

# JES & EtaJES in 8.16TeV p+Pb Collisions - Status Update

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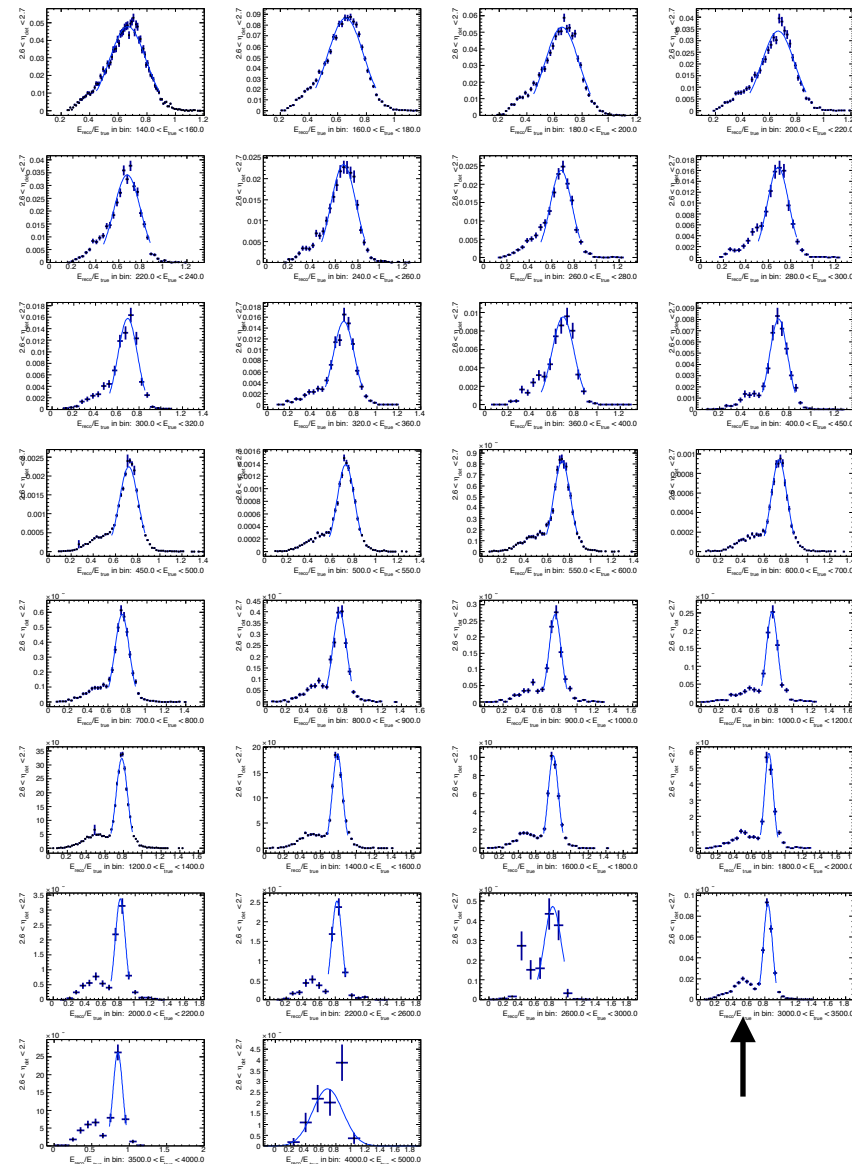
# Outline

- Task: (1) perform JES calibration for 2016 8.16TeV pPb data and (2) test applicability of 2015 PbPb, pp cross-calibration via  $Z/\gamma$  +jet events, (3) deriving additional uncertainties if required
- Today: current results of (1) for both run periods, discussion of parameter choices and complications thus far
- Steps for deriving JES from MC provided on [twiki](#)
- Some terminology:
  - “period A” or “p-Pb” = Pb going to  $+\eta$  beam config.
  - “period B” or “Pb-p” = Pb going to  $-\eta$

# 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
  - Primary difference is underlying event subtraction
- Portion of hadronic end cap 'HEC' was off during 2016 run:  
 $1.5 < \eta < 3.2$ ,  $\pi < \phi < 3\pi/2$  (for  $\phi \in [0, 2\pi)$ )
  - Solution: 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, ...)

