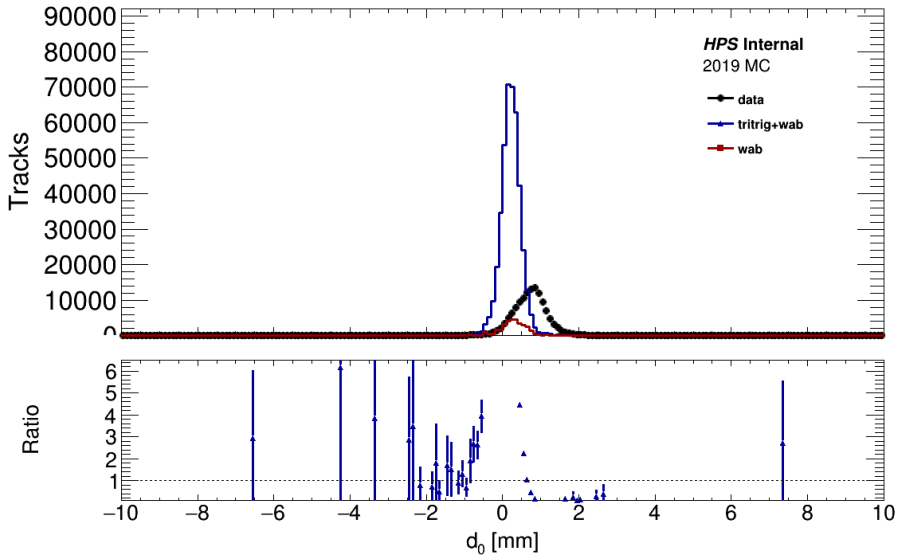
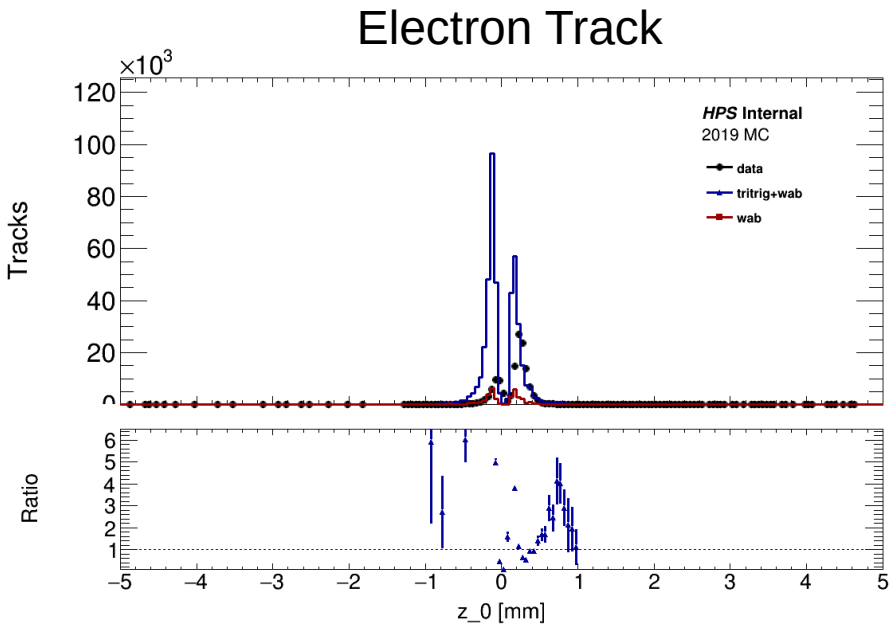
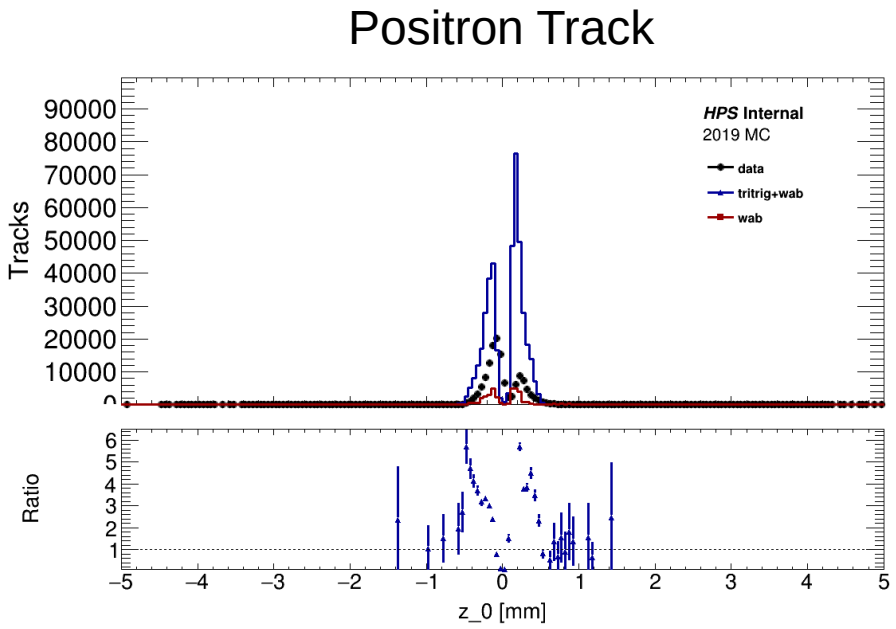


