EtaJES in 8TeV p+Pb Collisions - Update

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Outline

- Task: (1) perform JES calibration for 2016 8.16TeV pPb data and (2) test applicability of 2015 PbPb, pp cross-calibration via vector boson+jet events, (3) deriving additional uncertainties if required
- Today: brief summary of results of (1) for both run periods separately, presentation of (new) results for (2)
- Steps for deriving JES from MC provided on twiki

Samples & ‘data’ selection

- 5 JZ slices used for each collision period (JZ1 - JZ5)
- ‘HI’ jet algorithm being used (as opposed to EM, LC, etc.) with only R=0.4 right now
- Select on truth jets outside HEC by at least dR=0.2 (also tried 0.4), in addition to standard cuts (isolation, p_T cuts,…)

Samples Used

- For EtaJES derivation, dijet samples were used:

  2x5 Slices, 40M events: mc15_pPb8TeV.
  42001*.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ*R04.merge.AOD.e651*_s3084_s3153_r9985_r9647

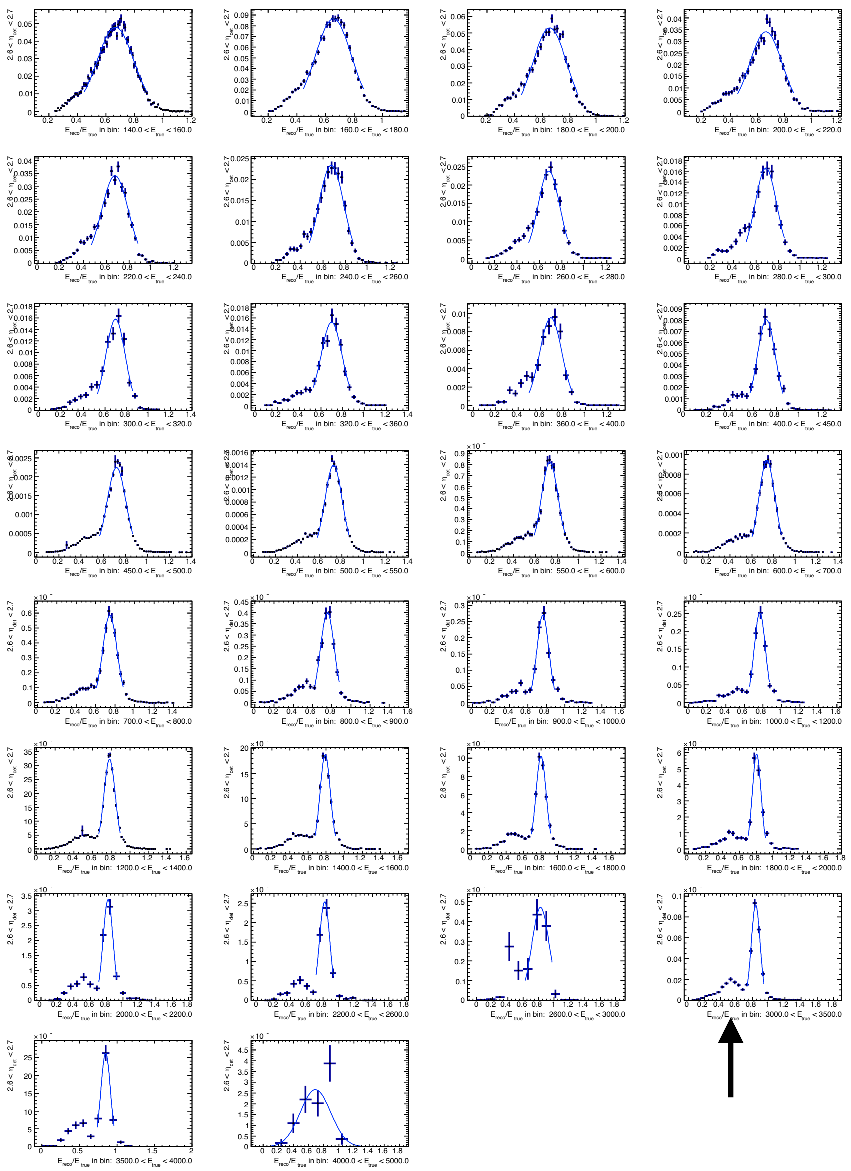
- For cross-calibration checks, Z->ee, Z->μμ and gamma + jet samples were used:

  2x5 files, 1M events mc15_pPb8TeV.
  361106.PowhegPythia8EvtGen_AZNLOCTEQ6L1_Zee.merge.AOD.e536*_s316*_r943*_r9006
  (Note these are signal only pp samples to avoid known issues with egamma calibration - see slides 13,14)

  2 files, 370k Events: mc15_pPb8TeV.
  361107.PowhegPythia8EvtGen_AZNLOCTEQ6L1_Zmumu.merge.AOD.e643*_d146*_r10136_r9647

  2x6 Slices, 12M events: mc15_pPb8TeV.
  42310*.Pythia8EvtGen_A14NNPDF23LO_gammajet_DP*_*.merge.AOD.e544*_e5984_d143*_r9645_r9647

