

# A'+beam MC sample production

Sarah Gaiser  
Stanford/SLAC  
March 5, 2024



U.S. DEPARTMENT OF  
**ENERGY**

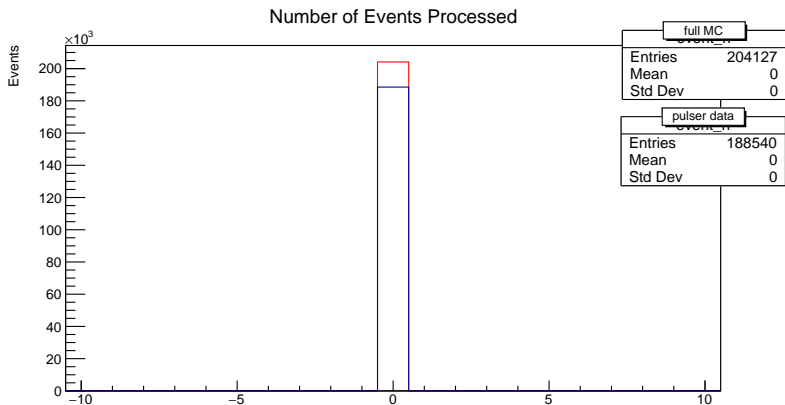
Stanford  
University



NATIONAL  
ACCELERATOR  
LABORATORY

- Full MC
  - Beam and signal simulated
  - Signal spaced by event interval = 250
  - Using LCIOMerge to merge both samples
- Pulser data
  - Overlay random beam data and simulated signal
  - Space events with event interval = 250
- For both samples: run same readout and reconstruction
  - Steering for readout: `PhysicsRun2021TrigMultiSingles.lcsim`
- Detector used: `HPS_Run2021Pass1_v4`; run number: 14229

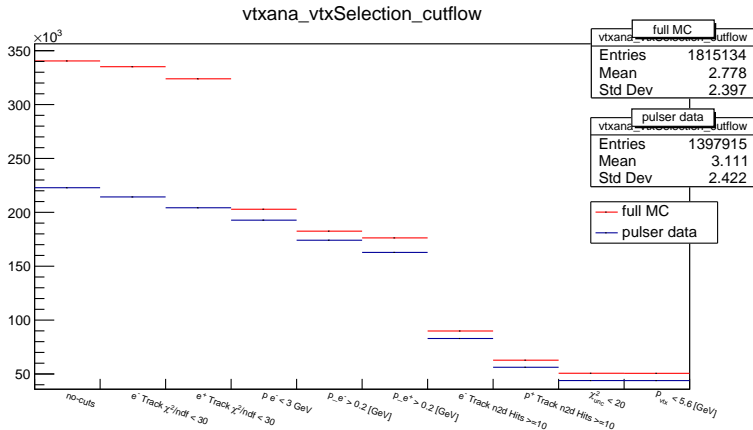
# Number of processed events



- Full simulation has more triggers  $\rightarrow$  investigate this in more detail

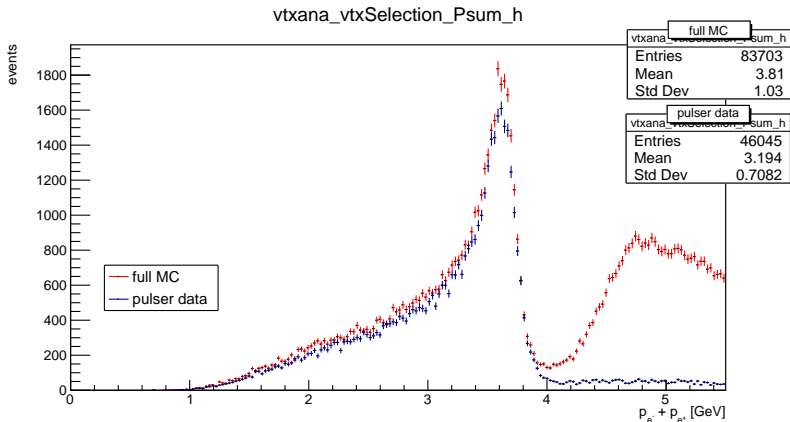
- We need to understand the difference in the number of processed events
- Where are the extra triggers in full MC coming from?
- Do we miss anything using new way of generating MC samples?