- The shape of d_0 is clearly off for both tracks still

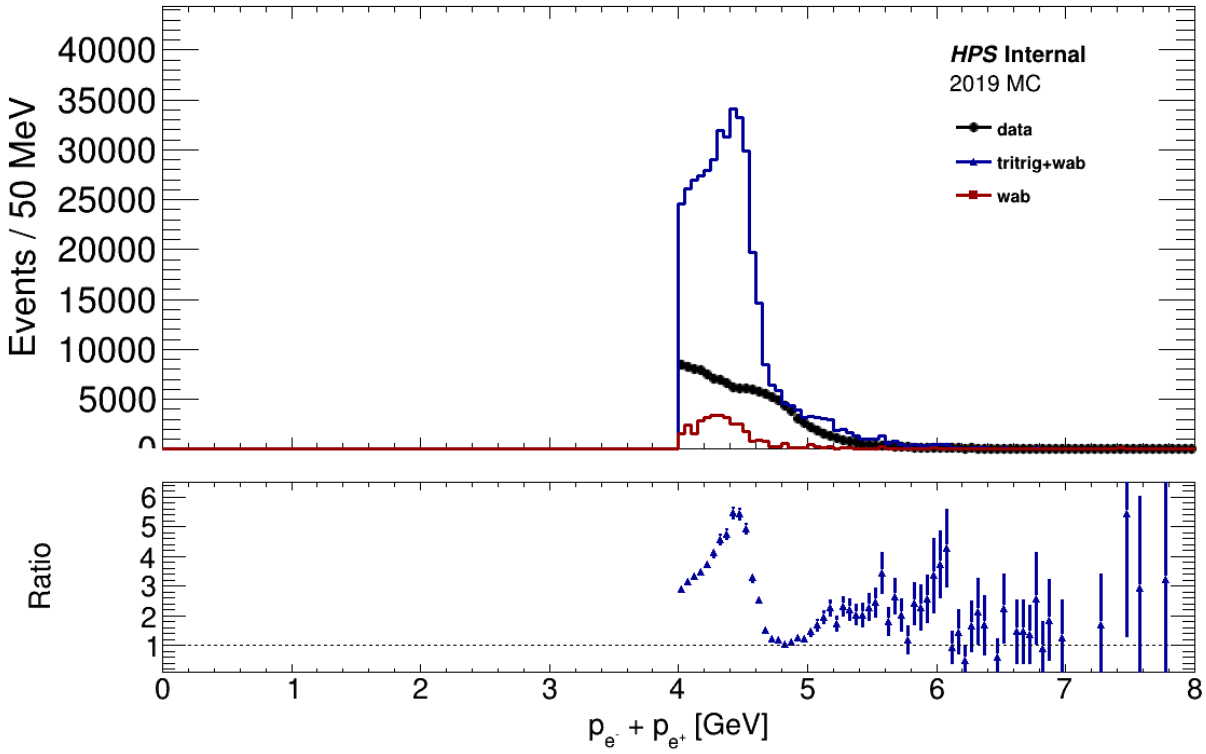
Tight Selection Track Extrapolations





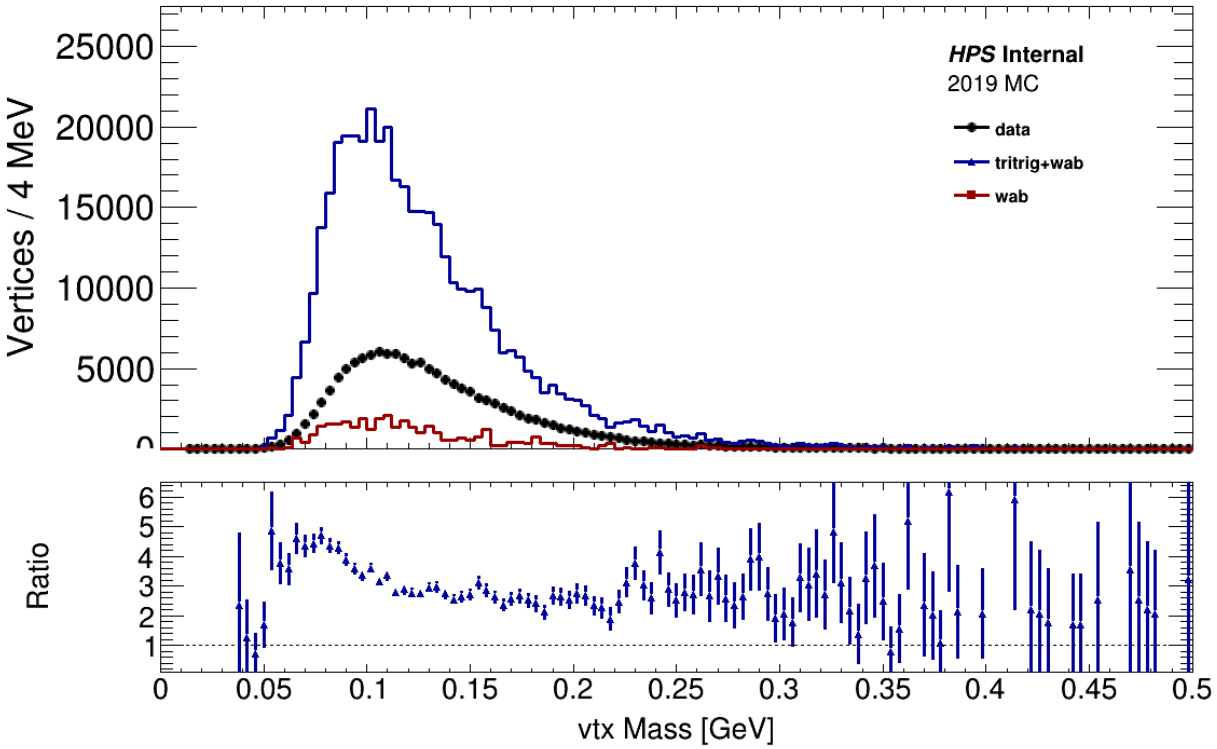
- The shape of z_0 is clearly off for both tracks
- The direction of the asymmetry seems backwards?

Tight Selection Psum



- This doesn't look much different from preselection apart from the minimum requirement

Tight Selection Vertex Mass



- Shape is definitely closer than it is with only the preselection, but still not quite right

Discussion

- Data/MC rate is about 1/3
- Some of the variable shapes sorta match, but most don't
- The funny asymmetries in tan(λ) and Z_0 are potentially a hint into what we might be missing?
  - Missing positron tracks in the top and electron tracks in the bottom?
  - Minus sign somewhere flipping top and bottom in data or MC but not both?
  - Just some crazy ideas
- I have more plots, and can pull them up if we want

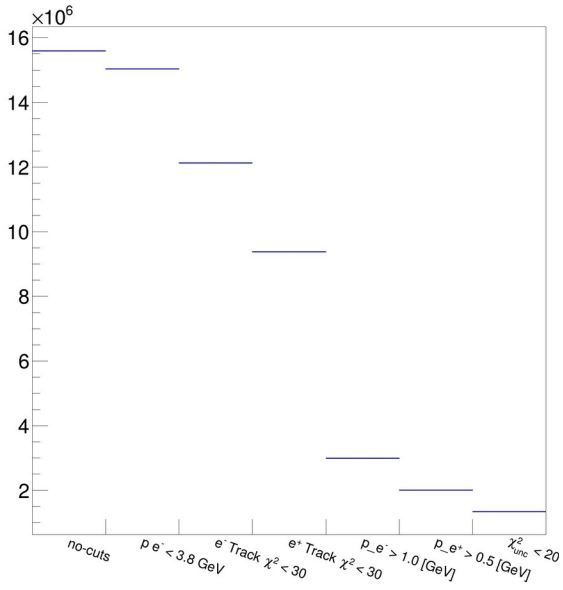
Whats Next?

- Spend some time getting the software more organized and accessible for the collaboration at large
  - Lots to get merged into master of hps-java and hps-mc
  - Will take a well coordinated effort
- Get setup to quickly repeat comparisons like this one for new detectors
  - This mostly is accomplished via the software organization
  - Also need to make a larger set of generator level files
- I am already starting to run even more beam files with different target thicknesses and beam currents

Backup

Preselection Cutflows

hps_010031



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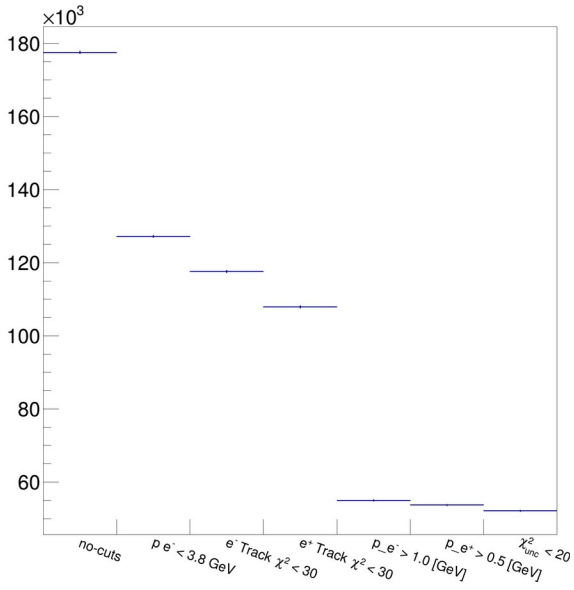

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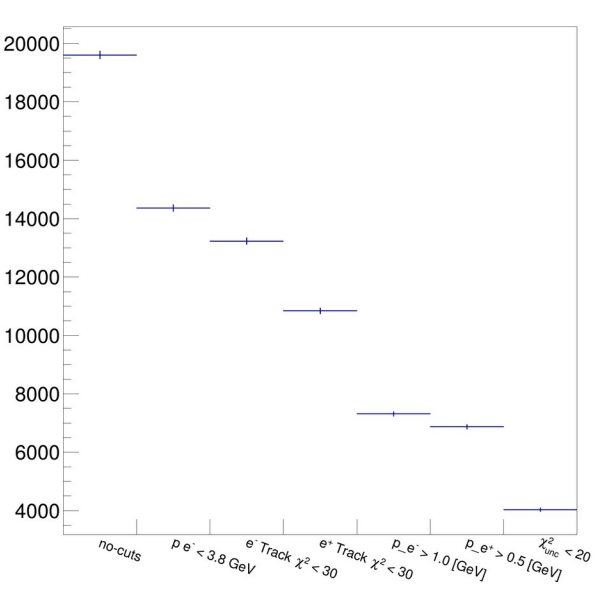

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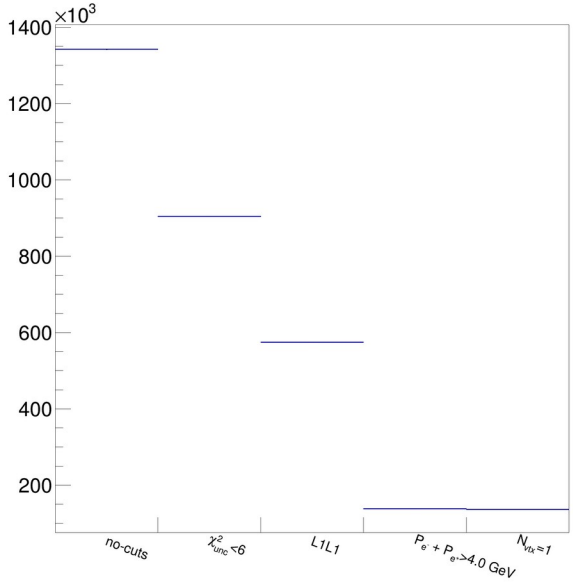