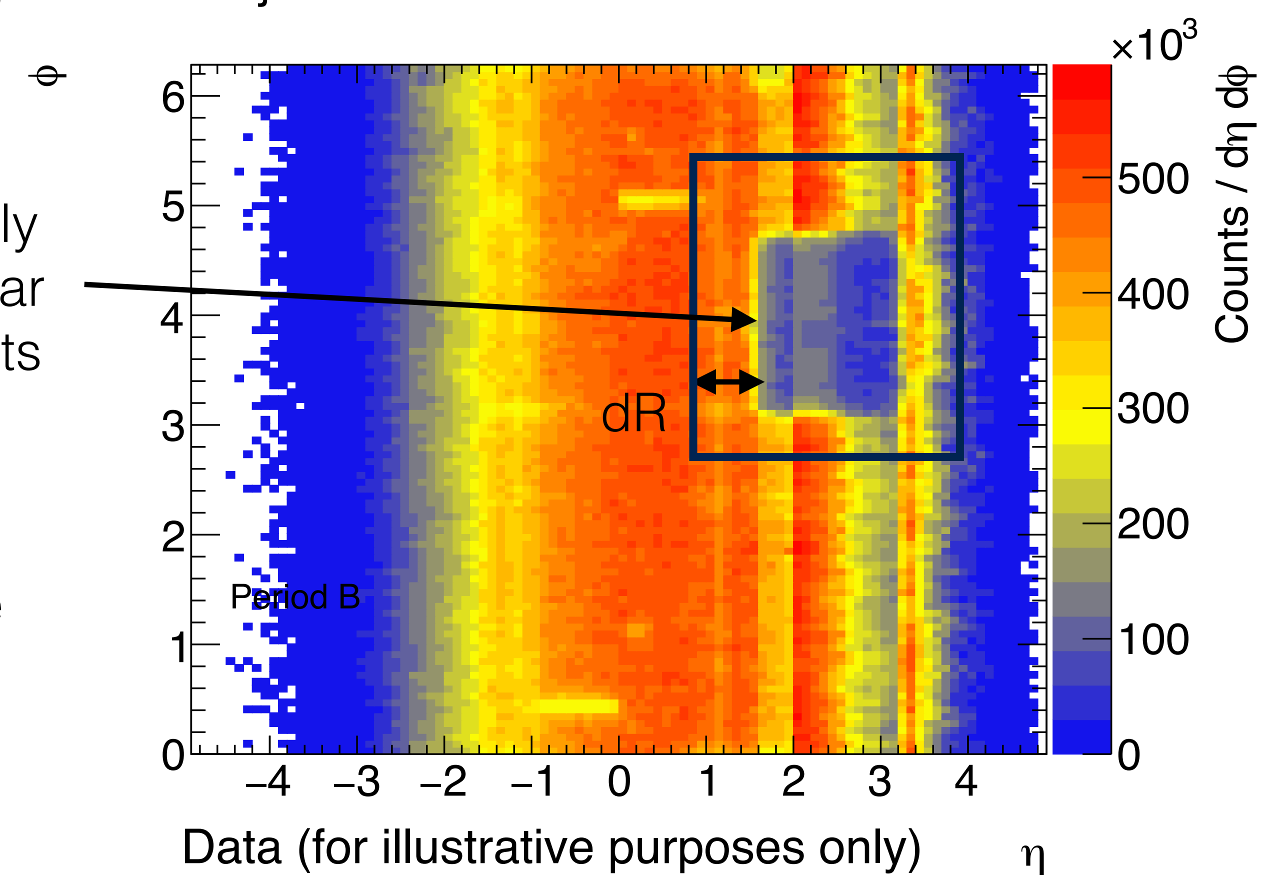
HEC cuts - details



Reco/truth energy, 2.6<η<2.7

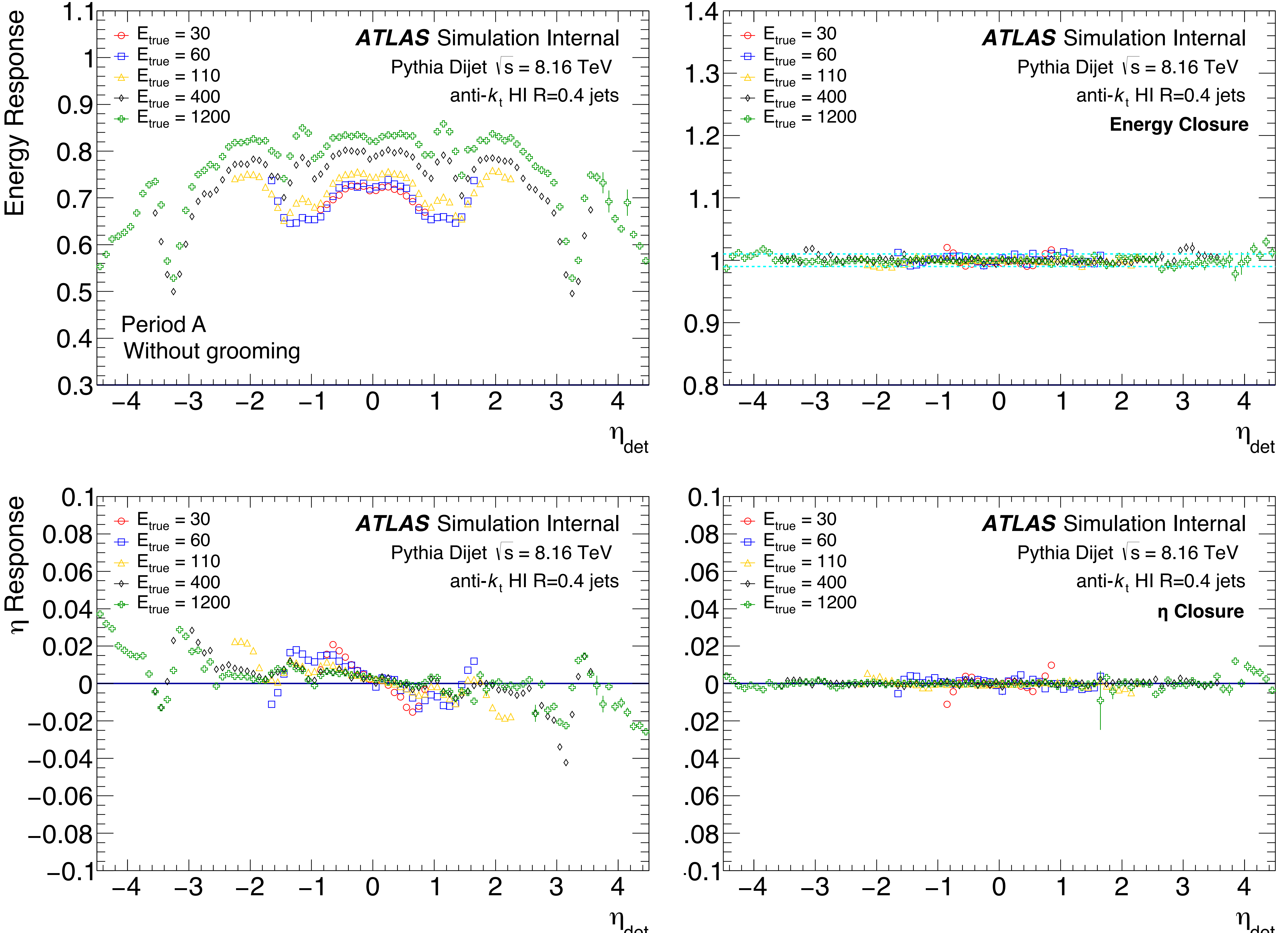
- Double peak observed across truth energy bins in all JES calibrations with ~1.5 < η < ~3.2
- Jet matching inherently flawed from assuming "complete" coverage in η-Φ phase space
  - Truth jet can be matched to much lower p_T reco jet leading to:
  - non-Gaussian features at low truth p_T or
  - possible double peak structure at high truth p_T
- Solution: reject *truth* jets within disabled 'HEC'

