

Comparison of 2021 Data and MC Sample

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Software to Run Jobs by swif2 Mode

- On Jan of 2022, Jeremy updated hps-mc job system to run jobs by swif2.
- About two weeks ago, we started to produce large-scale MC samples by swif2 with new 2021 detector. During job running, Nathan suggested to fix some issues which caused that scicomp throttled jobs:
 1. SLIC logging verbosity; Omar released <https://github.com/slaclab/slic/releases/tag/v6.1.1> to avoid output of event-by-event information.
 2. MadGraph codes are copied into local for implementation, but not deleted before exiting job; With a setup in job configuration file, work directory is deleted after a job is finished.
 3. Buffer size is low for file copy by the python shutil module; A global variable for buffer size could be set, but the global variable is available for python3.8 or higher. hps-mc is reinstalled by python3.9.5 in hps account at ifarm. For final fixing, a CCPR is submitted to ask for installation of some site-packages under /apps/python/3.9.5 of the central system. (By default, version of python3 at JLab is 3.4.3, and full site-packages are under /apps/python/3.4.3)
- Additionally, some bugs in the hps-mc job system were found and fixed during MC production.
- Thank Nathan, Jeremy, Omar and Cameron for supports.

Setup for Pass0 of 2021 MC Samples

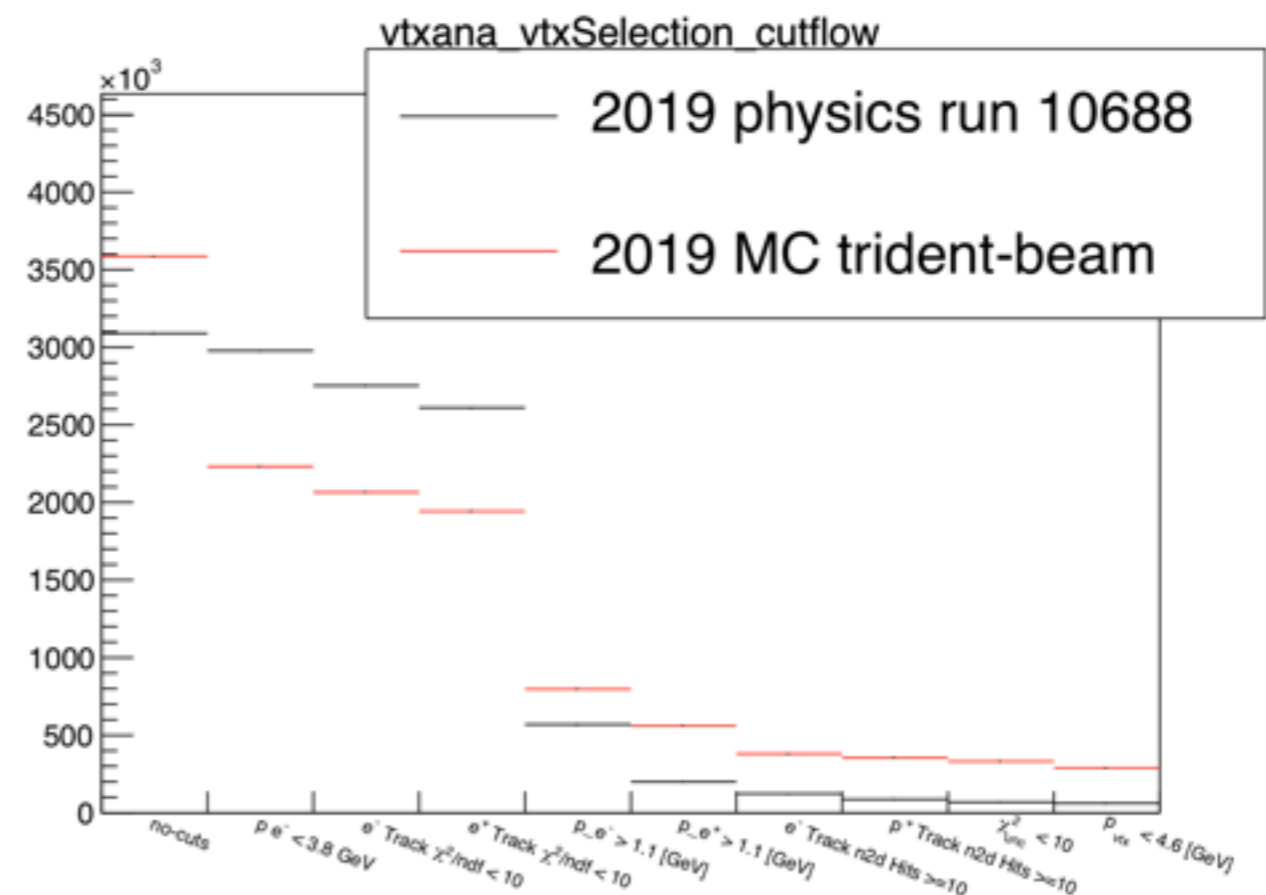
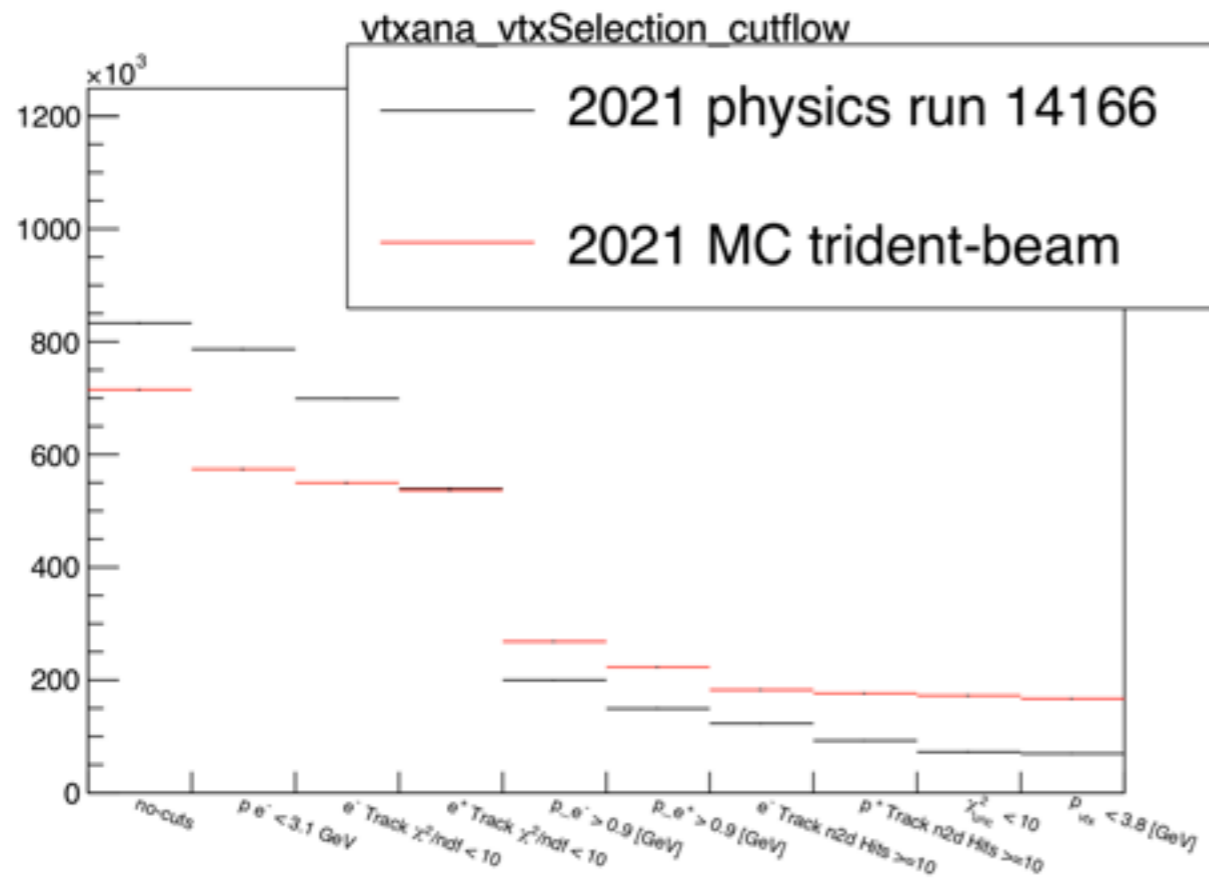
- Detector: HPS_Run2021Pass2FEE
- MC configuration corresponds to run 14166 (low luminosity):
 - Beam: 50nA (625 electrons per bunch); beam rotates 30.5 mrad around y; beam size 0
 - target: 8um; position (0, 0, 0)
 - DAQ configuration for readout: hps2021_v1_2
- Filter for signals before merging with background: Require at least one hit at Hodoscope for each event
- Readout: steering file PhysicsRun2019TrigMultiSingles.lcsim; Events are triggered by single2 & single3 top and bot triggers; Trigger bits are saved in TS bank like experiment.
- Recon: steering file PhysicsRun2019MCRecon.lcsim; With check by Matt and Norman, the file for 2019 MC is available for 2021 MC; The only change is to set target z as 0.

Status of MC Production

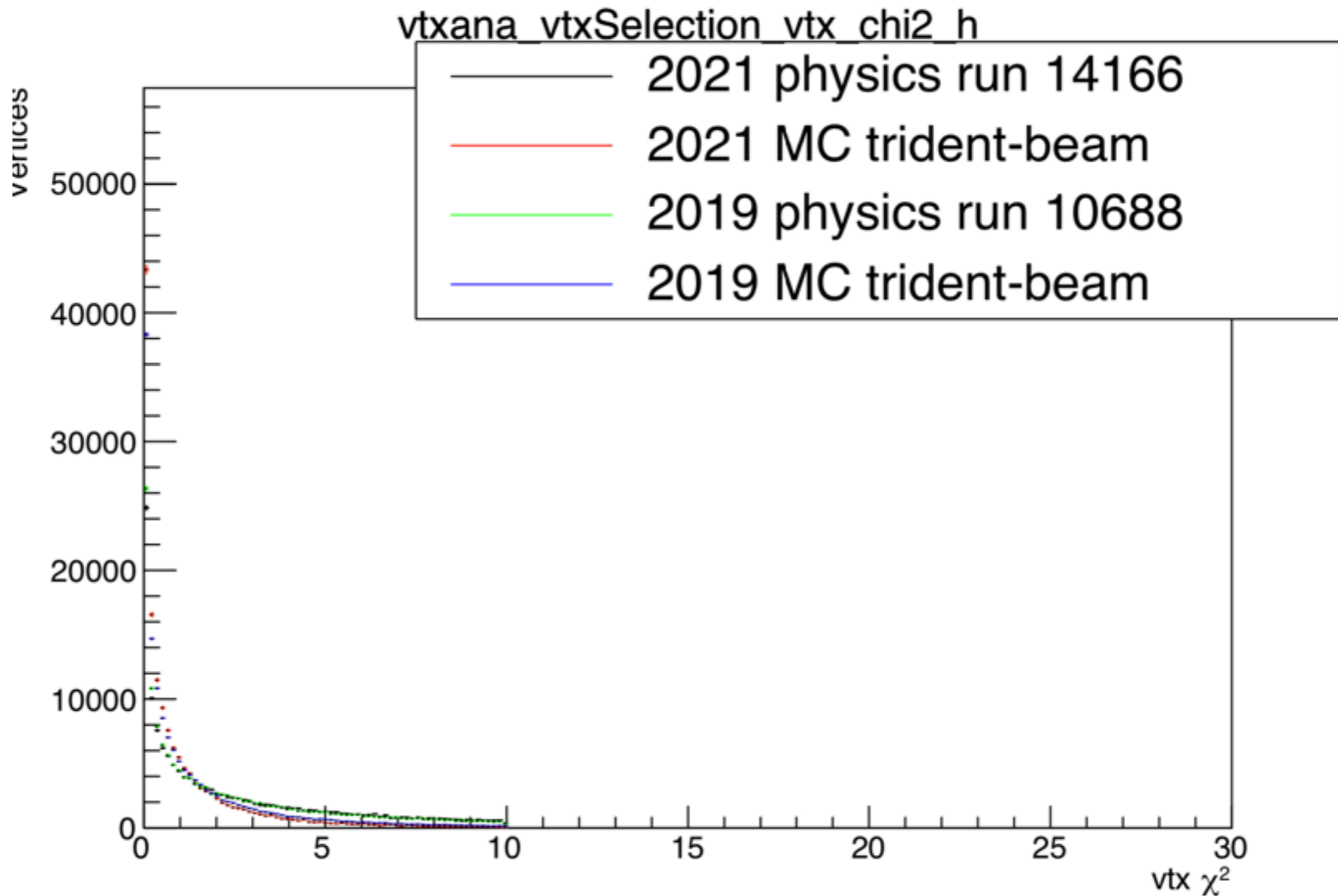
- All produced samples are stored at `/cache/hallb/hps/production/mcData/2021/pass0/3pt7/HPS_Run2021Pass2FEE`
- Events at generation level:
 - tritrig: 1k files * 10k events/file (10M events); $\sigma = 6.85499e+08 \pm 1.93186e+06$ pb
 - wab: 10k files * 10k events/file (100M events); $\sigma = 7.58925e+10 \pm 6.84298e+09$ pb
 - beam: 4k files * 250k bunches/file (1B bunches = 2s beam)
 - Prompt ap (50, 75, 100, 125, 150, 175, 200 MeV/c²): 500 files * 10k events/file (5M events per mass point required); Jobs are in progress
- Events at reconstruction level:
 - tritrig-beam: 302100 events
 - wab-beam: 47187 events; Require wab-beam samples by random/FEE trigger without filtering?
 - ap-beam: next

Comparison tritrig-beam to Run 14166

- Collection for UC vertices is applied.
- As reference, 2019 MC tritrig-beam and 2019 run 10688 join the comparison; Note: target $z = -7.5$ mm and beam size = (125, 50) μm for 2019 MC.
- Some loose cuts are applied.

