JME Trigger: status report

Santiago Rafael Paredes Saenz, Pallabi Das* for JME

5th HLT Upgrade Workshop

14/12/2021

Introduction

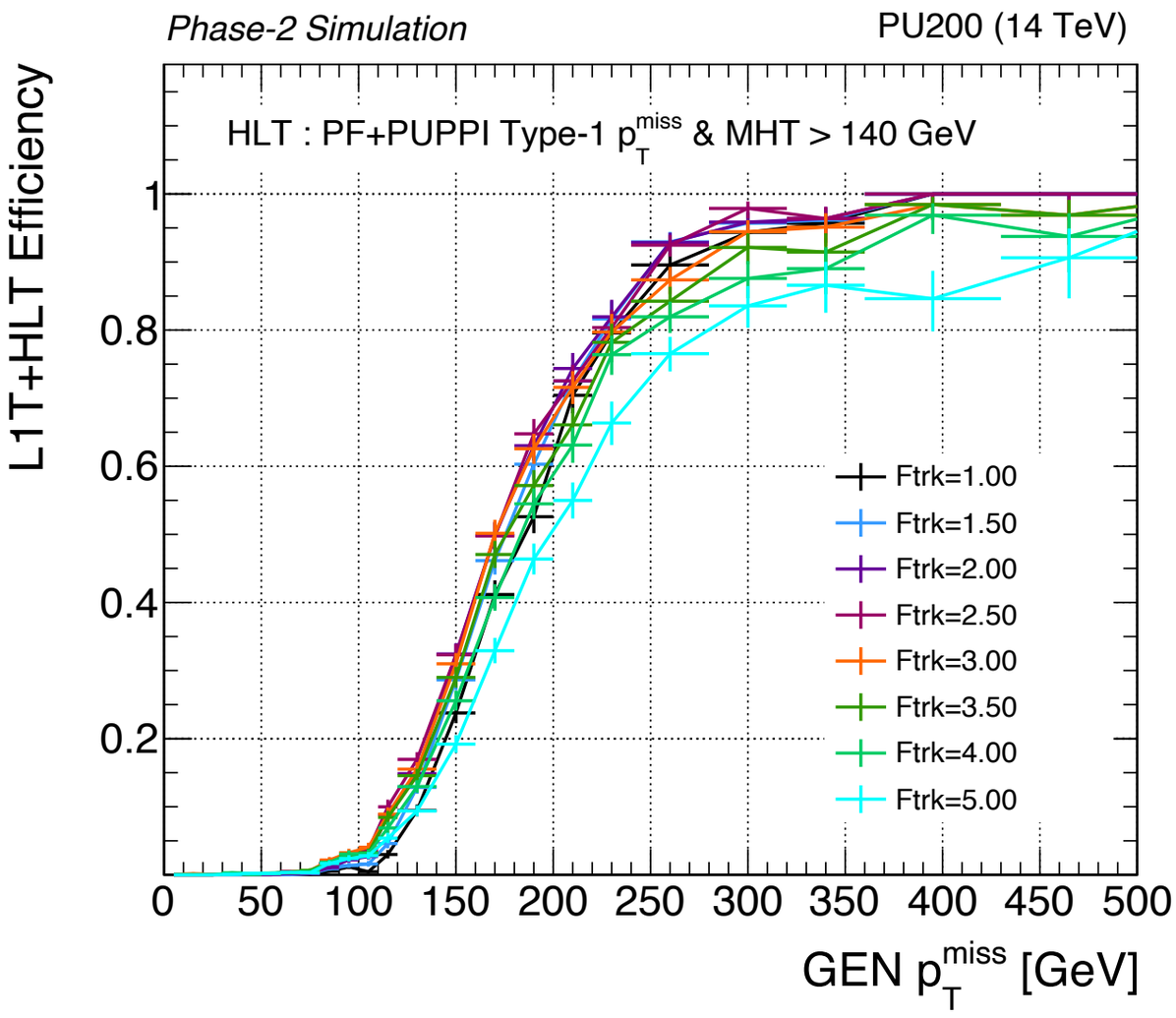
- Phase-2 HLT TDR work is completed
  - Final LHCC UCG approval happened at the end of August
  - Some follow up tasks remain, to be offered along with EPR in 2022
- MET trigger performance as a function of tracking thresholds
  - First study reported in September
  - For PU200 sample, a slight increase of track thresholds improved behaviour in MET trigger efficiency turn-on, whereas efficiency is observed to worsen in case of NoPU sample
  - For large increase in threshold, both samples show consistent worsened efficiencies
  - We have tried few more thresholds with the PU200 sample to understand the transition
- MTD timing studies
  - For understanding the effect of pileup by studying time distribution in reconstructing jets that are matched or unmatched to MC truth

