Analysis Updates

Cameron Bravo (SLAC)



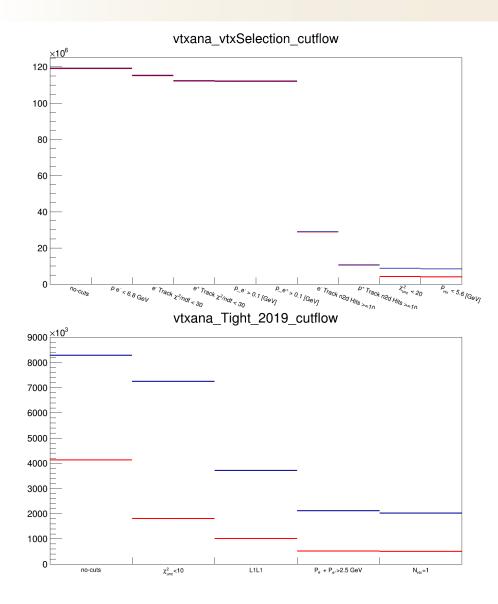




Current 2019 Reco

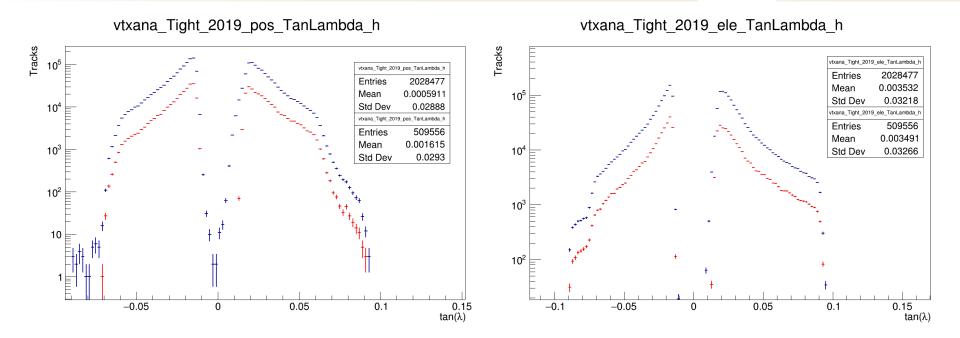
- Reconstructed 2019 data
 - Master branch up to hash 47712878302
 - HPS_PhysicsRun2019-v2-FEE-Pass0
 - All sample partitions, about 125 million events
- Will discuss needs of analysis group more after some plots
- This is meant to be a preliminary look because people kept asking for these plots towards the end of last year
 - Trying to look for some insight into what could be going on with the alignment and inspire some next steps there

Cutflow



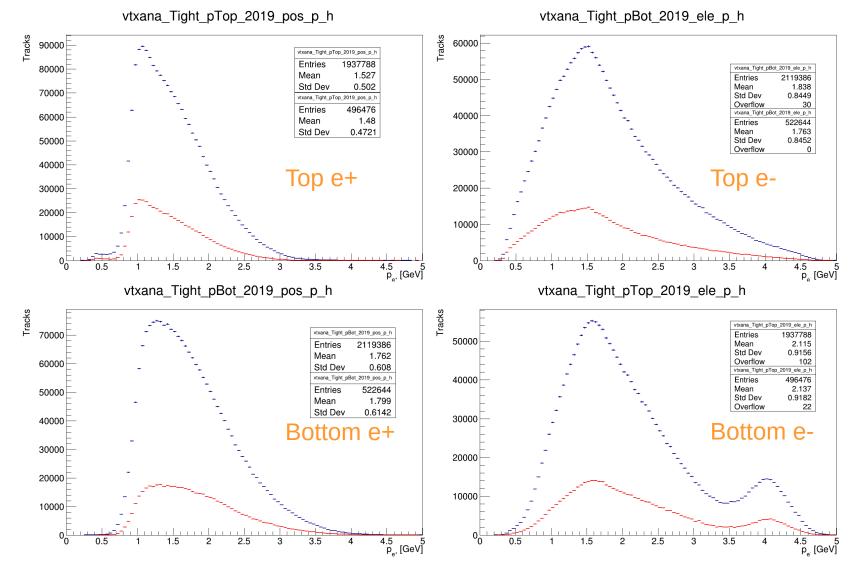
- Constrained vertices in red and unconstrained are in blue
- Top is preselection
- Bottom is "Tight" selection
- Less constrained vertices due to combination of state of alignment and vtx chi² cut