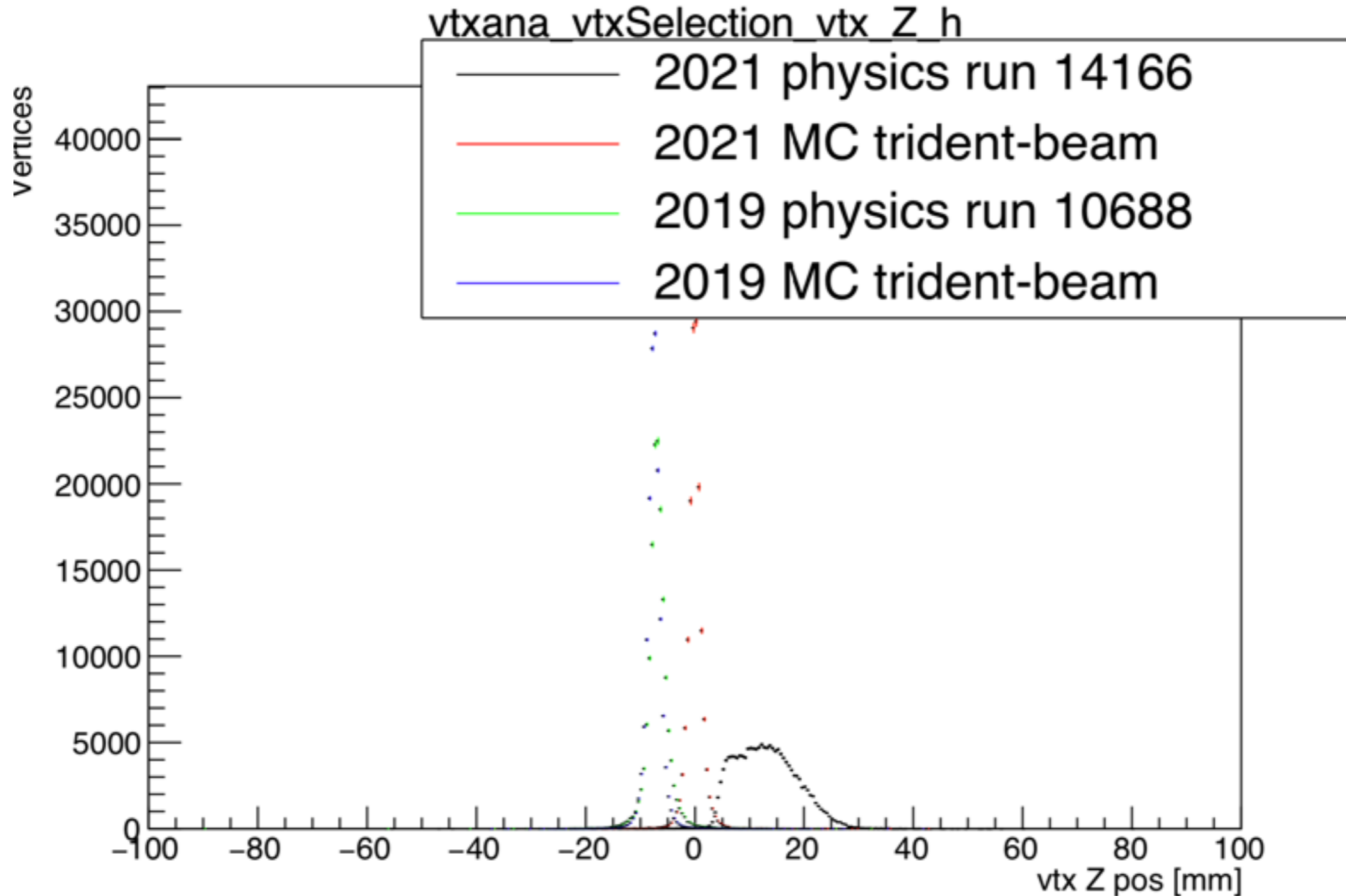


Chi2 for Vertex



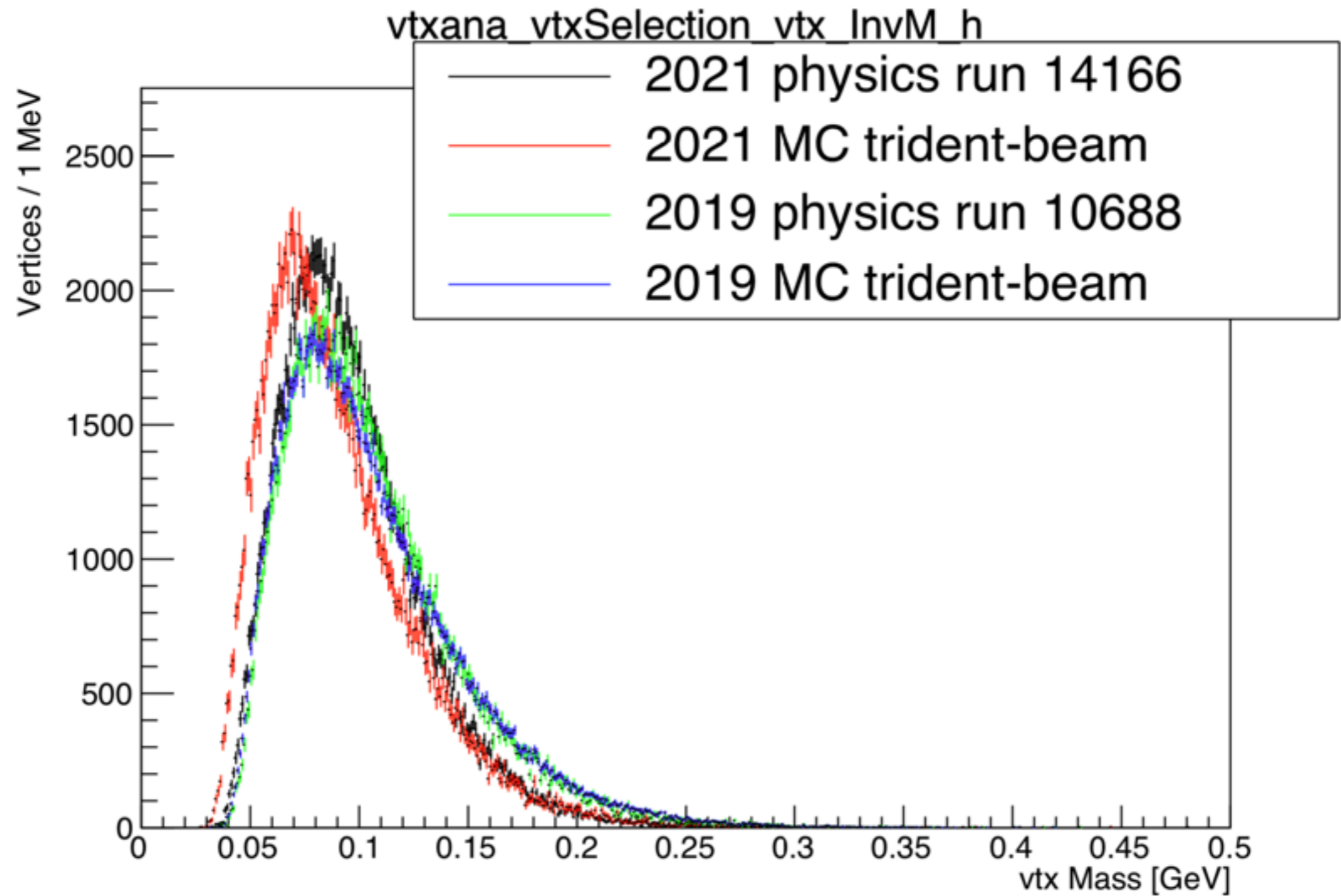
Have difference between data and MC, while no significant difference between 2021 and 2019.