# HEC cuts - details

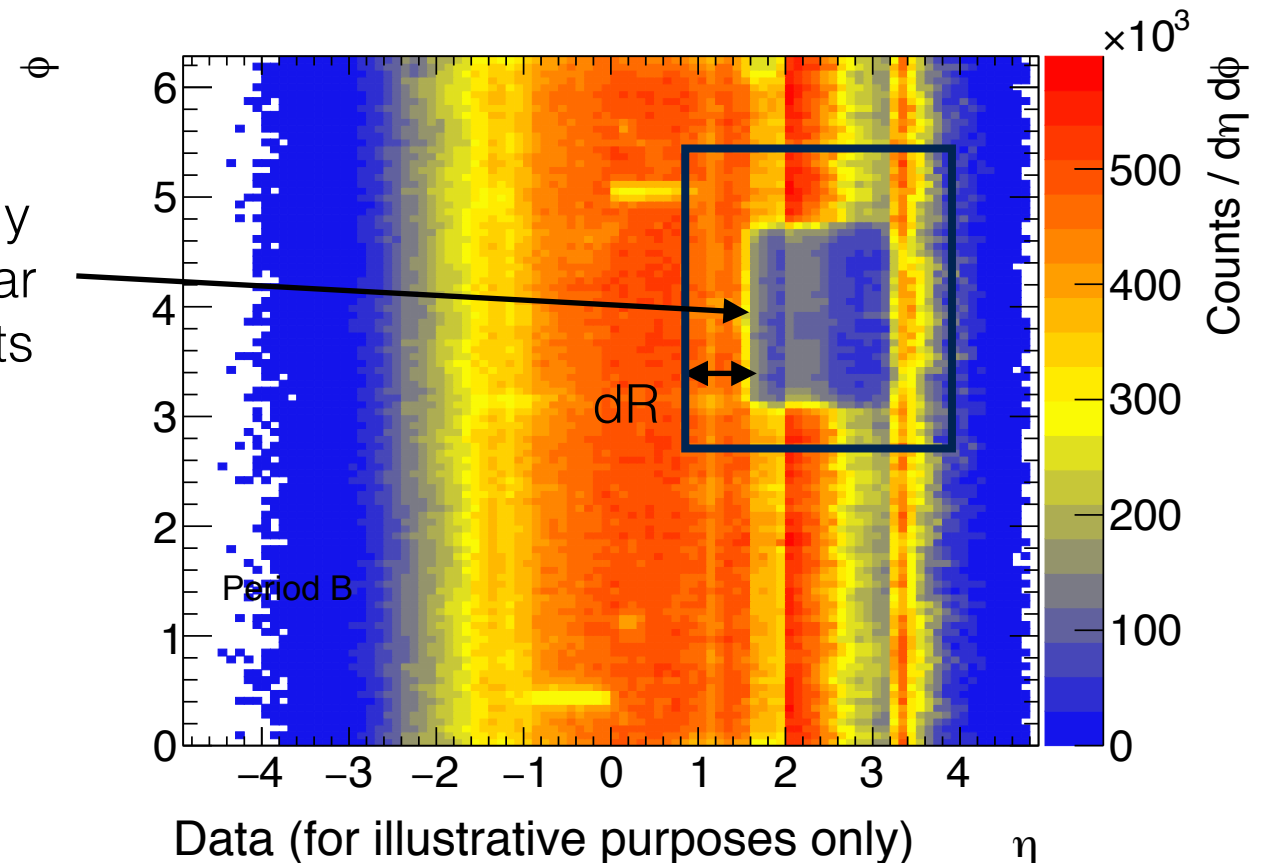


Reco/truth energy,  $2.6 < \eta < 2.7$

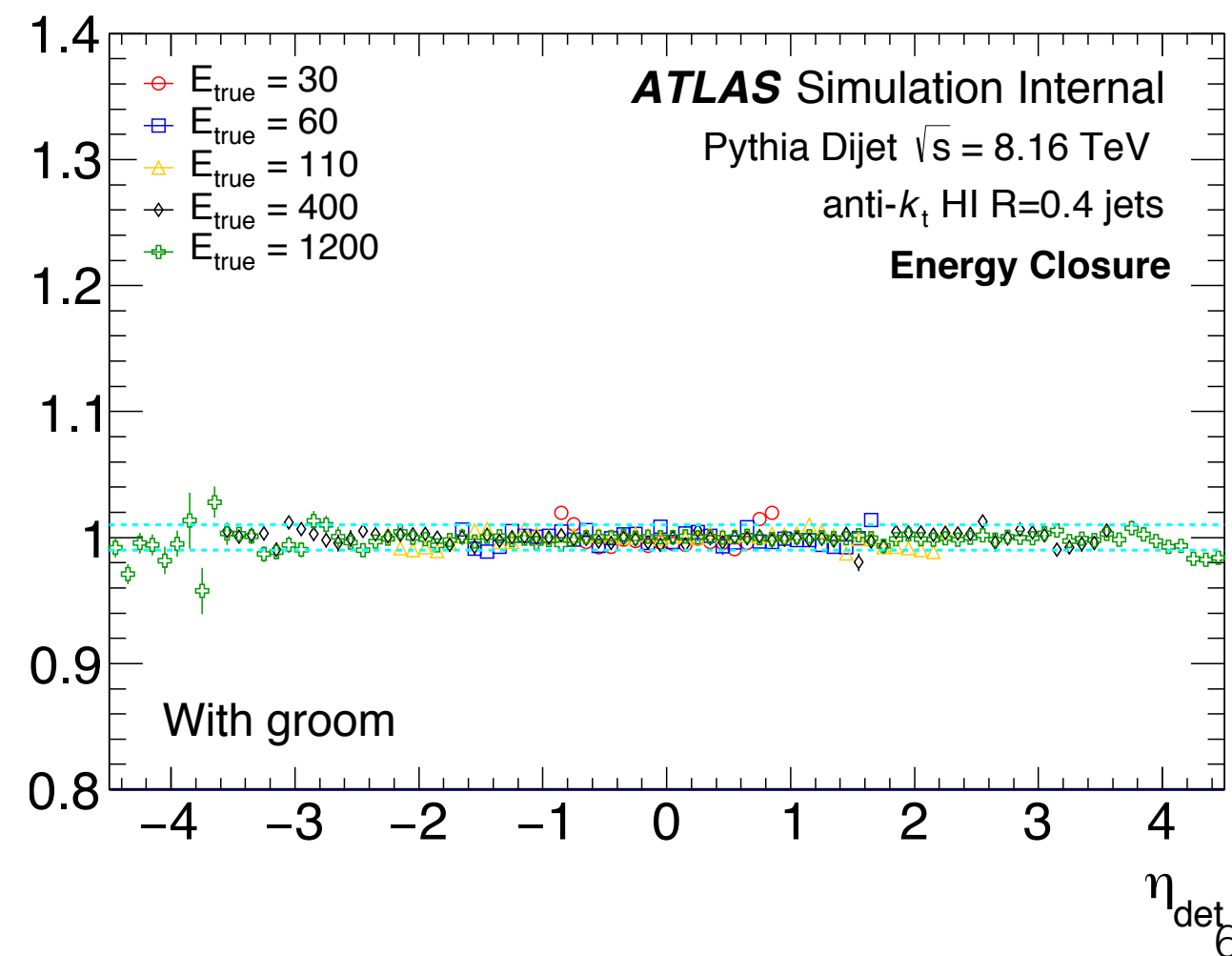
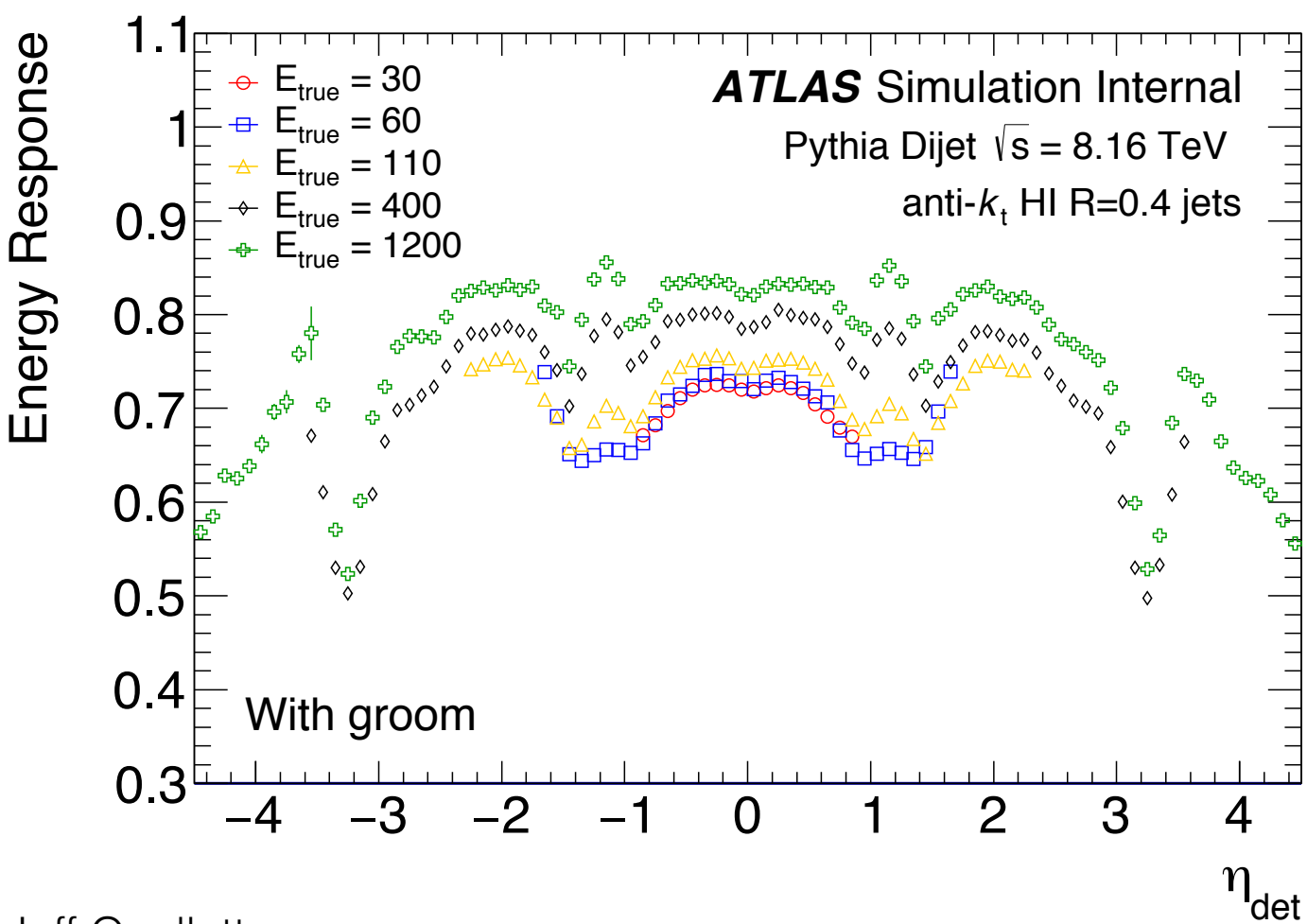