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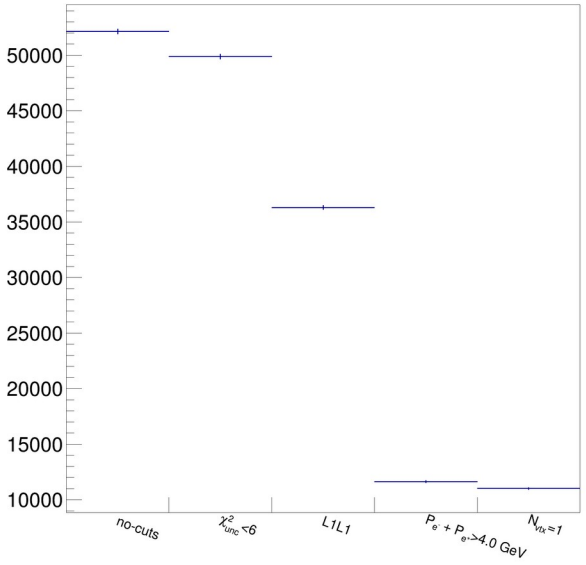

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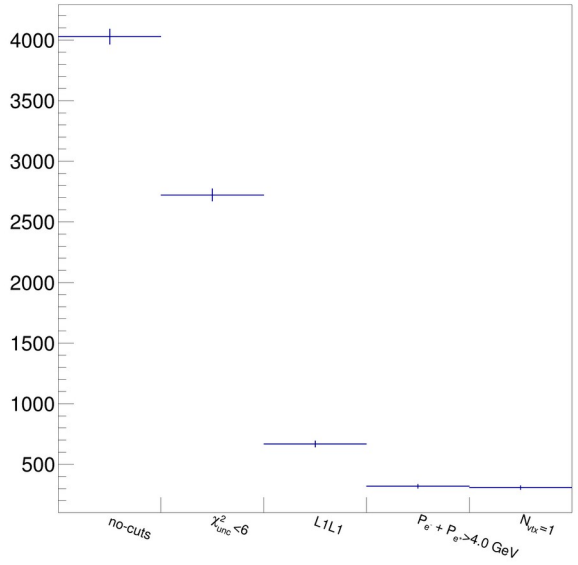

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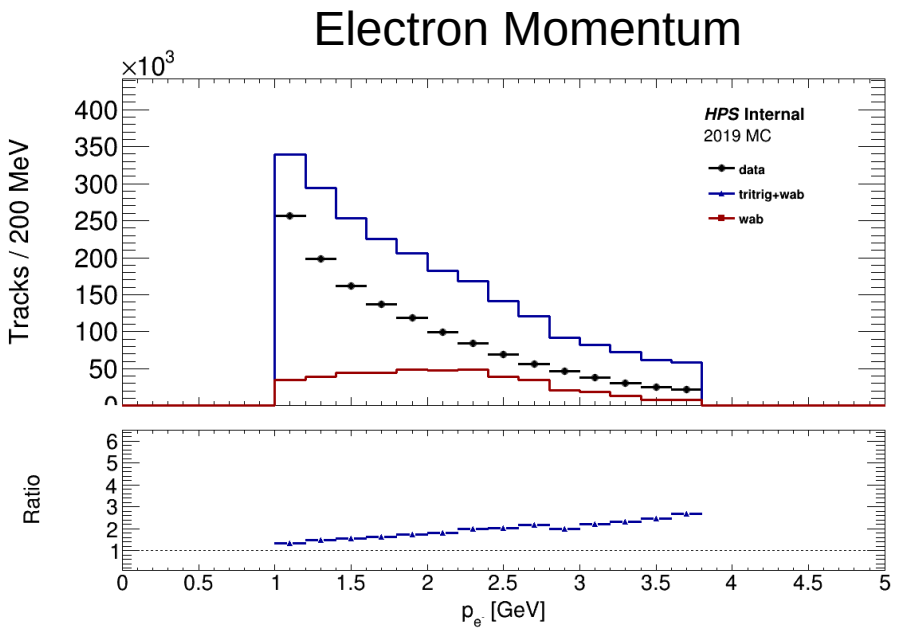

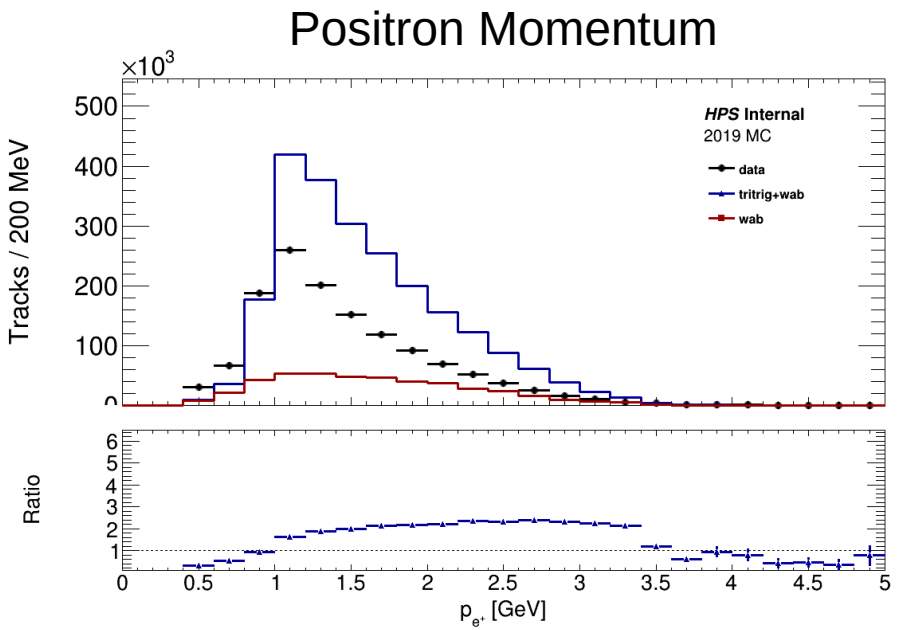

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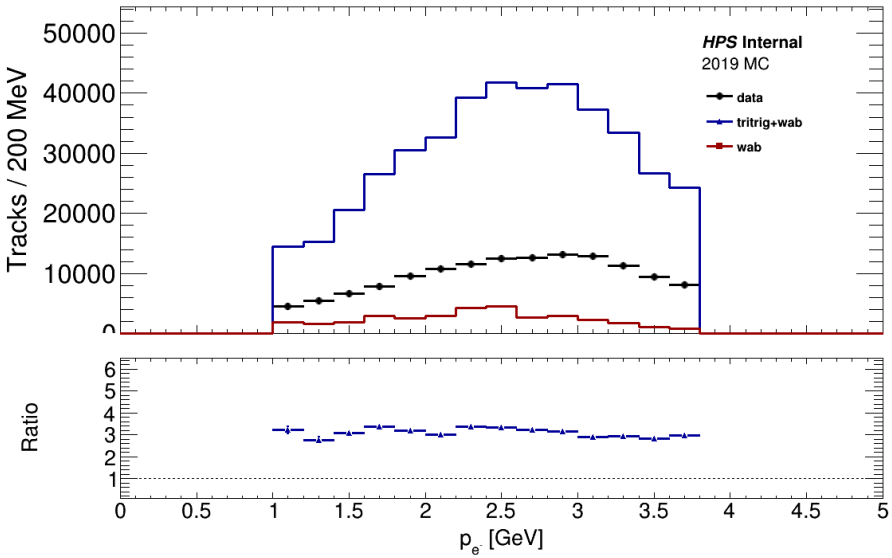
Electron Momentum