z at Vertex



Unexpected bump for 2021 data

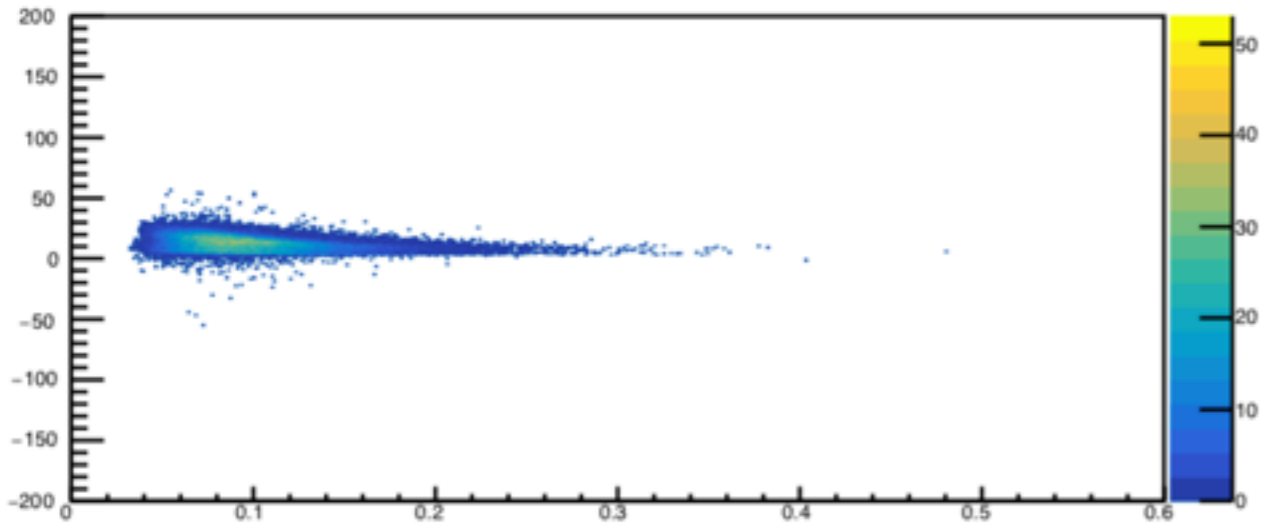
IM



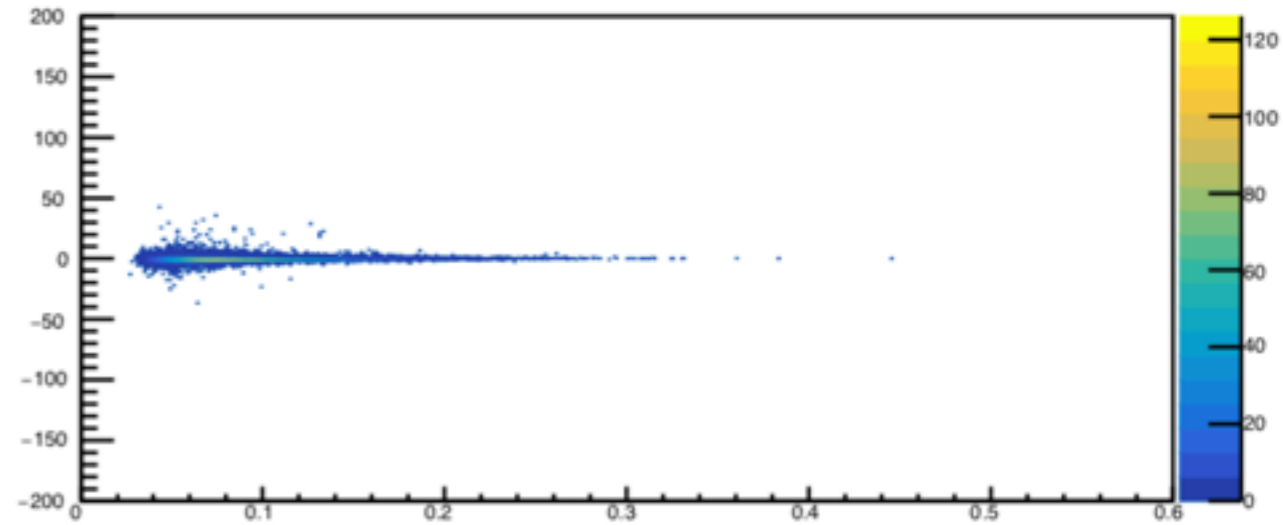
Clear shift between 2021 data and MC

IM vs Z

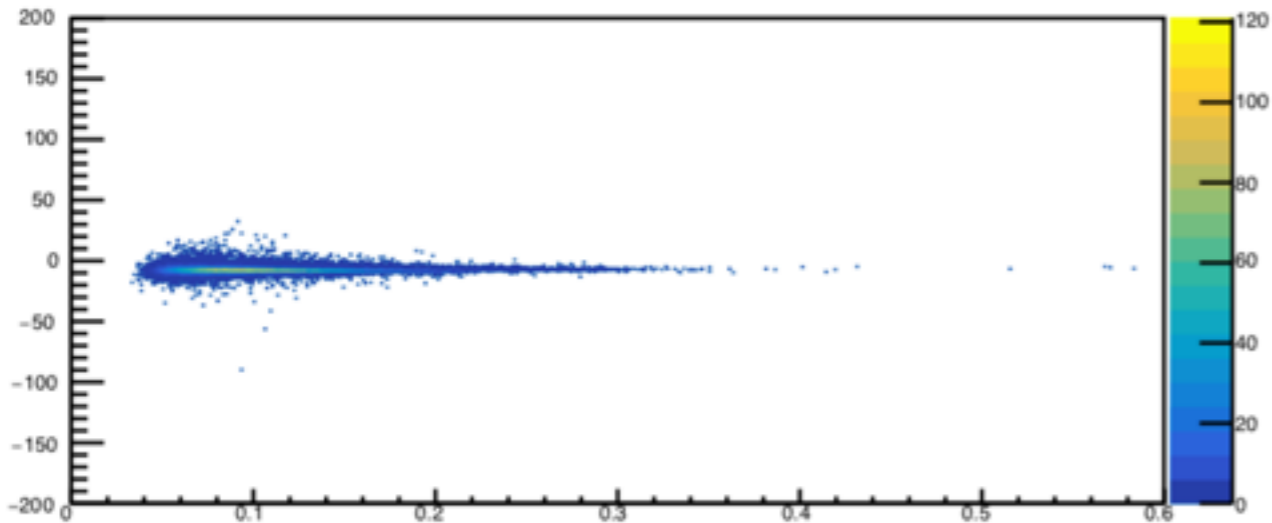
vtxana_vtxSelection_vtx_InvM_vtx_z_hh: 2021 physics run 14166



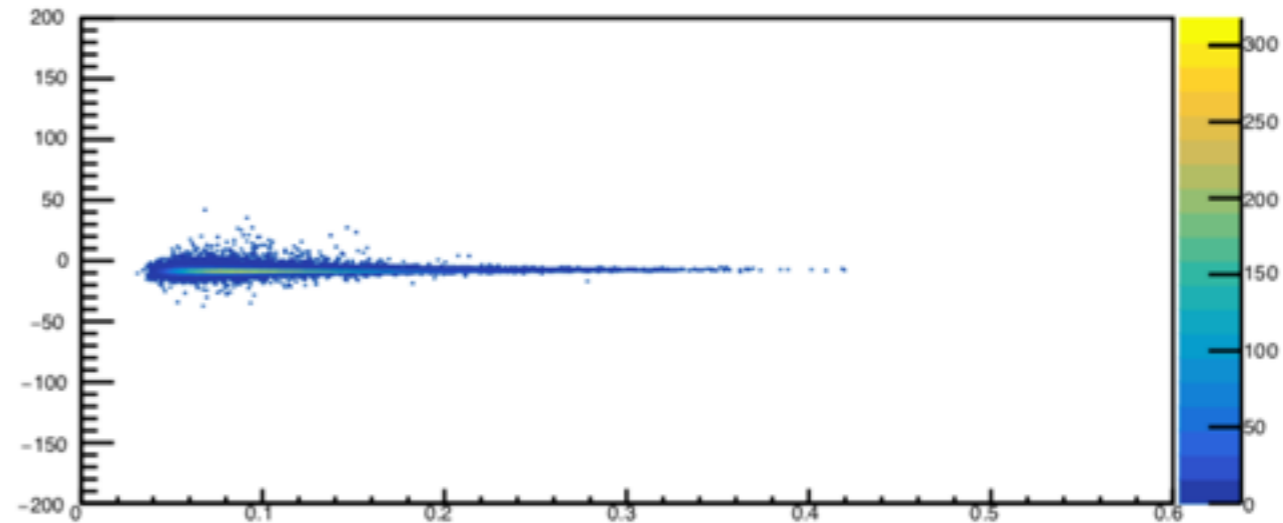
vtxana_vtxSelection_vtx_InvM_vtx_z_hh: 2021 MC trident-beam



vtxana_vtxSelection_vtx_InvM_vtx_z_hh: 2019 physics run 10688



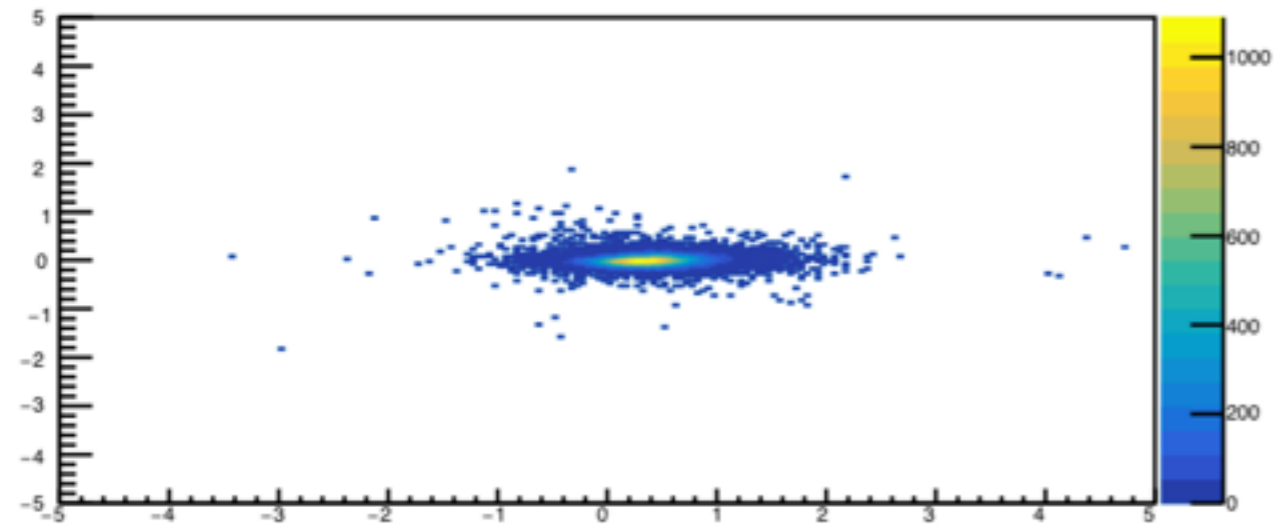
vtxana_vtxSelection_vtx_InvM_vtx_z_hh: 2019 MC trident-beam



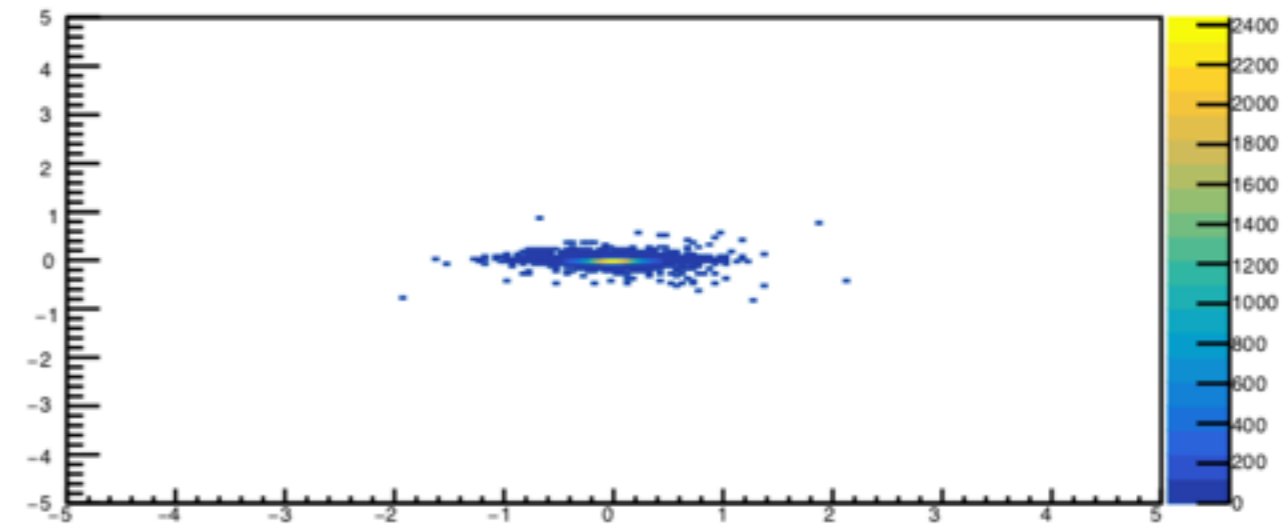
- Unexpected bump at z distribution and shift of IM for 2021 data should be related to each other.
- Target Z looks larger than 0.

X vs. Y at Vertex

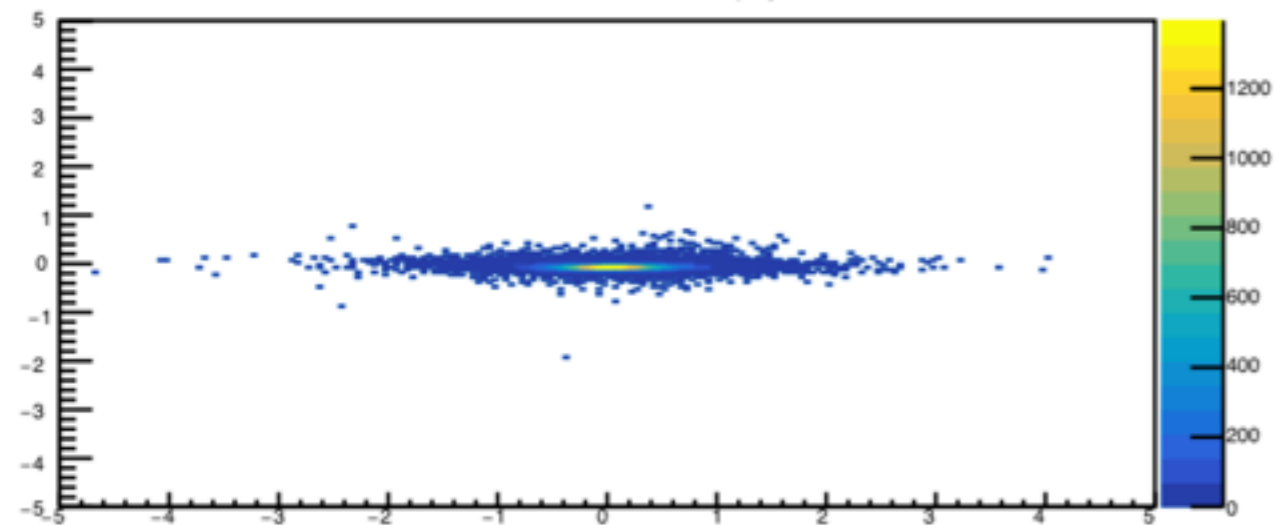
vtxana_vtxSelection_vtx_XY_hh: 2021 physics run 14166