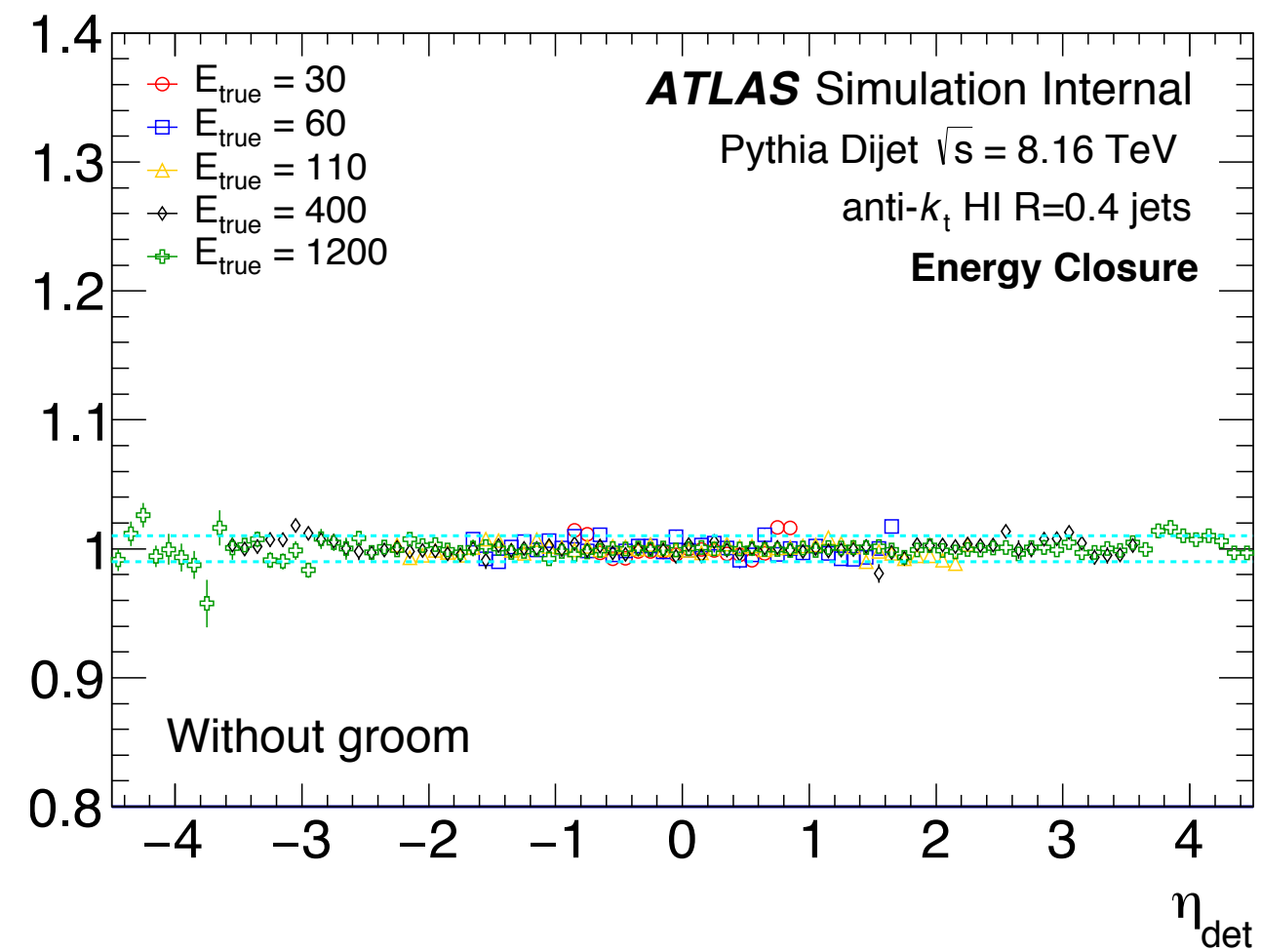
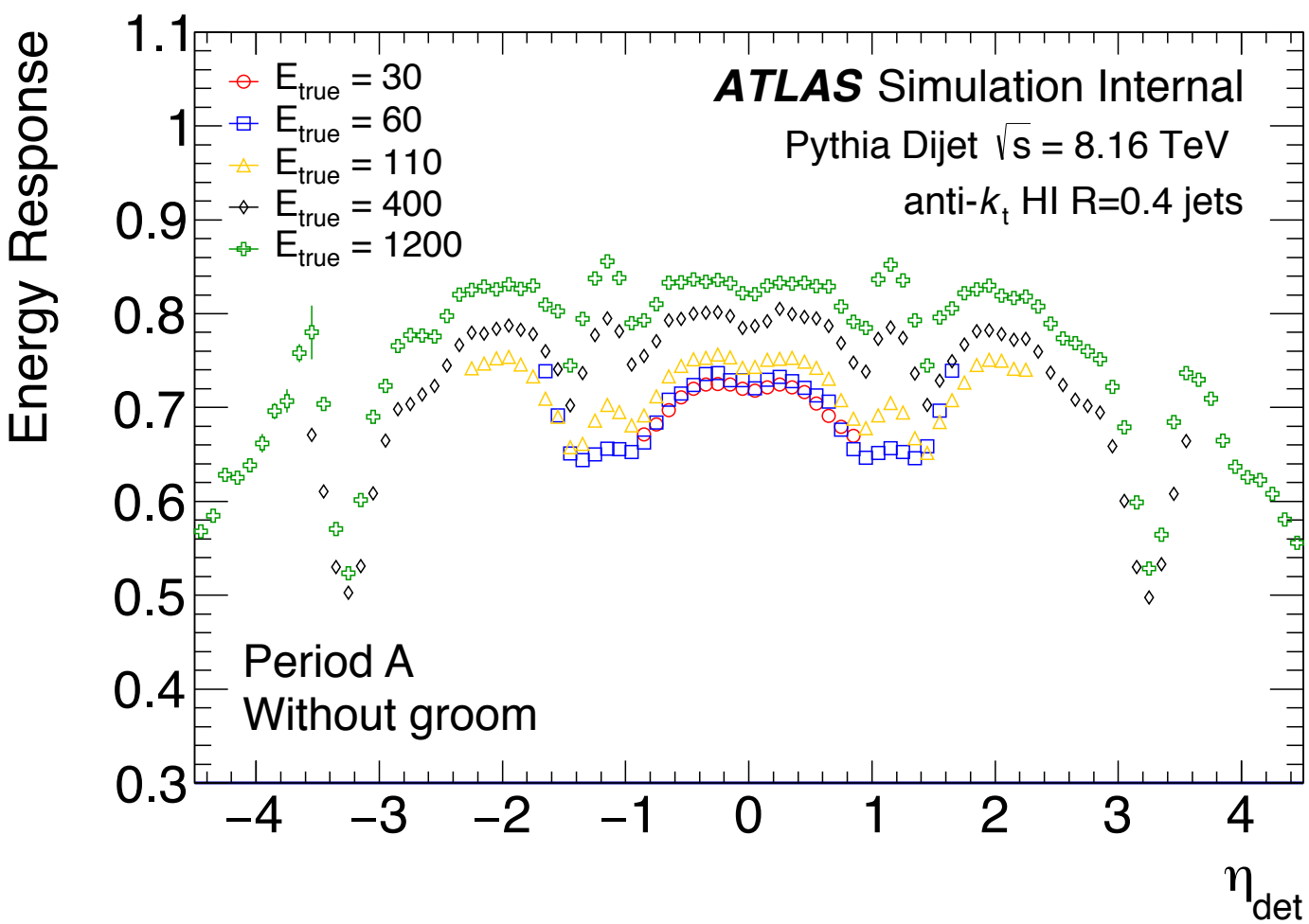
Potential bias: jets near the edge of HEC will be reconstructed further away - impose additional  $dR=0.2$  cut on truth jets,

