Overview of HPS MC

T. Cao
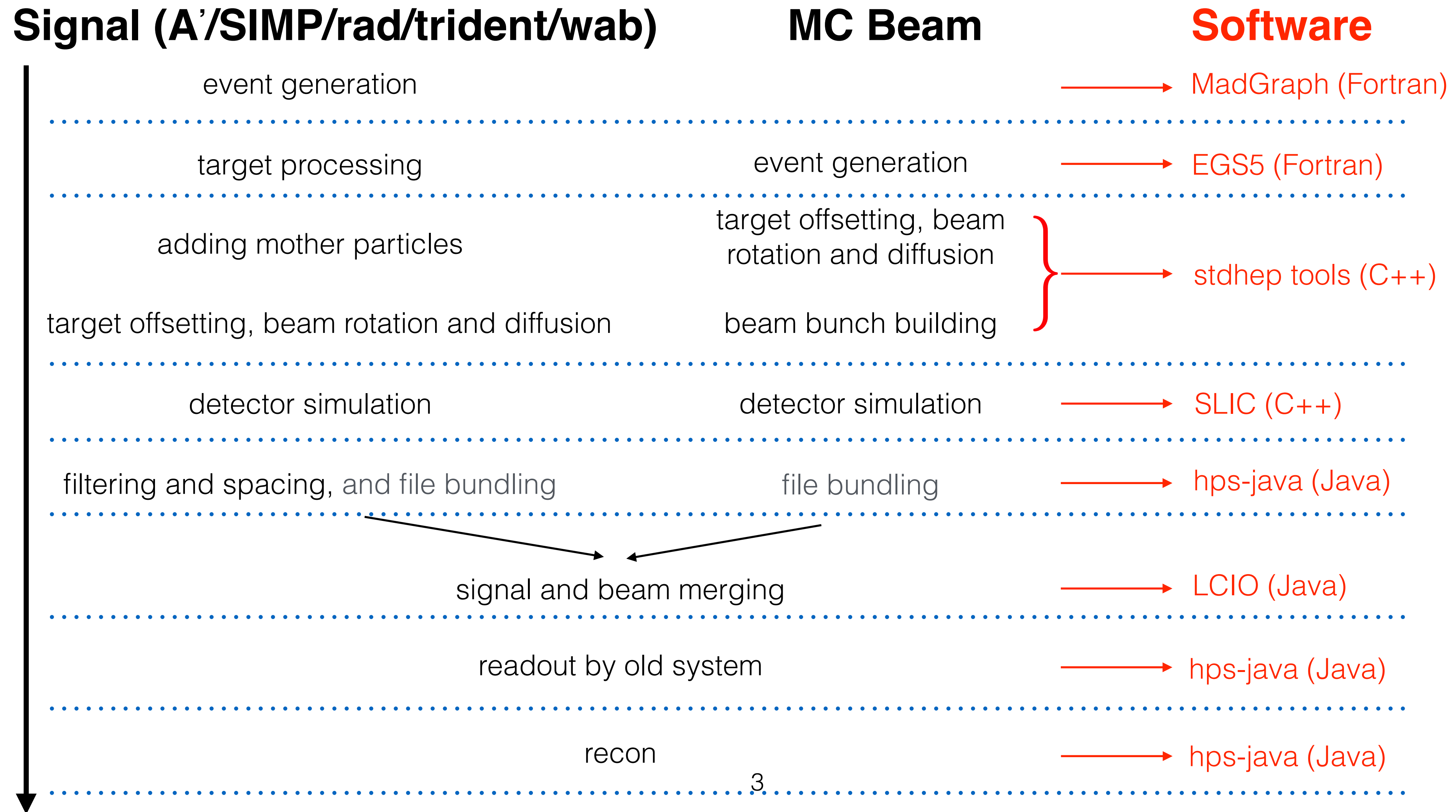
Jefferson Lab

HPS Collaboration Meeting
June 3 - 5, 2024

Outline

- Review of MC softwares

- Recent progress:

  - 2016 MC: software updates, new samples and validation

  - Validation for 2019&2021 MC with pulser data merging (See details in Sarah's talk)

  - Issue and fixing for track extrapolation to Ecal (See details in Lewis's talk)
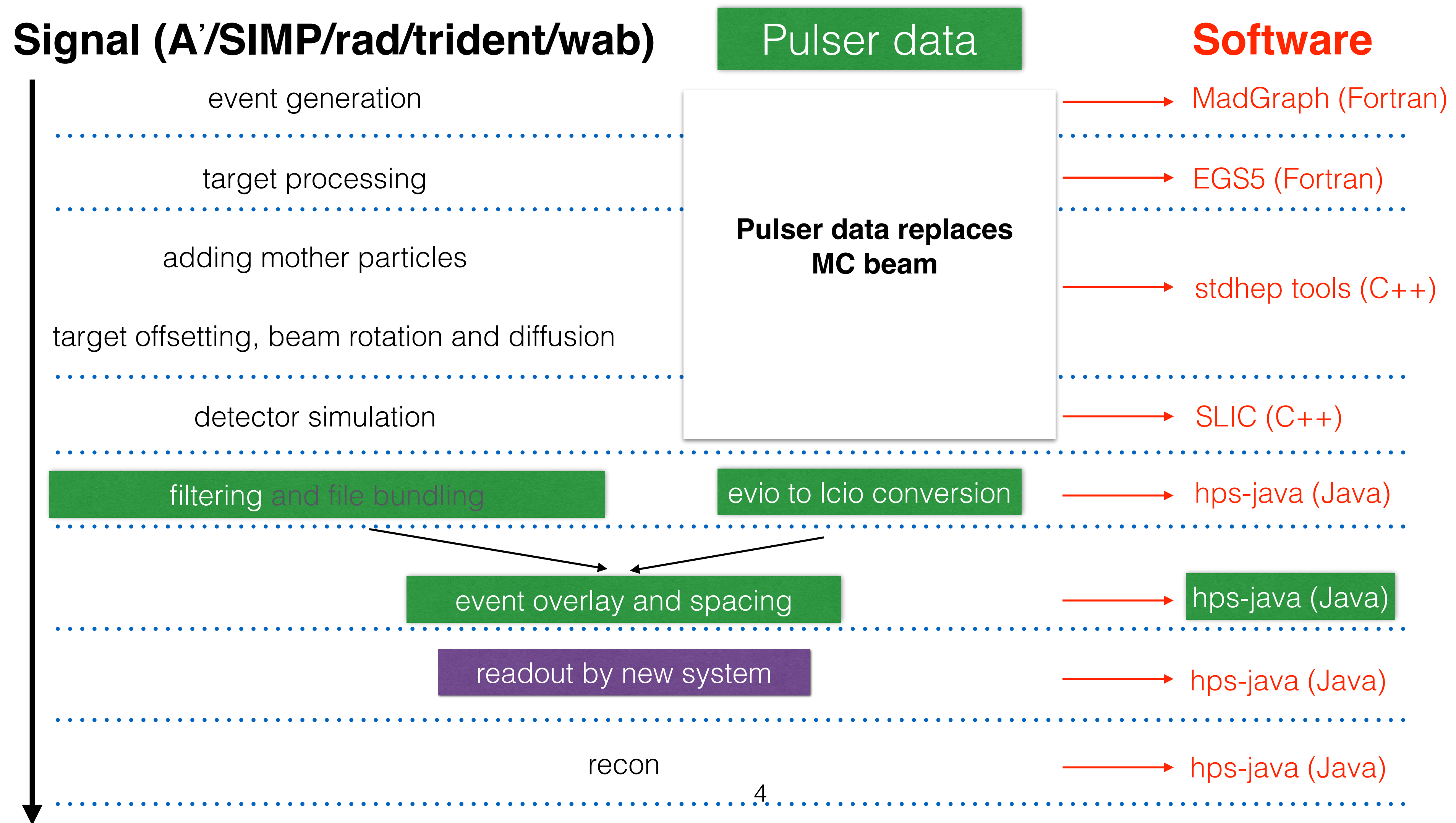
- Plans