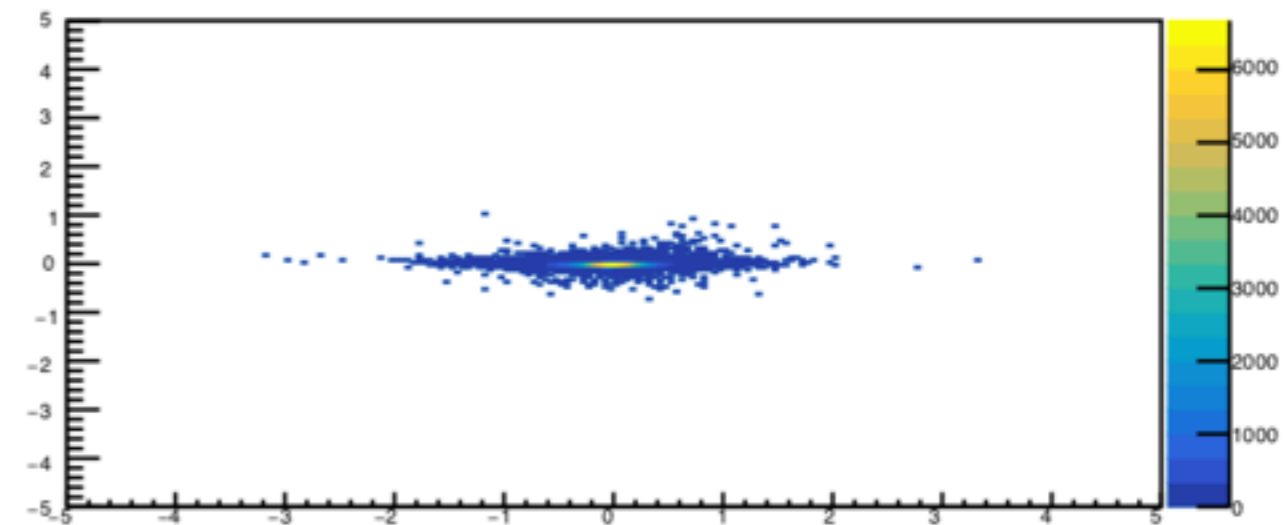
vtxana_vtxSelection_vtx_XY_hh: 2021 MC trident-beam



vtxana_vtxSelection_vtx_XY_hh: 2019 physics run 10688

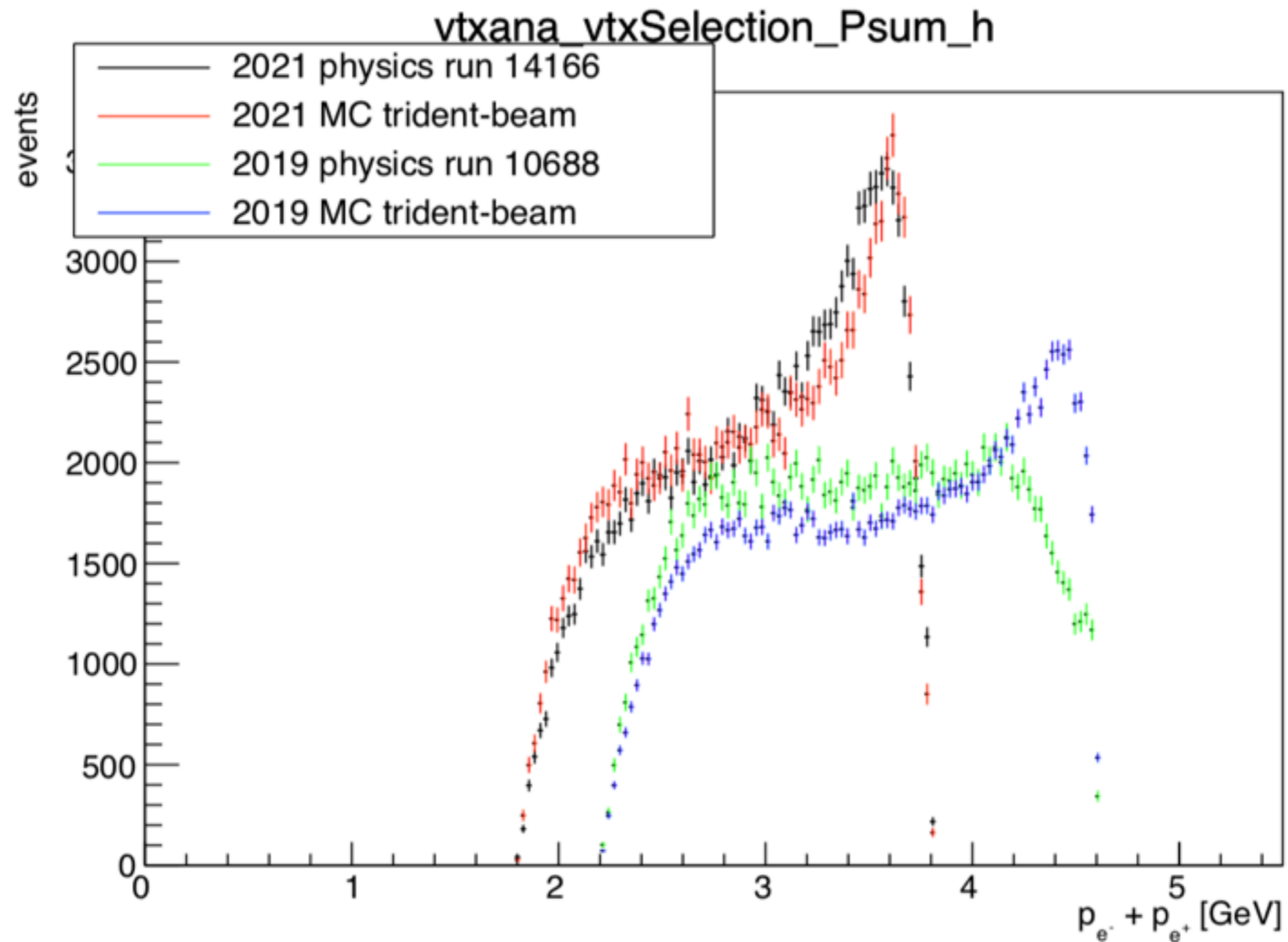


vtxana_vtxSelection_vtx_XY_hh: 2019 MC trident-beam



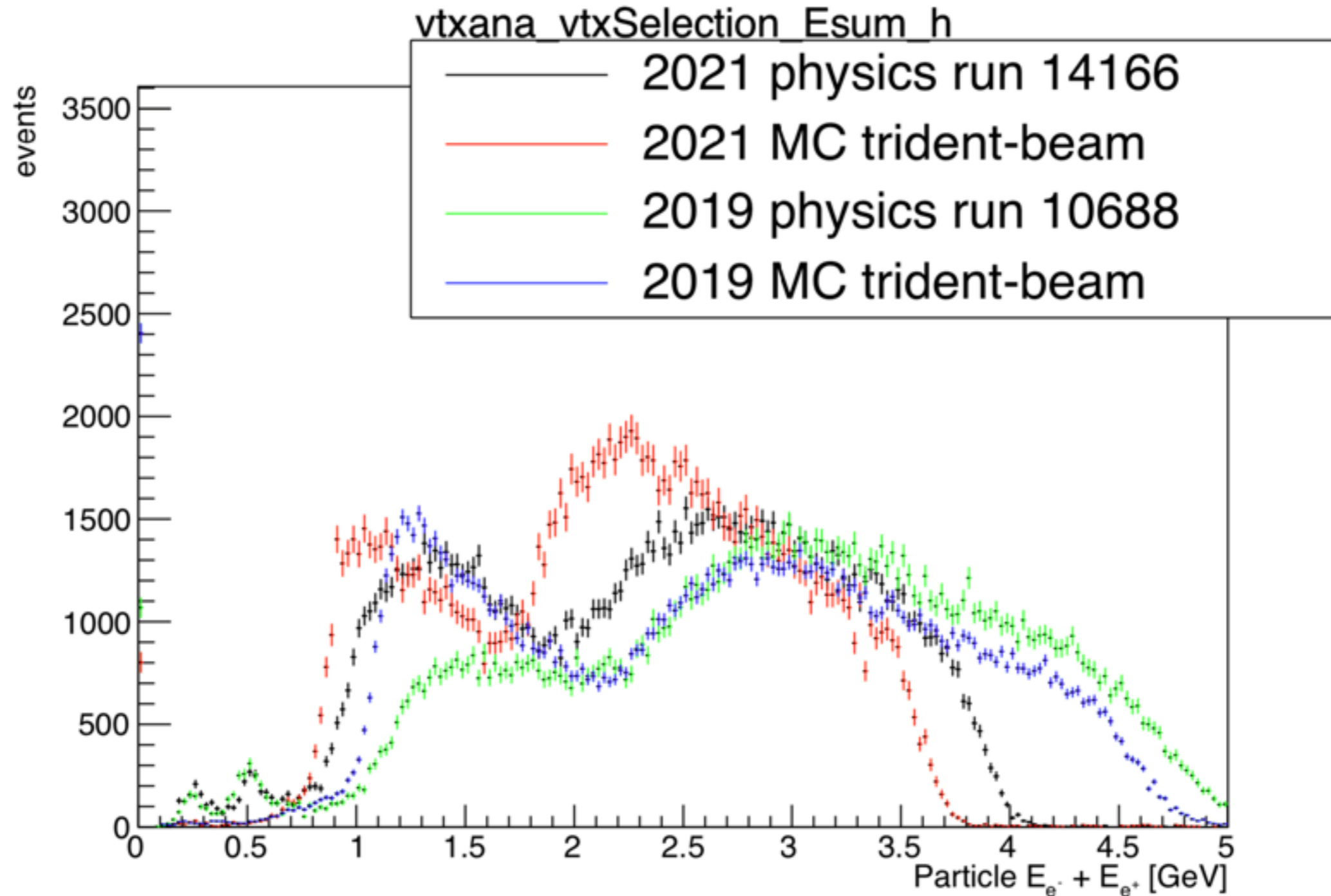
- Cannot judge resolution since beam size = 0 for 2021 MC.
- X shifts right to 0 for 2021 data with the current detector.

pSum at vertex



2021 data has a sharp peak close to beam₁ energy while 2019 data does not have.