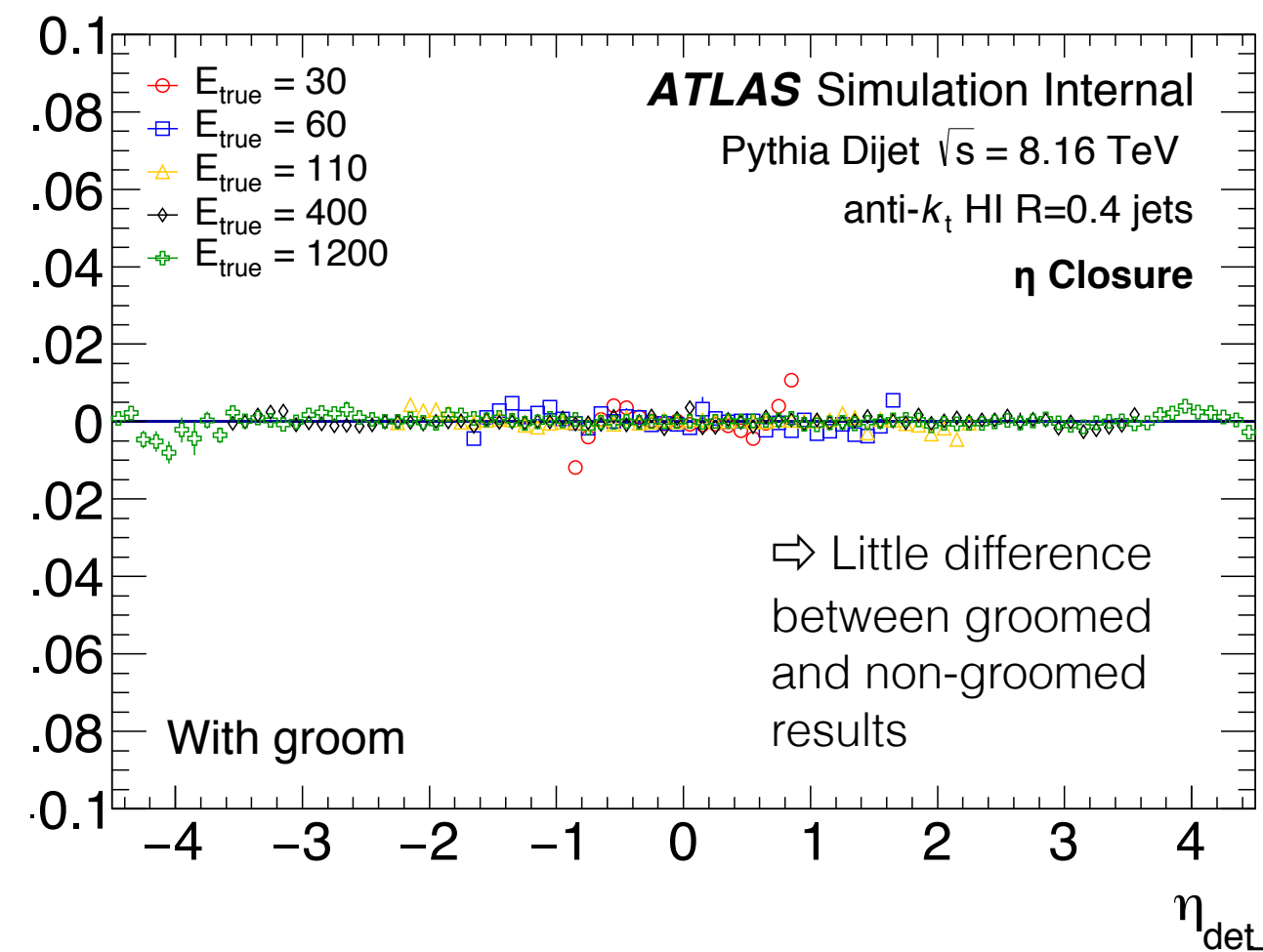
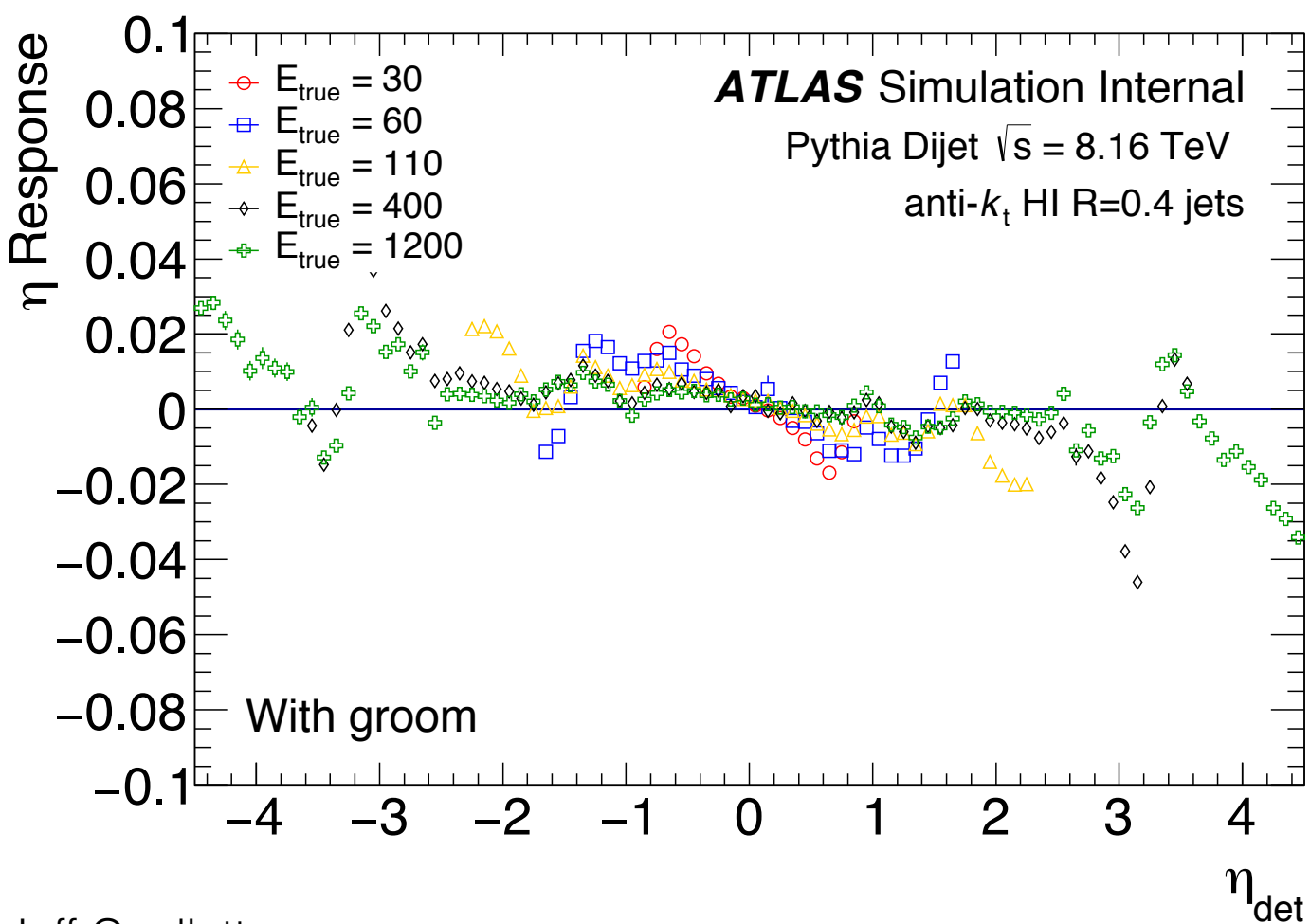
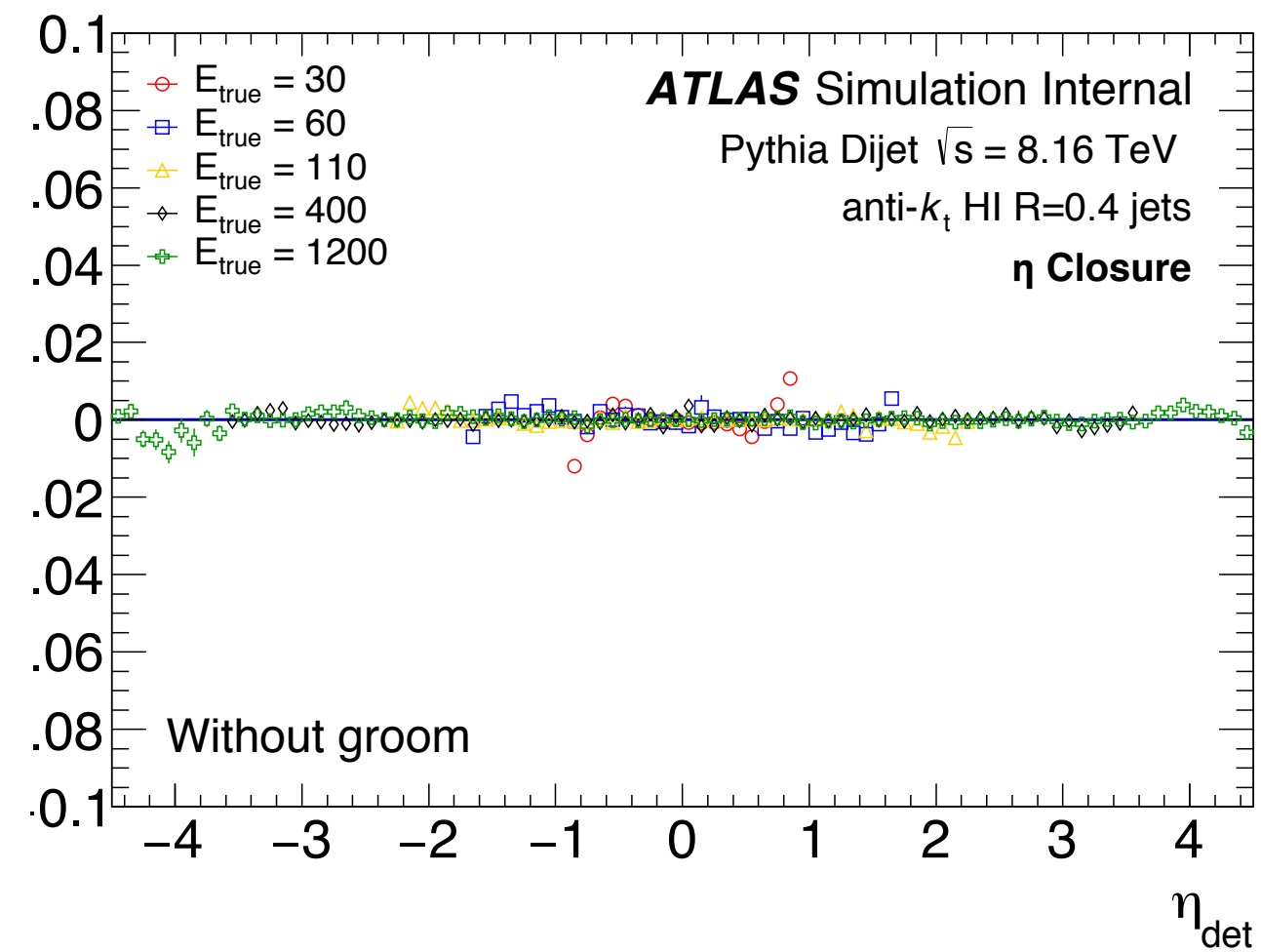
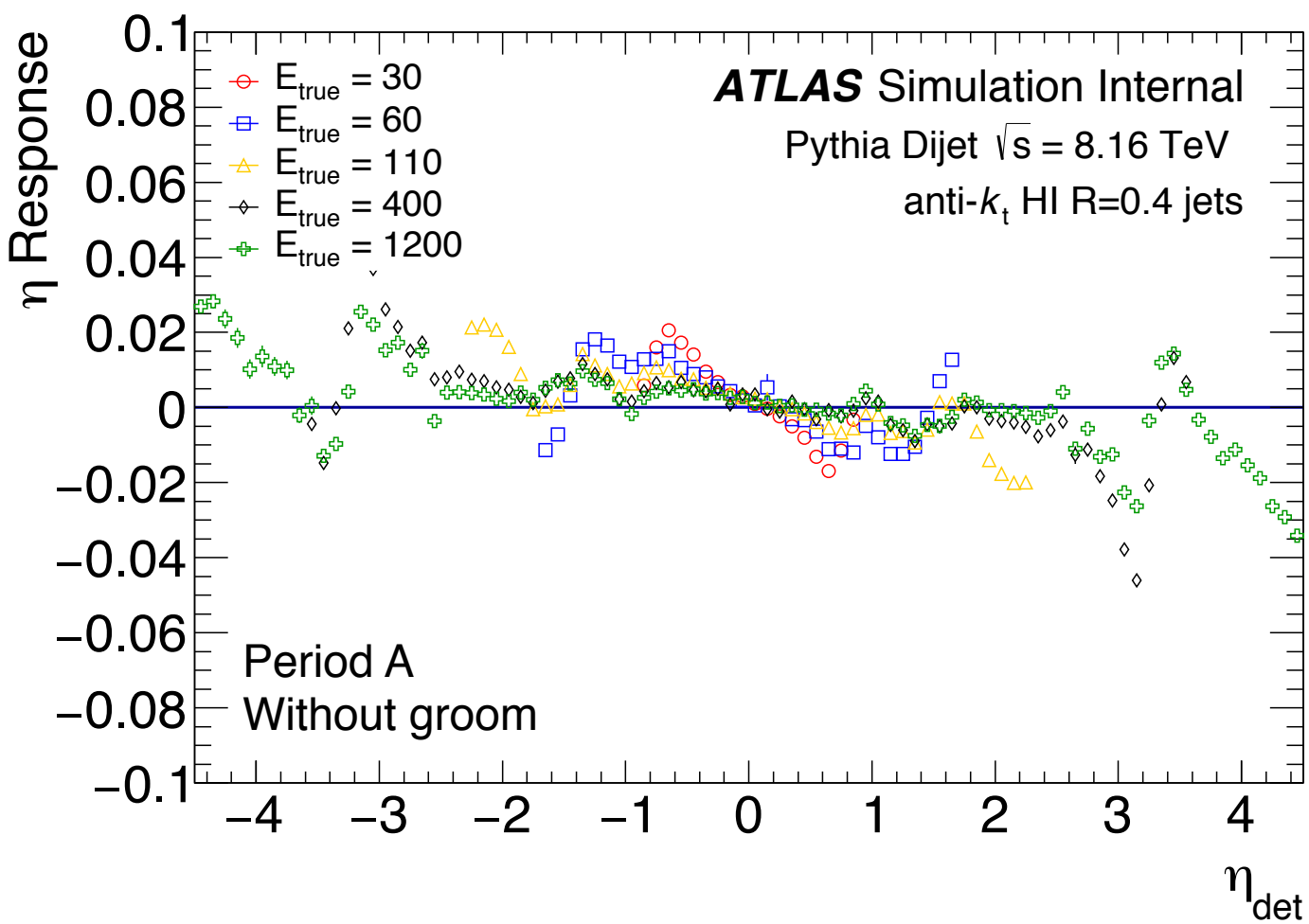
- Double peak observed across truth energy bins in all JES calibrations with  $\sim 1.5 < \eta < \sim 3.2$
- Jet matching inherently flawed from assuming “complete” coverage in  $\eta$ - $\Phi$  phase space
  - Truth jet can be matched to much lower  $p_T$  reco jet leading to:
    - non-Gaussian features at low truth  $p_T$  or
    - possible double peak structure at high truth  $p_T$
- Solution: reject *truth* jets within disabled ‘HEC’