Review of MC Softwares
MC chain with old readout system

Signal (A'/SIMP/rad/trident/wab)	**MC Beam**	**Software**
event generation		MadGraph (Fortran)
target processing	event generation	EGS5 (Fortran)
adding mother particles	target offsetting, beam rotation and diffusion	stdhep tools (C++)
target offsetting, beam rotation and diffusion	beam bunch building	
detector simulation	detector simulation	SLIC (C++)
filtering and spacing, and file bundling	file bundling	hps-java (Java)
	signal and beam merging	LCIO (Java)
	readout by old system	hps-java (Java)
	recon	hps-java (Java)

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Review of MC Softwares
MC chain with new readout system

Signal (A'/SIMP/rad/trident/wab)

Pulser data

Software

Process	Software
event generation	MadGraph (Fortran)
target processing	EGS5 (Fortran)
adding mother particles	stdhep tools (C++)
target offsetting, beam rotation and diffusion	
detector simulation	SLIC (C++)

Pulser data replaces MC beam

filtering and file bundling   evio to lcio conversion → hps-java (Java)

event overlay and spacing → hps-java (Java)

readout by new system → hps-java (Java)

recon → hps-java (Java)

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Review of Readout Softwares
More to be reminded

- The package hps-mc (Python) builds scripts for integration of MC chains and provides commands for MC production in single/batch modes.

- Run-dependent DAQ configuration is automatically loaded and applied into readout systems.

- Readout systems can simultaneously process multiple triggers, and store trigger bits in the TS bank, like experiment.

- Wab biasing in SLIC is available.

- Here are [documents](#) for information of HPS MC.