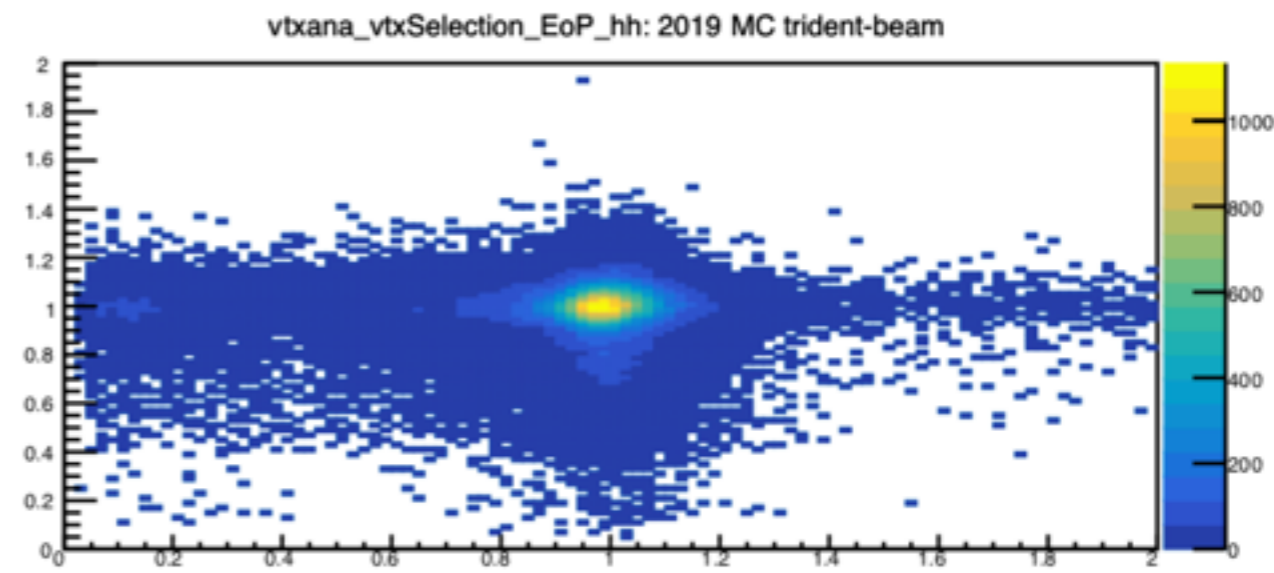
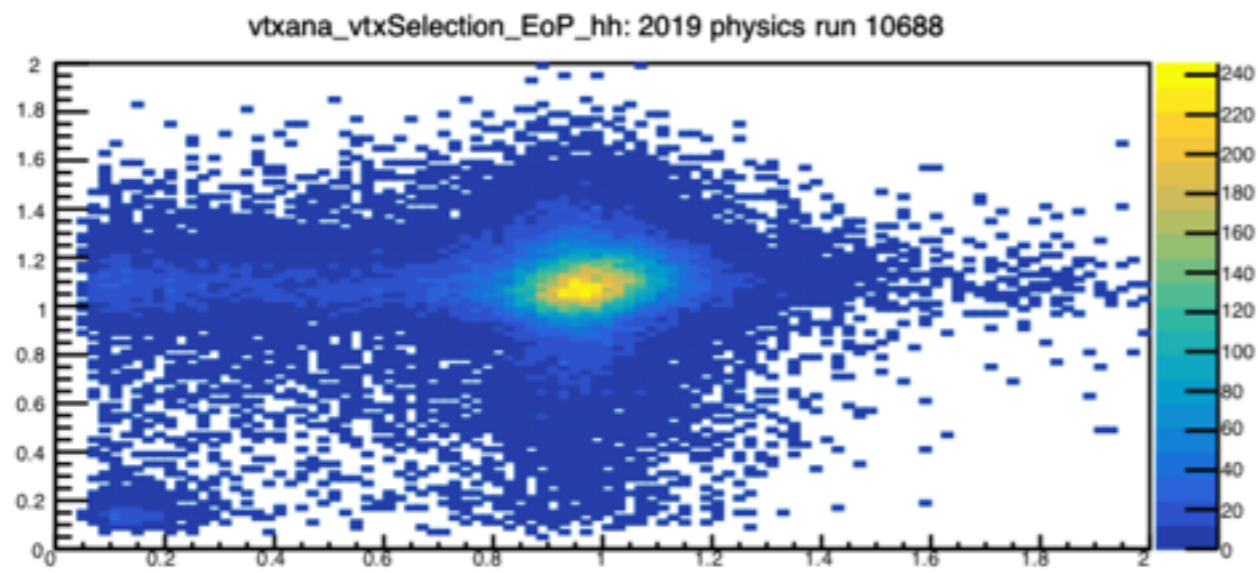
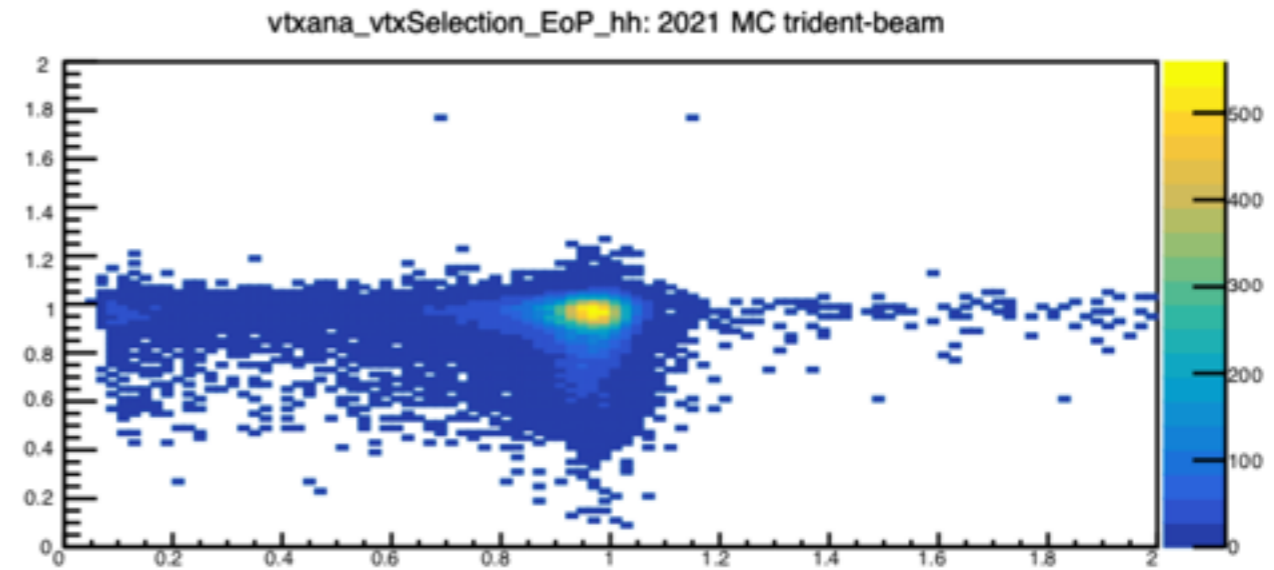
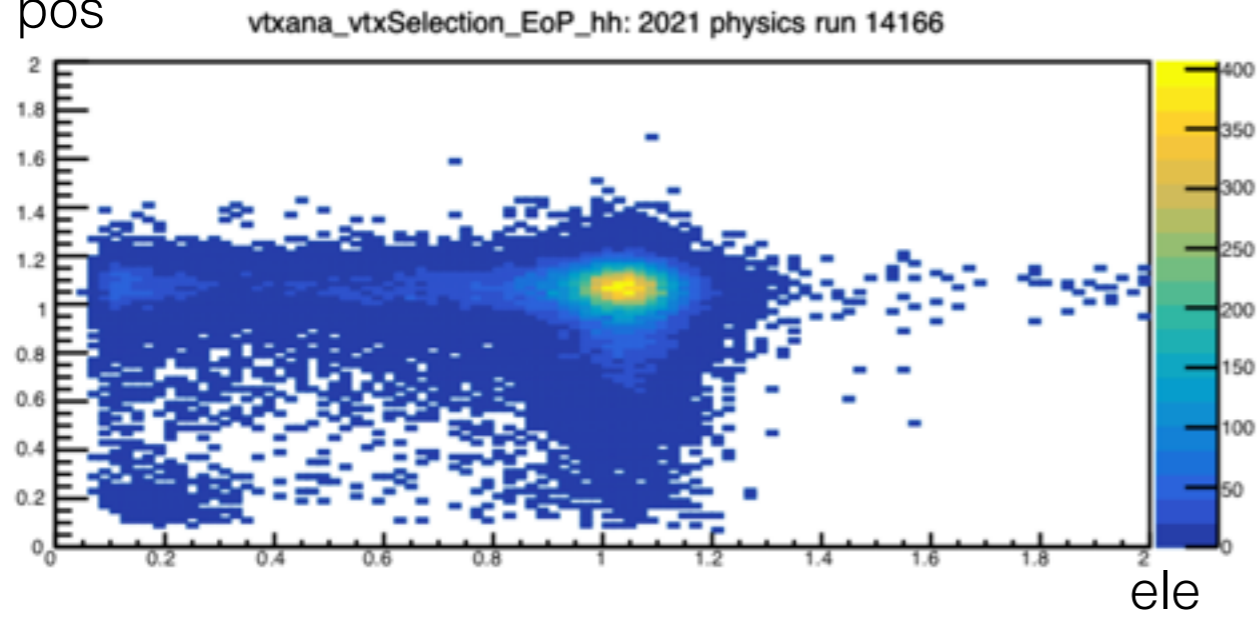
ESum



It seems closer between 2019 data and MC than between 2021 data and MC.

E/p

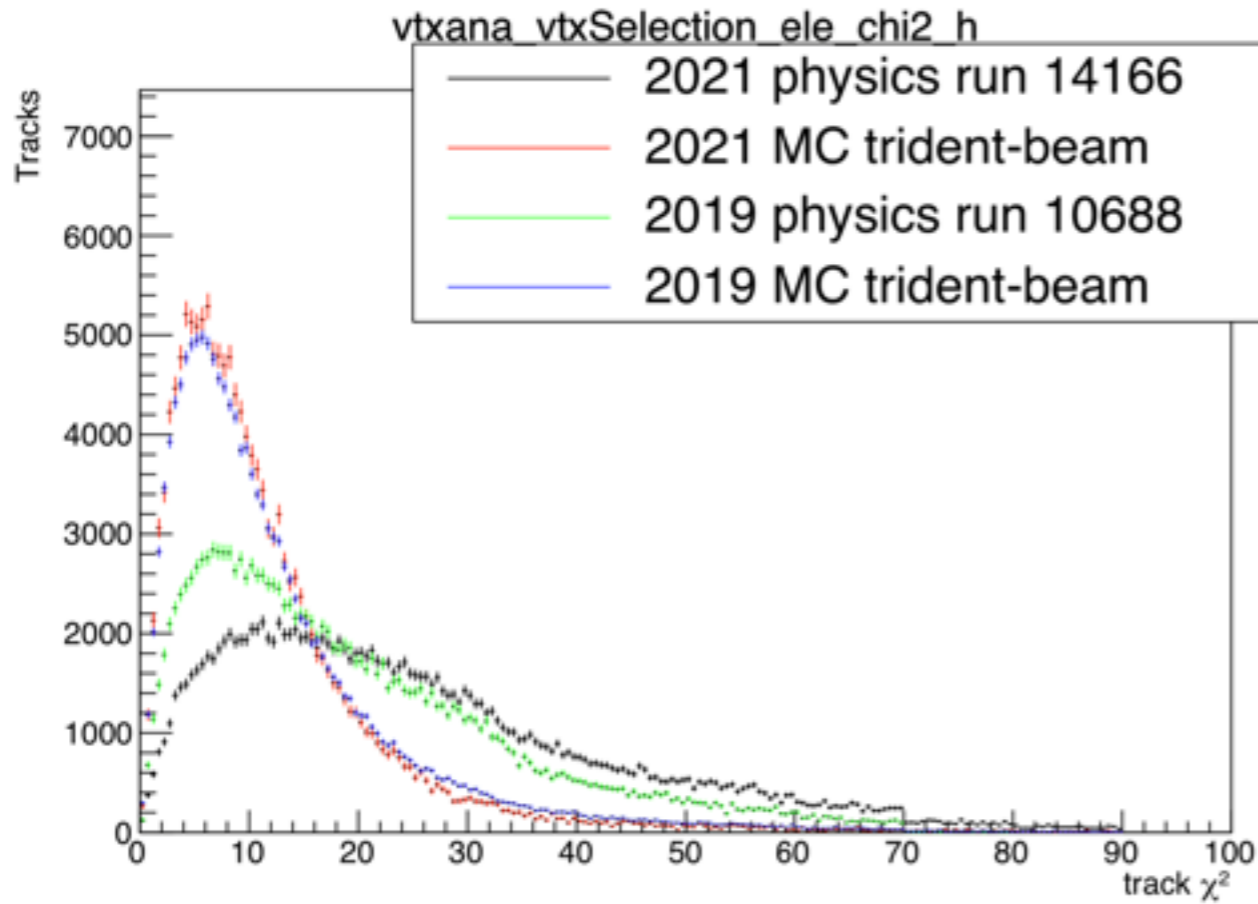
pos



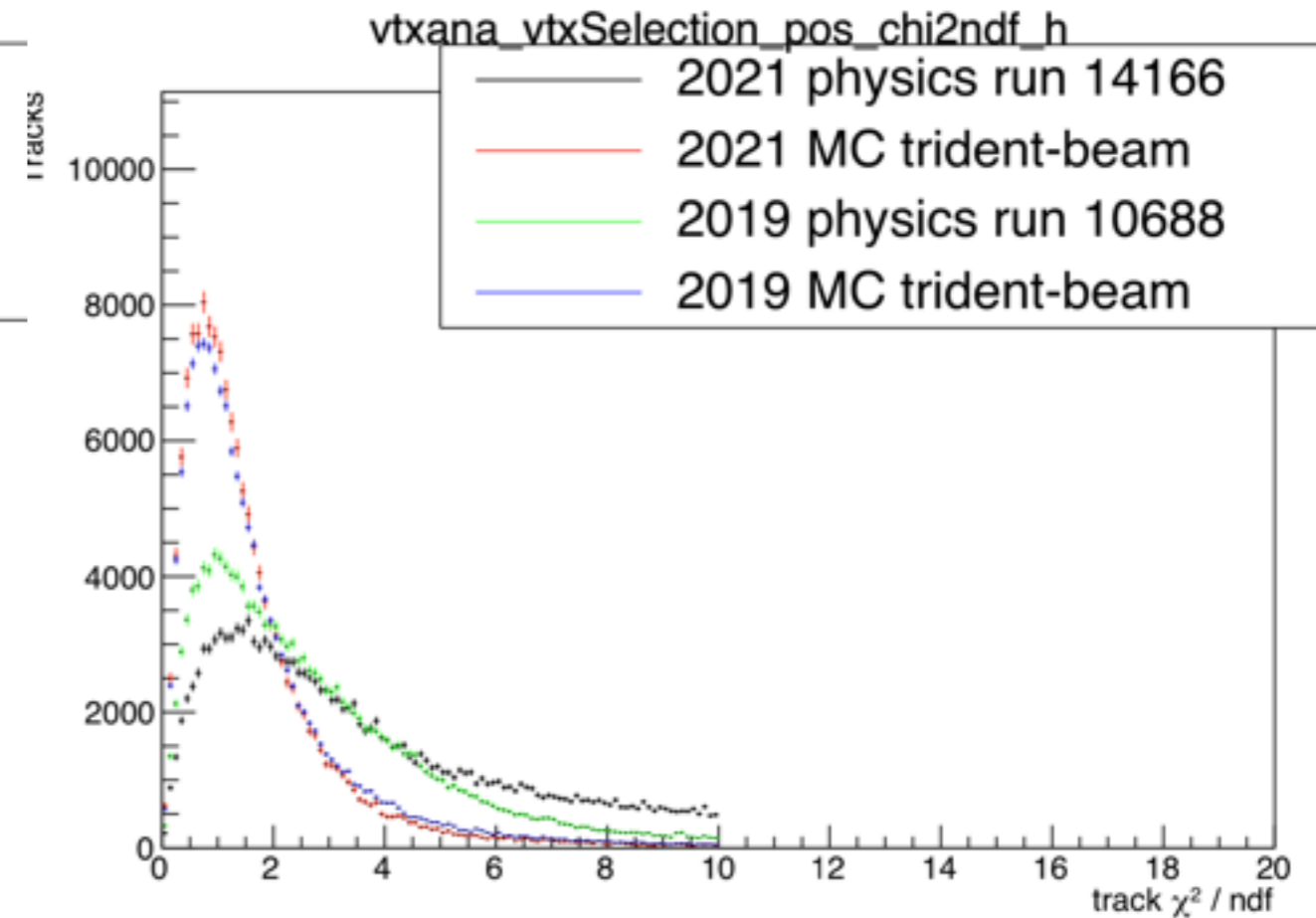
2021 data has clear shift.

