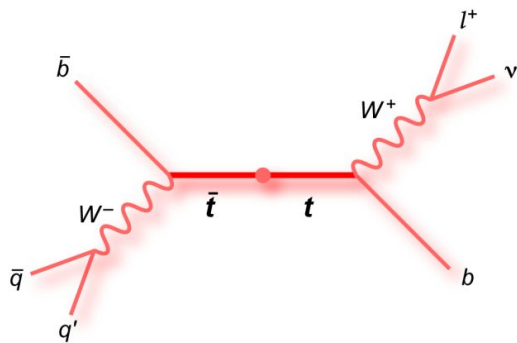
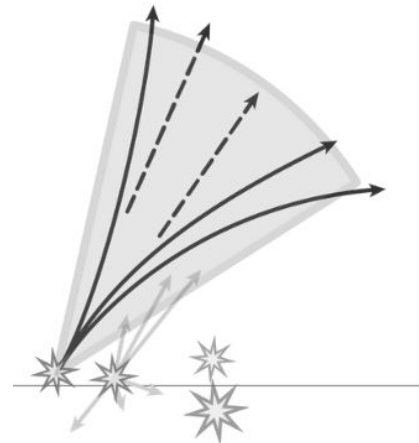


# Status update



...

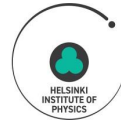
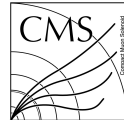
Mikael Myllymäki  
 ProjekTiistai  
 4 October 2022



# Overview

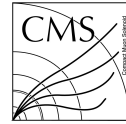


- FullSim variation studies
  - Switched to UL18 MiniAODv2 samples
  - JER hadron calibration studies for Juska and Andrea
- Top Analysis
  - Mostly focusing on top analysis and on understanding the profile likelihood method and Combine
  - CP5 tune studies with Zqq
- Tier2 work
  - Slowly progressing with adding new nodes to configuration
- Other activities
  - Top JetMET contact work ending in few months, starting to guide Seungkyu Ha
  - IPP1 assistant work started smoothly with Kimmo's guidance
  - Some courses also still for the autumn
- TOP2022 conference report

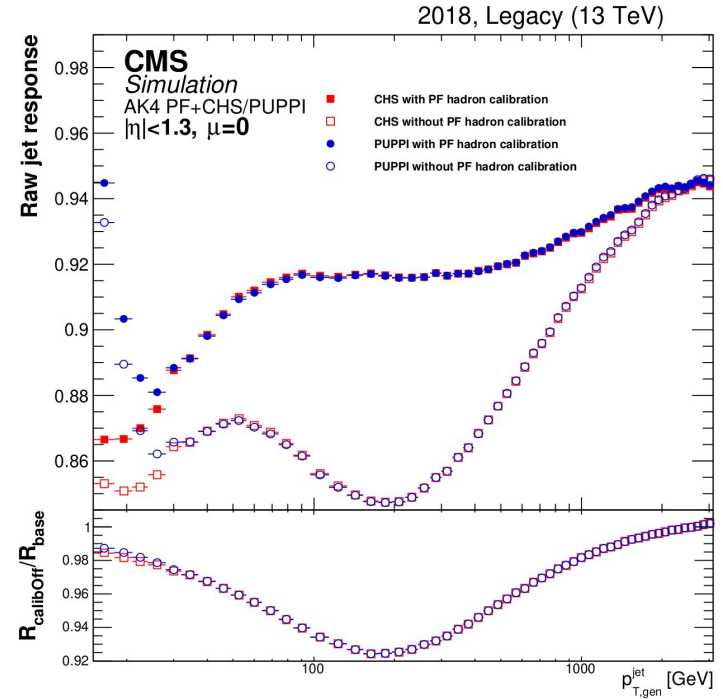


# FullSim studies

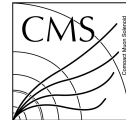
# Hadron calibration studies



- Turning off the PF hadron calibration and observing the effect on reconstructed jets
- FullSim variation framework
- using McM by PdmV to browse samples:  
<https://cms-pdmv.cern.ch/mcm/>
- private simulation using official configuration files
- reconstruction steps
  - GEN -> SIM -> DIGI -> HLT -> RECO -> MINIAOD
- possible to implement variations in different steps and observe the effect on MiniAOD level
- also we have studied
  - L2L3Residuals: ECAL scale / HCAL scale / tracking efficiency variations at RECO step
  - top mass: Pythia8 parameter variations at GEN step

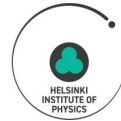
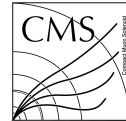