2016 MC
Software update in readout

- Update of Ecal smearing

- Application of DAQ configuration

Old pass4 sample before update
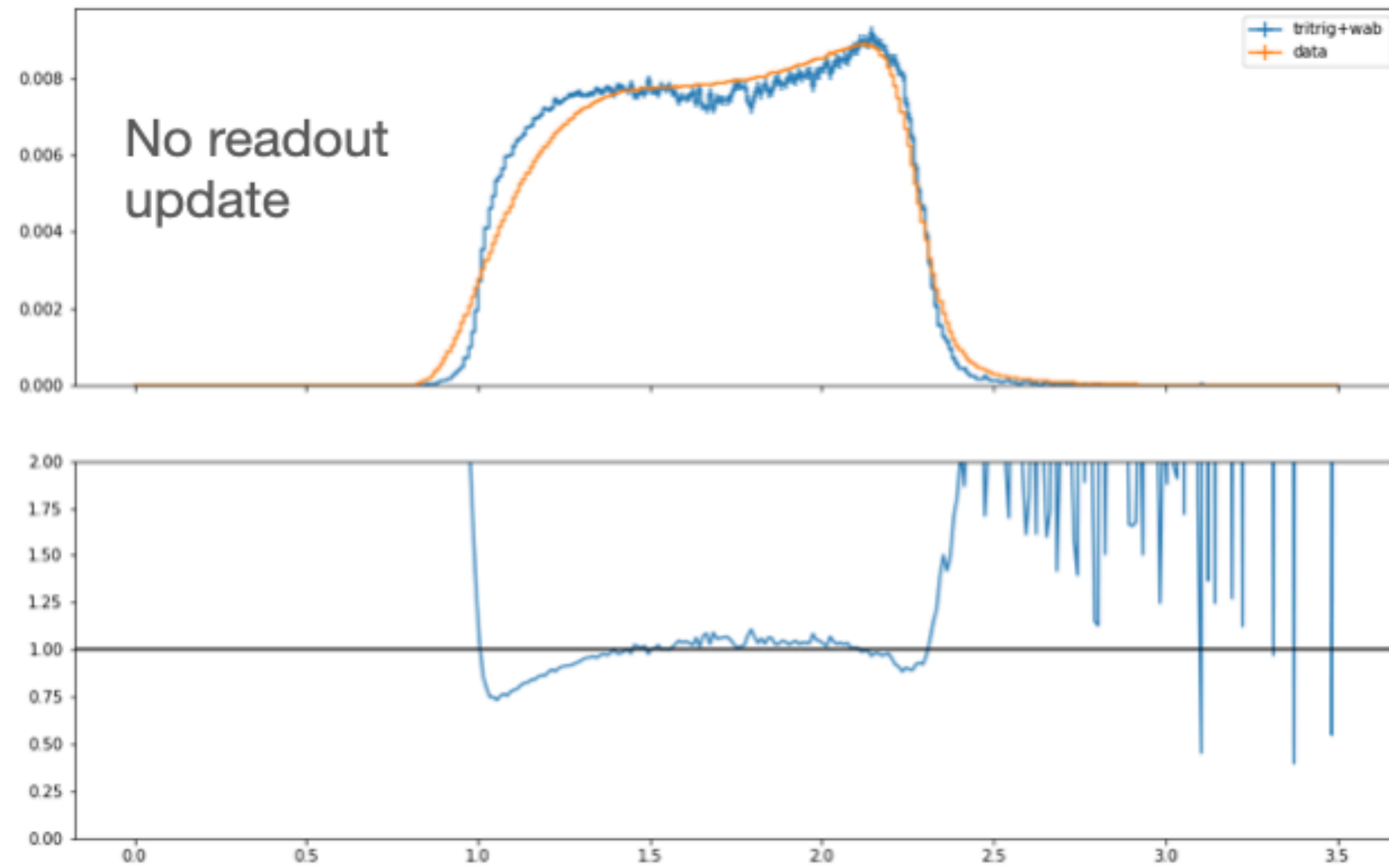
After update
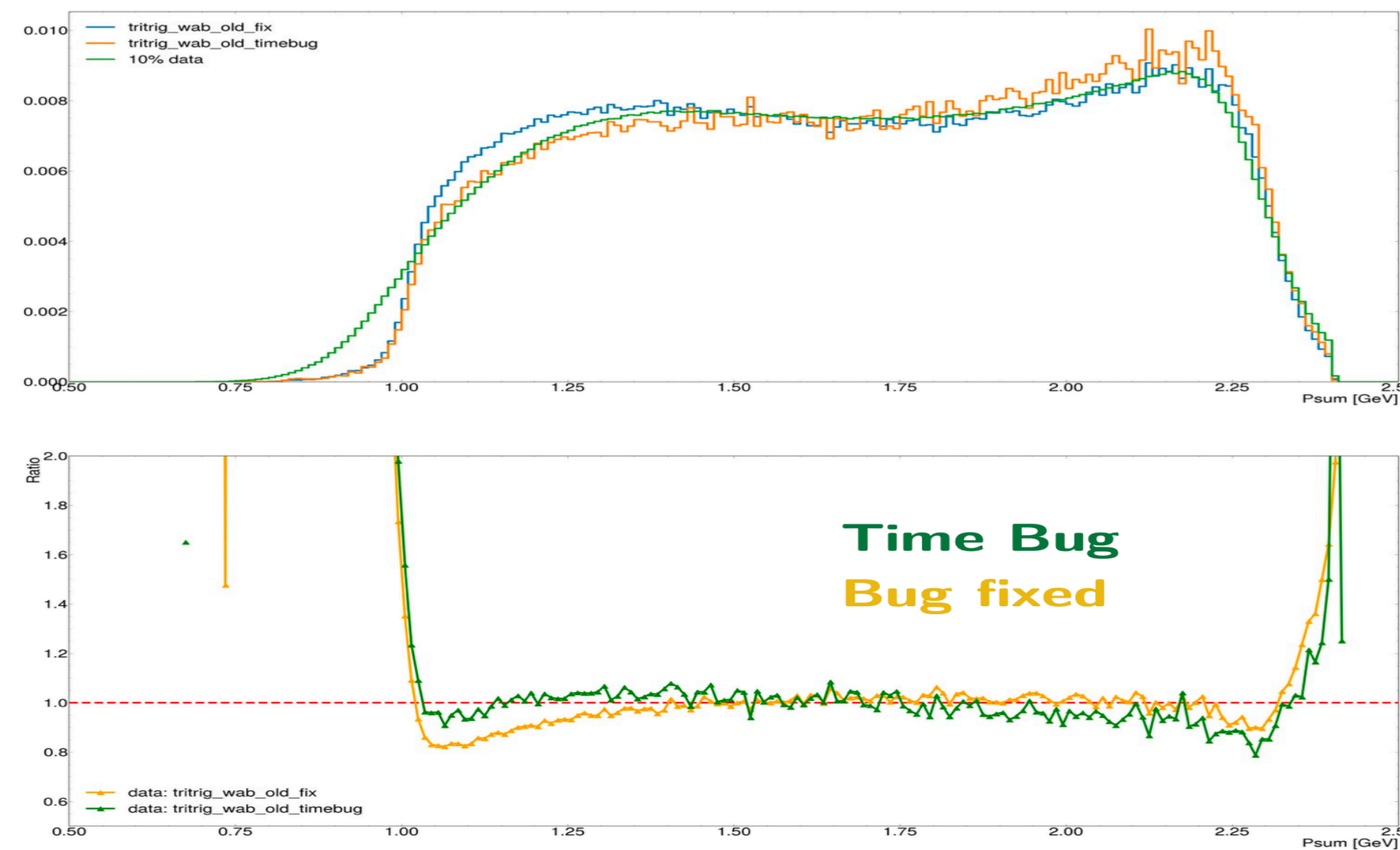
Yellow is correct, while **green** was made previously with an issue in analysis process.