Chi2 for Eletrons and Positrons

ele



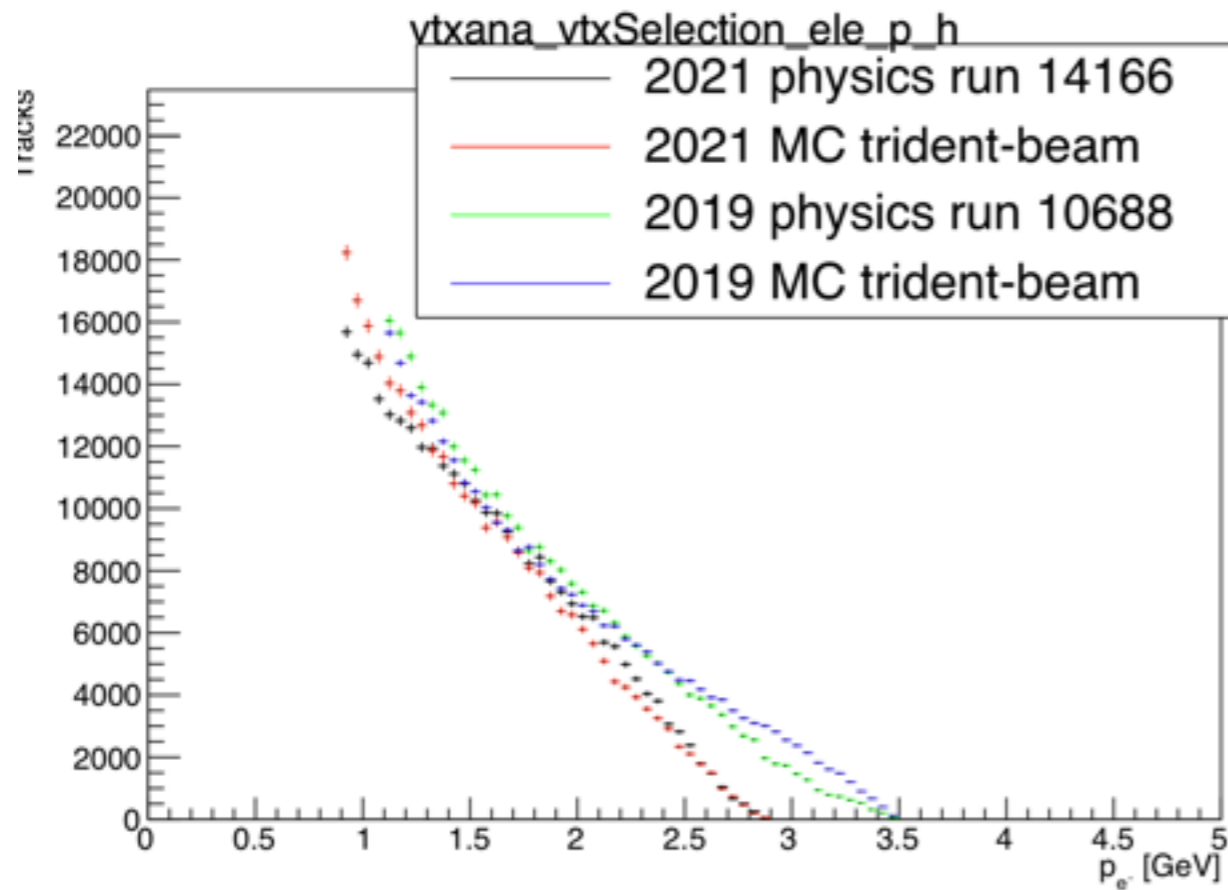
pos



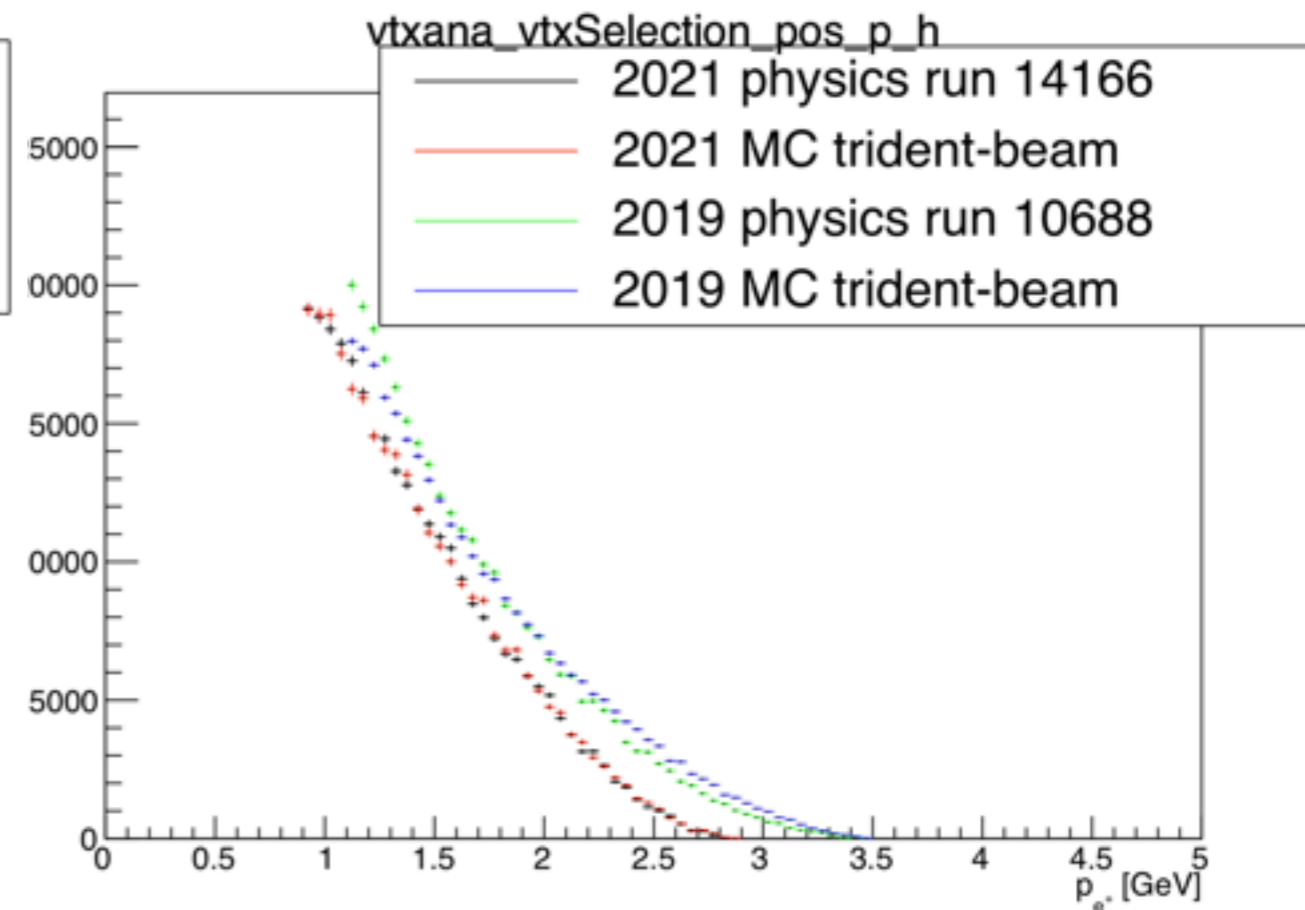
2019 data is better than 2021 data for both electrons and positrons.

p for Electrons and Positrons

ele



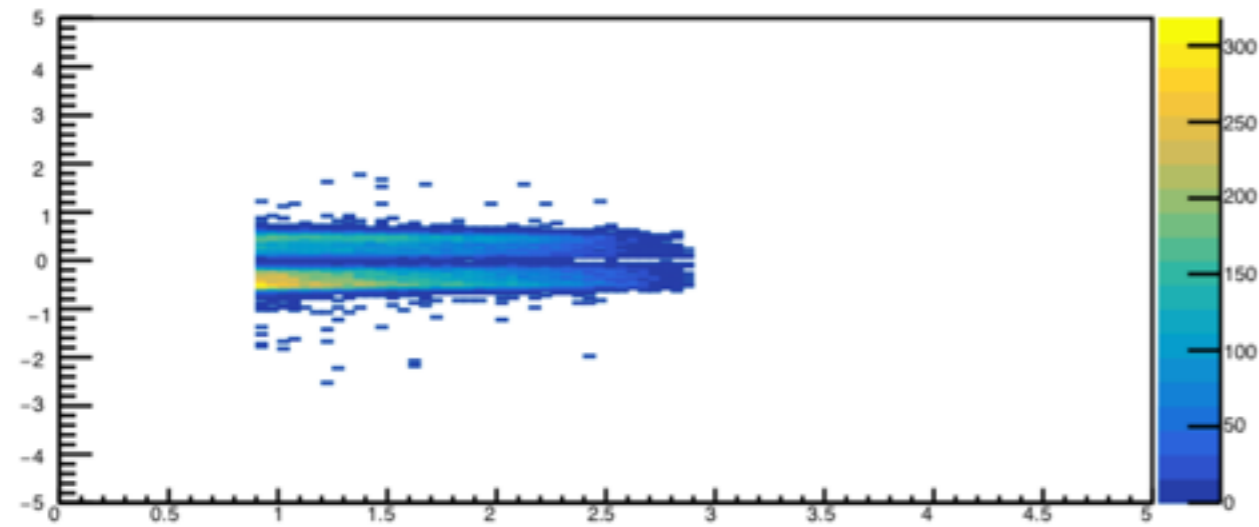
pos



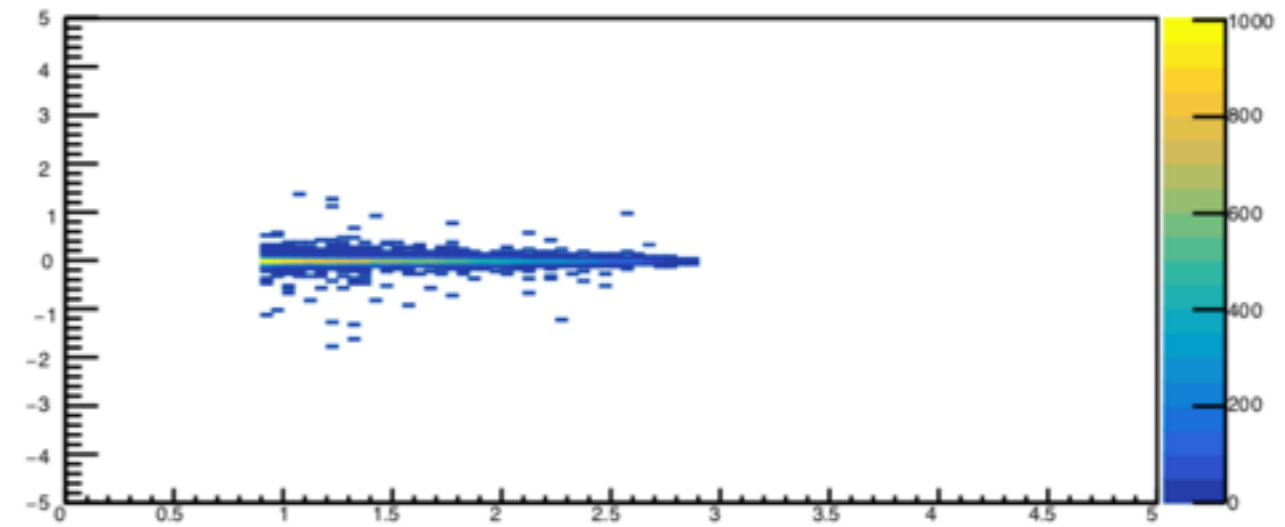
2019 and 2021 are not separated clear at low p for electrons.