# PF hadron calibration study setup

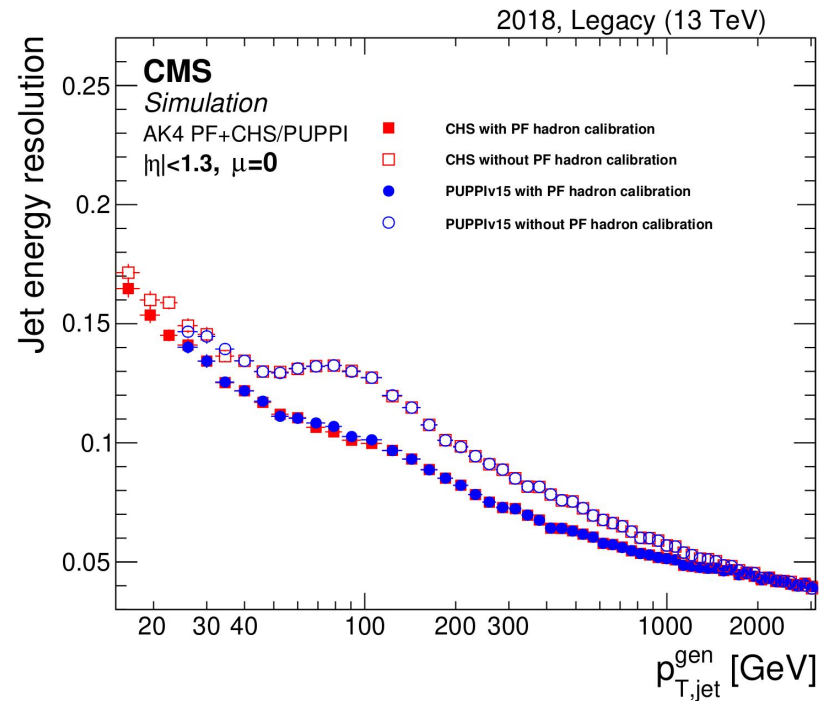


- re-reconstruction of epsilonPU UL QCD samples
  - /QCD\_Pt-15to7000\_TuneCP5\_Flat2018\_13TeV\_pythia8/RunIIISummer19UL16MiniAOD-EpsilonPU\_106X\_mcRun2\_asymptotic\_v13-v2/MINIAODSIM
  - /QCD\_Pt-15to7000\_TuneCP5\_Flat2018\_13TeV\_pythia8/RunIIISummer20UL18MiniAODv2-EpsilonPU\_106X\_upgrade2018\_realistic\_v16\_L1v1-v2/MINIAODSIM
- commented hadron calibration from PFAIgo.cc
  - ```
//calibration_ ->energyEmHad( trackMomentum,calibEcal,calibHcal,  
//                               clusterRef->positionREP().Eta(),  
//                               clusterRef->positionREP().Phi() );
```
  - re-run RECO and MINIAOD steps
- CMSSW\_10\_6\_X
- minimal selections
  - selecting all jets with matching genJet
  - mu/e fraction < 0.2
- compare **raw** jets from the baseline and the hadCalibOff variation