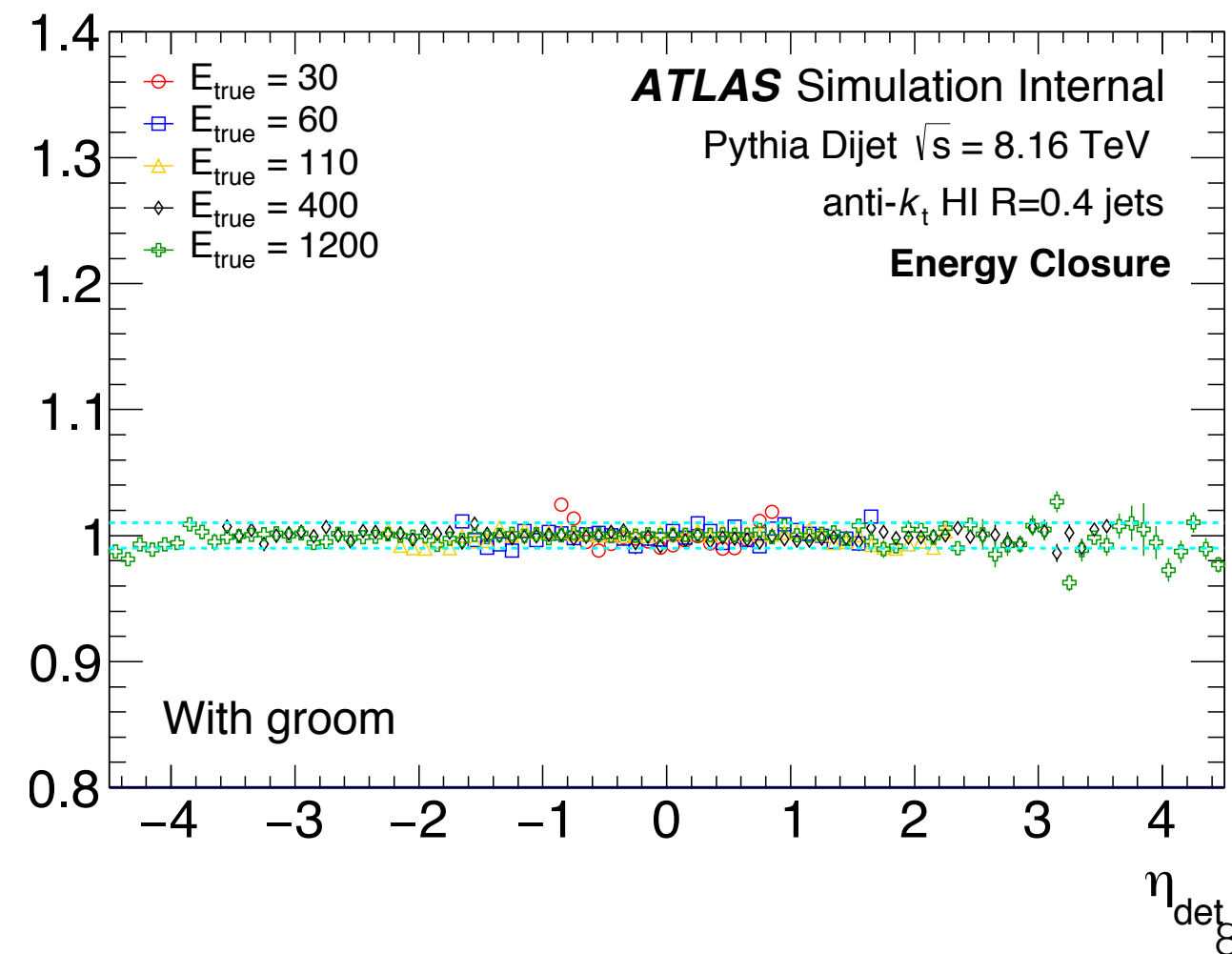
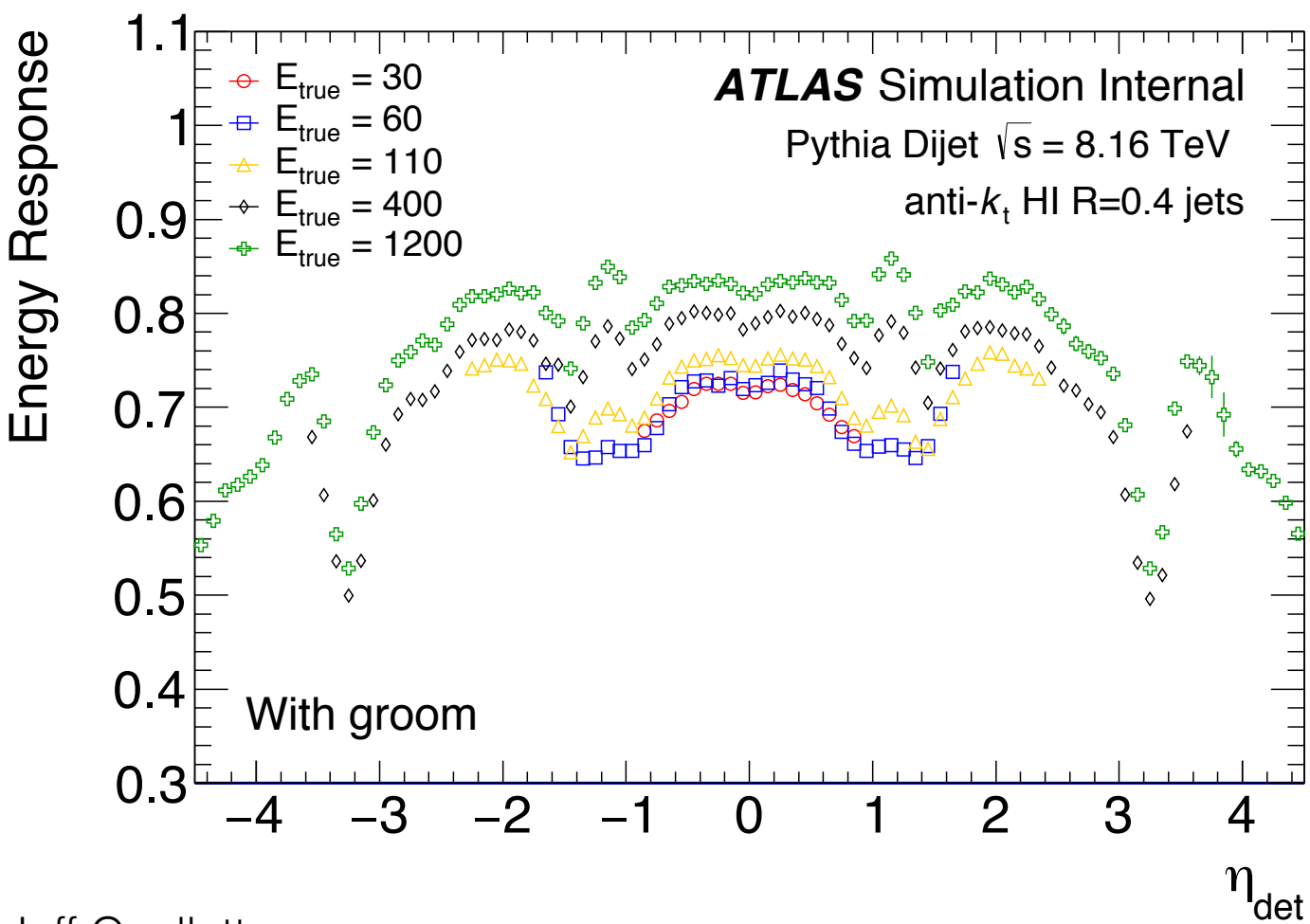
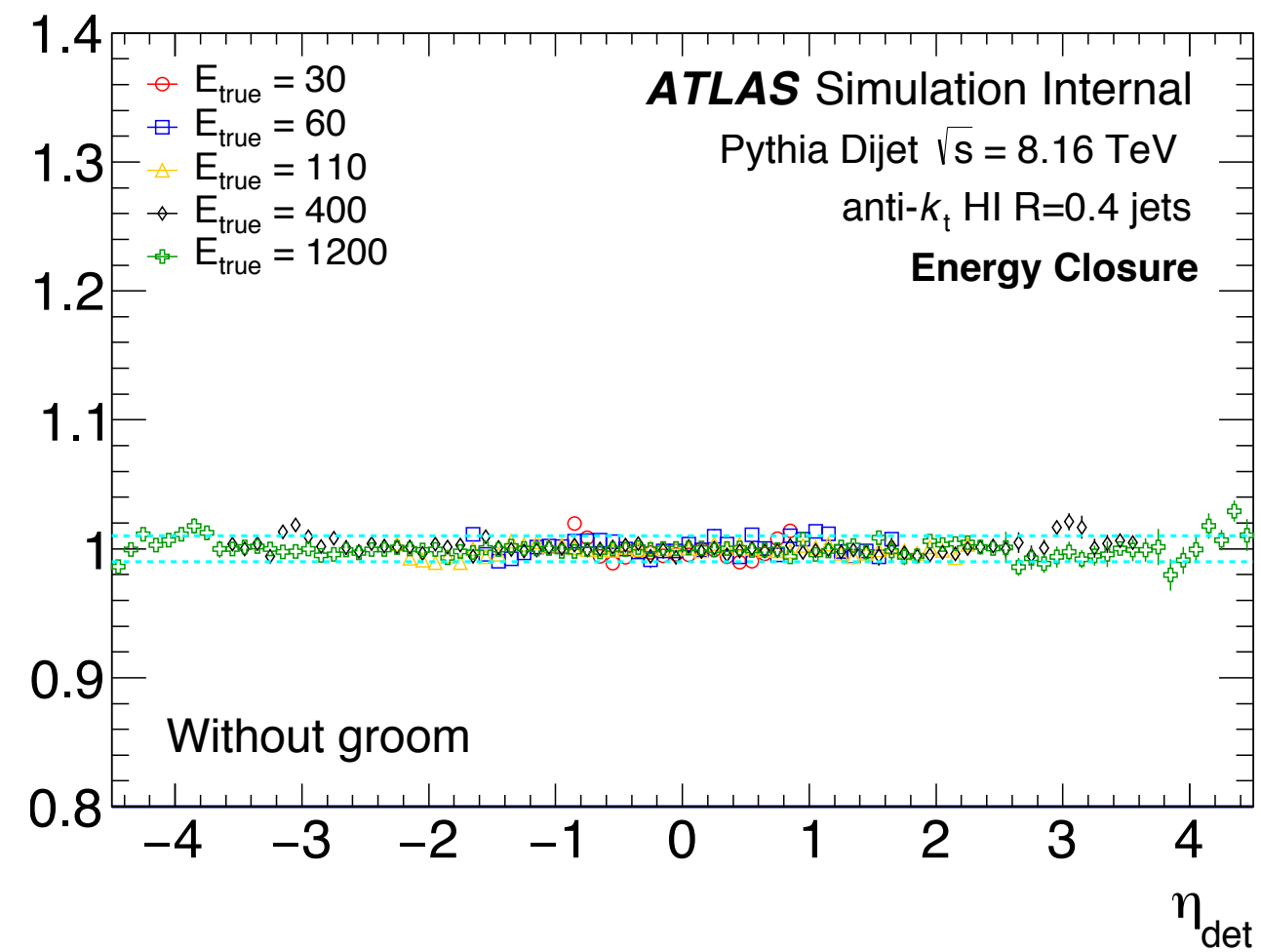
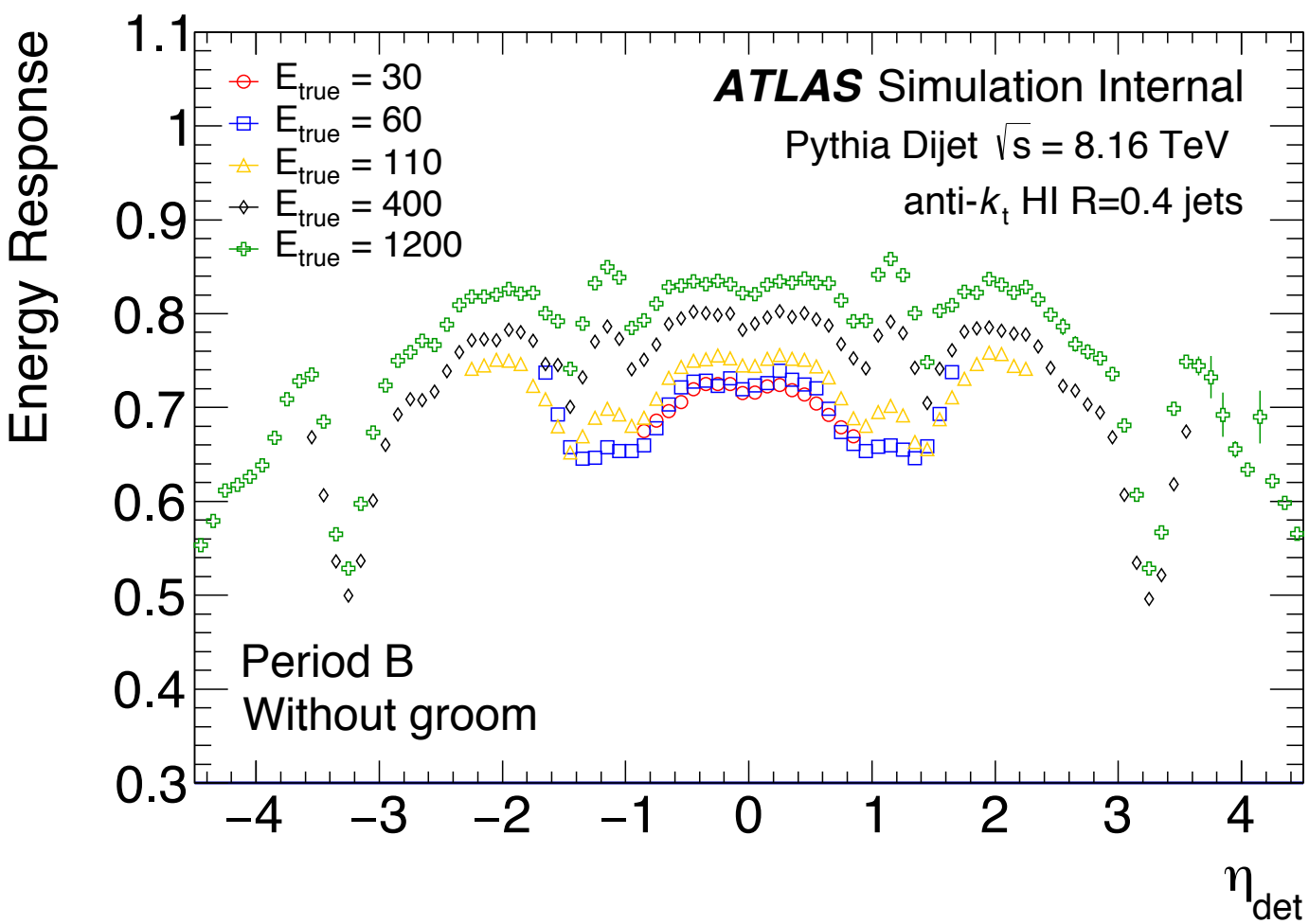
HEC zone clearly evident in angular distribution of jets