Plots from Alic   Shape at the high p region looks better, but still there is discrepancy at the low p region.

2016 MC
Software update for hit killing in reconstruction by Matt

Old pass4 MC was applied for the study.
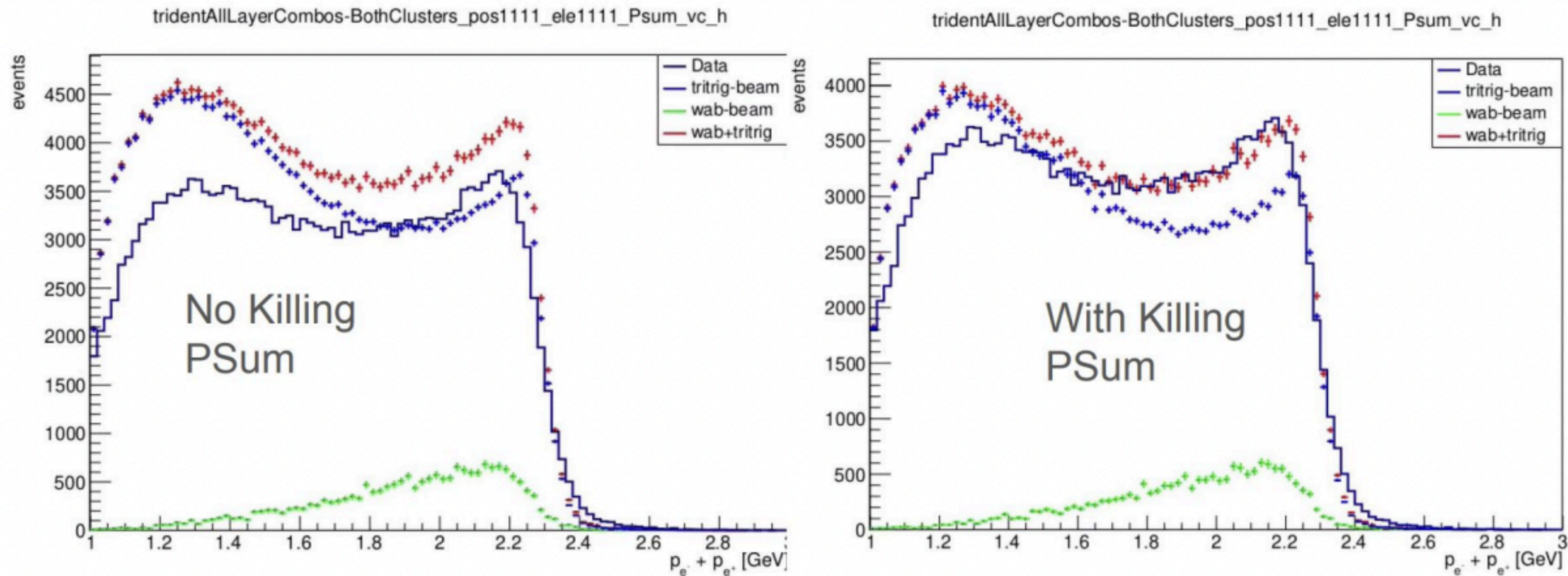
Plots from Matt