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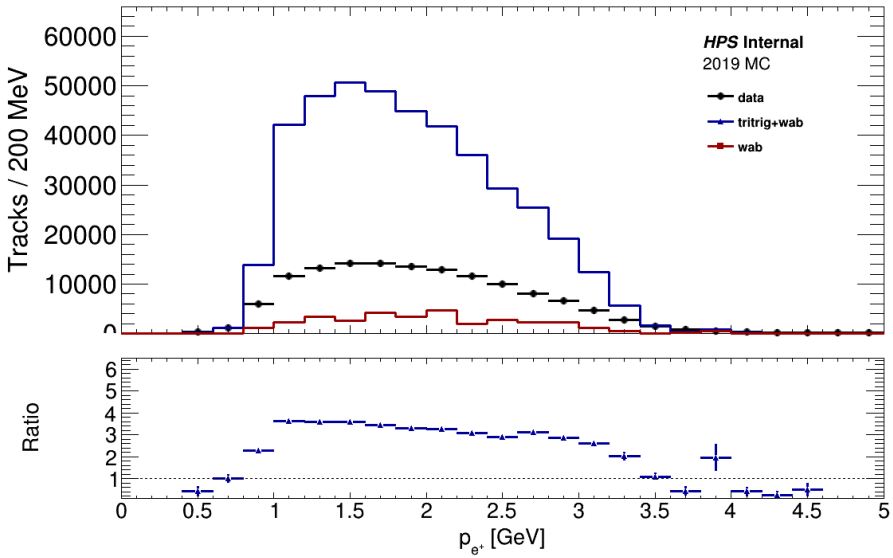
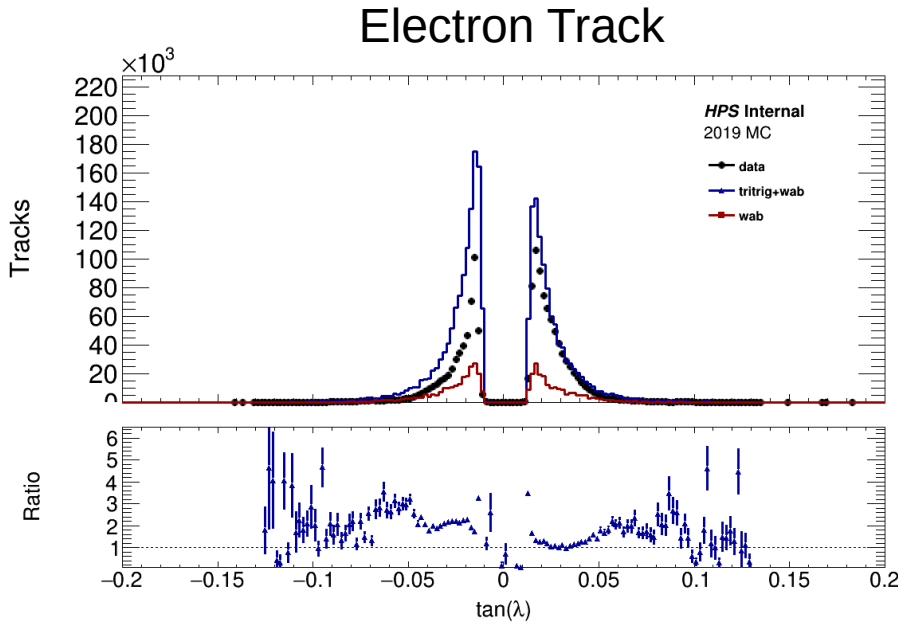
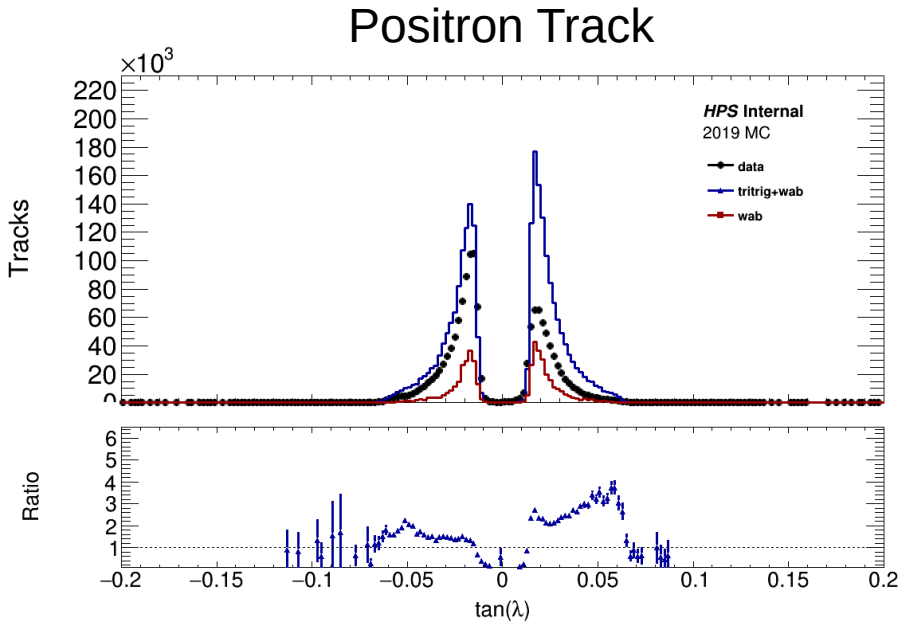


- Shapes match better with Tight selection
- Rate is off by roughly a factor of 3

Preselection Track Directions





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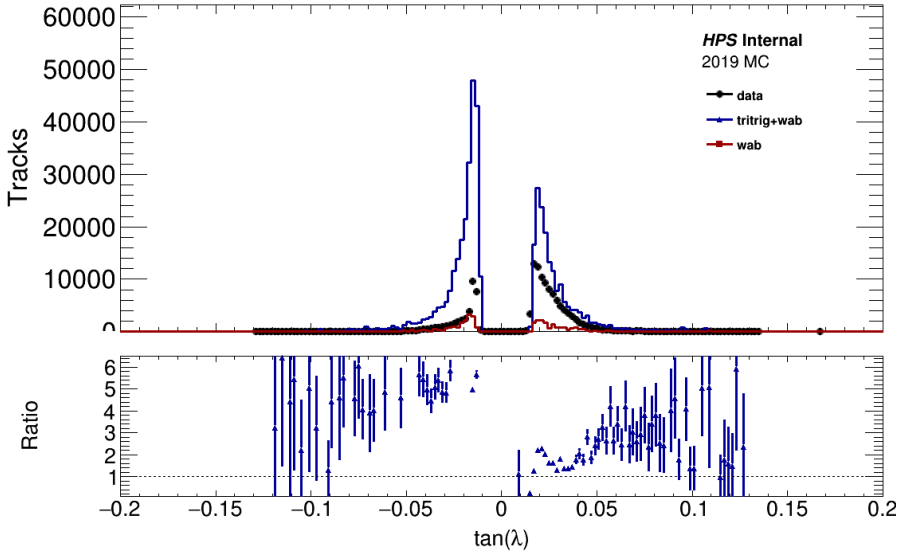
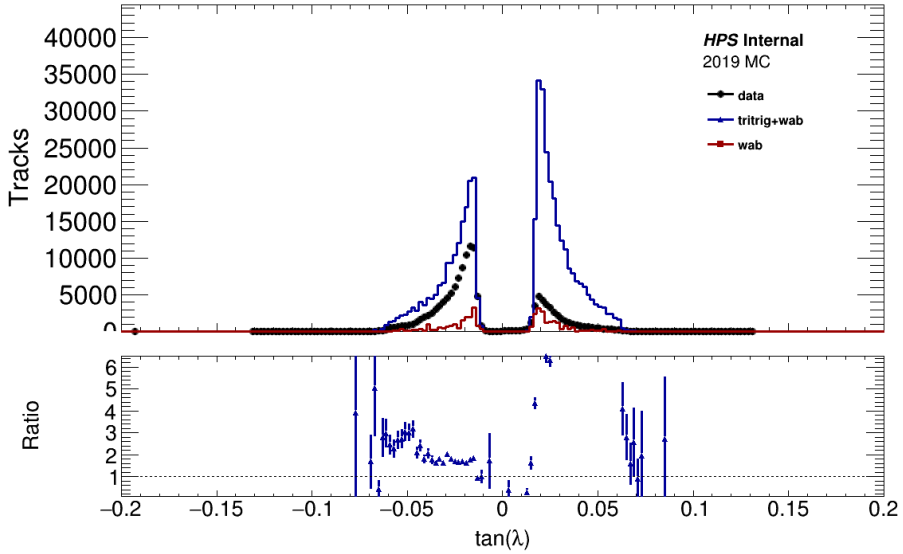