z_0 vs p for ele

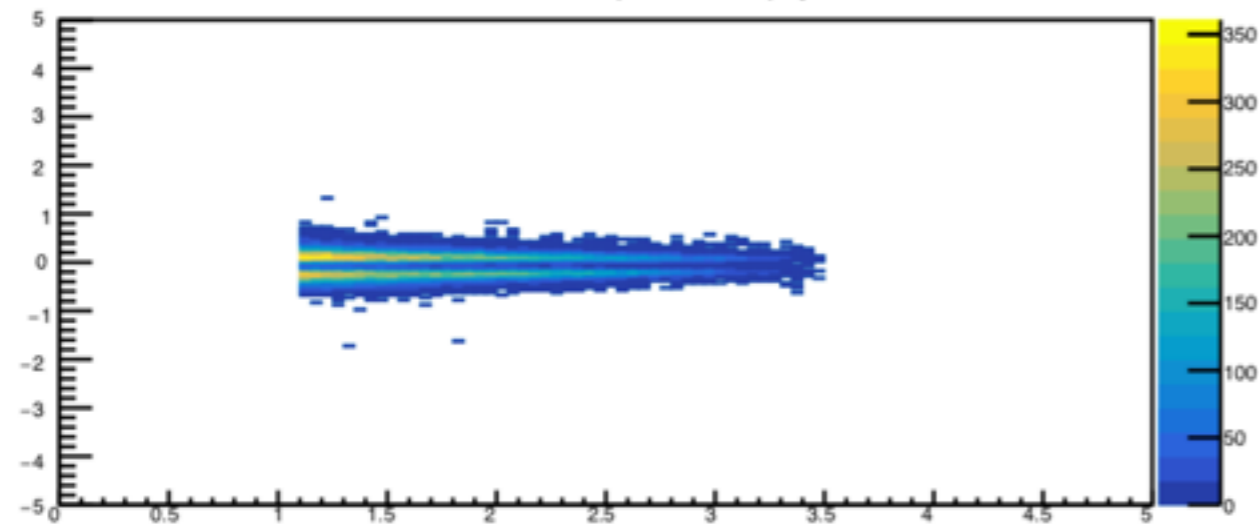
vtxana_vtxSelection_ele_z0_vs_p_hh: 2021 physics run 14166



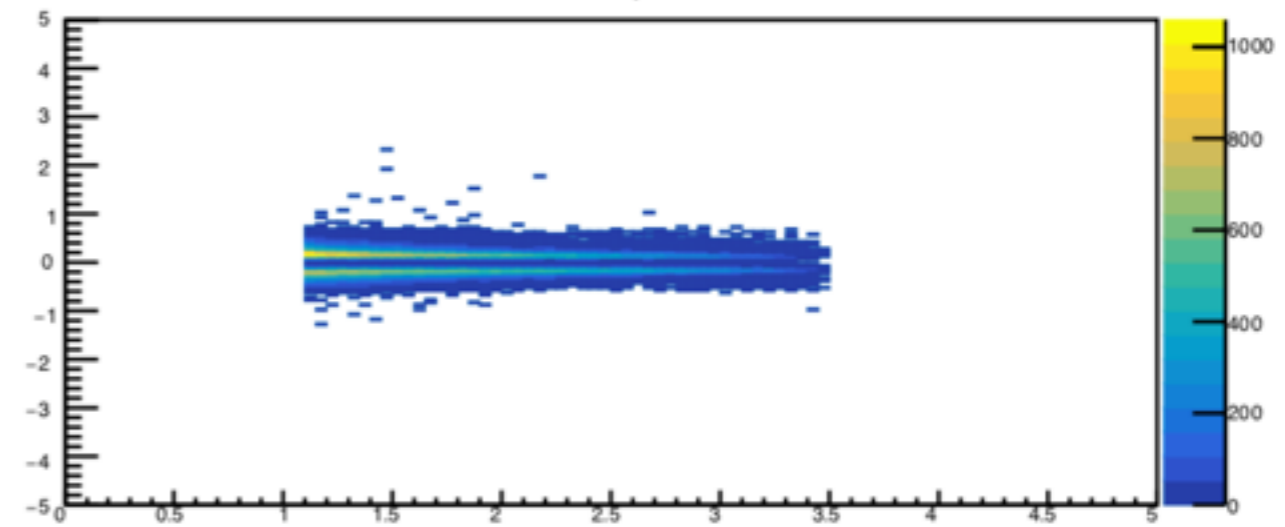
vtxana_vtxSelection_ele_z0_vs_p_hh: 2021 MC trident-beam



vtxana_vtxSelection_ele_z0_vs_p_hh: 2019 physics run 10688



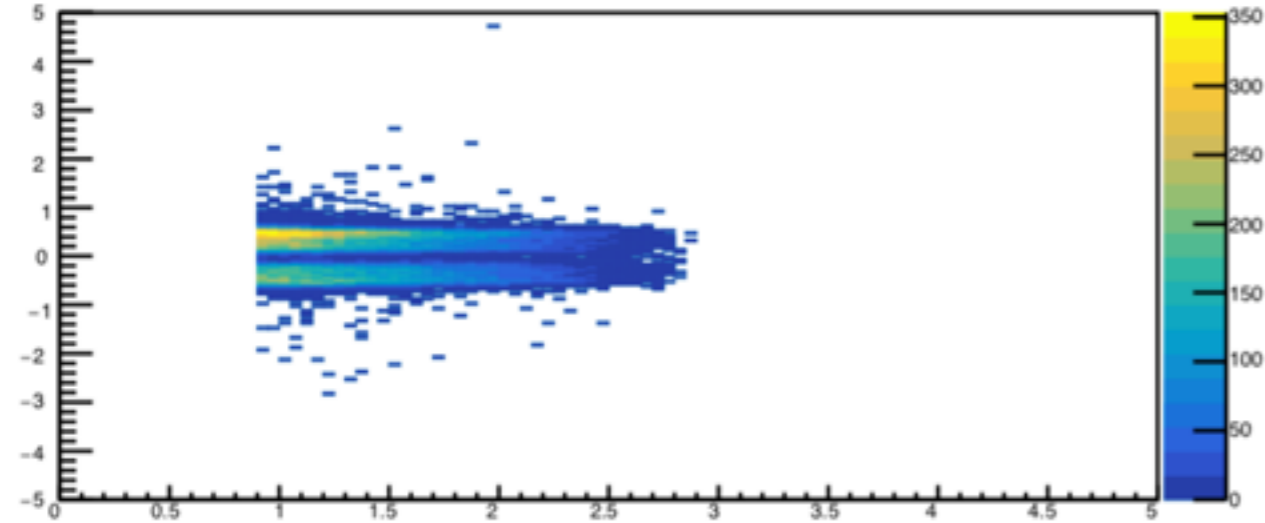
vtxana_vtxSelection_ele_z0_vs_p_hh: 2019 MC trident-beam



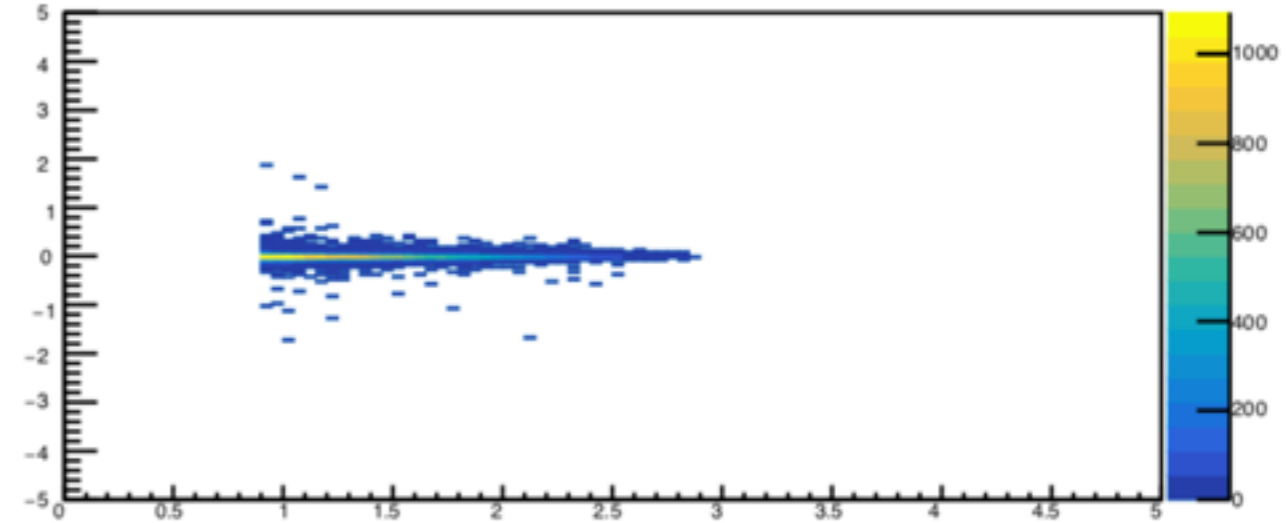
- 2021 MC has only one band since target is set as 0.
- 2021 Data looks not normal.

z0 vs p for pos

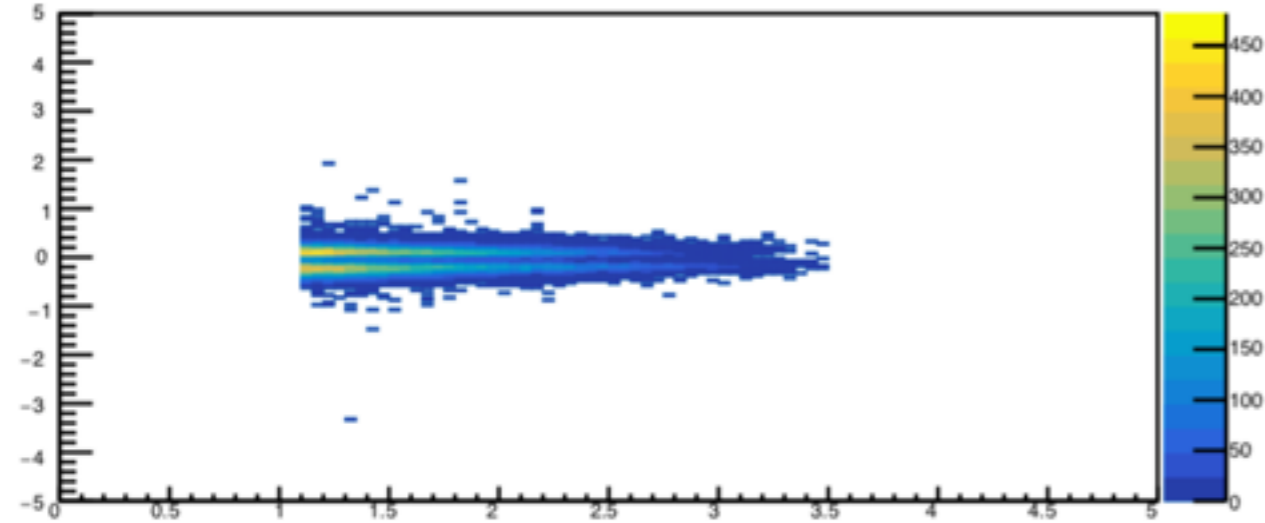
vtxana_vtxSelection_pos_z0_vs_p_hh: 2021 physics run 14166