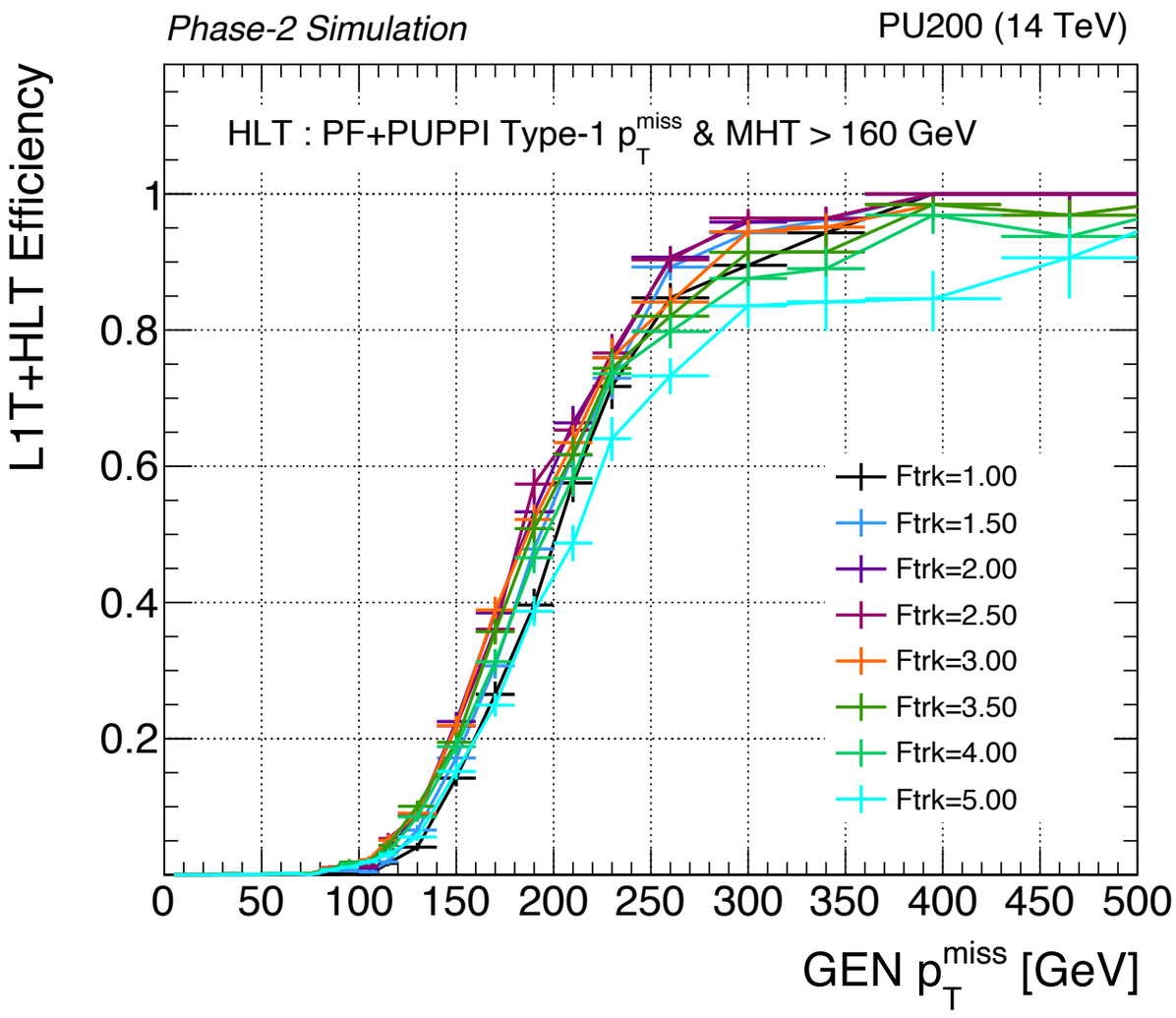
Setup for varying track-p_T thresholds

```
scramv1 project CMSSW CMSSW_11_1_8
cd CMSSW_11_1_8/src/
cmsenv
git cms-merge-topic cms-sw:32903
git cms-addpkg FastSimulation/Event
git remote add hatakeyamak https://github.com/hatakeyamak/cmssw.git
git fetch hatakeyamak
git diff 0cf67551731c80dc85130e4b8ec73c8f44d53cb0^
0cf67551731c80dc85130e4b8ec73c8f44d53cb0 | git apply
mkdir -p HLTrigger
git clone https://github.com/veelken/mcStitching.git HLTrigger/mcStitching
git clone https://github.com/missirol/JMETriggerAnalysis.git -o missirol -b
phase2
scram b -j 10
```