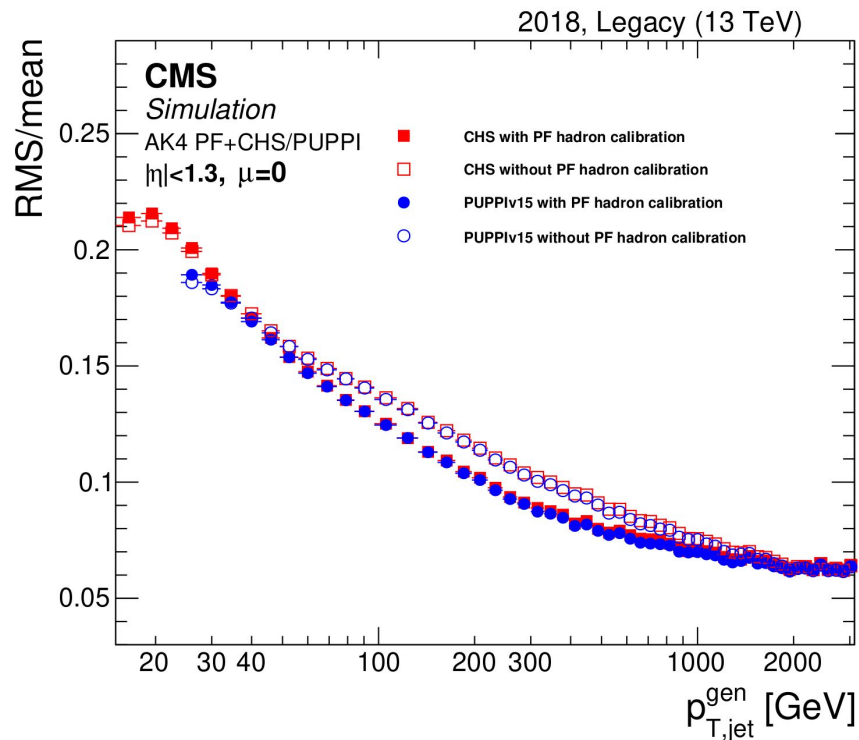
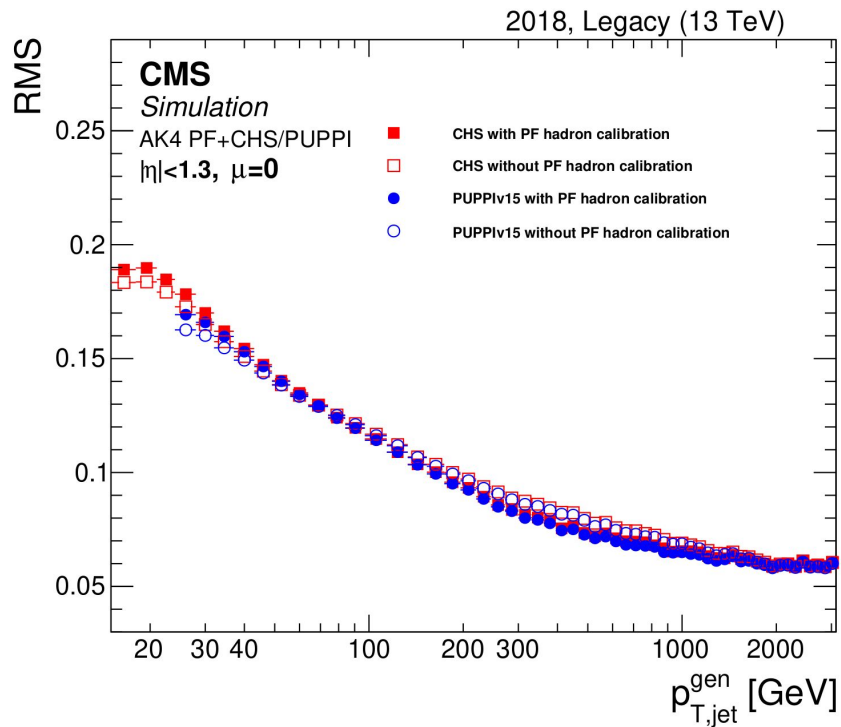
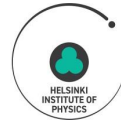
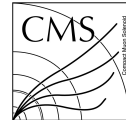
# UL18 pt-dependent



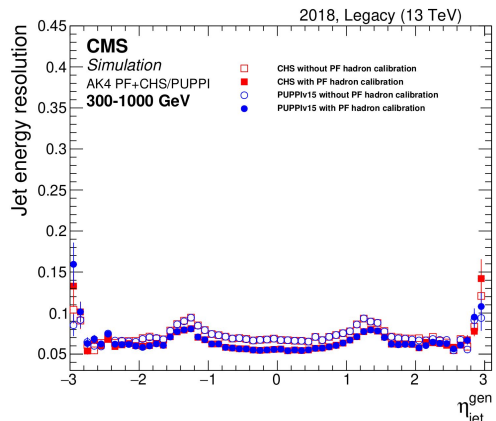
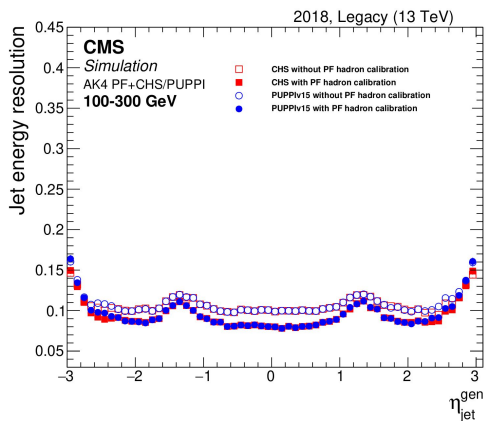
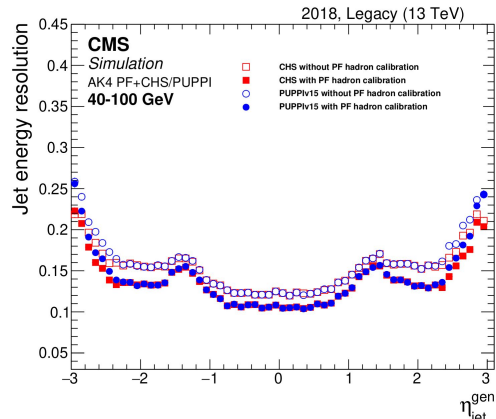
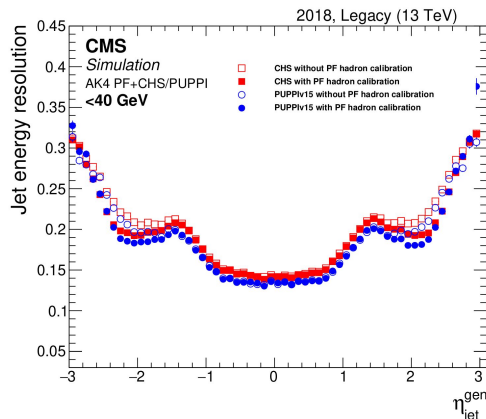
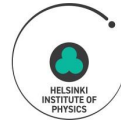
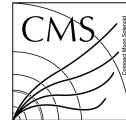
- ~2M events
  - /QCD\_Pt-15to7000\_TuneCP5\_Flat2018\_13TeV\_pythia8/RunII Summer20UL18MiniAODv2-EpsilonPU\_106X\_upgrade2018\_realistic\_v16\_L1v1-v2/MINIAODSIM
- PUPPIv15 tune matching nicely, previous tune had large disagreements