Looks that MC and data match better

2016 MC
New samples — Pass4b

- Updated readout and reconstruction are applied.

- Beam and target parameters are adjusted by Alic's study.

- New steering files are developed and applied due to software updates and parameter adjustment:

  - Readout: /org/hps/steering/readout/PhysicsRun2016TrigPairs.lcsim

  - Recon: /org/hps/steering/recon/PhysicsRun2016FullReconMC_KF_TrackClusterMatcher_StripHitKiller.lcsim

  - Note: Due to update of software trigger system, track-cluster time offset is adjusted from 44.8 to 36.8 ns (two clock cycles)

- Full samples, including rad-beam, tritrig-beam, wab-beam, ap-beam and SIMP-beam, were produce.

- Here is link for detailed information.

2016 MC
Validation for new samples by Alic

Plots from Alic

Worse with hit killing

Close with hit killing
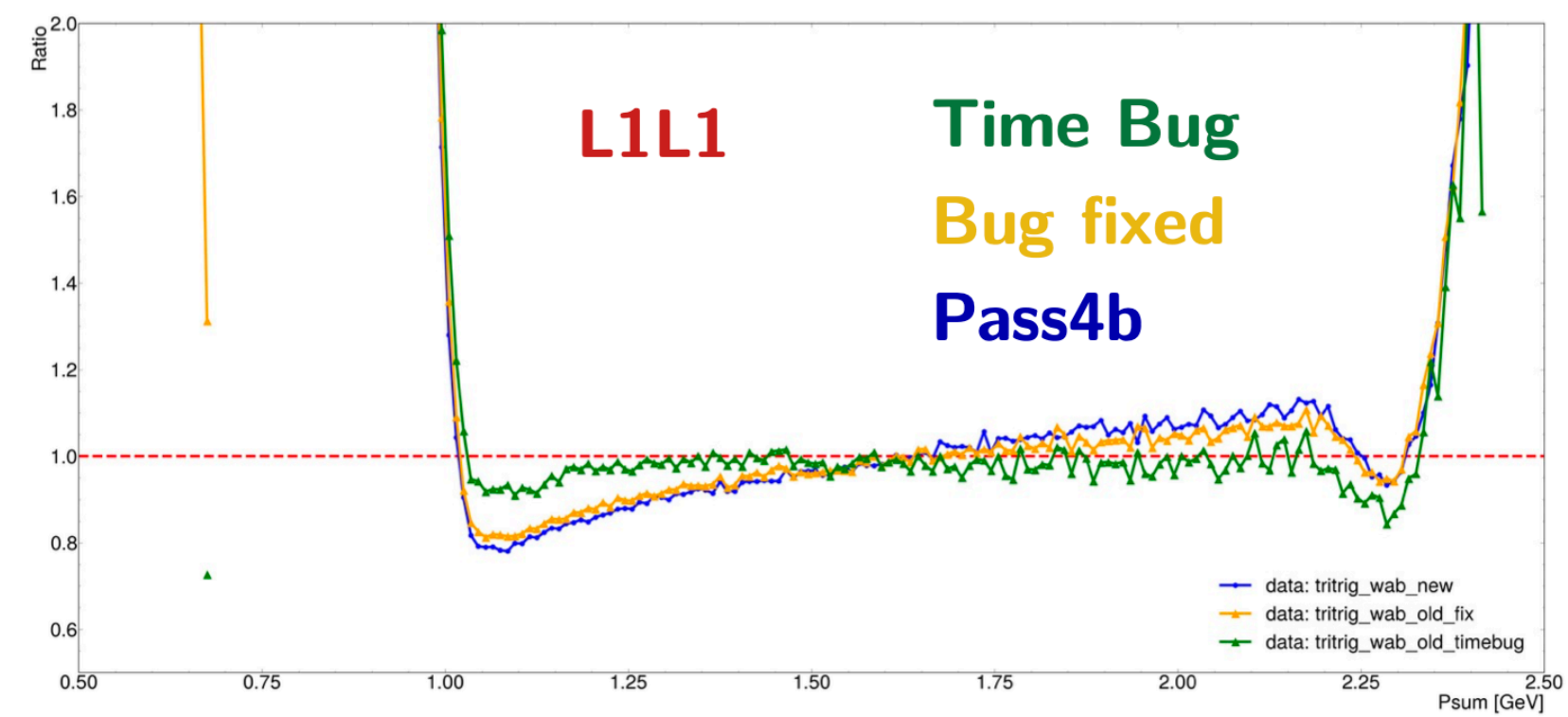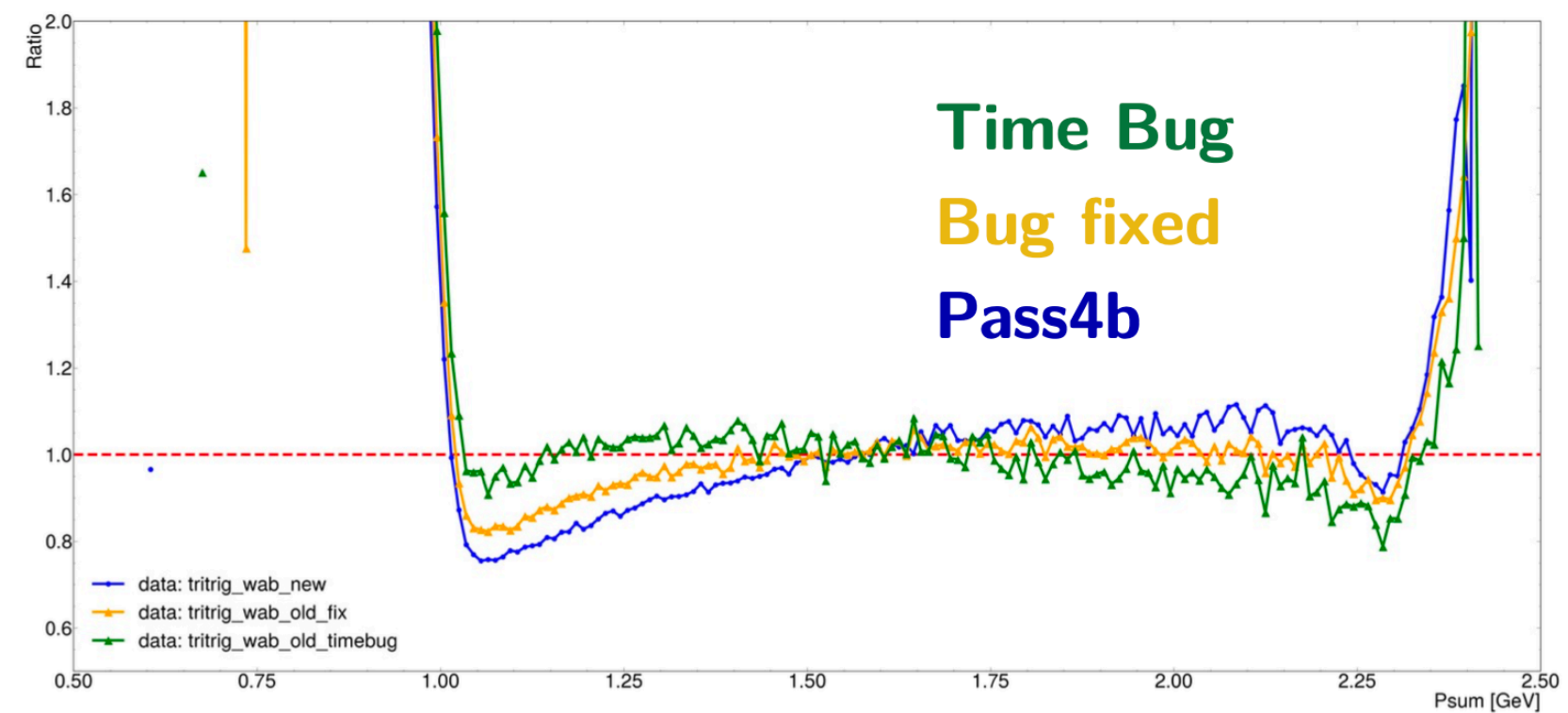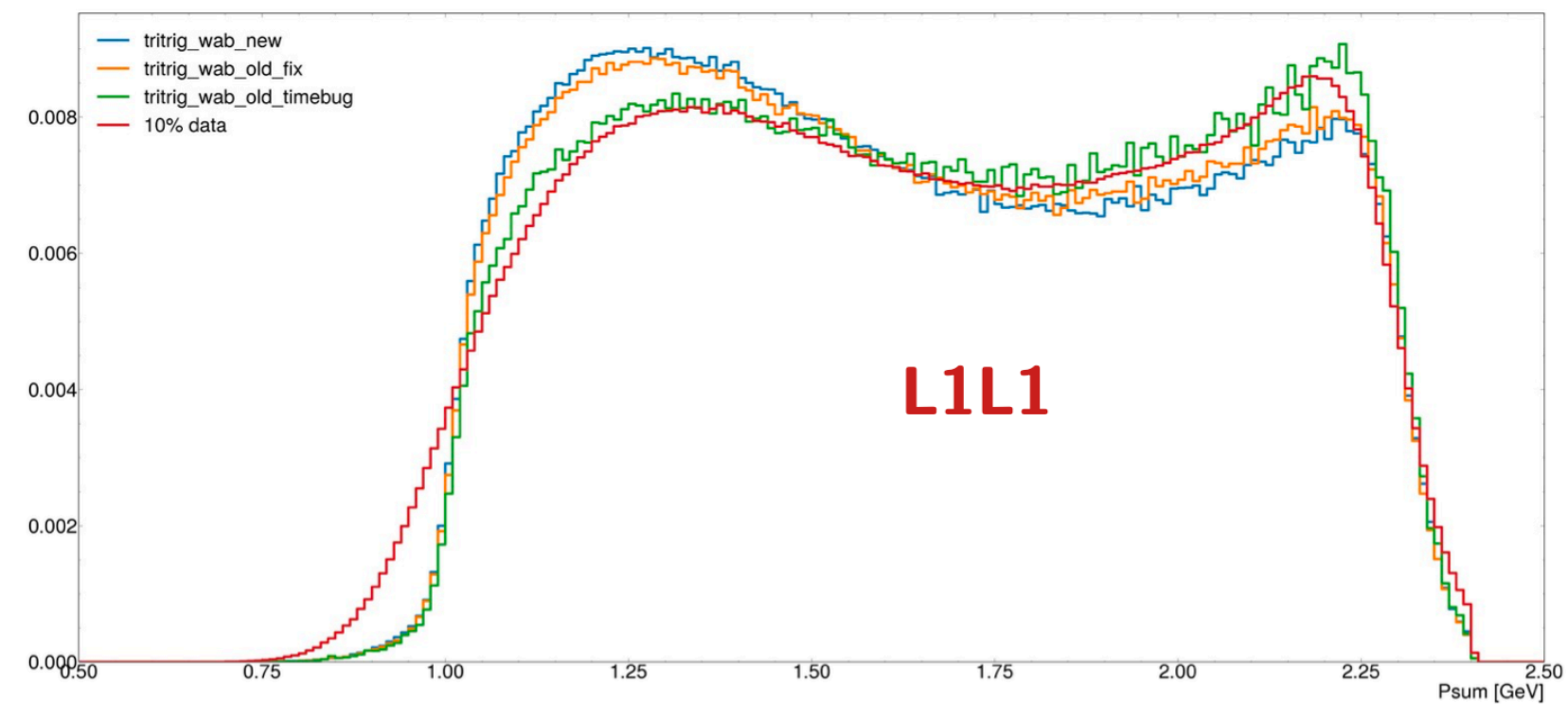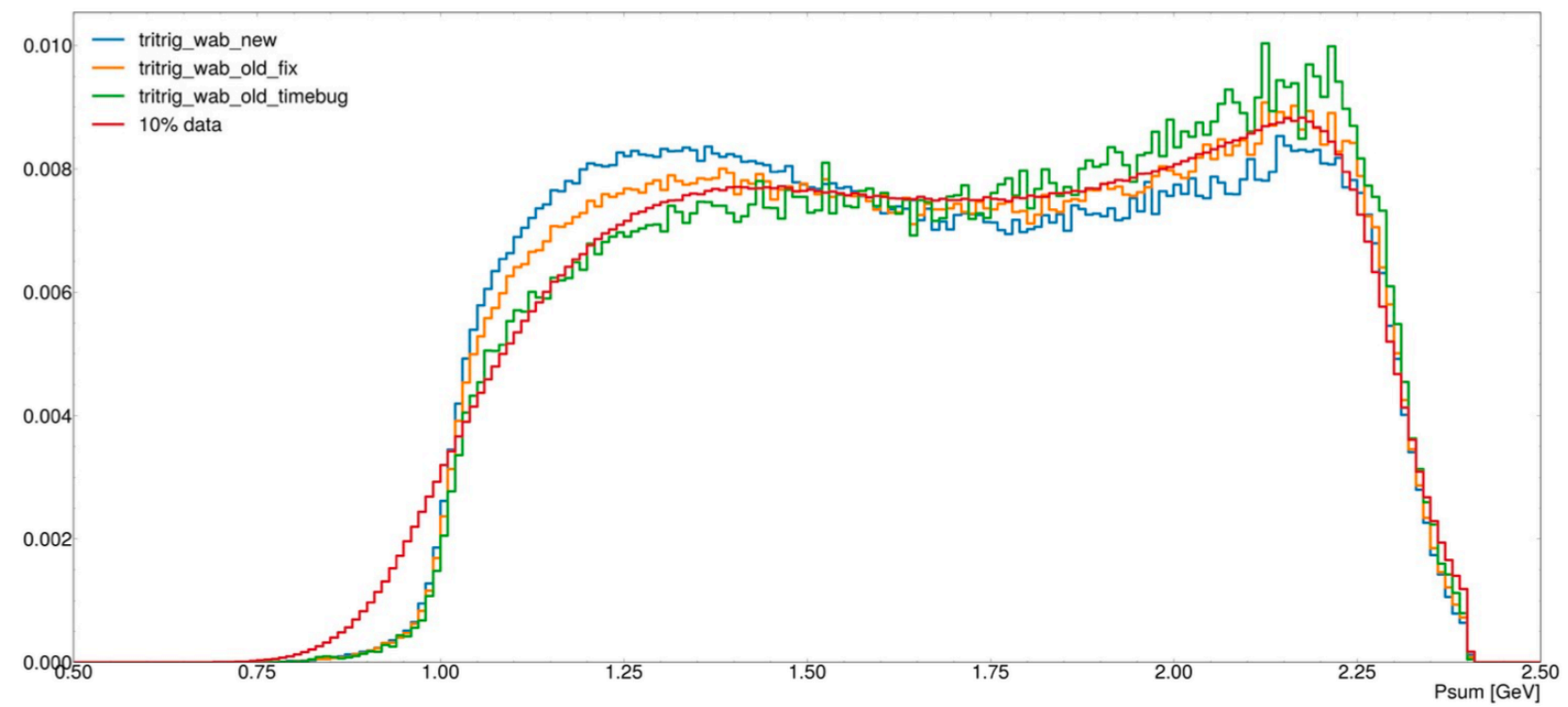
Yellow: no hit killing
Blue: with hit killing