Track Tan(Lambda)



- Red are tracks in constrained vtx
- Blue are tracks in unconstrained vtx

Track Momenta



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Track d₀

vtxana Tight pTop 2019 pos d0 h vtxana_Tight_pBot_2019_ele_d0_h Tracks Tracks vtxana_Tight_pBot_2019_ele_d0_h 10⁵ 10⁵ vtxana_Tight_pTop_2019_pos_d0_h Entries 1059693 Entries 968894 Mean 0.3579 Mean 0.1389 Std Dev 0.4626 Std Dev 0.4582 10⁴ 10⁴ vtxana_Tight_pBot_2019_ele_d0_h vtxana_Tight_pTop_2019_pos_d0_h Entries 261322 248238 Entries Mean 0.4072 Mean 0.2865 Std Dev 0.2569 10³ 10³ Std Dev 0.2294 Top e+ Top e-10² 10² 10 10 -10 -2 0 3 10 d₀ [mm] -2 -8 -6 -4 2 6 8 0 2 4 6 8 d₀ [mm] 4 -4 vtxana_Tight_pBot_2019_pos_d0_h vtxana_Tight_pTop_2019_ele_d0_h Tracks Tracks vtxana_Tight_pBot_2019_pos_d0_h 105 vtxana_Tight_pTop_2019_ele_d0_h 10⁵ Ē Entries 1059693 Entries 968894 Mean 0.3077 Mean 0.2599 Std Dev 0.4483 Std Dev 0.43 10⁴ 10⁴ vtxana_Tight_pBot_2019_pos_d0_h E vtxana_Tight_pTop_2019_ele_d0_h Entries 261322 Entries 248238 Mean 0.3512 0.3578 Mean Std Dev 0.283 10³ Std Dev 0.2886 10³ Bottom Bottom ee+ 10² 10² 10 10 1 -10 3 10 d₀ [mm] -10 -8 -6 -4 -2 0 2 4 6 8 -8 -6 -4 -2 0 2 4 6 8 10 d₀ [mm]

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Track d₀

vtxana Tight pTop 2019 pos Z0 h vtxana_Tight_pBot_2019_ele_Z0_h Tracks Tracks vtxana_Tight_pTop_2019_pos_Z0_h vtxana_Tight_pBot_2019_ele_Z0_h 10⁵ Entries 968894 10⁵ Entries 1059693 Mean 0.1909 Top e+ Mean 0.1961 Std Dev 0.1159 vtxana_Tight_pTop_2019_pos_Z0_h Std Dev 0.1377 10⁴ 10⁴ vtxana_Tight_pBot_2019_ele_Z0_h Entries 248238 Entries 261322 Mean 0.2311 Mean 0.2499 Std Dev 0.09288 10³ 10³ Std Dev 0.1257 10² 10² Top e-^{`+}+₊ +++₊†_{+†} 10 10 1 1⊨ 0 2 3 -2 -1 0 2 3 1 4 -1 1 z_0 [mm] z_0 [mm] vtxana_Tight_pBot_2019_pos_Z0_h vtxana_Tight_pTop_2019_ele_Z0_h Tracks Tracks vtxana_Tight_pBot_2019_pos_Z0_h Bottom e+ vtxana_Tight_pTop_2019_ele_Z0_h 10⁵ 10⁵ Entries 1059693 Entries 968894 Mean -0.2035 -0.2197 Mean Std Dev 0.1156 Std Dev 0.1176 10⁴ 10⁴ vtxana_Tight_pBot_2019_pos_Z0_h vtxana_Tight_pTop_2019_ele_Z0_h Entries 261322 Entries 248238 Mean -0.1703 -0.1826 Mean 10³ Std Dev 0.09404 10³ Std Dev 0.1029 E Bottom e-10² 10² Ē 't⁺⁺+, ⁺⁺⁺, 10 10 нĦ 1 1 _____2 3 z_0 [mm] -3 -2 -1 0 1 -1 0 2 z_0 [mm]