# UL18 RMS



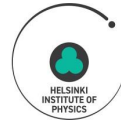
# UL18 eta-dependent





# Top Analysis & CP5 tune studies

# Top Analysis



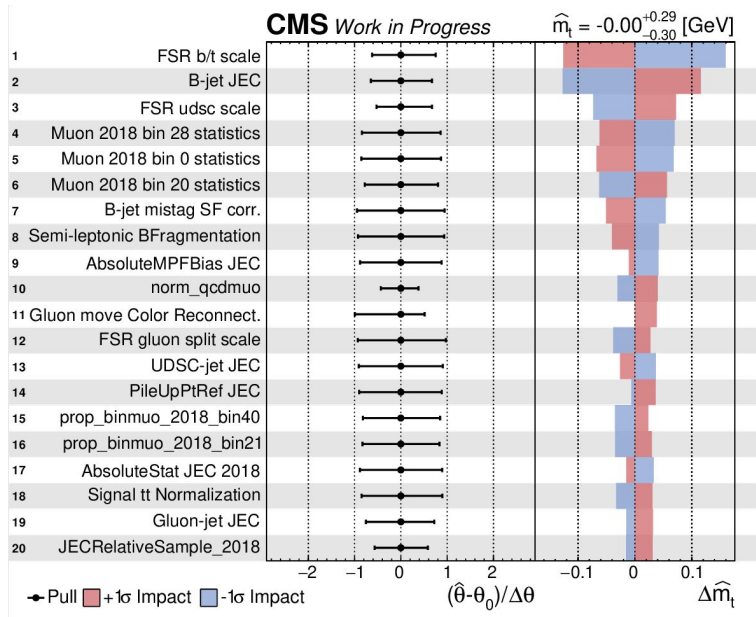
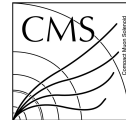
- Focusing on understanding the profile likelihood method and Combine
- Reproducing Hannu's UL1718 results
- Simple tests: for example switching off some statistical uncertainties and plotting impacts
- Starting to configure also UL16 for Combine at least for an educational purposes

- Likelihood function:

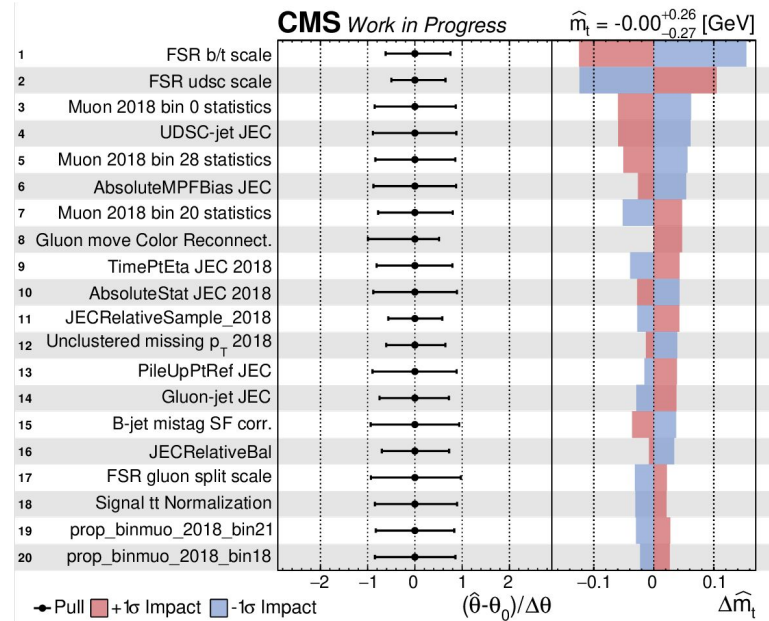
$$\mathcal{L}(\vec{n}) = \prod_{i \in \text{bins}} \mathcal{P} \left( n_i \mid \sum_{j \in \text{samples}} (1 + \kappa_j)^{\eta_j} \times \nu_i^j(\vec{\theta}, m_t) \right) \\ \times \prod_{k \in \text{nuisances}} \mathcal{G}(\theta_k) \times \prod_{j \in \text{samples}} \mathcal{G}(\eta_j).$$