Discussion for New 2016 MC

- Improvement by hit killing was observed for the old pass4 sample, why no similar improvement and even worse with hit killing for the new pass4b sample?

- Discrepancy at the low momentum region still exists.

  - Re-weight MC events based on pSum ratio of data to MC?

  - Discrepancy at the low momentum is caused by MC beam as background? Will check MC with pulser data merging.
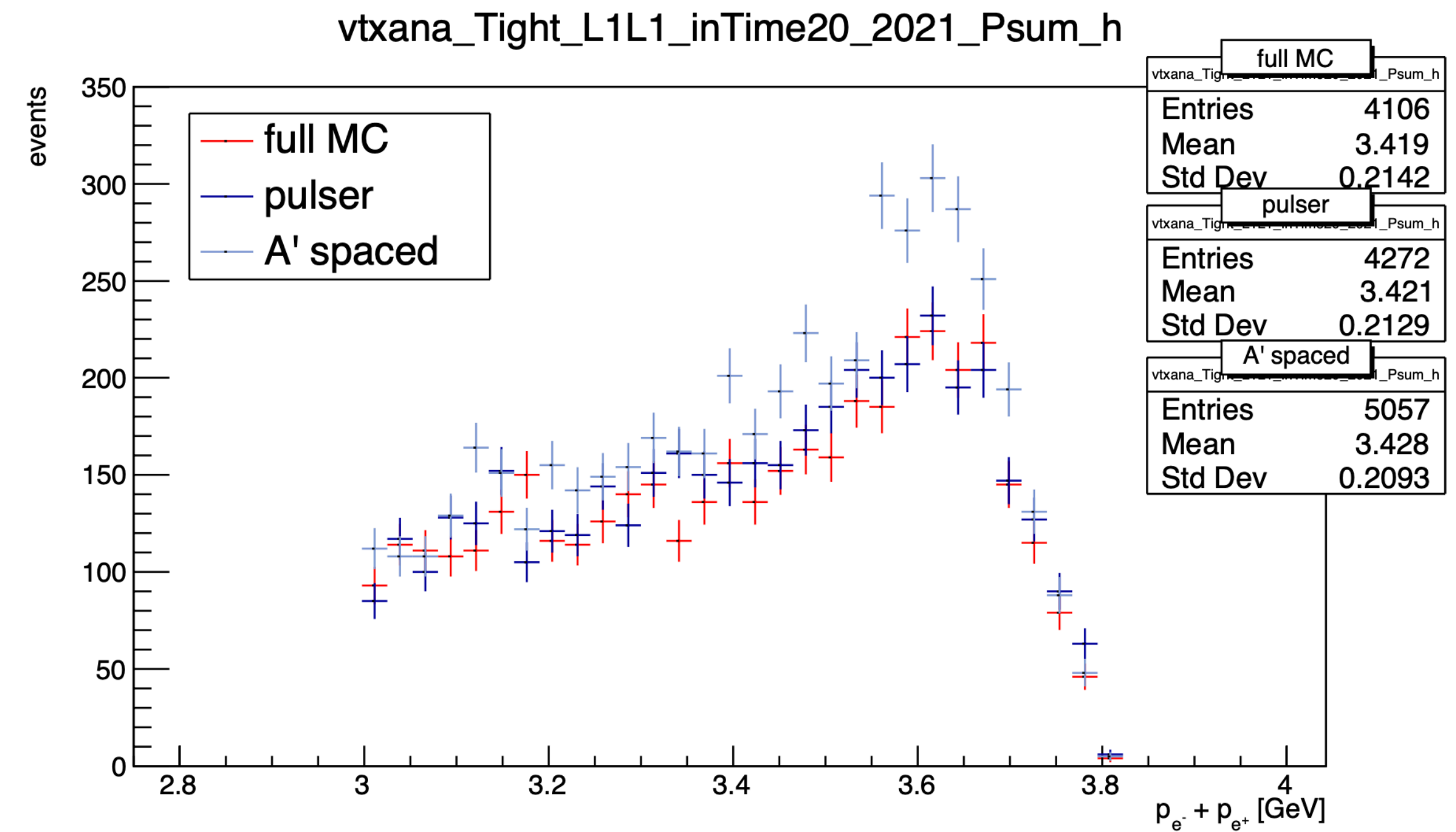
- Need to investigate momentum smearing for new sample.
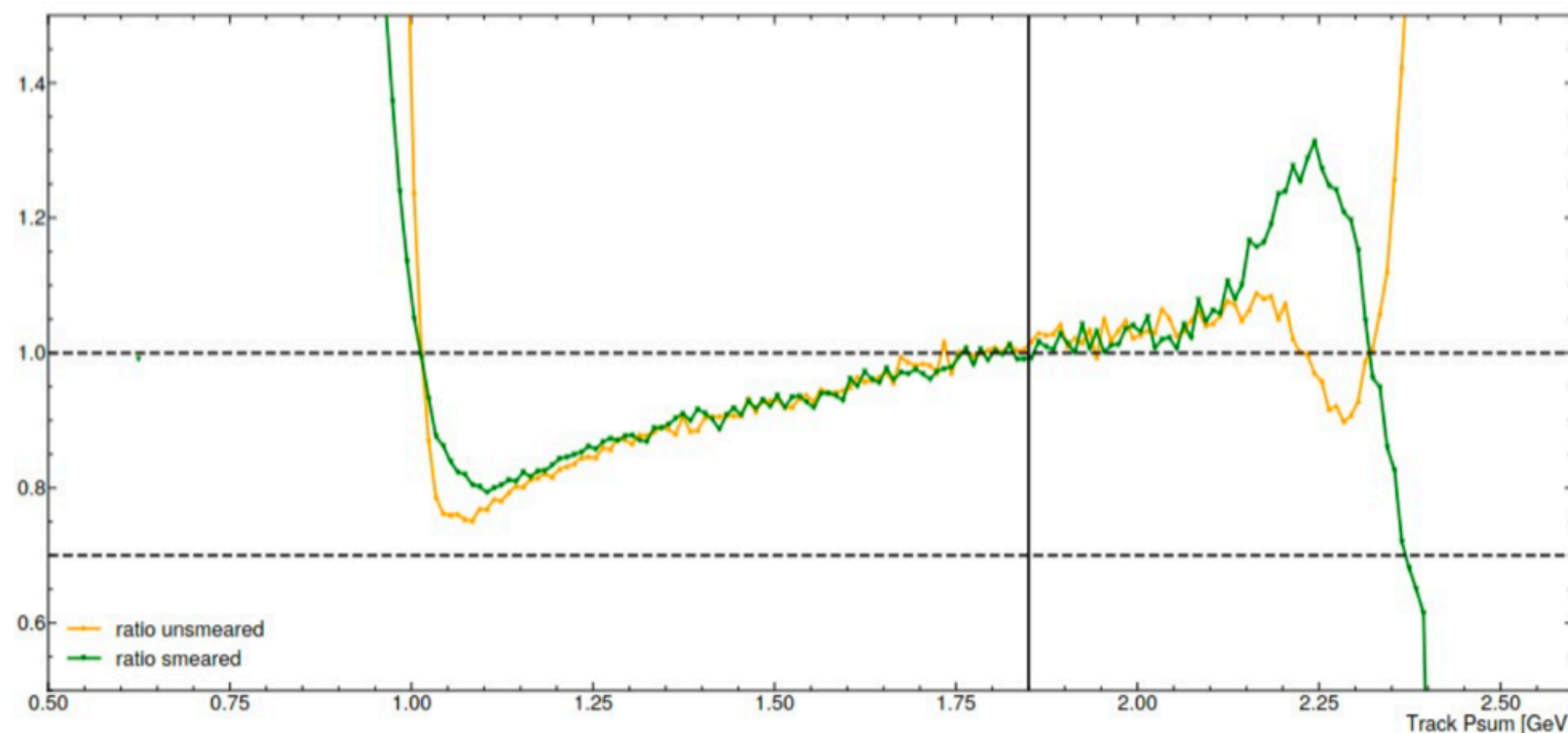
Shape at the low p region is improved a little, while shape is worse near beam energy.