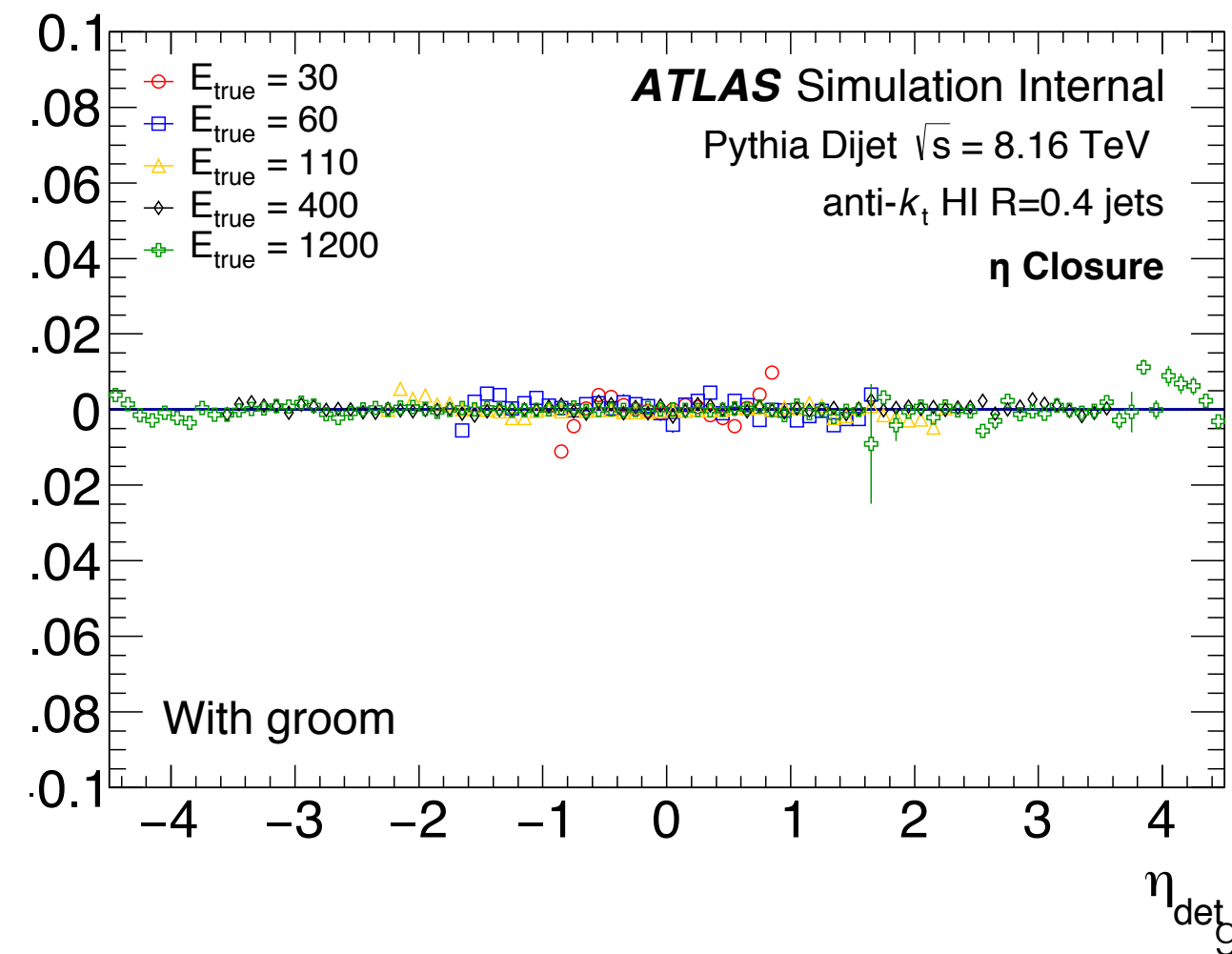
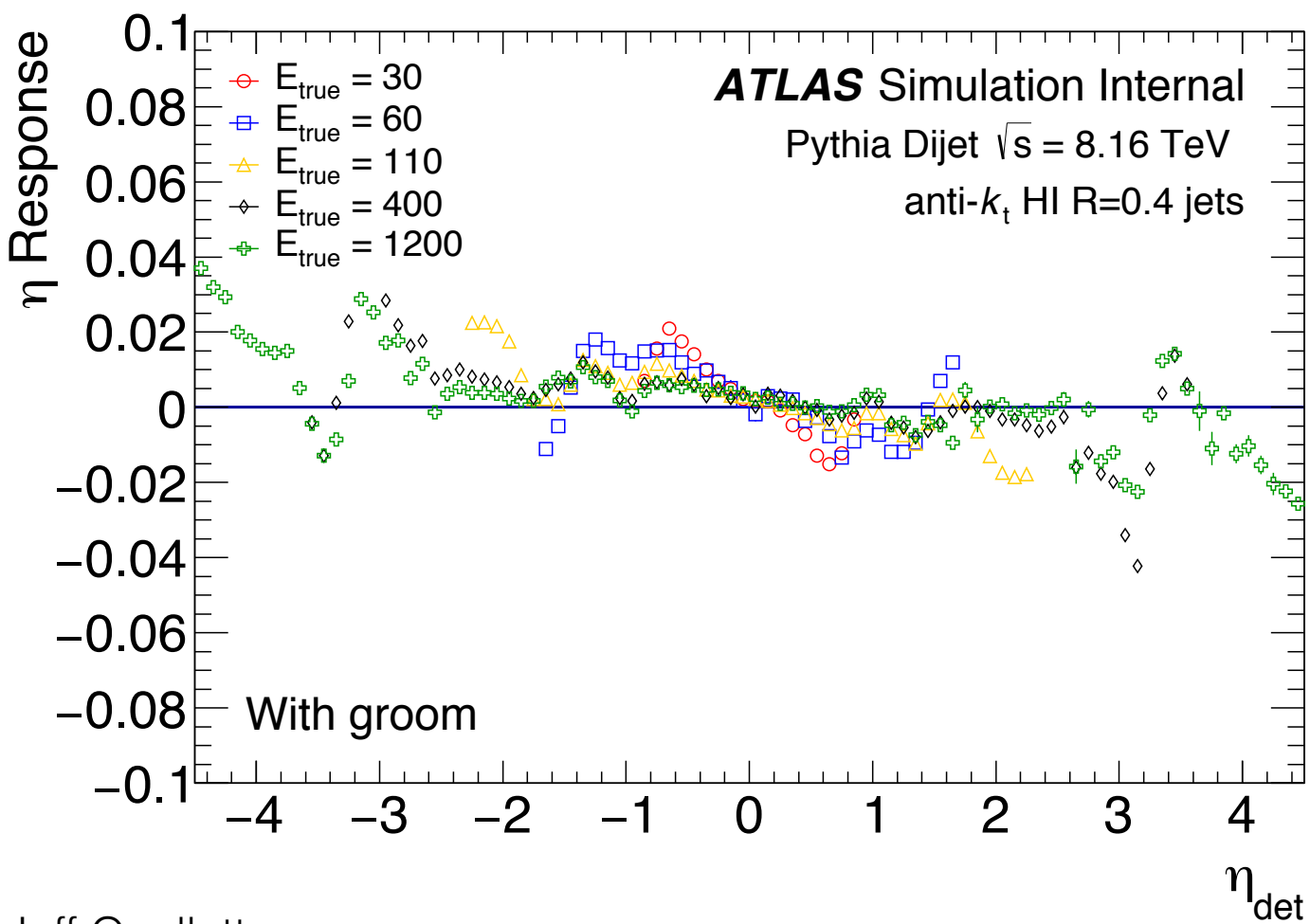
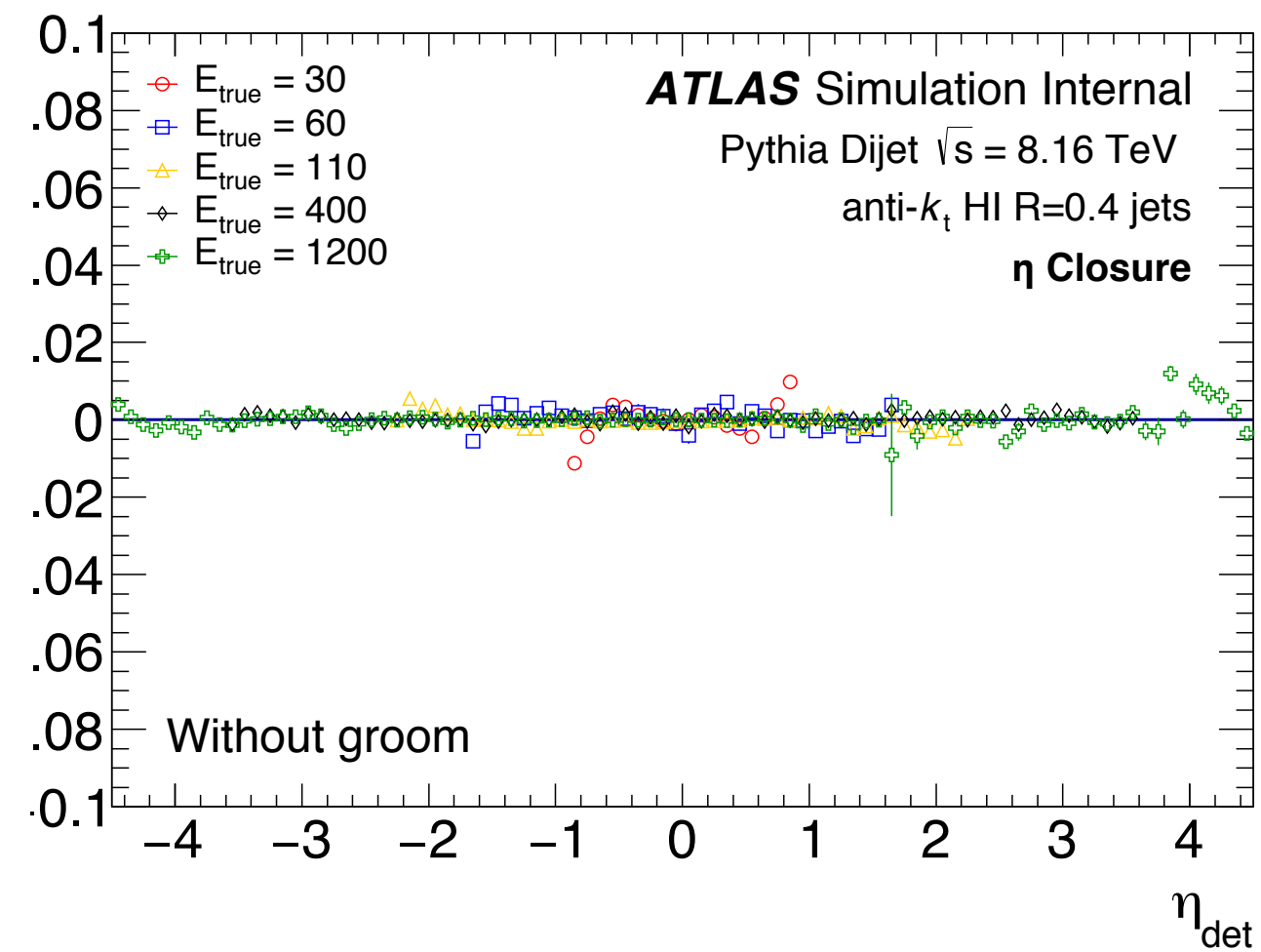
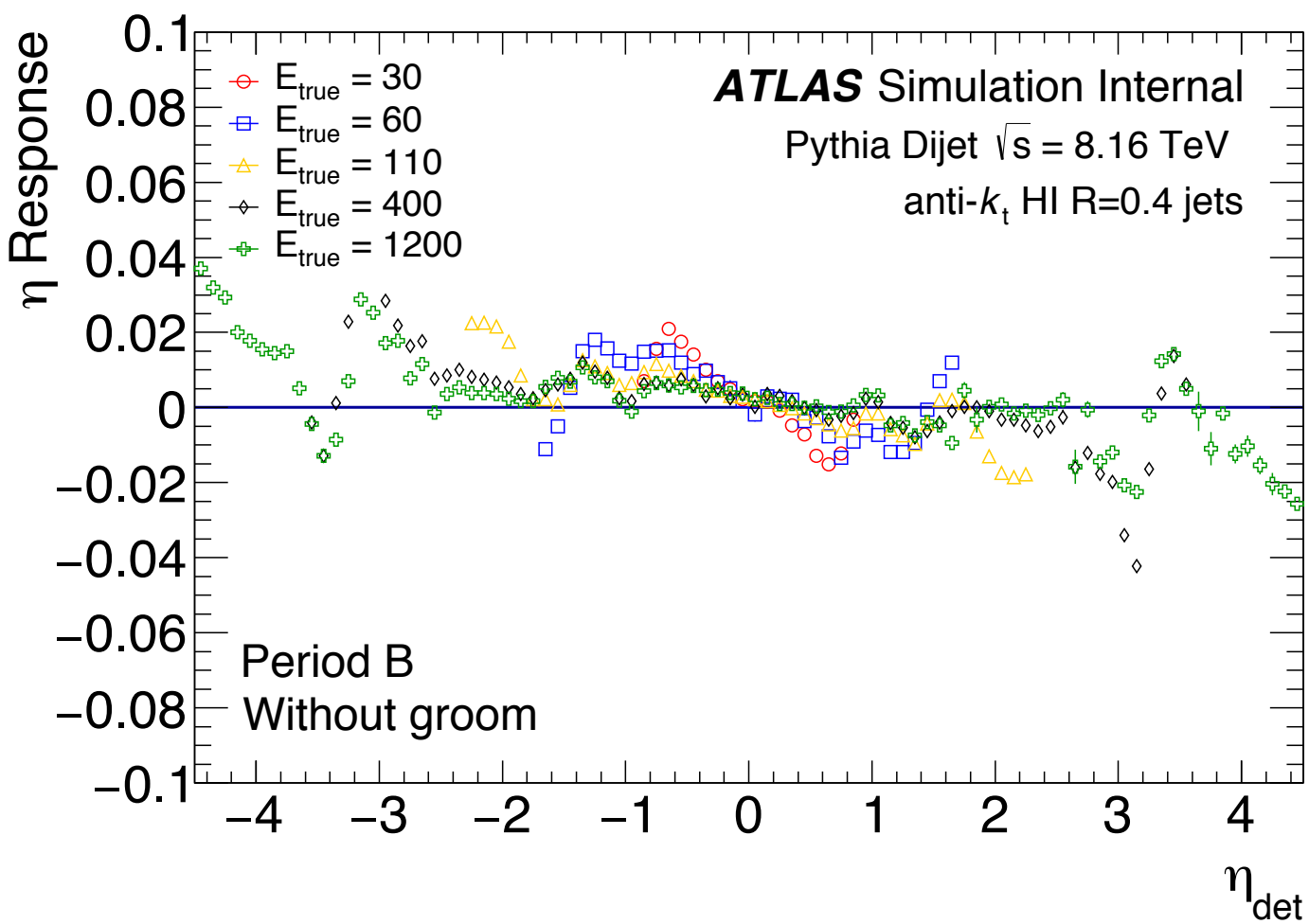
# I. JES & EtaJES Summary Plots