- $m_t$  is our parameter of interest (POI)
- Systematic uncertainties introduce gaussian constraints
- For impact plots Combine varies each nuisance by +-sigma and output the effect of the nuisance on our POI ->  $m_t$  shifts

# Top Analysis

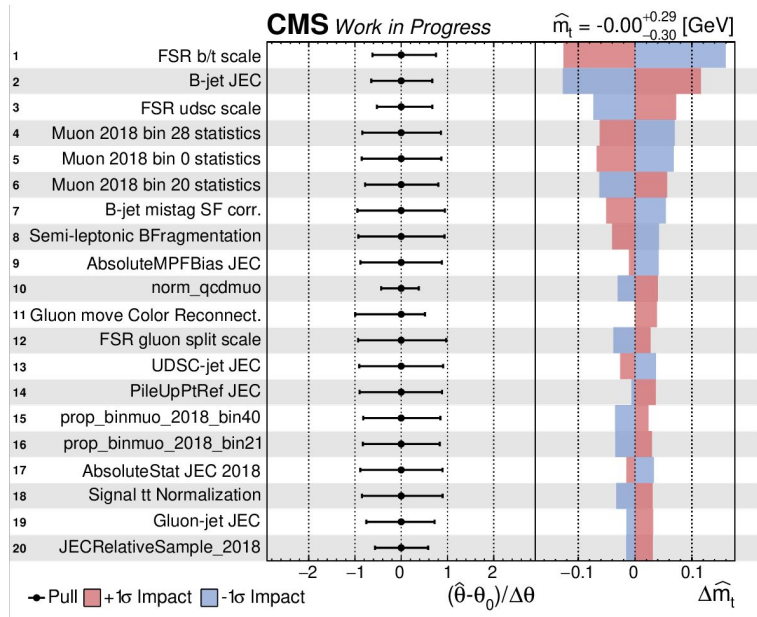


baseline

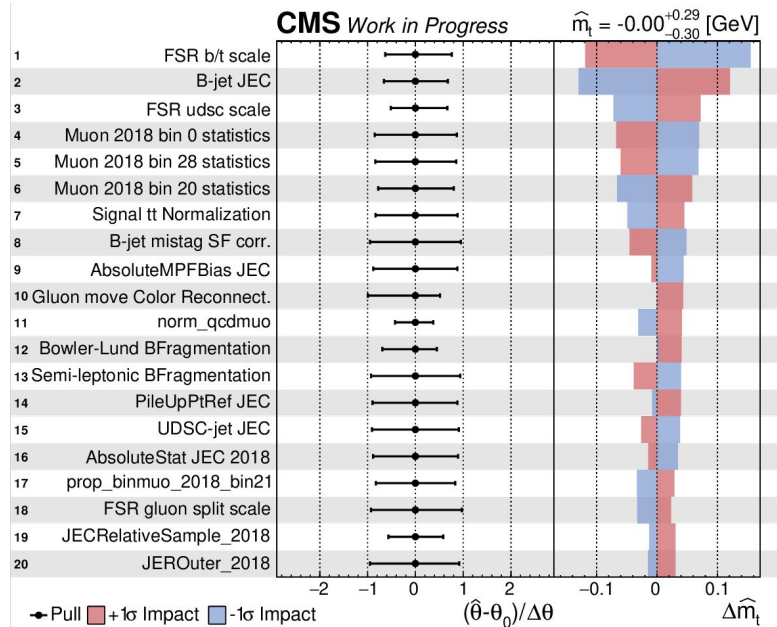


no BJEC uncertainty

# Top Analysis

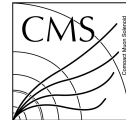


baseline



dilepton channel uncert. off

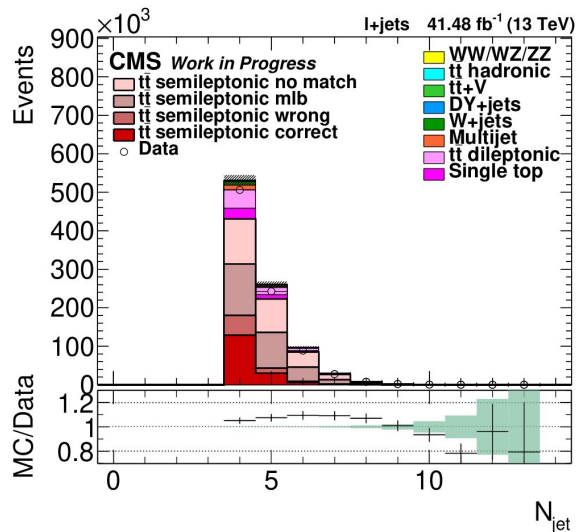
# CP5 tune studies



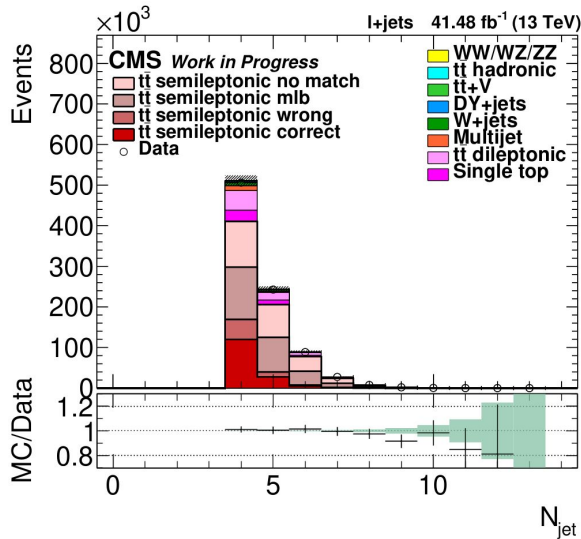
- Indication from Hannu and some other results that  $\alpha_S$  FSR value in CP5 tune might be off
- Variations