- MC sample: /VBF_HToInvisible_M125_14TeV_powheg_pythia8_TuneCP5/ Phase2HLTTDRSummer20ReRECOMiniAOD-PU200_111X_mcRun4_realistic_T15_v1-v1/FEVT
- The track-p_T threshold is modified from the default value (0.9 GeV) using a scale-factor (Ftrk)

L1+HLT MET trigger efficiencies

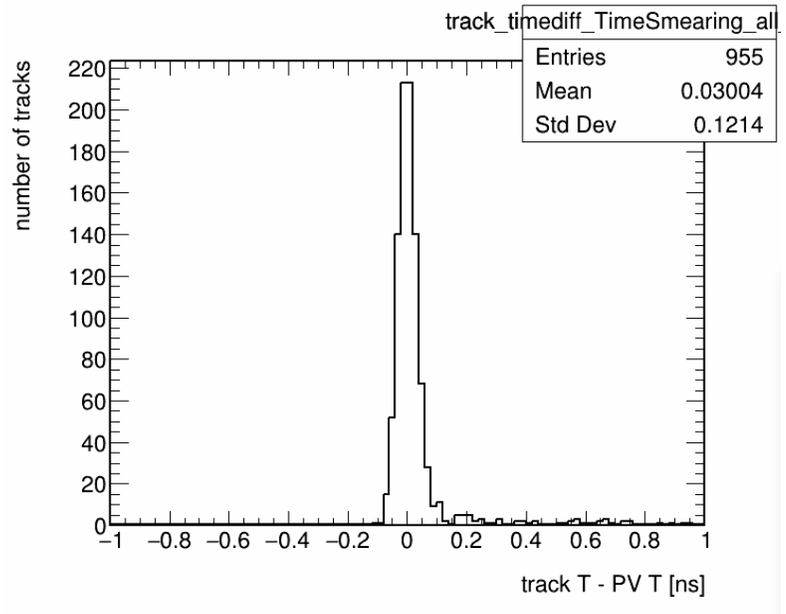


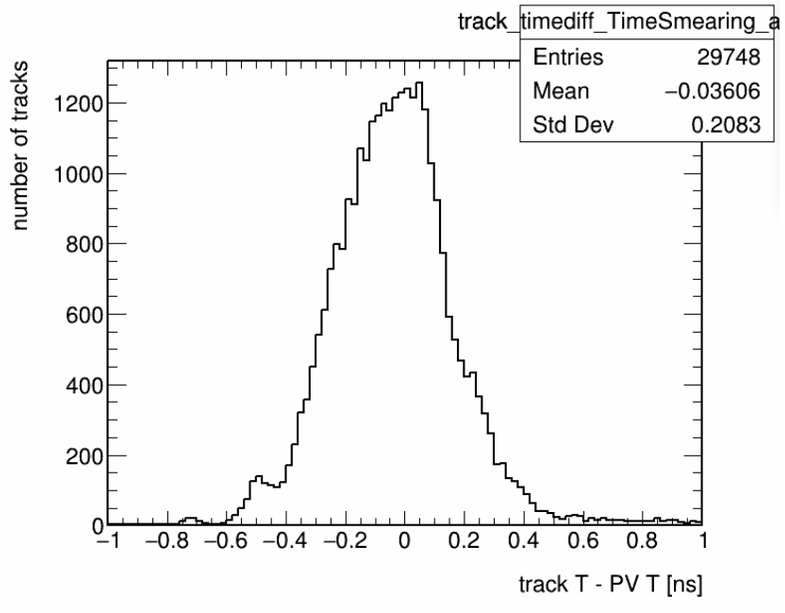


- For all MET+MHT triggers the transition from better to worse efficiency seems to happen at the track-p_T threshold ~2.25 GeV (Ftrk = 2.5)