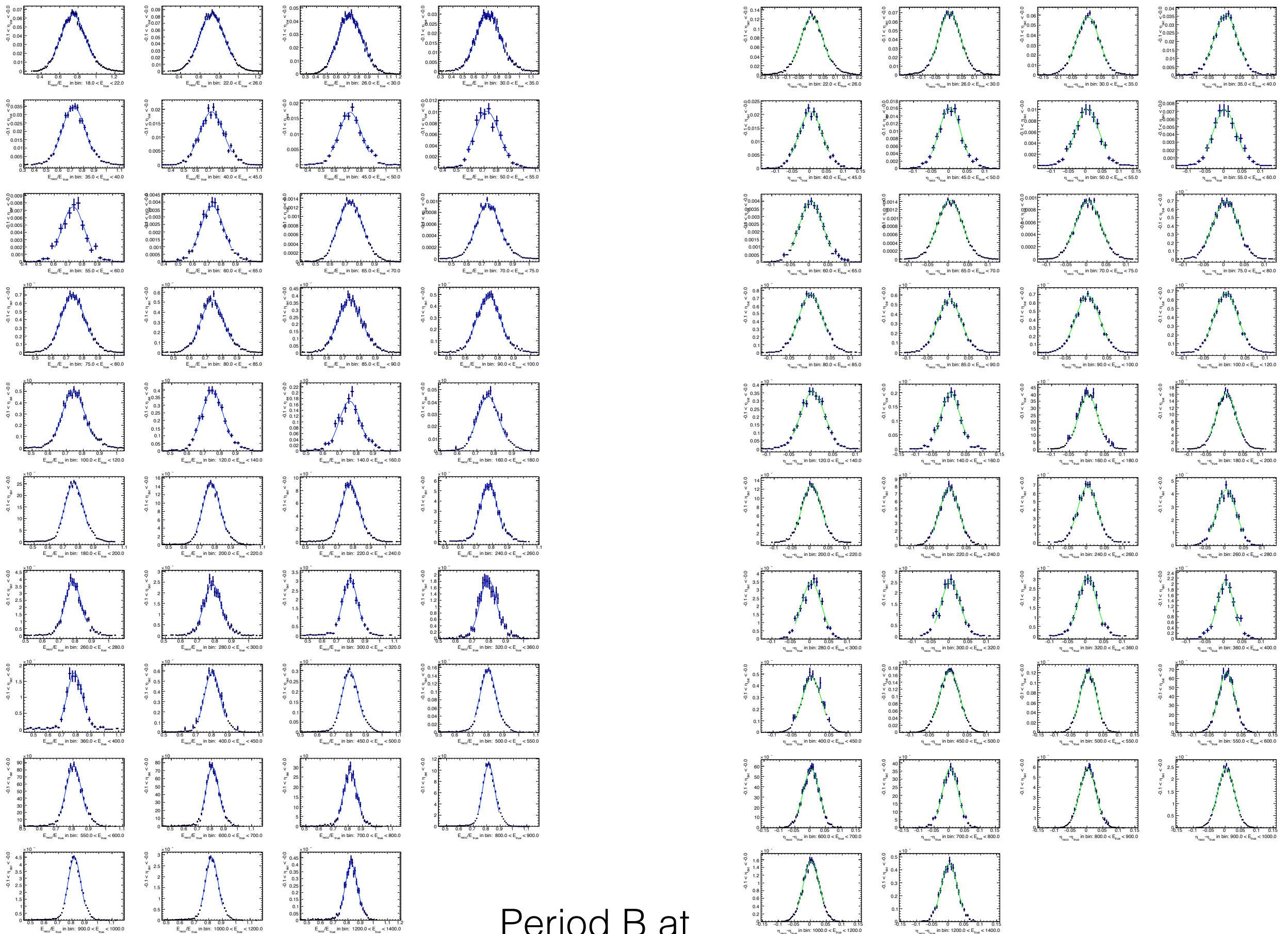








# II. Sample of $\eta$ -specific summary plots (no grooming)

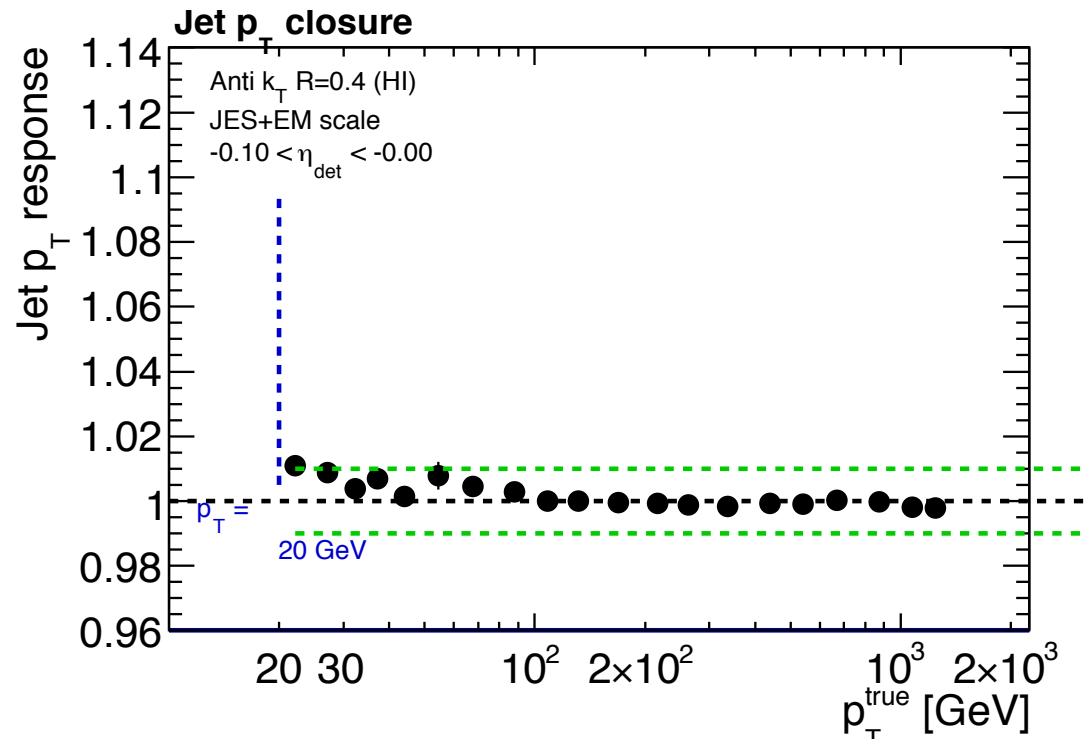
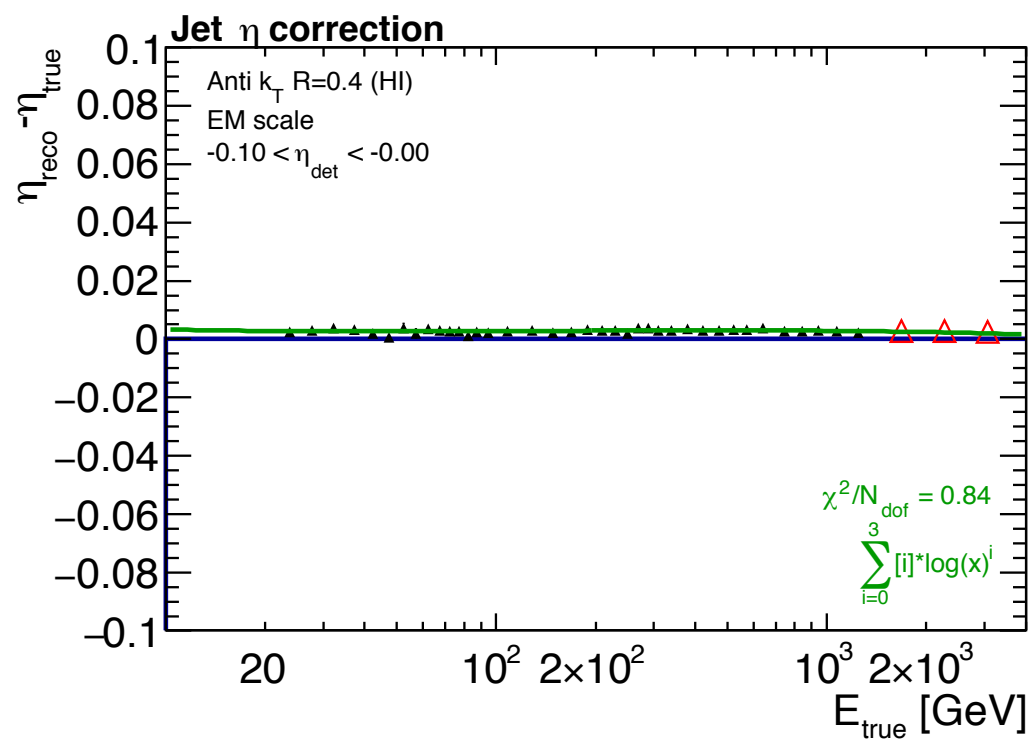
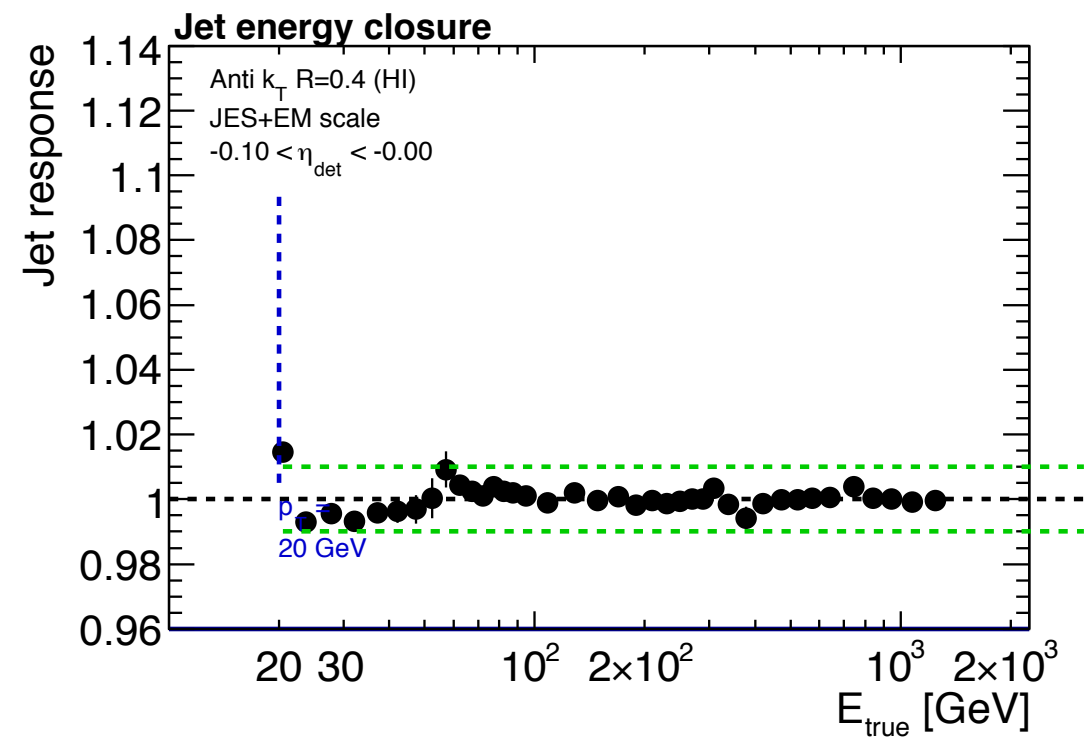
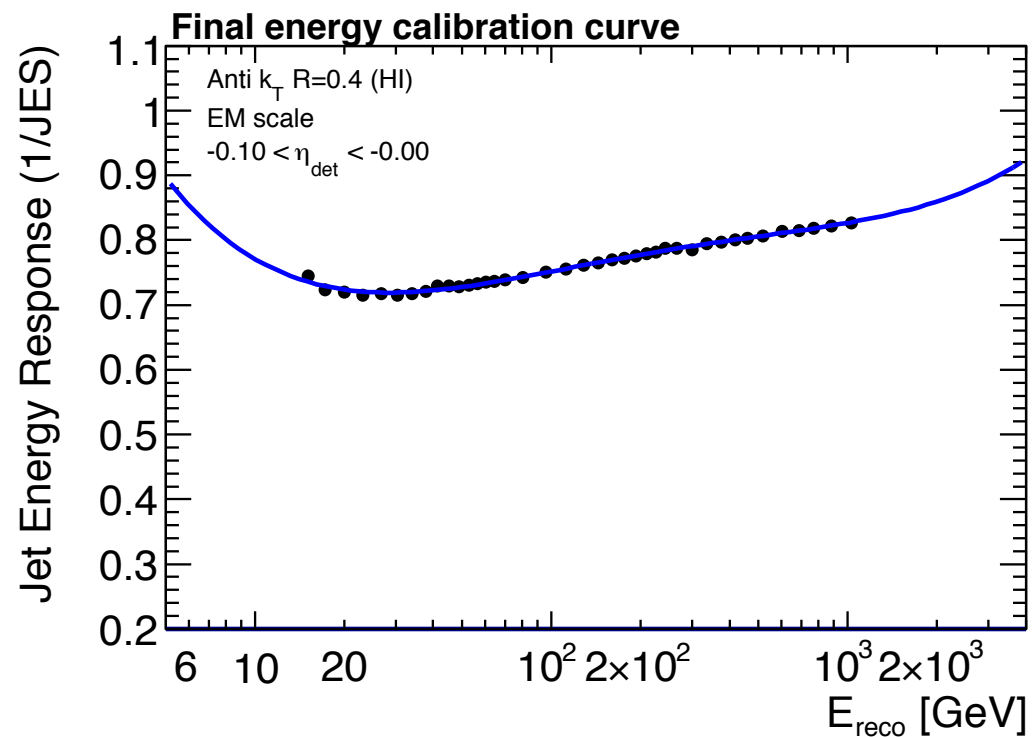