  - $\alpha_S$  value = 0.118  $\rightarrow$  0.127
  - TimeShower: $\alpha_S$ useCMW=on  
 $\rightarrow$  has similar effect
- Number of jets spectrum in  $t\bar{t}$  semileptonic channel
- Simple and effective Z-boson mass peak study in GEN level
  - Tune should not change the Z-boson mass peak drastically

# Number of jets spectrum

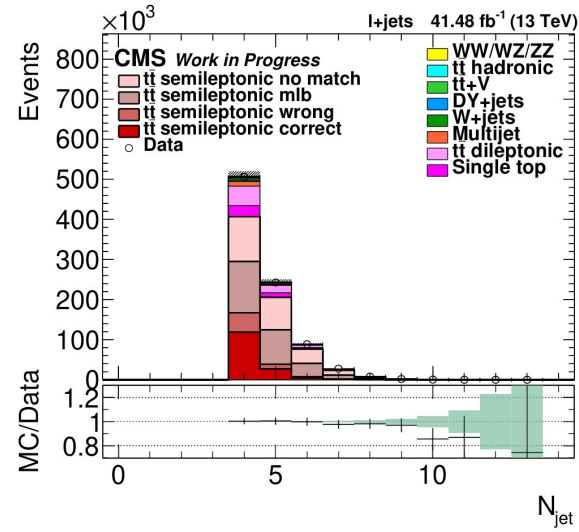
- Variations for UL17 ttbar semileptonic mt analysis
- Initially observed better agreement with FSR scale down variations ( $\alpha_S$ )
- Plots from Hannu



baseline

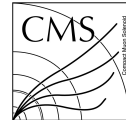


$\alpha_S=0.127$

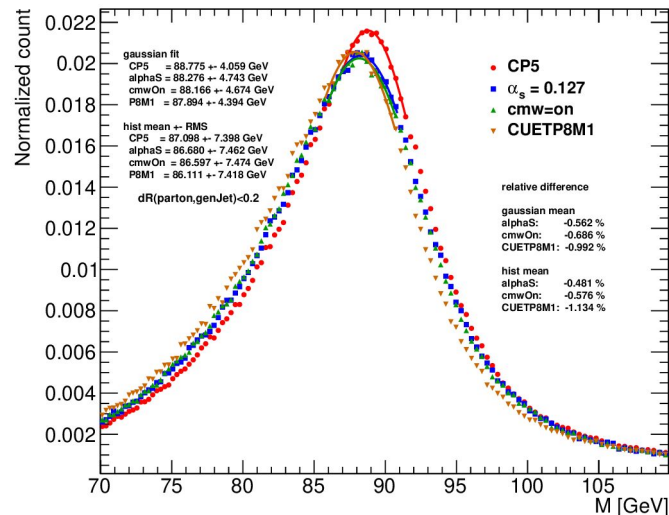
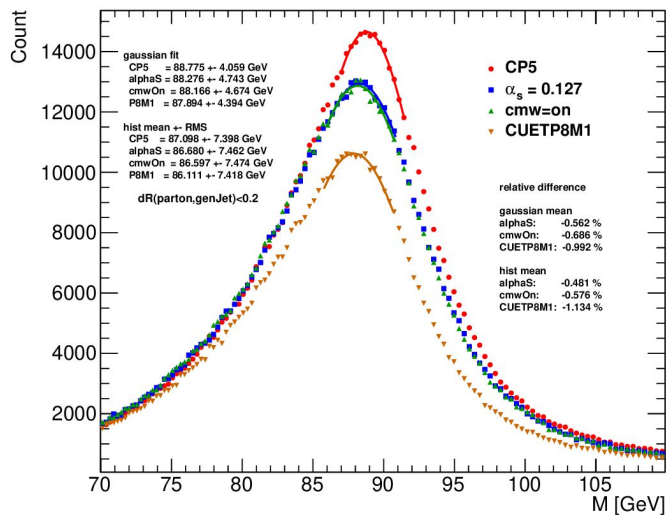