Positron Track



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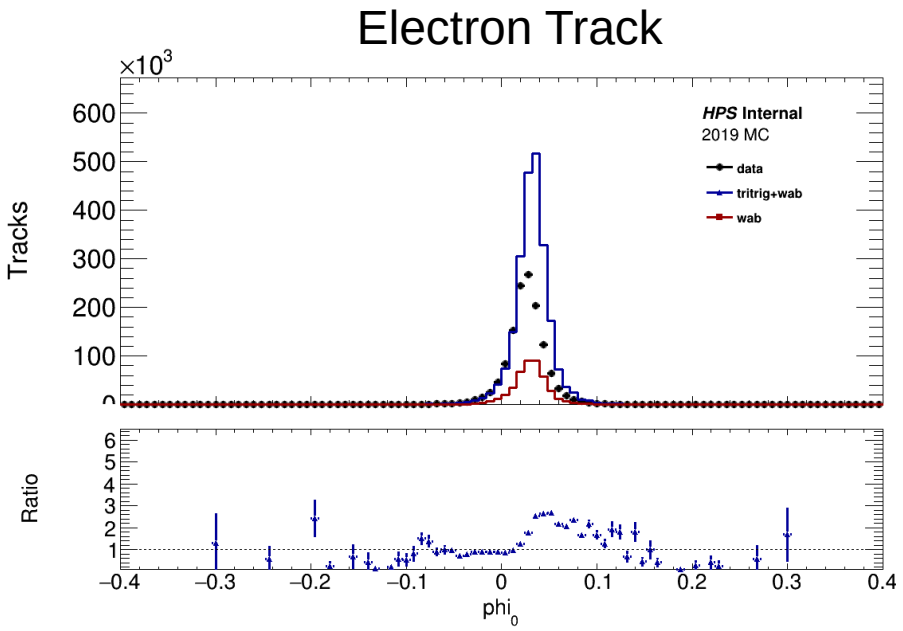

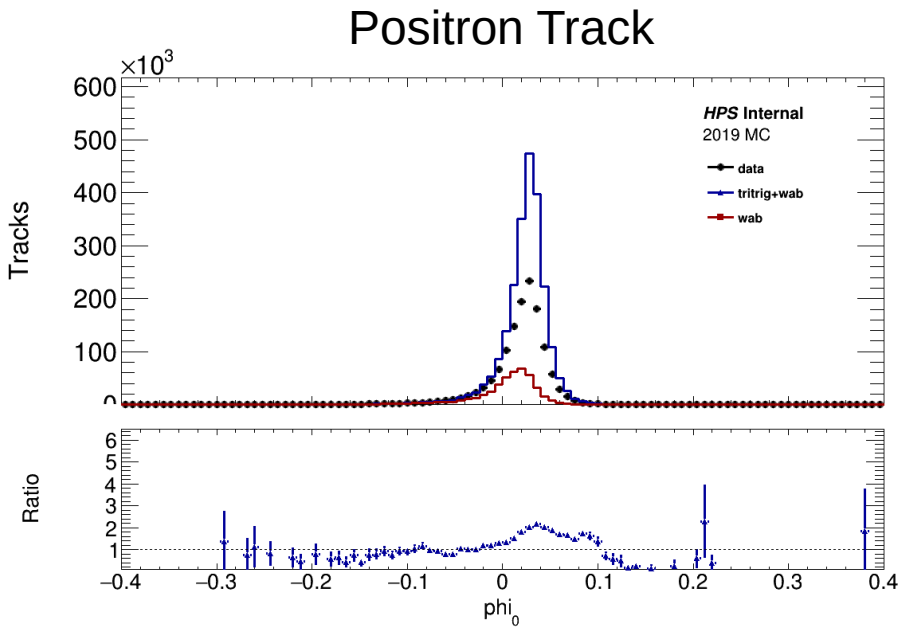

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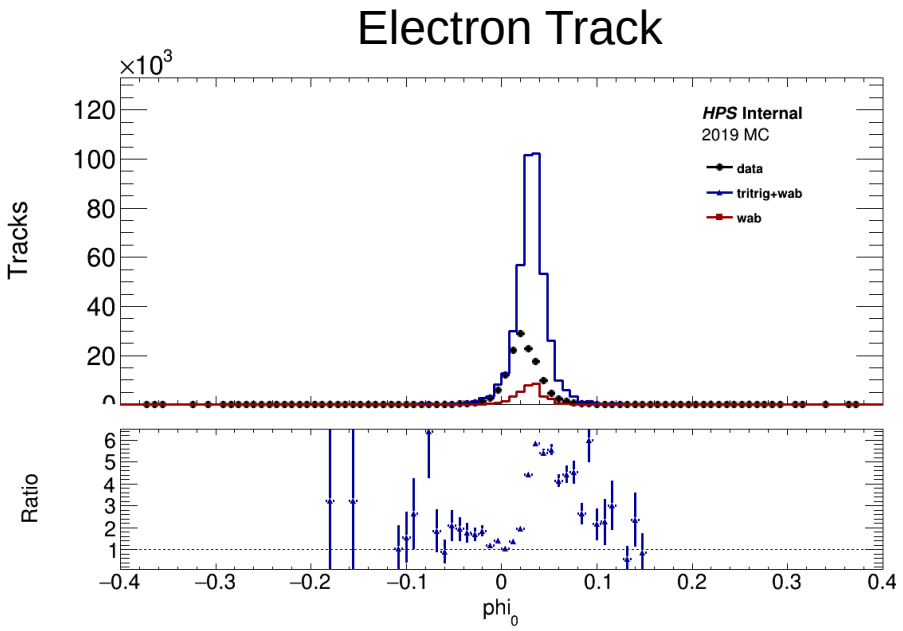

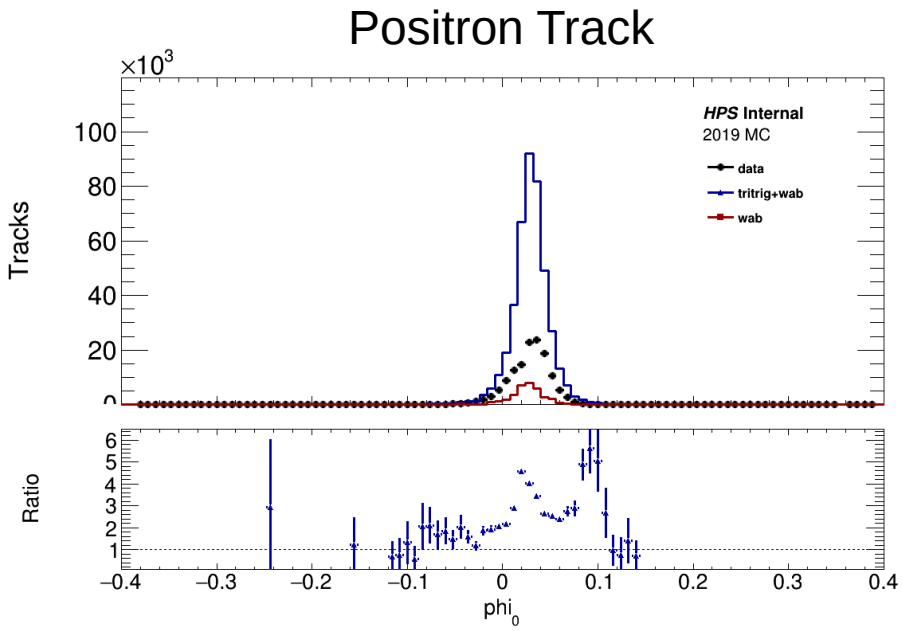

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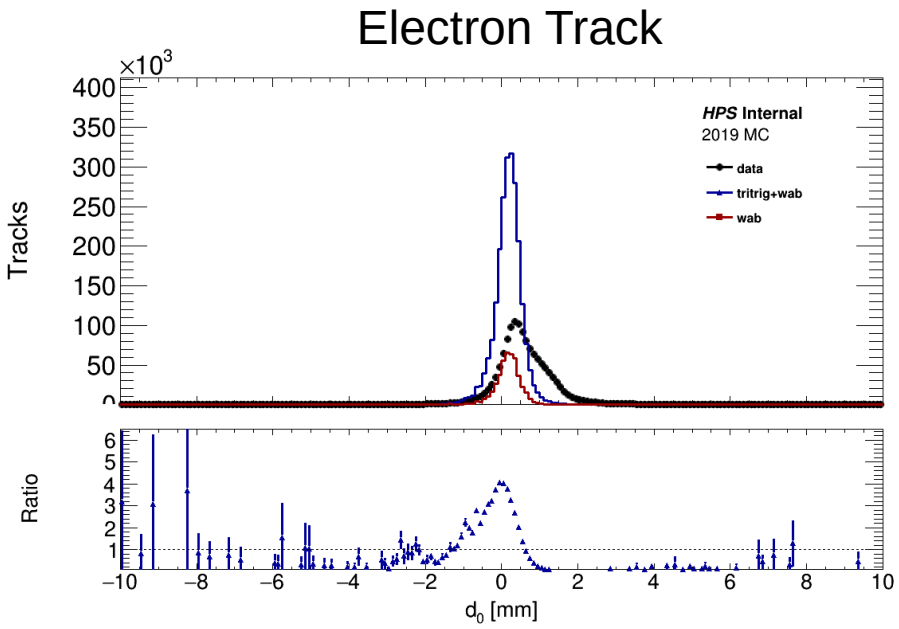