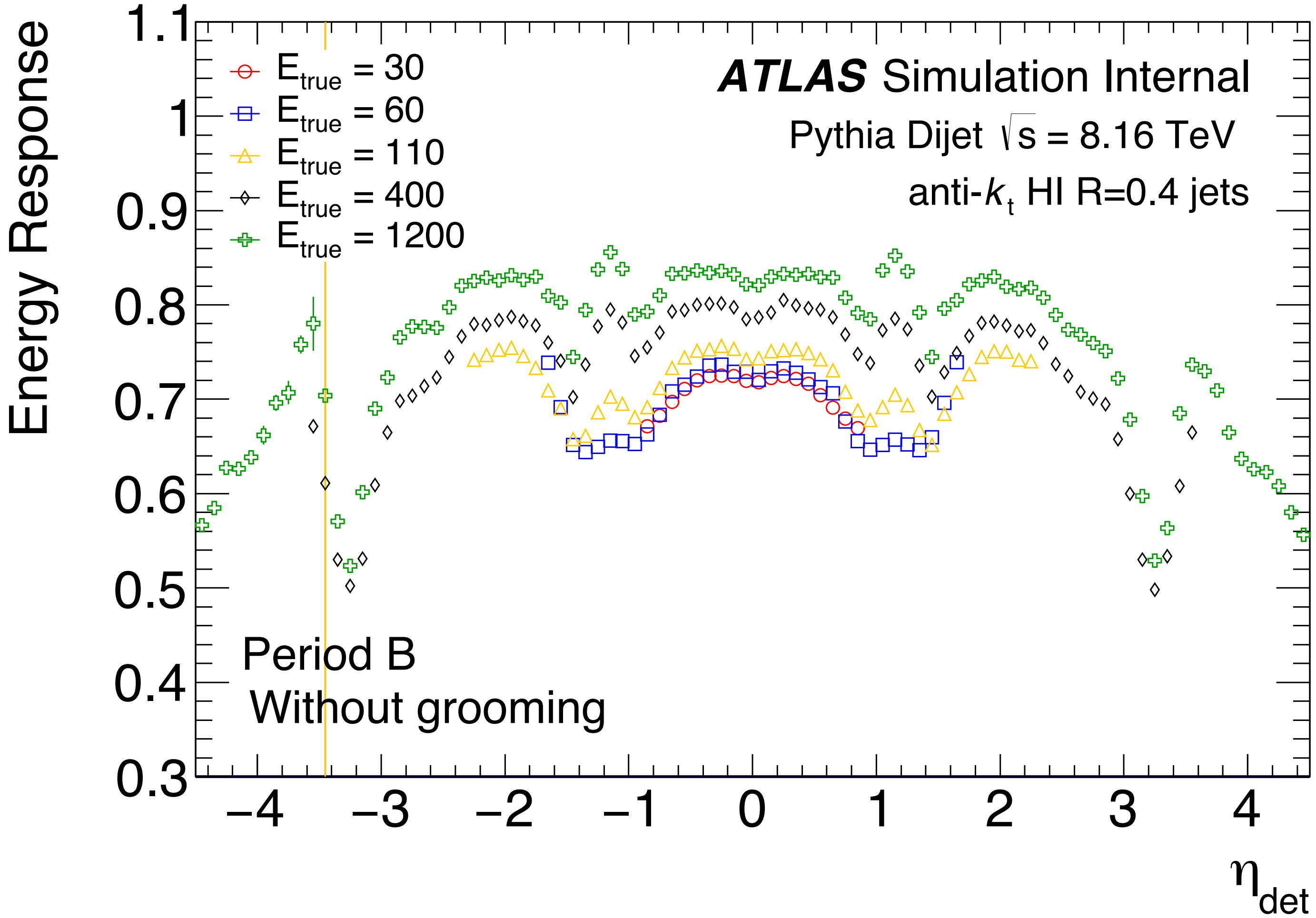
HEC zone clearly evident in angular distribution of jets



Potential bias: jets near the edge of HEC will be reconstructed further away - impose additional dR=0.2 cut on truth jets,

I. EtaJES Calibration Summary Plots


Energy Response
E_true = 30
E_true = 60
E_true = 110
E_true = 400
E_true = 1200
ATLAS Simulation Internal
Pythia Dijet √s = 8.16 TeV
anti-k_t HI R=0.4 jets
Period A
Without grooming
η_det
Energy Closure
η Response
η Closure



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ATLAS Simulation Internal
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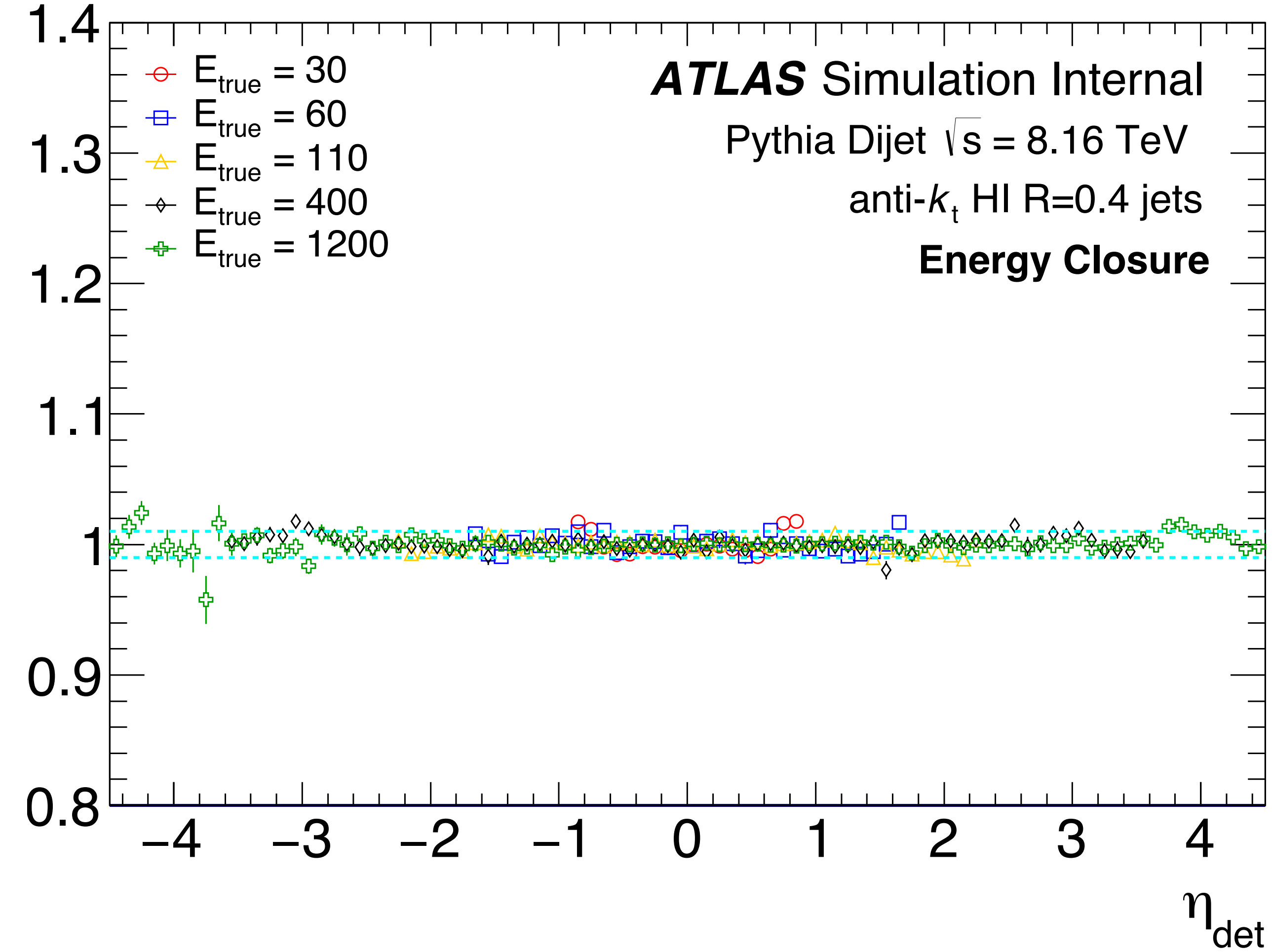
anti-k_t HI R=0.4 jets
Period B
Without grooming
η_{det}