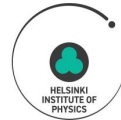
cmw=on

# Zqq mass peak



- Getting two parton-level quarks and plotting/fitting the mass peak
- Including also earlier CUETP8M1 tune for comparison
- Clear shift in mass peak with different tunes
- Hannu is combining the evidence for a report

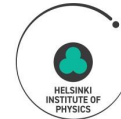




# TOP2022 in Durham



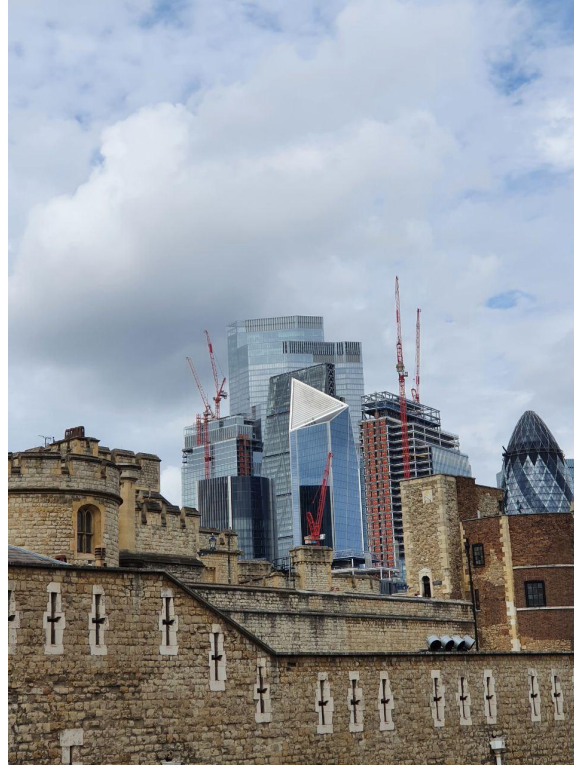
# TOP2022



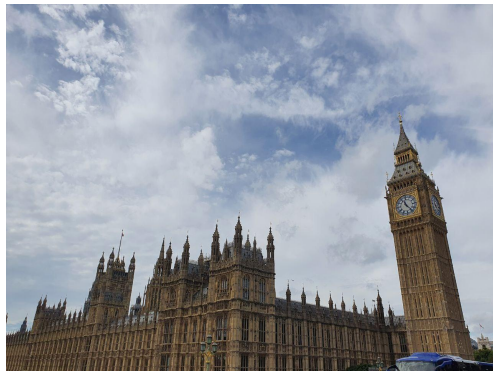
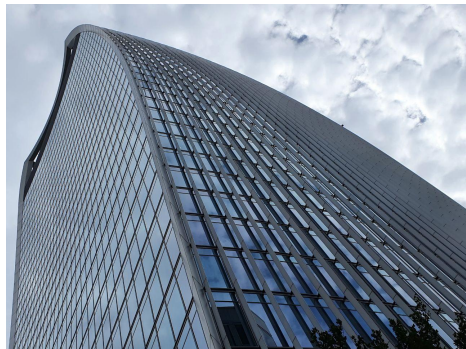
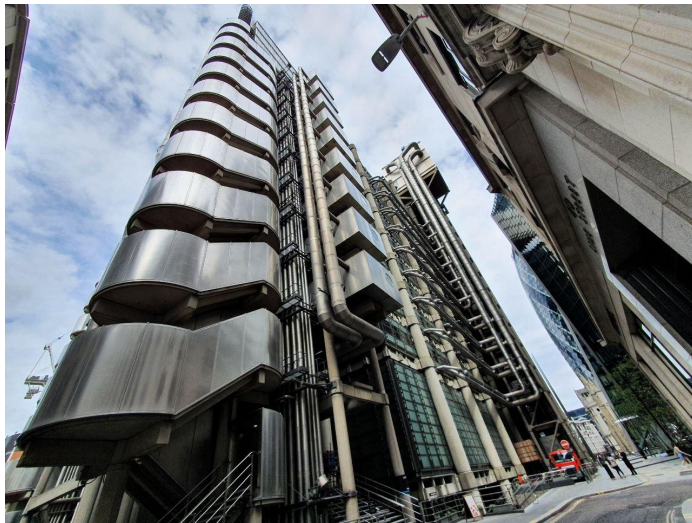
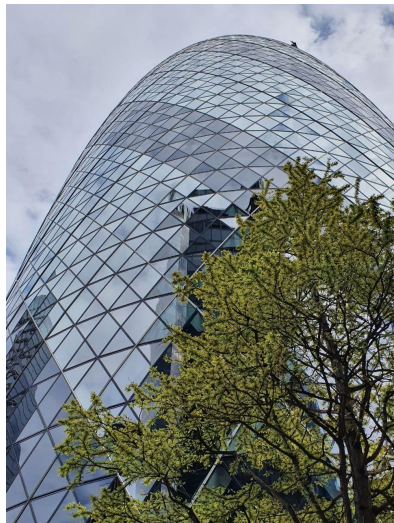
- [Durham 04.-09.09.](#)
- Flew to Heathrow on 4th
- Few hours in London and train to north
- 5 days in Durham and back to London on 9th
  