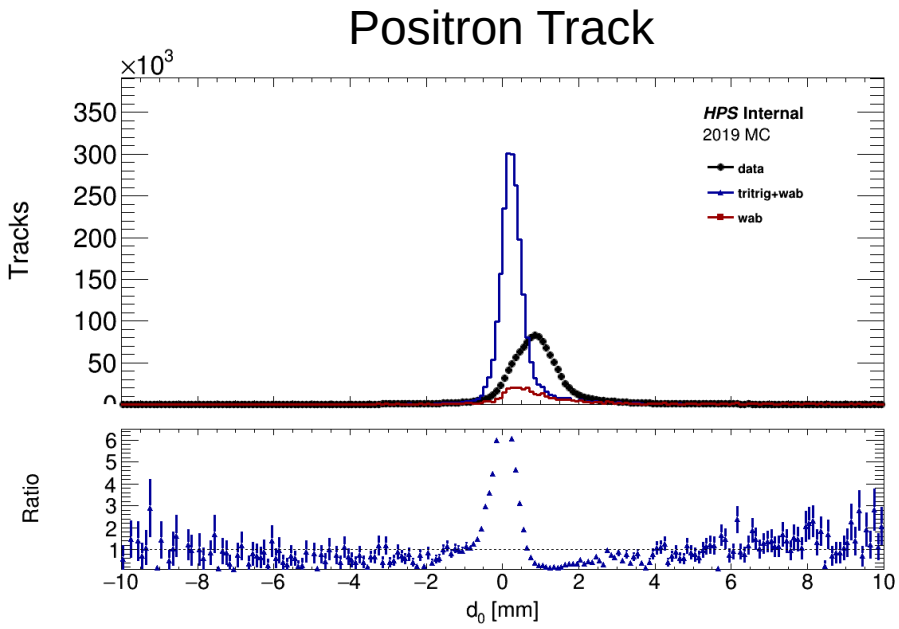

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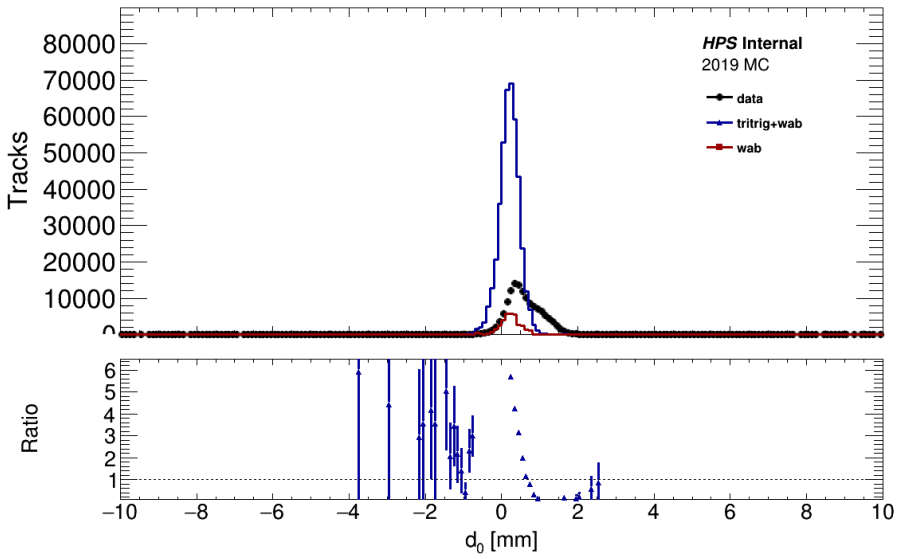
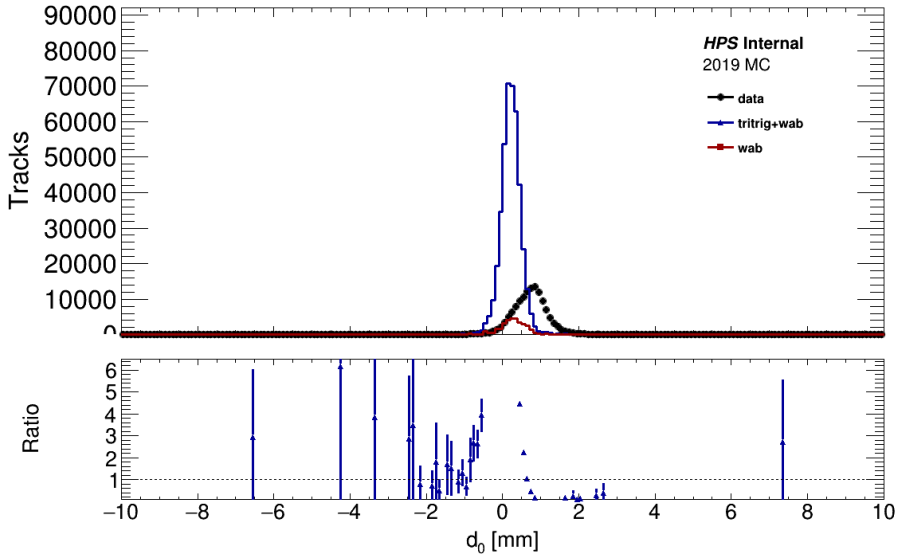
Tight Selection Track Extrapolations