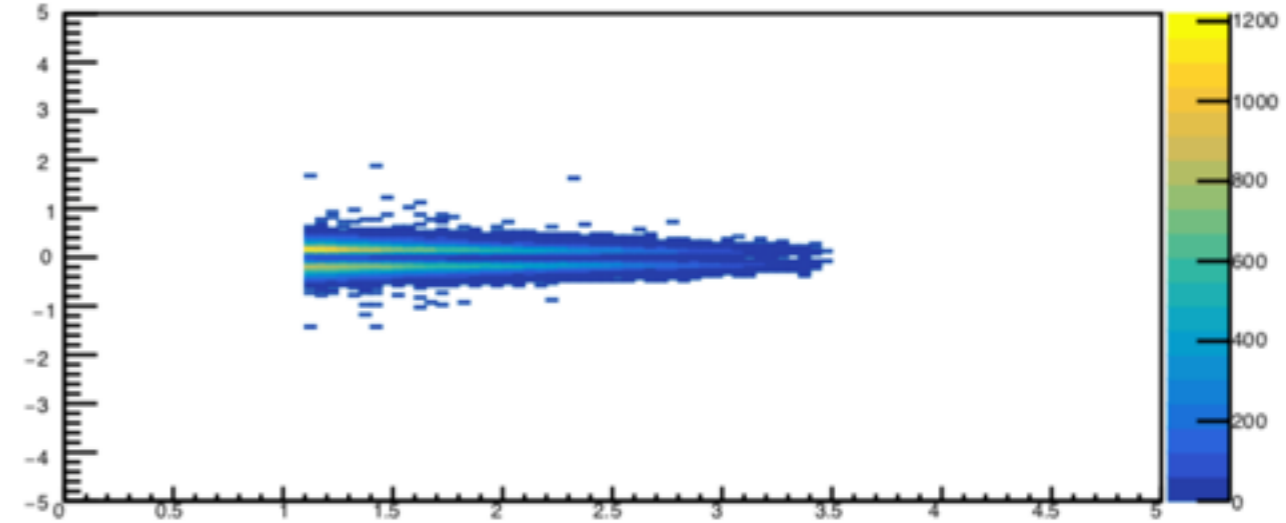
vtxana_vtxSelection_pos_z0_vs_p_hh: 2021 MC trident-beam



vtxana_vtxSelection_pos_z0_vs_p_hh: 2019 physics run 10688

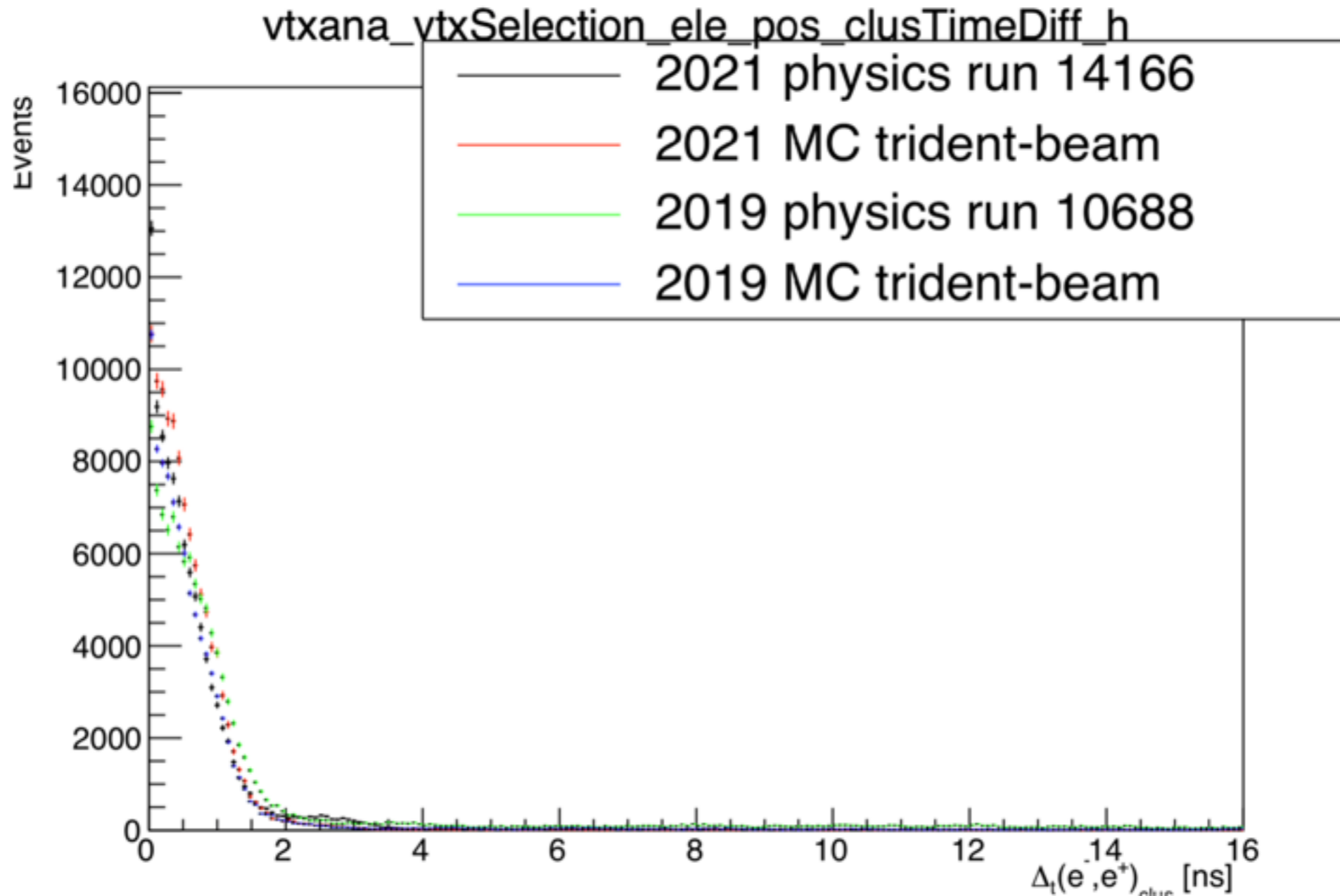


vtxana_vtxSelection_pos_z0_vs_p_hh: 2019 MC trident-beam



2021 MC has only band since target is set as 0.
2021 Data looks not normal.

Ecal Cluster Time Diff. between ele and pos

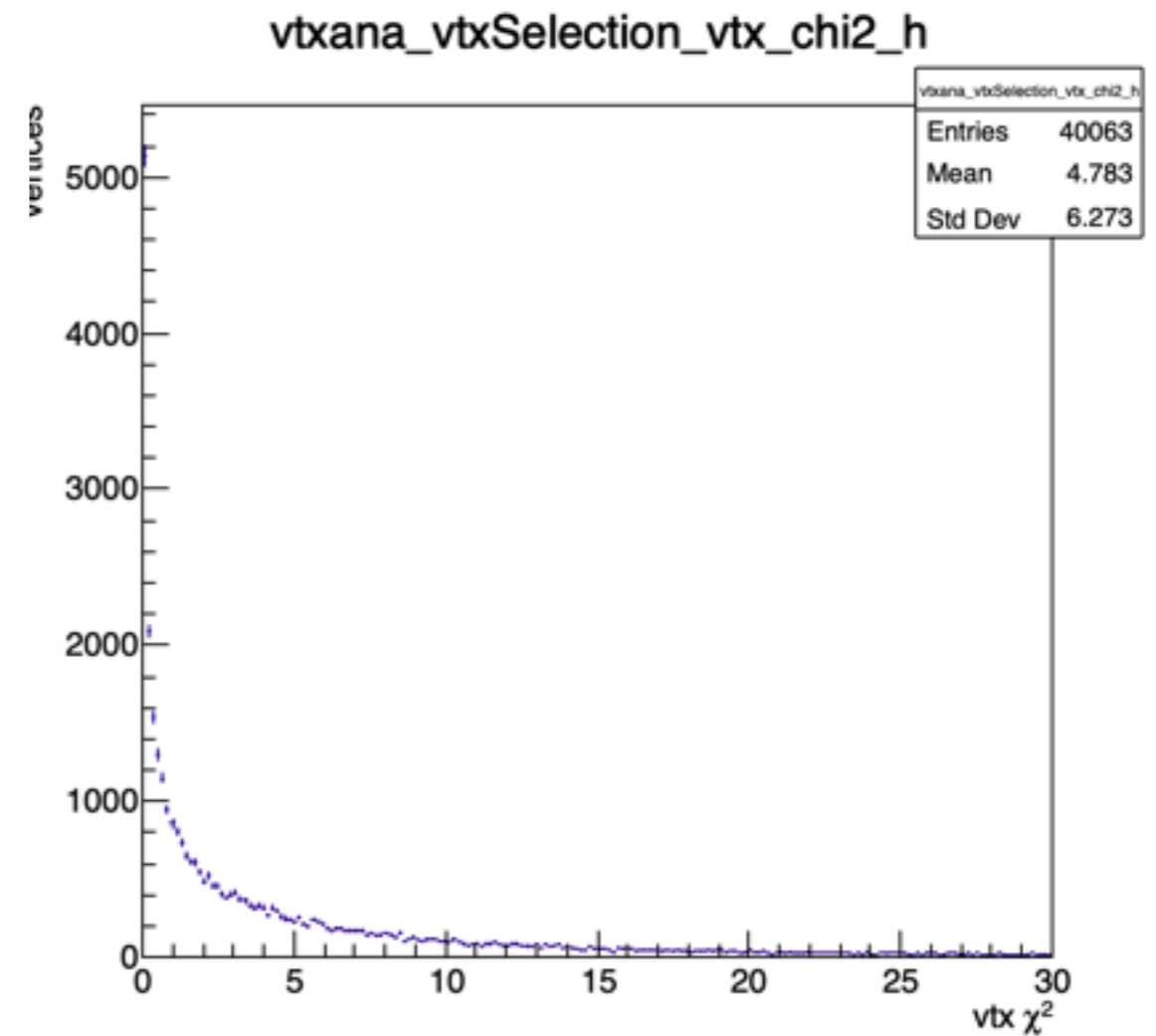
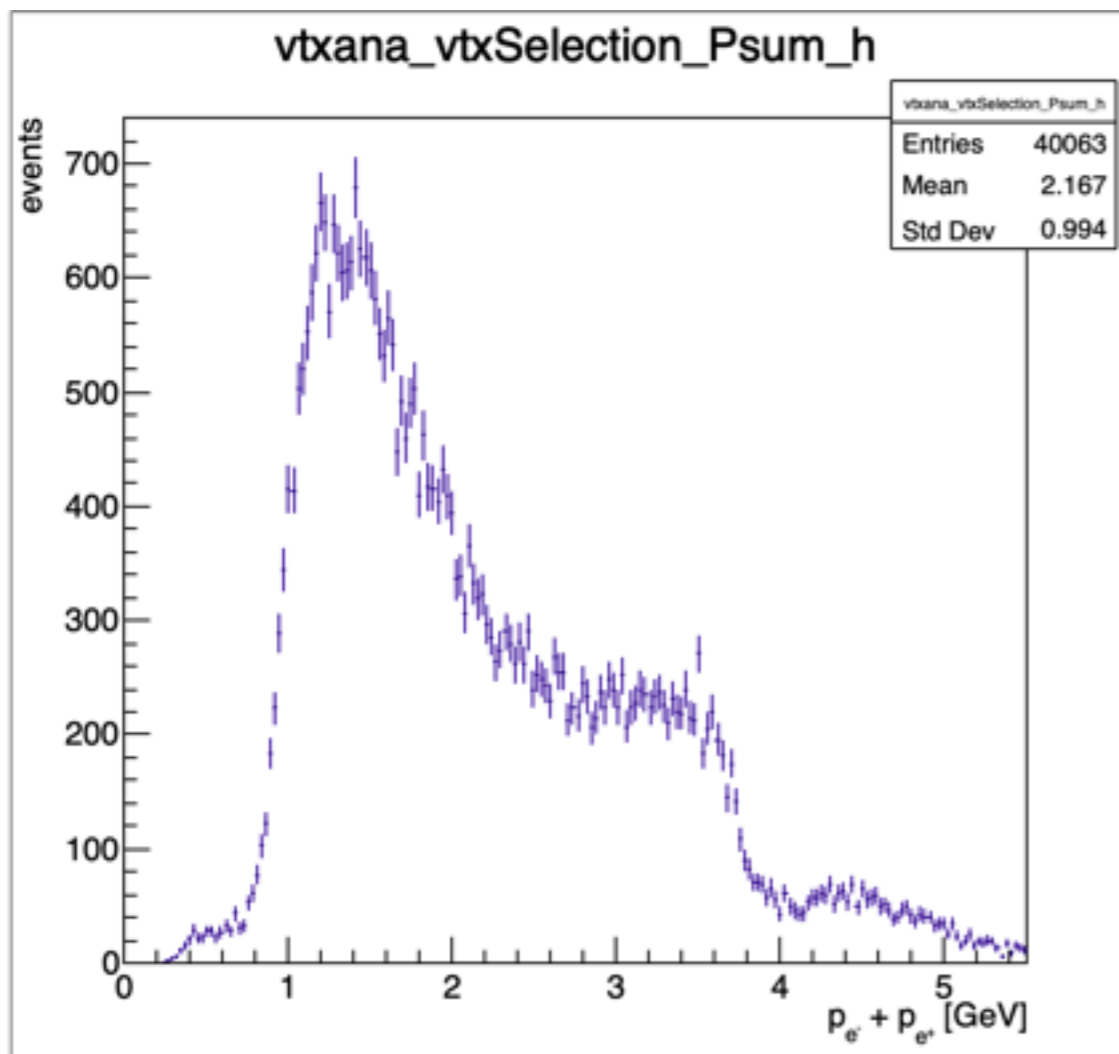


Summary

- With some issues fixed to run jobs by swif2, samples for tritrig-beam and wab-beam have been produced, and production for ap-beam is in process.
- By comparison, alignment for 2021 still needs to be improved.
- Do we need samples for tritrig + pulser data before further alignment update?
- As suggested by Norman, Moller samples with ideal 2021 detector will be produced by Moller trigger. Please contact me if you need other types of samples for calibration or analysis, such as pure signals, FEE, other triggers, etc.

Backup

UC vertex for 2021 Run 14166 without Cut



Ele and Pos from Vertex