- Interesting discussions
  - CMS / ATLAS / theorists
  - Hamburg Legacy 16 top mass measurement
  - new uncertainty from ATLAS?
  - [first Run3 ttbar cross-section result from CMS](#)
- Extremely useful for me at this point



# London sightseeing



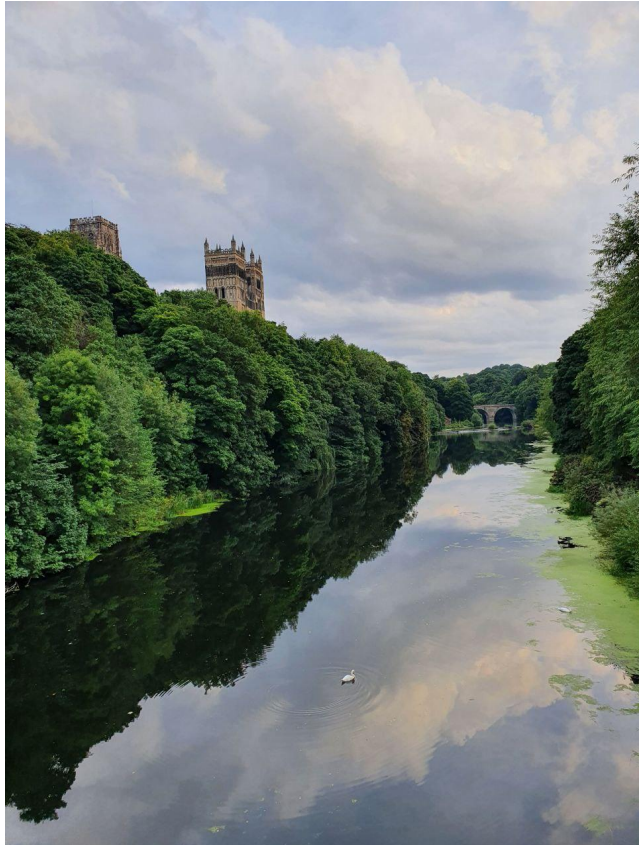
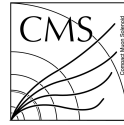
# London



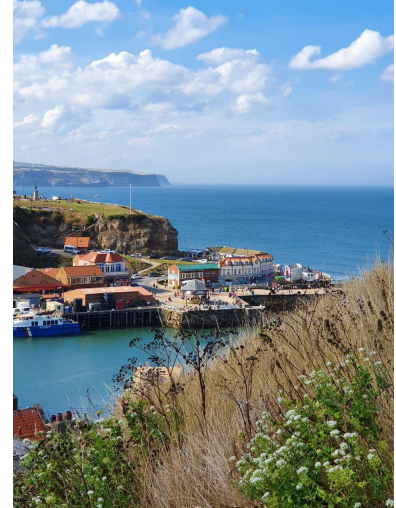
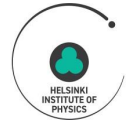
# Train to Durham



# Durham



# Conference trip to Whitby Abbey



# Dinner at Durham castle



# Queen's death





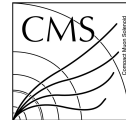
# Buckingham Palace



# Buckingham Palace



# Summary



- Different interesting analyses ongoing
  - Top mass analysis with Hannu
  - CP5 tune studies
  - FullSim analyses with Mikko and Juska & Andrea
  - Tier2 with Tomas - trying to get new nodes up and running
- Really useful and memorable trip to England