Validation for pulser data merging by Sarah

Loose selection
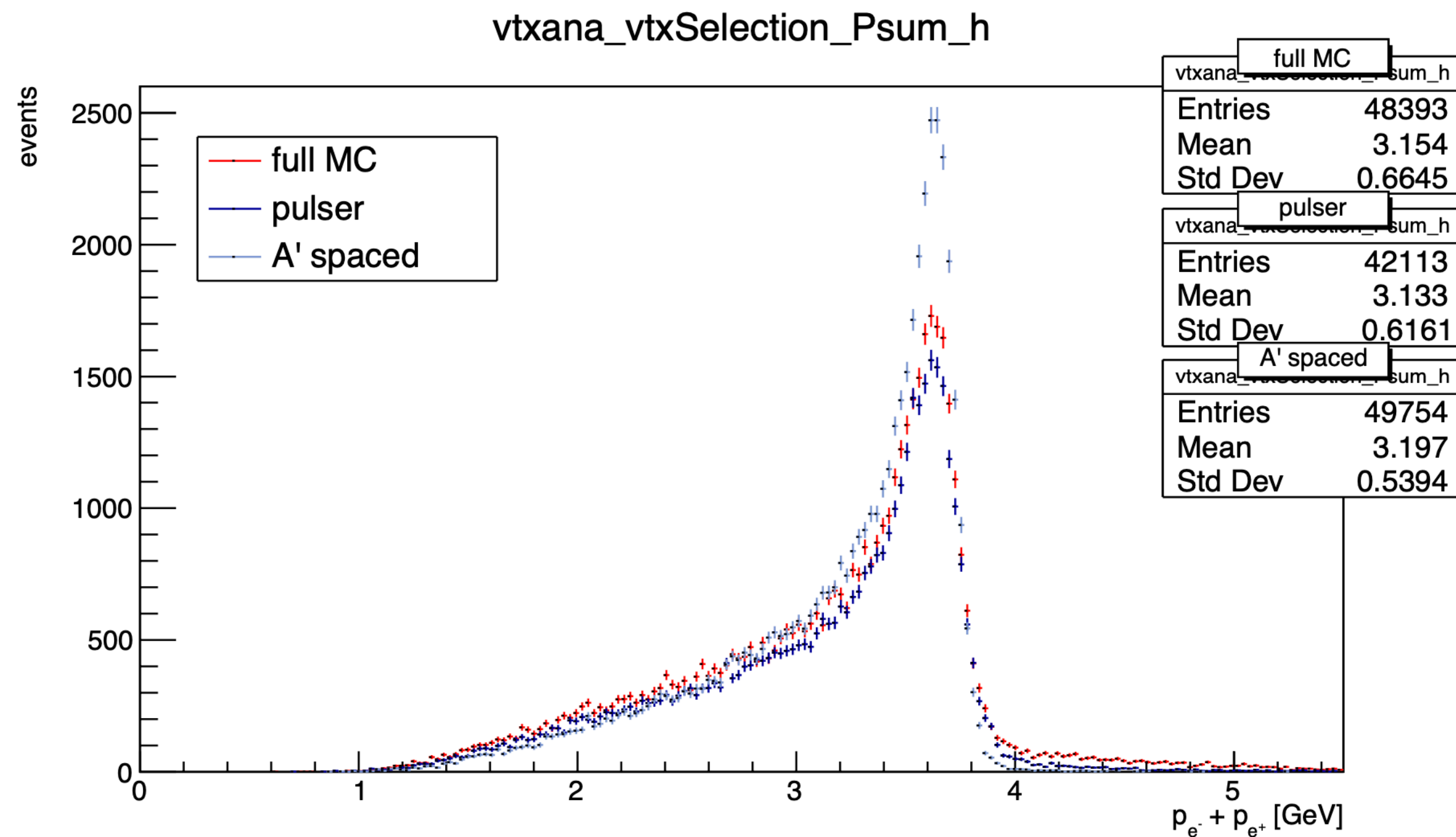
Tight selection

See details for the validation study in Sarah's talk

Issue and fixing for track extrapolation to Ecal by Lewis, Maurik, PF, etc

Track at the ECal compared to MC scoring plane at ECal scoring plane (blue).
Extrapolation from last tracker scoring plane to ECal scoring plane (magenta)
The extrapolation is simply a straight line in the direction of the MC truth momentum to the ECal scoring plane.
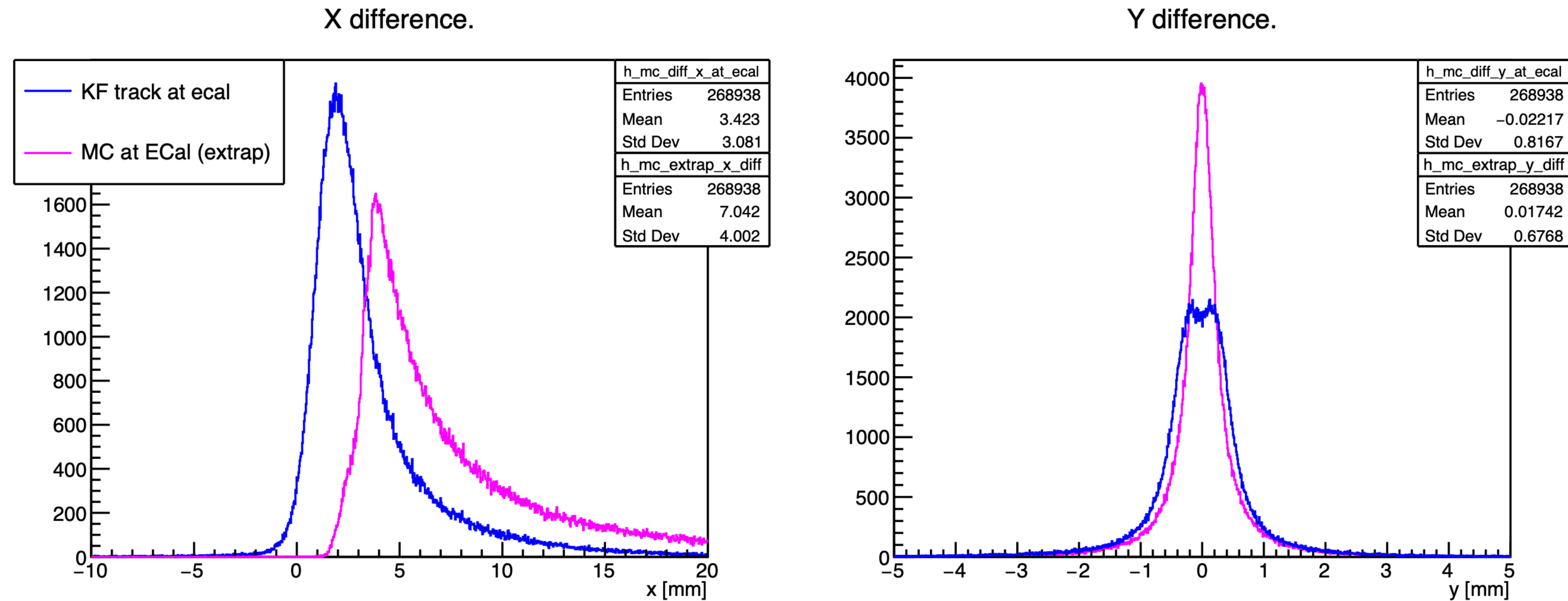
Plots from Maurik

See details for issue and fixing in Lewis's talk

Plans

- 2016 MC with pulser data merging:

  - Update for the new readout system was done, and PR was submitted by Sarah last week

  - Validation and comparison with MC beam as background by tritrig samples

  - Production of full new samples with the new readout system, including tritrig, rad, wab, A', SIMP with pulser data as background

- Production of new samples for 2019 & 2021 MC: should be discussed with analysis/calibration groups in workshop

  - What samples for calibration?

  - Wait for final 2019/2021 detectors for new sample production for analysis?

  - Final approval to apply the new readout system with pulser data merging for production of large-statistic samples?

- OSG?