Electron Track

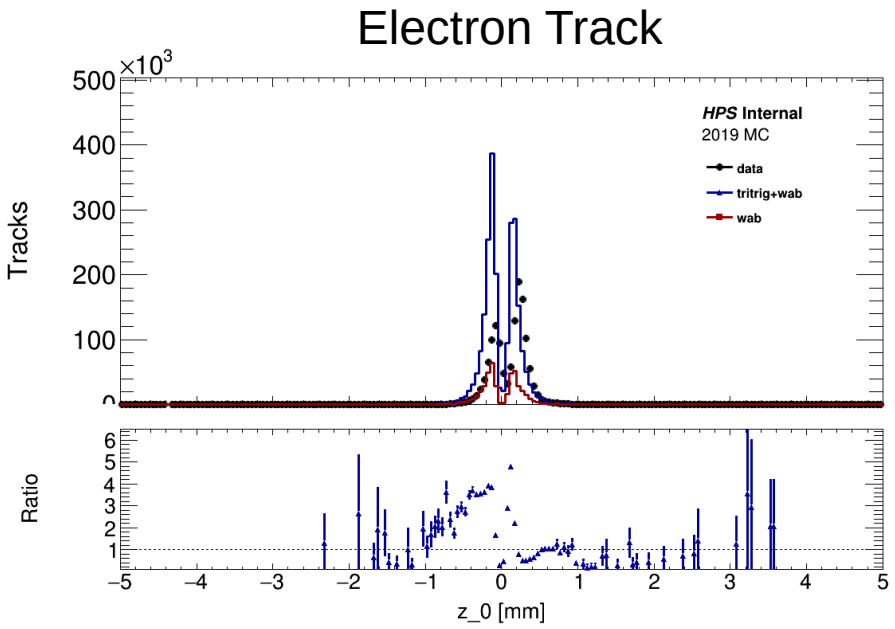


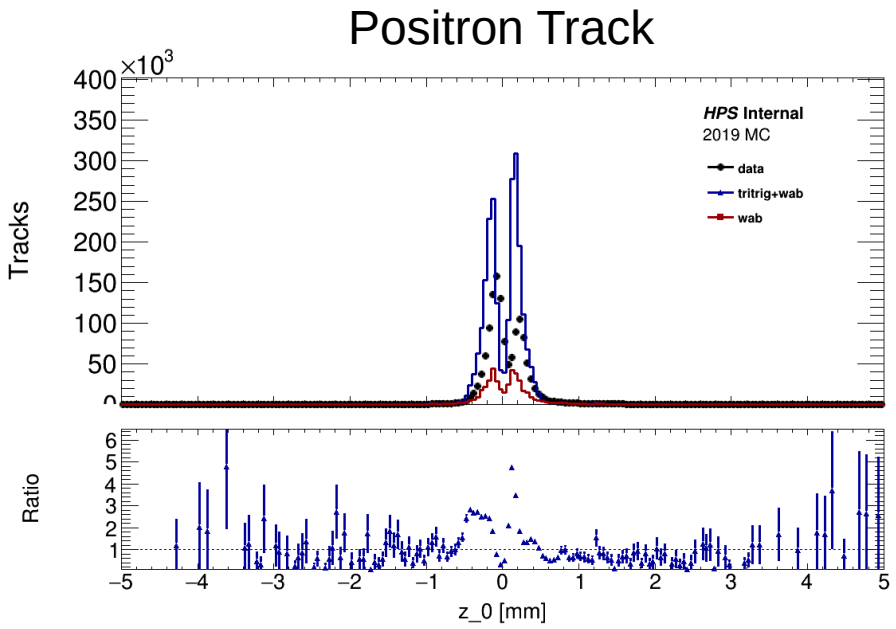
Positron Track



- The shape of d_0 is clearly off for both tracks still

Preselection Track Extrapolations

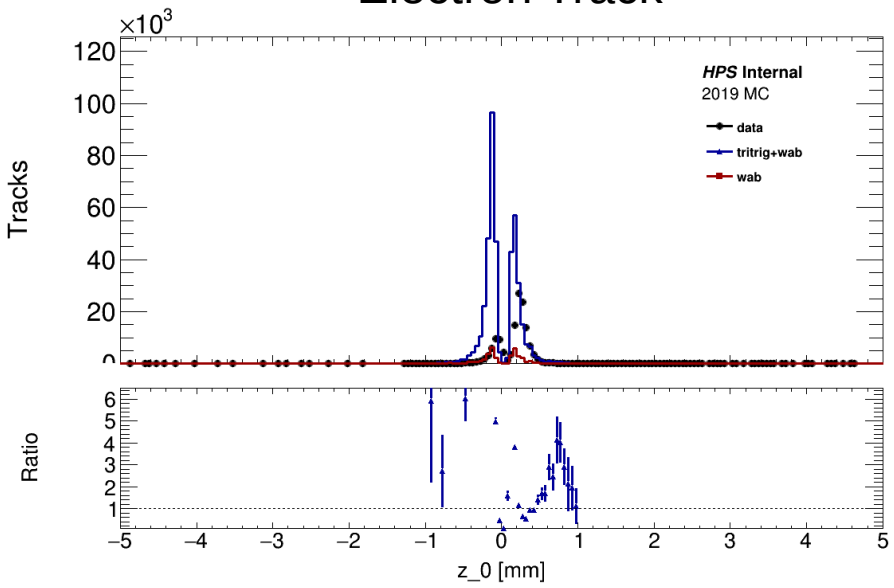




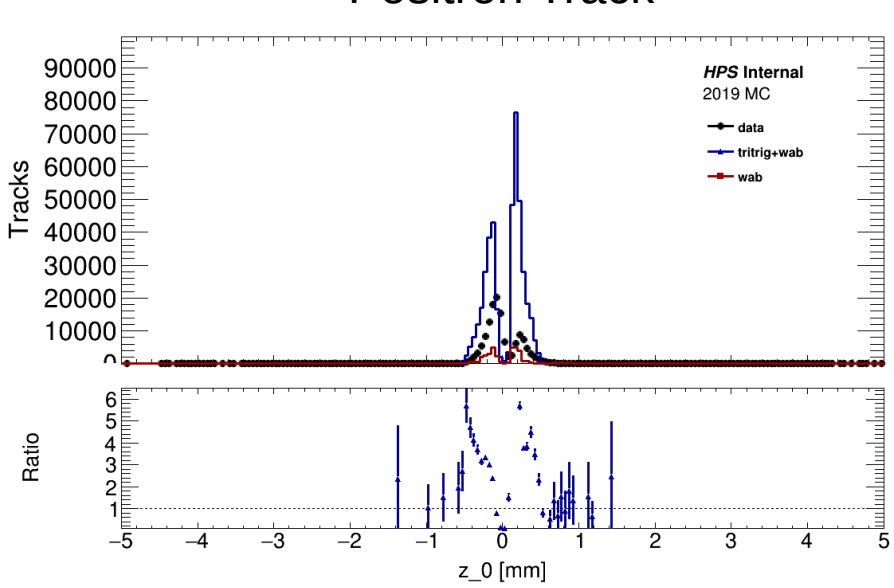
- The shape of z_0 is clearly off for both tracks
- Electrons are maybe worse than positrons?