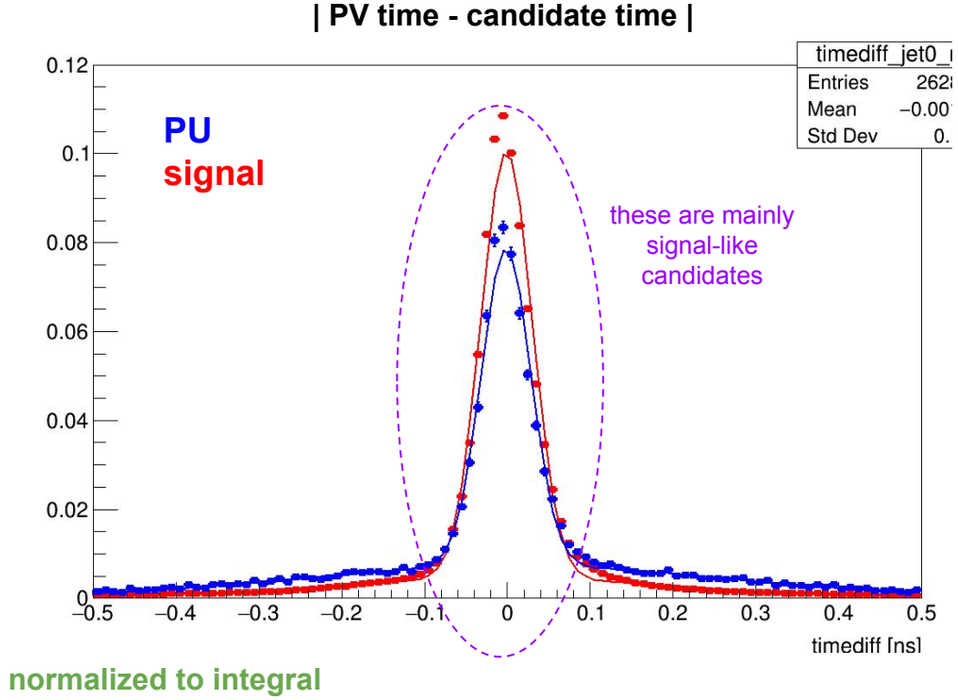
MTD timing for HLT jets (1)

- Key question: how do we define jet reconstruction time?
  - e.g. some kind of weighted average of timing of the PFCandidates associated with the jet?
- There has been some preliminary exploration of offline jets, a possible use-case is to identify non-PU jets from PU jets
- Use in PU jet id is promising on simulated jet constituents, but this hasn't been observed yet for more realistic cases





studies done using Puppi jets, Delphes simulation: [1]



MTD study of VBF HH→4b [2]

MTD timing for HLT jets (2)

- These studies are still at a very early stage
- At this point, analysers don't see any benefit from using the MTD timing info, at least for CHS jets and the current Puppi collection
- Further studies with Puppi and dedicated tuning are ongoing
- For HLT jets, we simply want to derive the reconstruction time as a fist step, before moving to jet ids, which involves:
  - Including MTD timing *trackExtenderWithMTD* info to our samples
    - big thanks to Soham Bhattacharya for helping with this step! MINIAOD available here: /eos/cms/store/group/phys_egamma/sobhatta/egamma_timing_studies/samples/QCD_Pt-15to3000_TuneCP5_Flat_14TeV-pythia8_Phase2HLTTDRWinter20DIGI-PU200_castor_110X_mcRun4_realistic_v3-v2_GEN-SIM-DIGI-RAW_2021-12-06_23-04-36/*
  - Updating the JMETriggerAnalysis's upgrade branch to retrieve the variables
    - no recipe for HLT level yet (as far as we know!)
    - start only by using offline jets as a first check? (this is what other groups have started with)

Other follow-up ideas for Phase-2

- Study jets/MET reconstruction using reduced inputs:
  - trimmed tracking configuration
  - pixel-only PF approach
  - regional and/or calo-only reconstruction
- Design filters to pre-select events before running full-tracking and HGCal reconstruction to improve timing, perform local reconstruction around L1 seed
- Improve MET rate
- Testing and integrating developments from other POGs with time

Summary

- Studied variation of MET trigger efficiencies with track-p_T thresholds in the high PU sample
- Identified the threshold where the best efficiency is achieved (2.25 GeV compared to default 0.9 GeV)
- Overview of ongoing MTD timing studies on offline jets are given, no recipe for HLT jets exist yet
- In order to carry forward the Phase-2 effort person-power is crucial, JME trigger group welcomes those interested to contribute (EPR task in 2022): join us!