# Impact of preselection



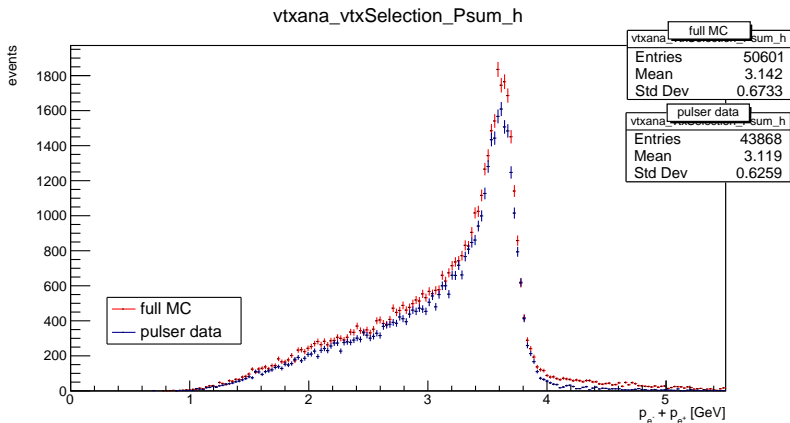
- Cuts have similar impact on both samples – exception: FEE cut
- Similar number of events after preselection

# Psum after preselection – no FEE cut



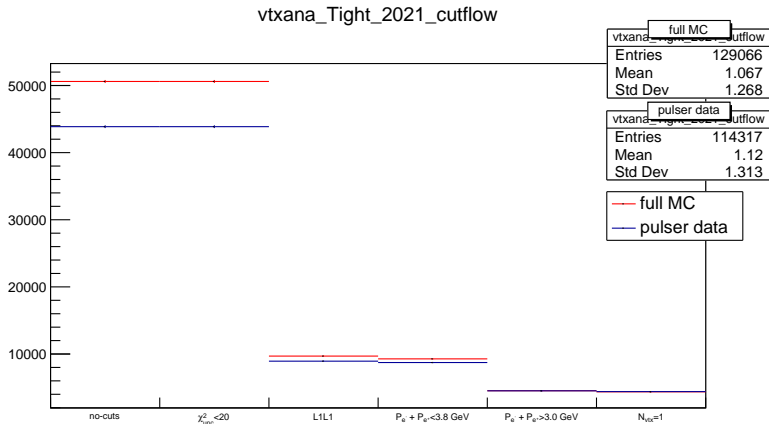
- Bump at high psum due to FEEs for full MC
- Higher rate of events in peak for full MC

# Psum after preselection – with FEE cut



- Rate for full MC higher in peak even after FEE cut

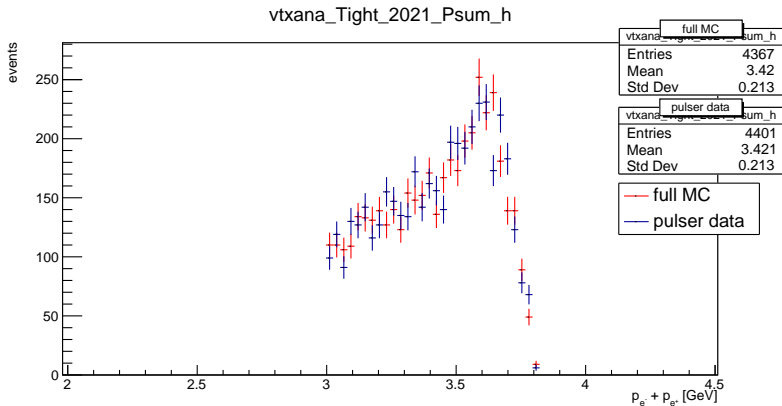
# Cutflow for tight selection – with FEE cut



- L1L1 cut leaves similar number of events for both methods
- Same number of events by end of cutflow