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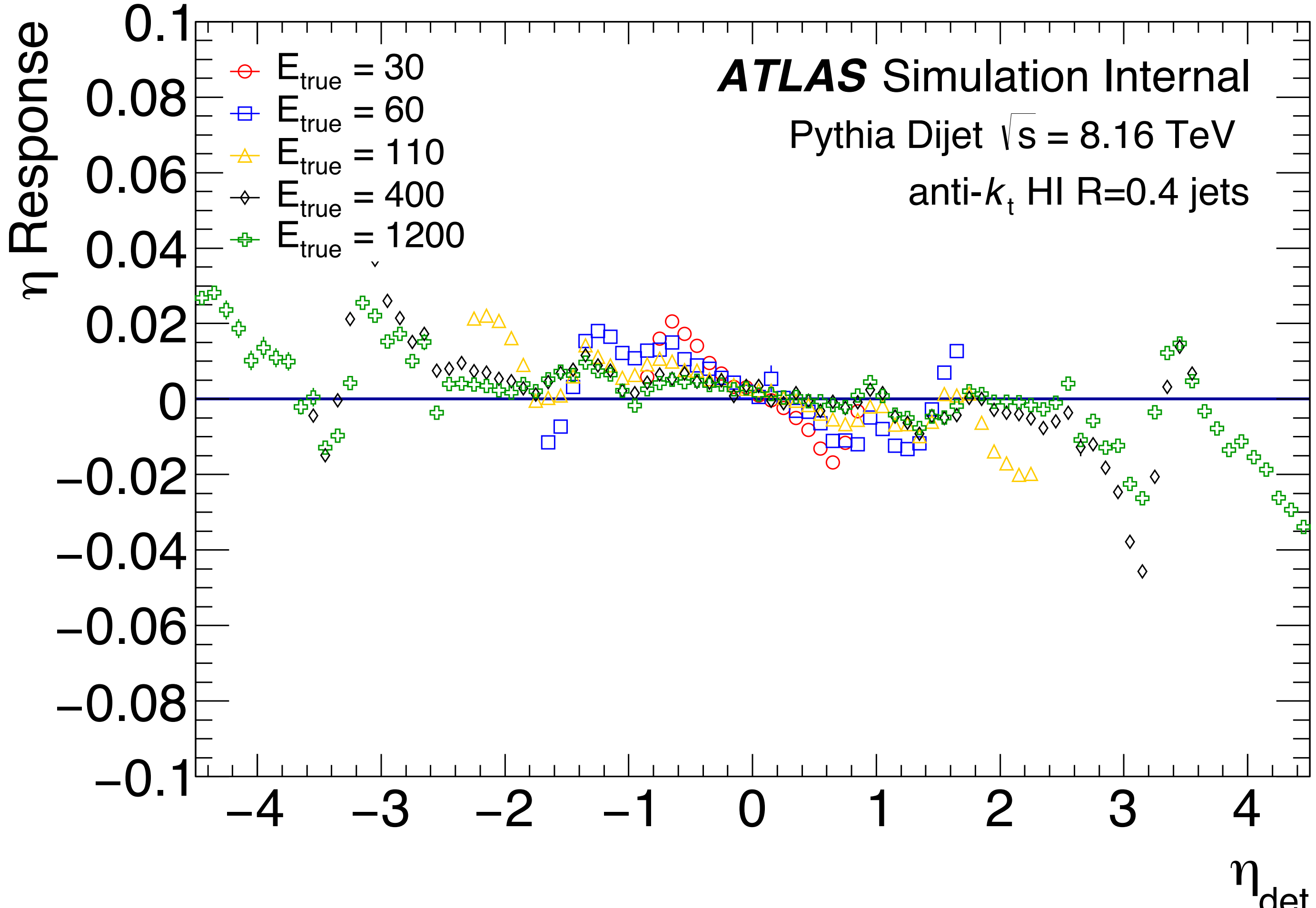
Energy Closure
η_{det}



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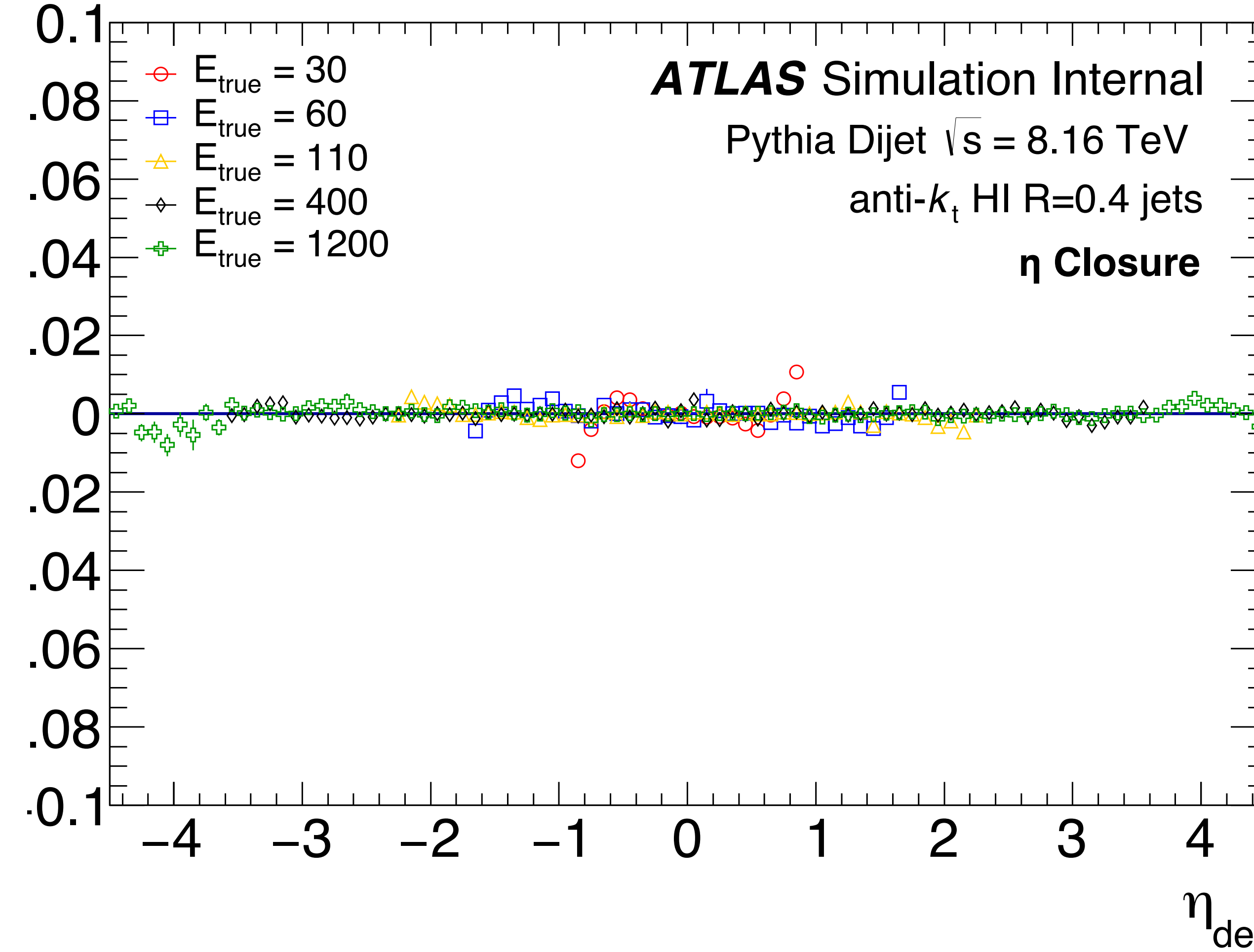