Tight Selection Track Extrapolations

Electron Track

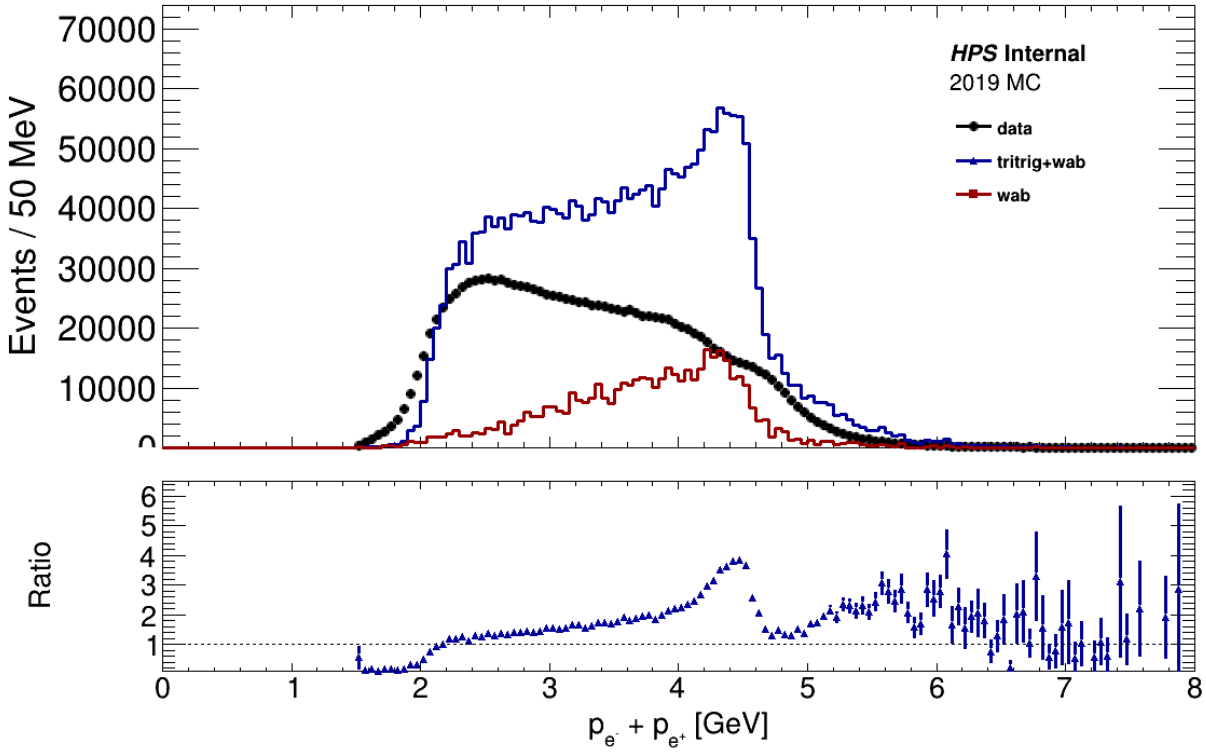


Positron Track



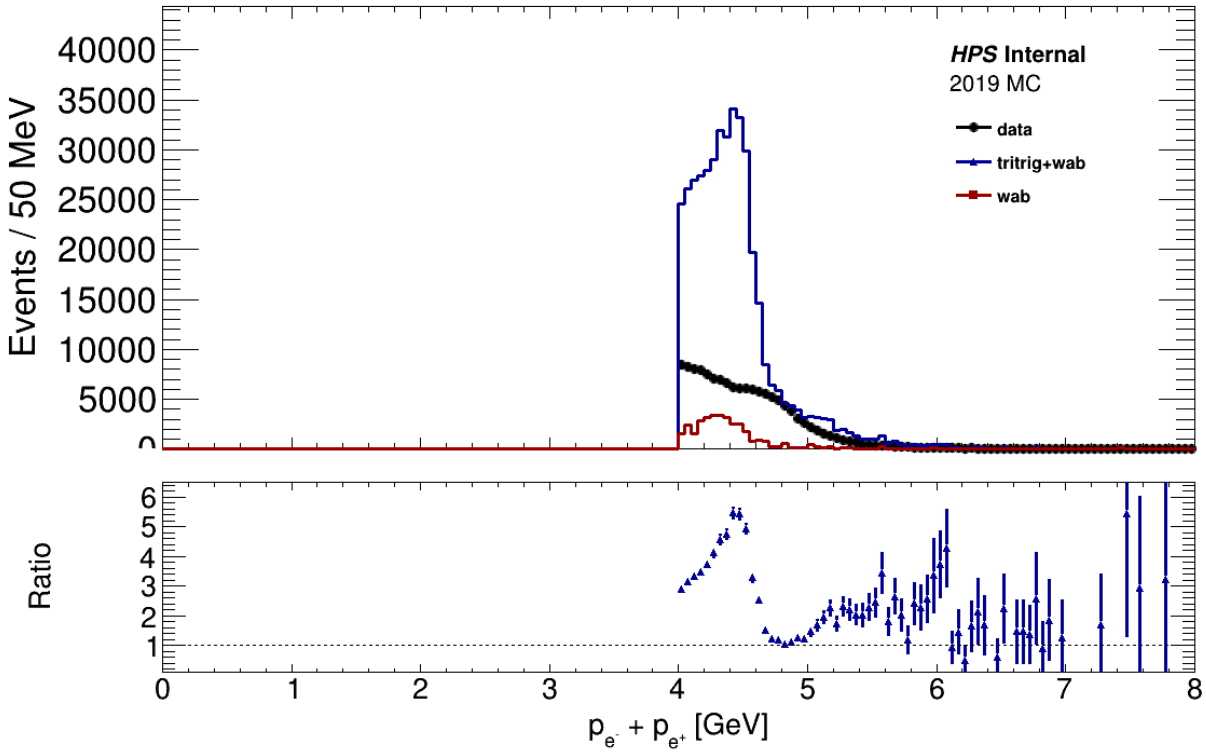
- The shape of z_0 is clearly off for both tracks
- The direction of the asymmetry seems backwards?

Preselection Psum



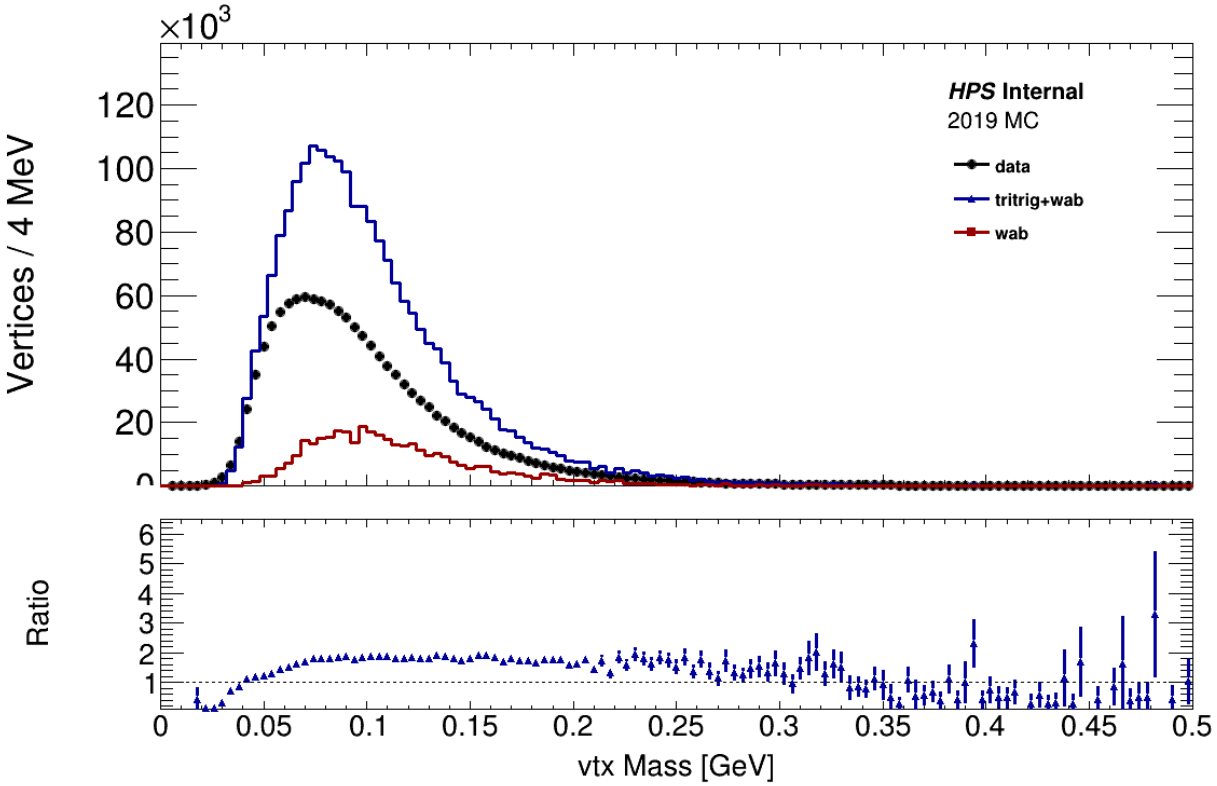
- Psum does not peak nearly as much in data

Tight Selection Psum



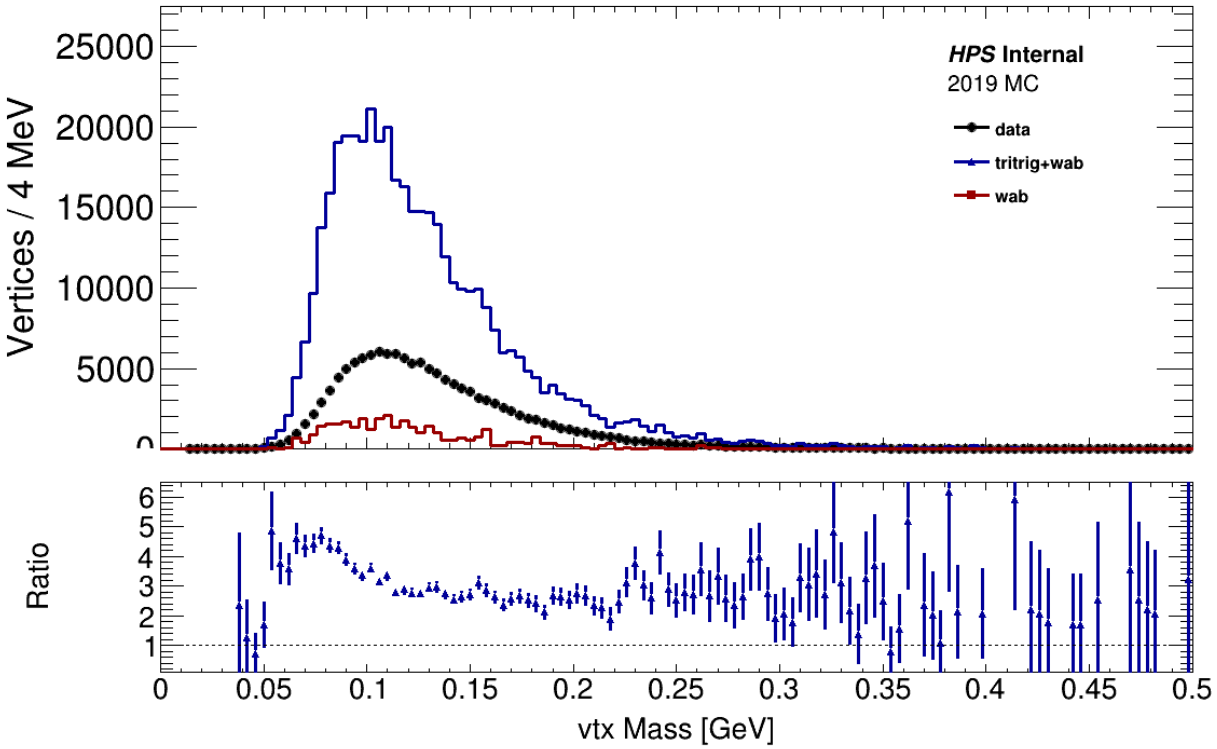
- This doesn't look much different from preselection apart from the minimum requirement

Preselection Vertex Mass



- Still need to spin up a rad+beam sample to be able to calculate the radiative fraction

Tight Selection Vertex Mass



- Shape is definitely closer than it is with only the preselection, but still not quite right