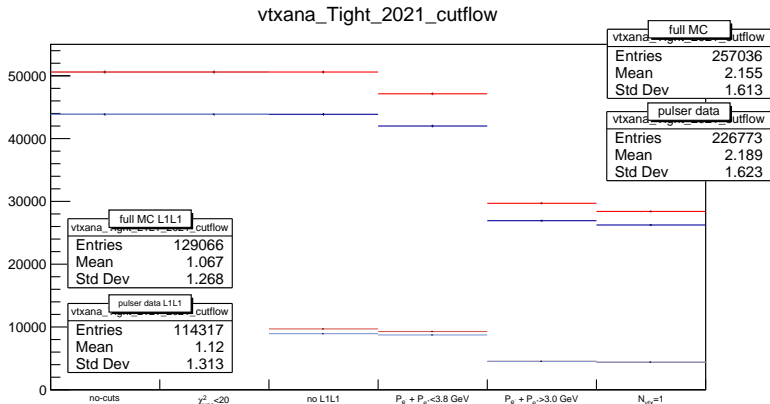


# Psum after tight selection – with FEE cut



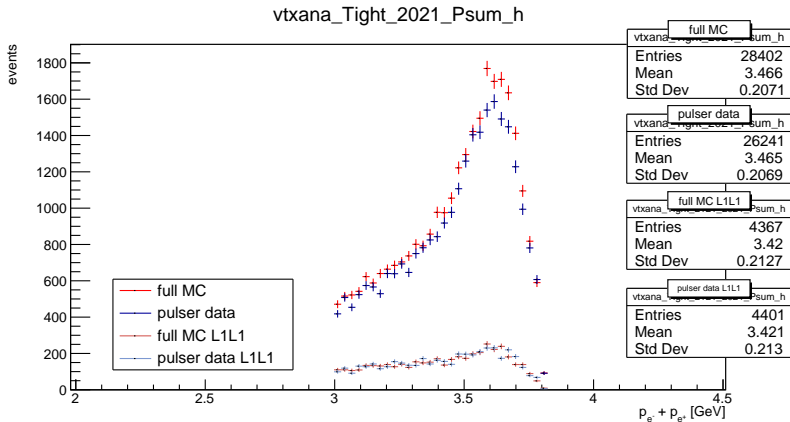
- Psum distributions match now – what caused this?

# Effects of L1L1 cut



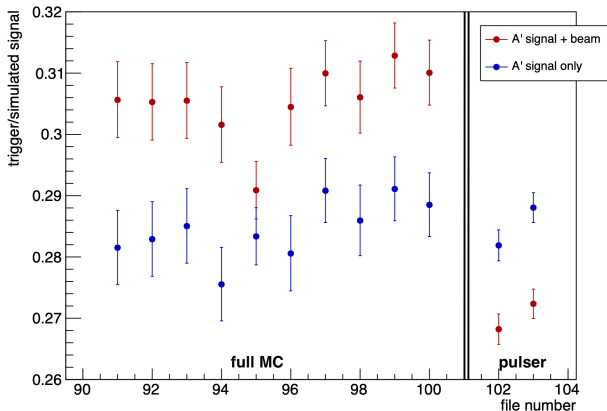
- Dark colors: no L1L1 cut; light colors: including L1L1 cut
- Number of events differs stronger if L1L1 cut is not applied

# Effects of L1L1 cut – Psum



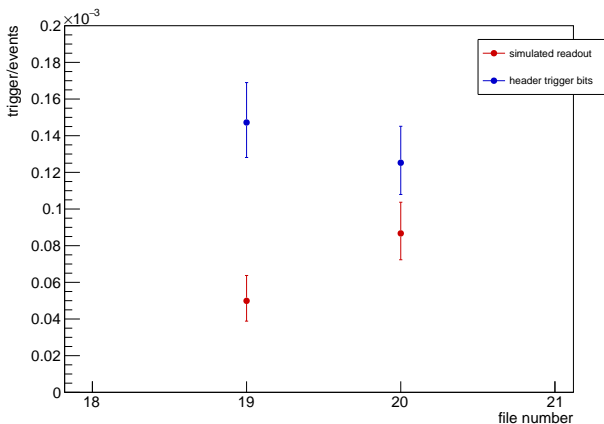
- Higher rate in peak for full MC if L1L1 not applied
- Rates very similar if L1L1 cut is applied

# Simulated trigger 'efficiency' – A' signal



- A' signal only: trigger rate same for both methods
- A' signal + beam: fewer events for pulser overlay

# Simulated trigger 'efficiency' – pulser



- More events with single triggers if we look at header
- Simulated readout underestimates trigger efficiency for pulser data

- Investigate trigger count/total events in file 95
  - Check number of events in slic step
- Look into merging and spacing code for full MC and pulser overlay
  - full MC: hps-java/ecal-readout-sim/src/main/java/org/hps/readout
  - pulser overlay: hps-java/digi/src/main/java/org/hps/digi
- Number of triggers changes every time readout simulation is run for **same** A' signal file
  - Floating point error?
  - Investigate by running multiple times on different systems – slac vs jlab