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η Closure
η_{det}

II. Checking the 2015 Cross-Calibration

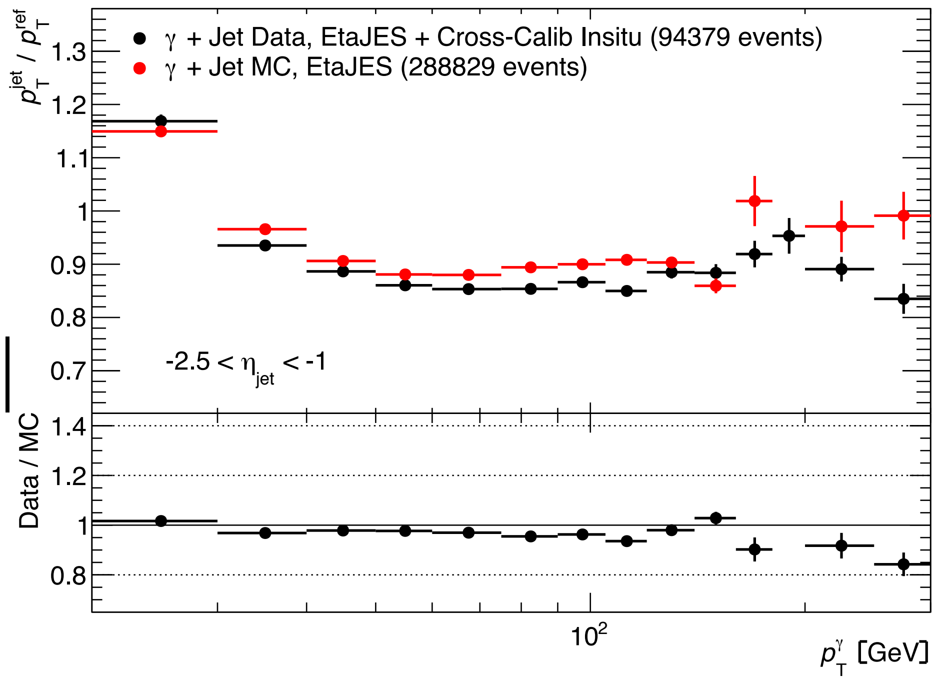
γ +jet Study

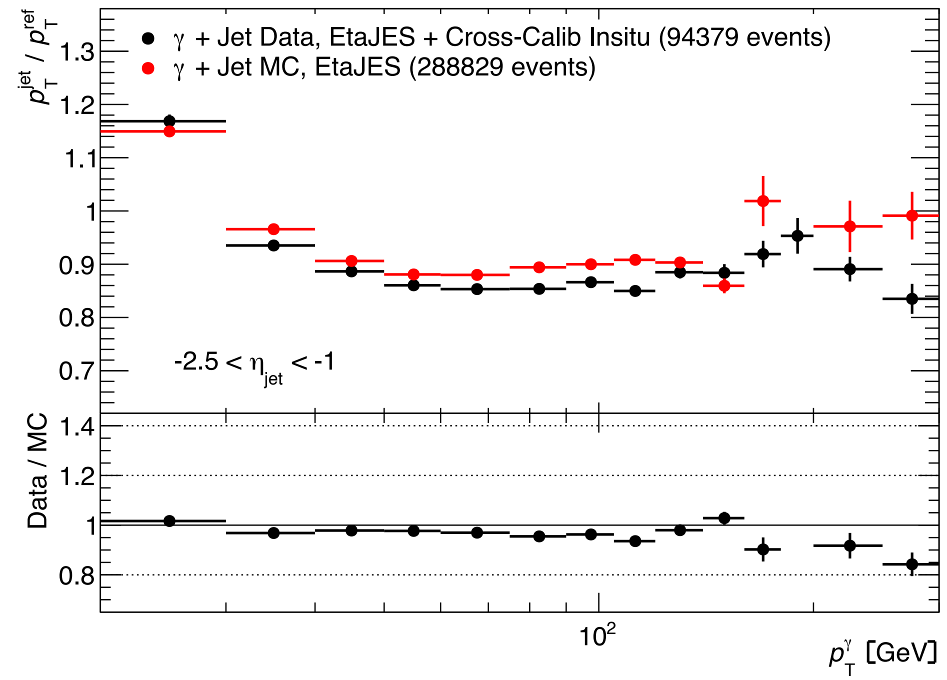
Idea: EtaJES + xCalib V+jet p_T balance compared in data & MC

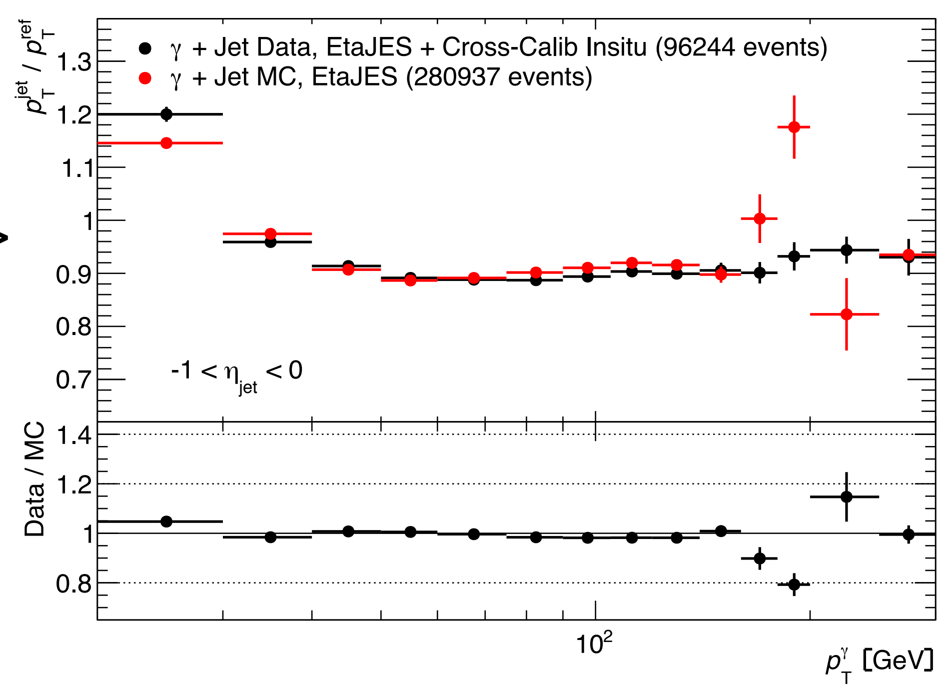
Use $x_J^{ref} \equiv x_{J\gamma} / |\cos\Delta\Phi|$

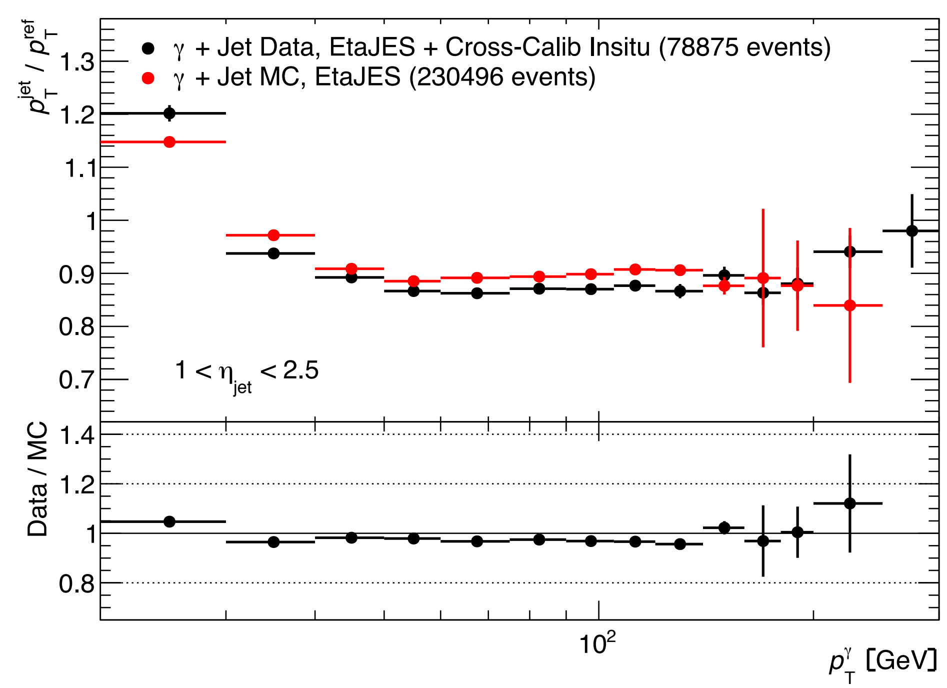
Event selection:

- Tight photons
- Photon trigger fired
- Isolation energy < 5GeV
- $p_T^{jets} > 20$ GeV, $p_T^{\gamma\text{'s}} >$ 10 GeV
- dR(γ, jet) > 0.6 for finding leading jet
- $d\phi_{J\gamma} > 7\pi/8$
- $p_T^{\text{sublead. jet}} / p_T^{ref} < 0.3$ (dijet suppression)







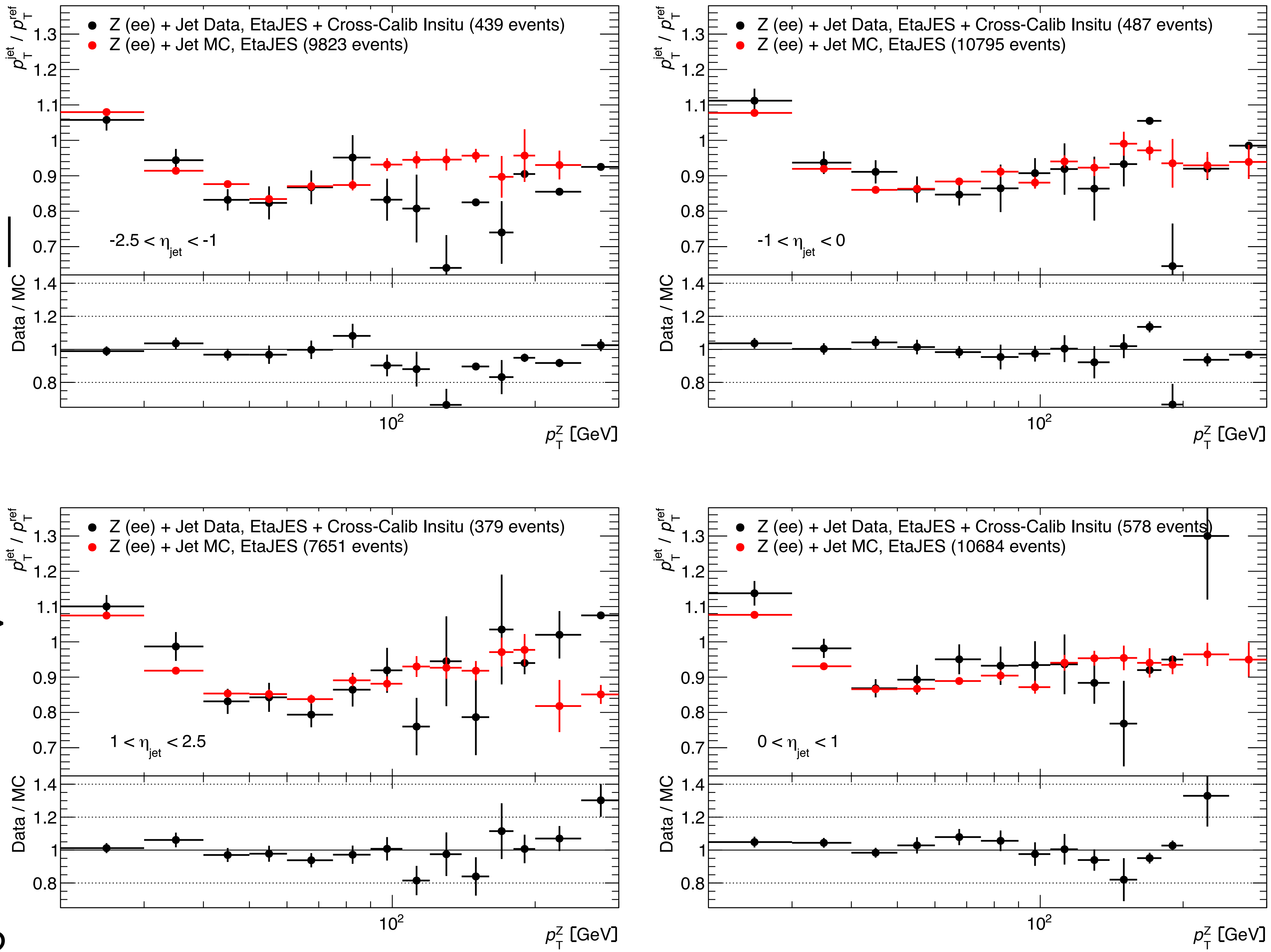


Photon triggers used: HLT_g*_loose with * = 10, 15, 20, 25, 30, 35, 60

Z(ee) +jet Study

Idea: EtaJES + xCalib V+jet pT balance compared in data & MC

Use $x_J^{ref} \equiv x_{JZ} / |\cos\Delta\Phi|$



Event selection:

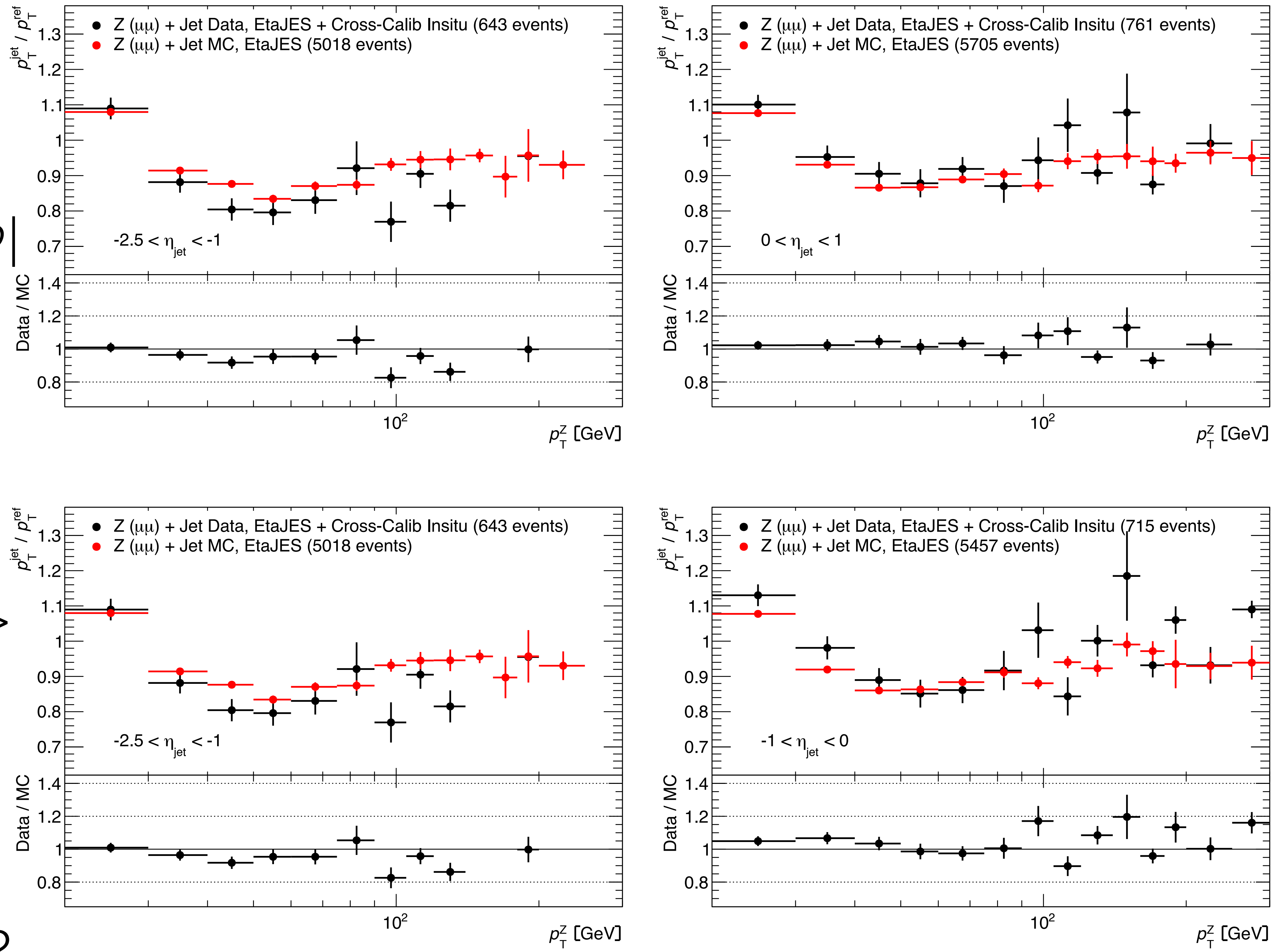
- 2 LHloose electrons
- Leading electron trigger fired
- $p_T^{jets} > 20$ GeV, $p_T^{e's} > 20$ GeV
- dR(e, jet) > 0.2 for finding leading jet
- $d\phi_{JZ} > 7\pi/8$
- $p_T^{sublead.\ jet} / p_T^{ref} < 0.2$ (dijet suppression)