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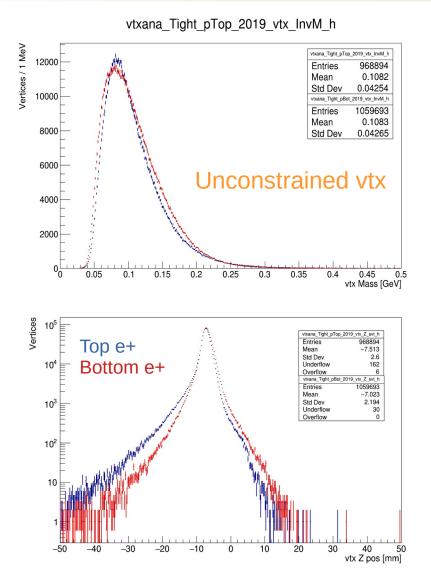
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Cutflow

vtxana_Tight_pTop_2019_Psum_h events 16000 14000 vtxana_Tight_pTop_2019_Psum_ 12000 Entries 968894 Mean 3.622 Std Dev 0.7599 10000 1.001e+04 Overflow vtxana_Tight_pTop_2019_Psum_h Entries 248238 8000 3.617 Mean Std Dev 0.7835 Overflow 2414 6000 4000 2000 0 p_e⁵ + p_e, [GeV] 1.5 2 2.5 3.5 4.5 з vtxana_Tight_pBot_2019_Psum_h events 20000 18000 16000 vtxana_Tight_pBot_2019_Psum_ Entries 1059693 14000 Mean 3.59 0.7736 Std Dev Overflow 5453 12000 vtxana_Tight_pBot_2019_Psum_h Entries 261322 10000 3.562 Mean Std Dev 0.7781 8000 Overflow 997 6000 4000 2000 0 3.5 $p_{e^{-}}^{3} + p_{e^{+}}^{3} [GeV]^{5.5}$ 2 2.5 3 4.5 4

- No FEE tracks on top vtx
- Vtx with positron in bottom have both tracks with clearly too high momentum scale
- Vtx with positron in top have peak a bit higher than beam energy

Cutflow



vtxana Tight pTop 2019 vtx InvM h 3500 Vertices / 1 MeV vtxana_Tight_pTop_2019_vtx_InvM_h 3000 Entries 248238 Mean 0.105 Std Dev 0.03873 2500 vtxana_Tight_pBot_2019_vtx_InvM_h Entries 261322 0.1053 Mean 2000 Std Dev 0.03949 1500 Constrained vtx 1000 500 0 0.25 0.05 0.1 0.15 0.2 0.3 0.35 0.4 0.45 0.5 vtx Mass [GeV]

- Blue are vtx with positron in the top, red the positron is in the bottom
- Vtx z distribution more symmetric for vtx with positron in bottom

- Aligned geometry for 2019 and 2021 detectors
 - This is the top priority at the moment by a lot
 - Not a trivial thing to do, PF leading the charge
- Merge DQM software improvements for 2021 run
 - Work done by Matt G has yet to be merged
- Merge Run2021 branch
 - Needs small fix PF promised, done yet?
 - I run all three years reco at least once per week
- Calibrated Ecal for 2021
 - Andrea has been pushing on this recently

Analysis Plans and Discussion

- Snowmass estimates for new physics beyond A'
 - ALPs, SIMPs, iDM are the three main signals we want to study as of now
 - Planning to meet with Phillip and Natalia soon on this
- Keep an eye on key analysis plots as geometry progresses
- Alignment work is priority now
 - Analysis group members focusing on this in near future
- Searching for SIMPs in 2016 data
 - Alic is proposing to work on this analysis for his thesis
 - Another iteration on alignment?
 - MC needs to study tritrig madgraph cuts and ensure we have all of the low Psum region for this analysis