Electron triggers used: HLT_e*_lhloose with * = 10, 15, 20, 22, 24

Z(μμ) +jet Study

Idea: EtaJES + xCalib V+jet pT balance compared in data & MC

Use $x_J^{ref} \equiv x_{JZ} / |\cos\Delta\Phi|$



Event selection:

- 2 loose muons
- Leading muon trigger fired
- p_T^{jets} > 20 GeV, $p_T^{\mu's}$ > 20 GeV
- dR(μ, jet) > 0.2 for finding leading jet
- $d\phi_{JZ} > 7\pi/8$
- $p_T^{sublead.\ jet} / p_T^{ref} < 0.2$ (dijet suppression)

Muon triggers used: HLT_mu15, HLT_mu18, HLT_mu20, HLT_mu20_L1MU15

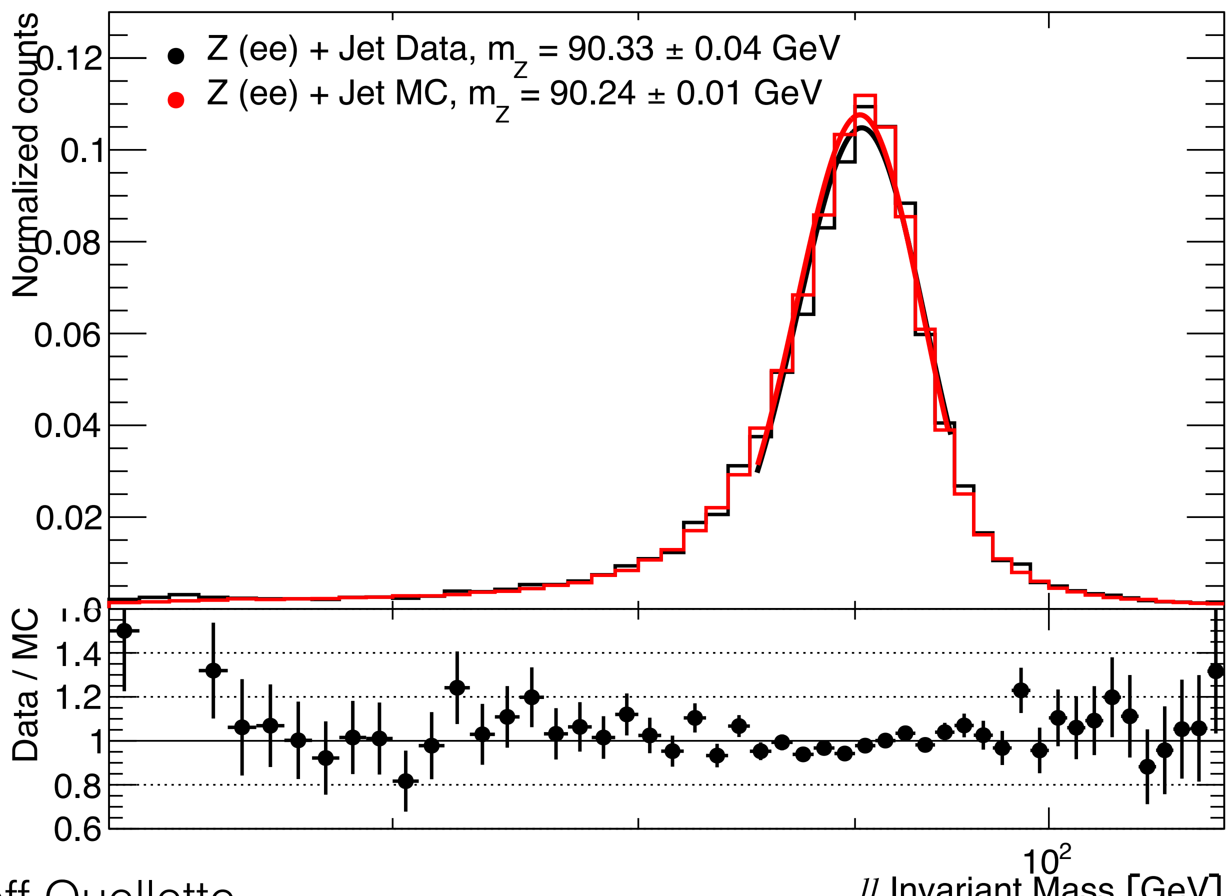
Understanding our Z sample

→ Plot Z mass with events weighted by trigger prescale, then fit peak recursively with Gaussian (simplified model) to get mass + width

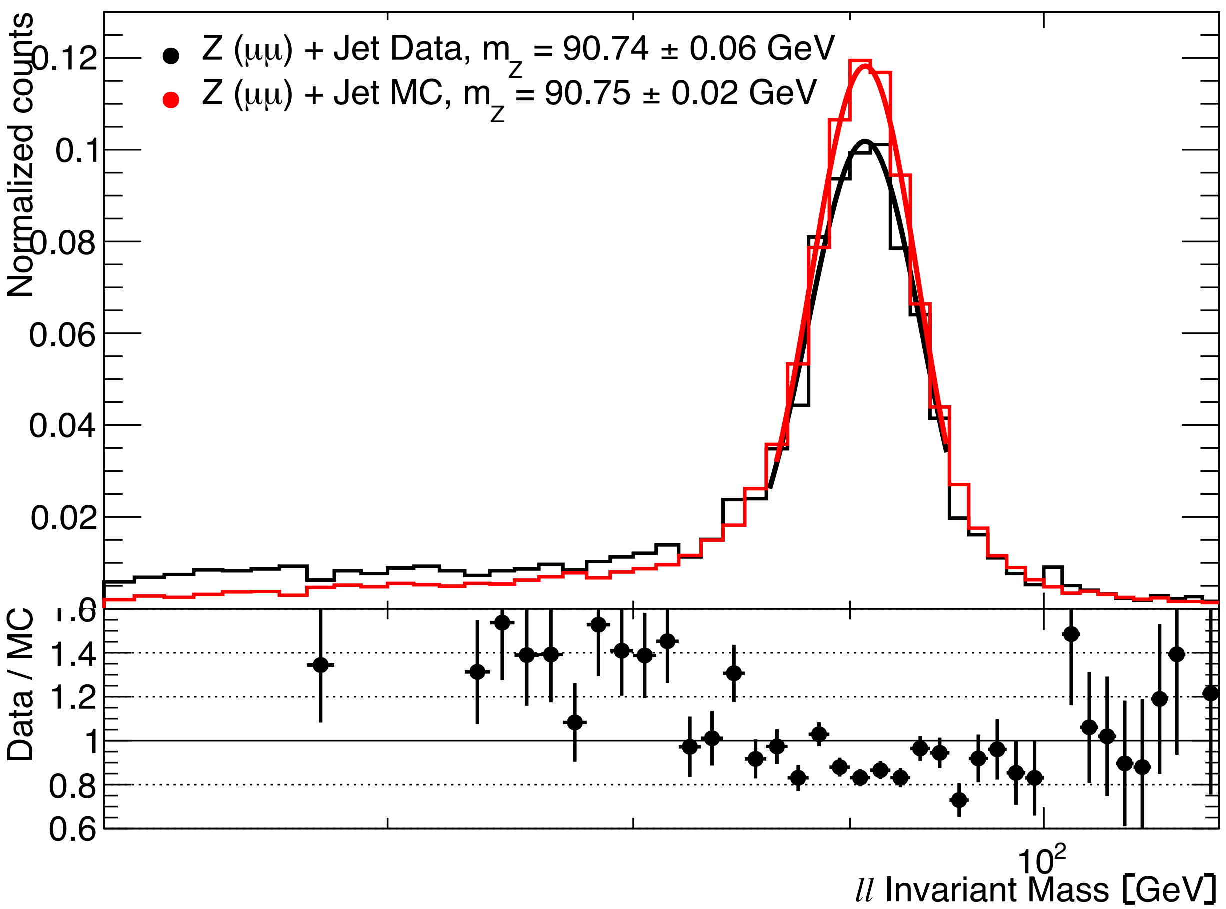
Good way to check validity of egamma calibration (there are known issues that lead to a shifted Z peak stemming from the egamma calib. tool)

→ Have encountered shifted electronic Z peaks using data overlay samples - now using pure pp signal samples for Z→ee events

Electronic Z's



Muonic Z's



Understanding our Z sample

→ Second check: does the Z mass spectrum change as a function of opposing jet pseudorapidity?

Can indicate whether the electron, muon calibrations are better/worse in the barrel vs. endcaps

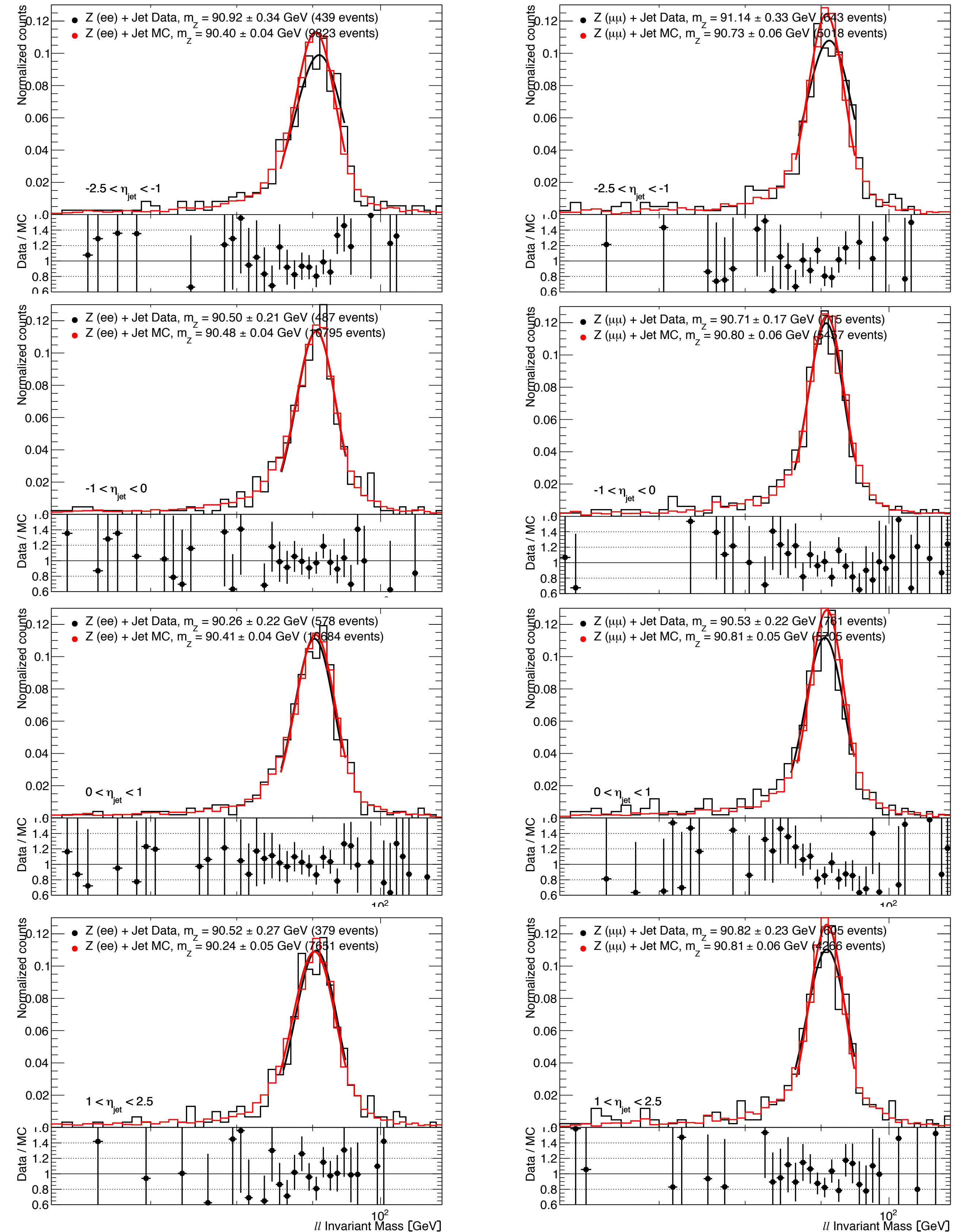
→ Fits all give consistent Z masses within errors for a particular decay channel across bins. Systematic bias in fitting “looks like” it can account for overall deviation from Z mass

⇒ Indicates that egamma, muon

calibration are consistent in jet η

Electronic Z’s

Muonic Z’s



Next steps

- Make any potential changes to the analysis (?)
- Acquire systematic uncertainties from 2015 cross calibration and propagate to results here
  - If systematics cover data/MC = 1, then effectively done
  - Otherwise need to figure out additional uncertainties

Backup