Reco/Truth Energy

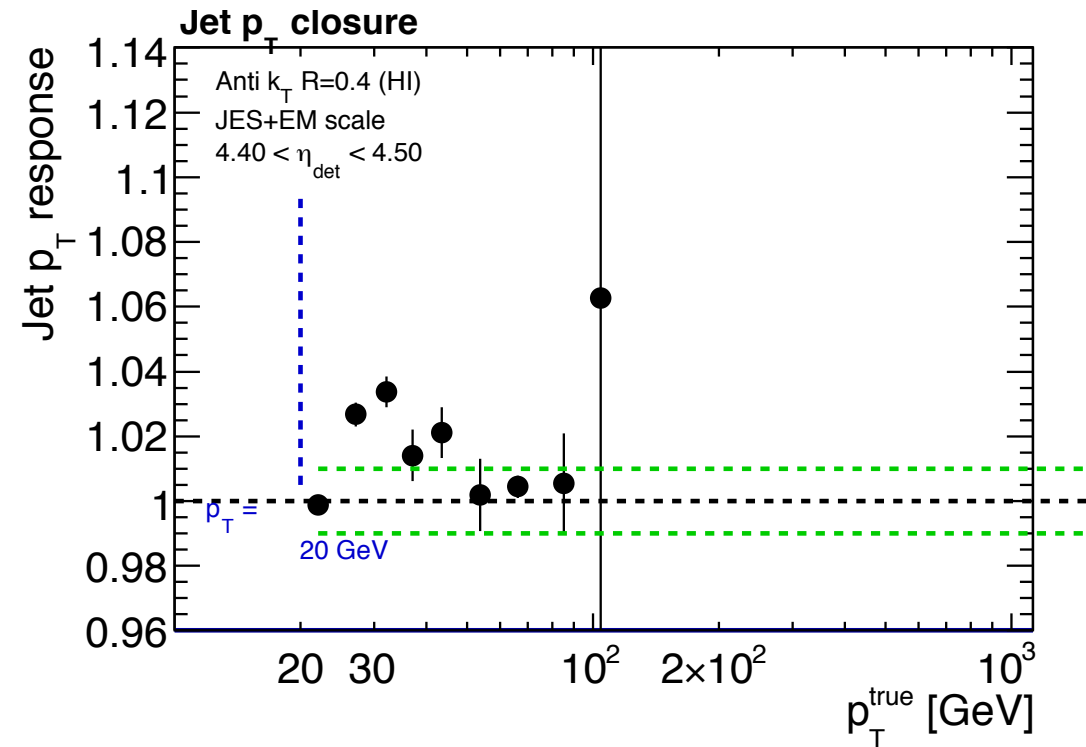
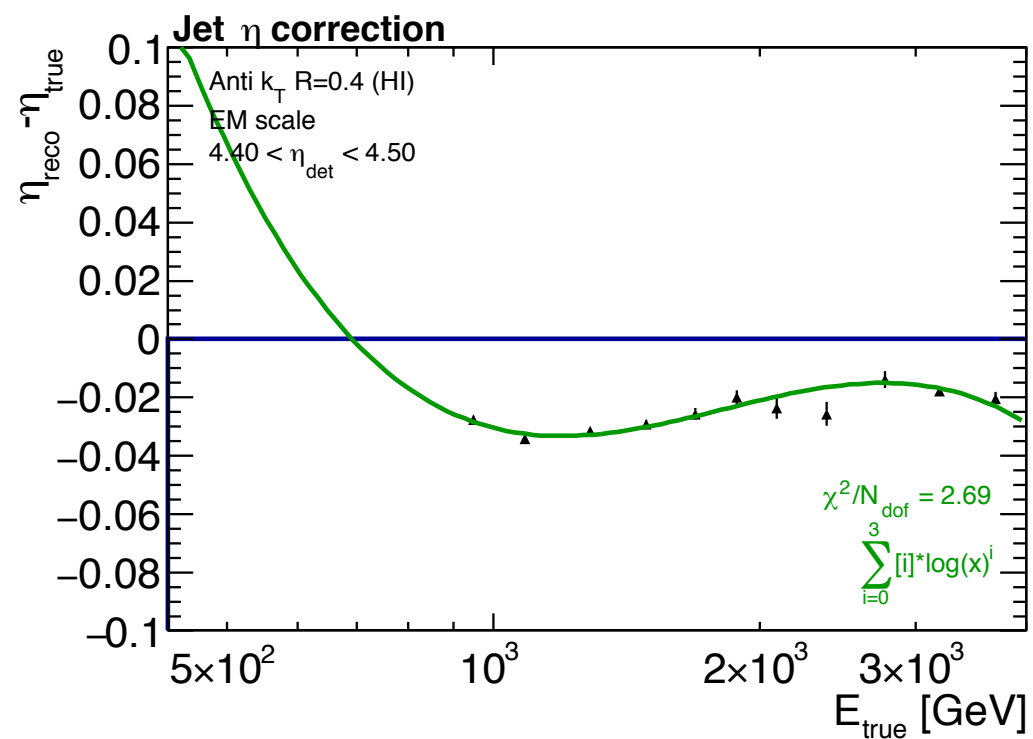
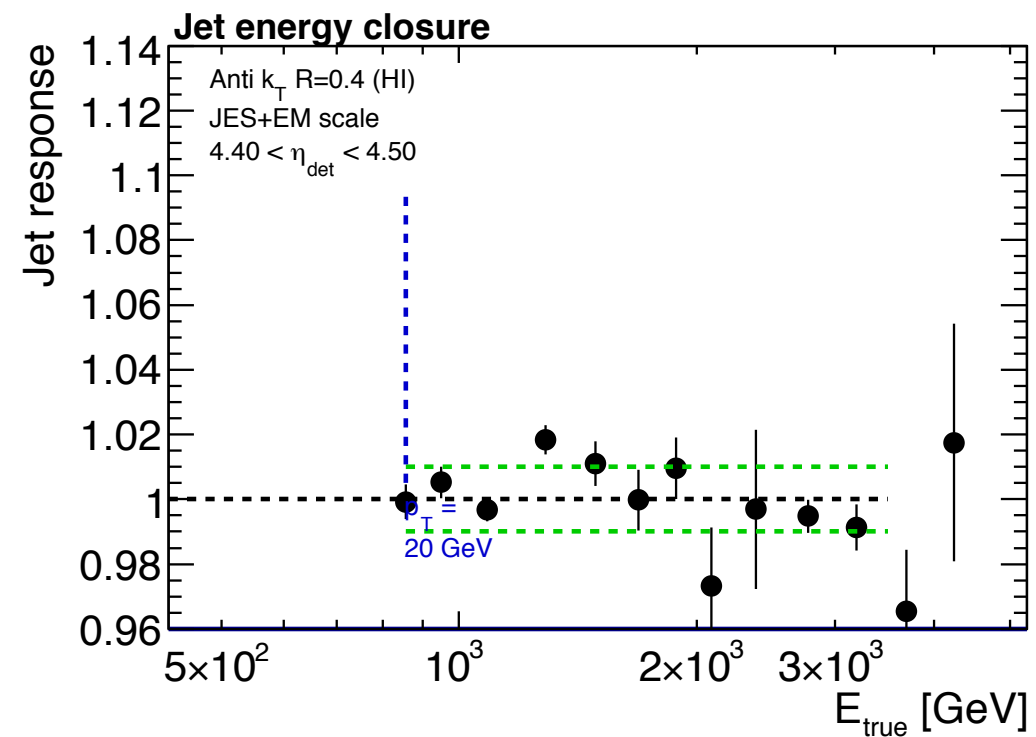
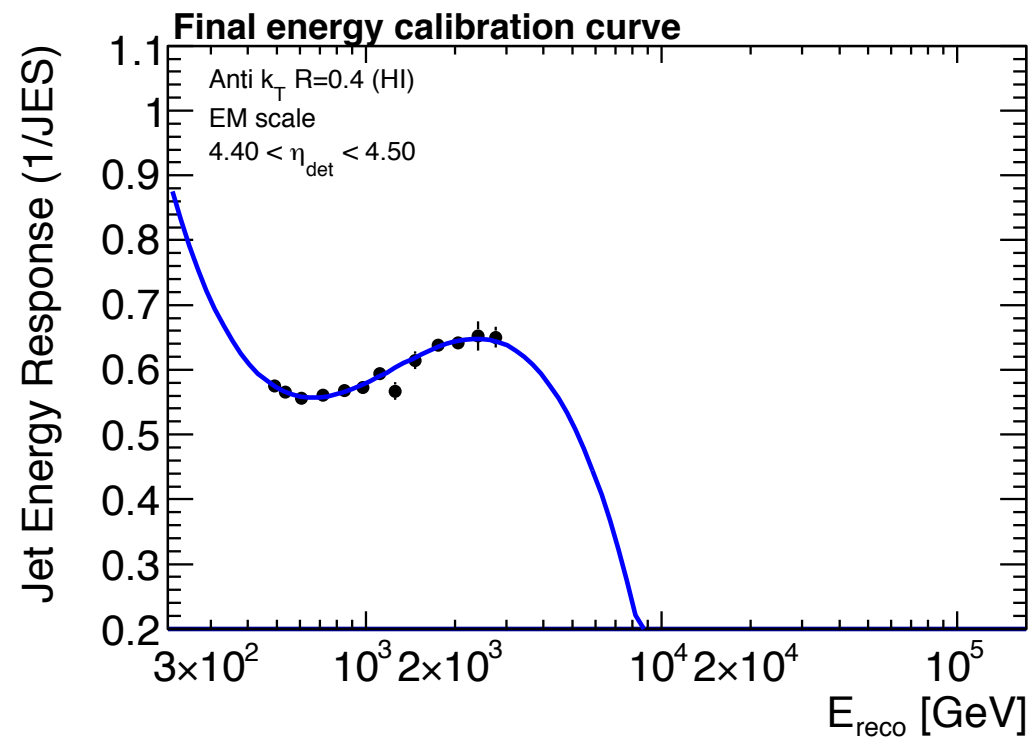
→ Fitting with  $\mu \pm 1.7\sigma$  in response to  
poor JES fits (as opposed to  $1.4\sigma$ )

Reco-Truth  $\eta$

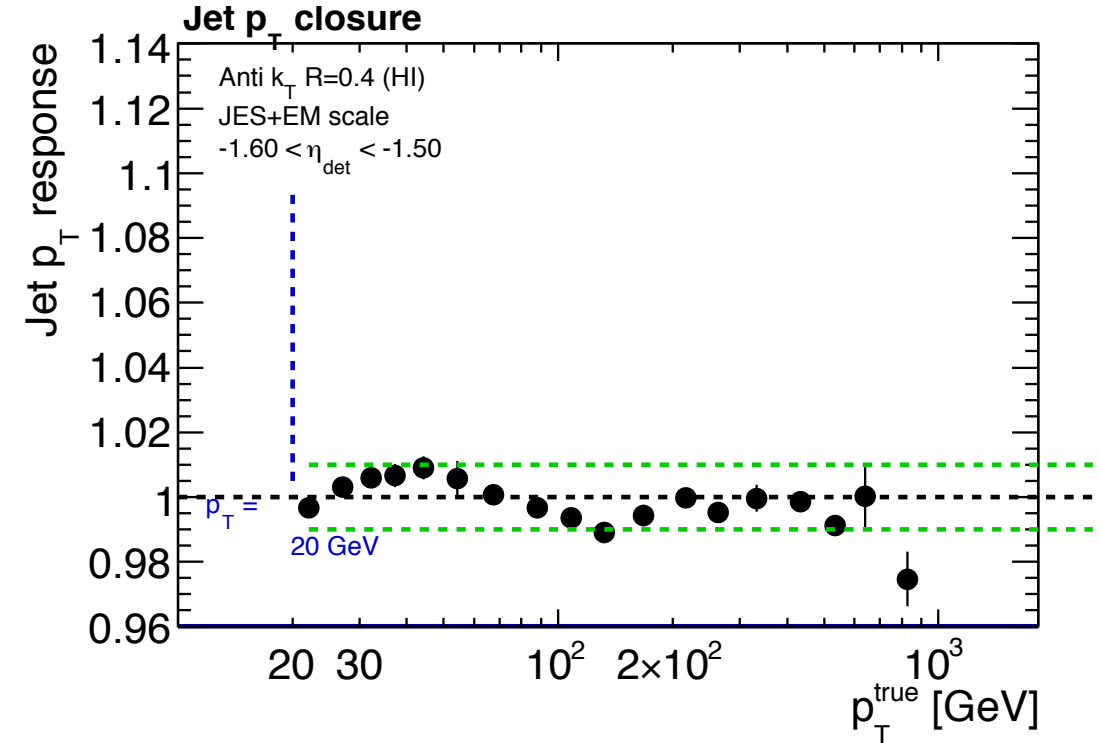
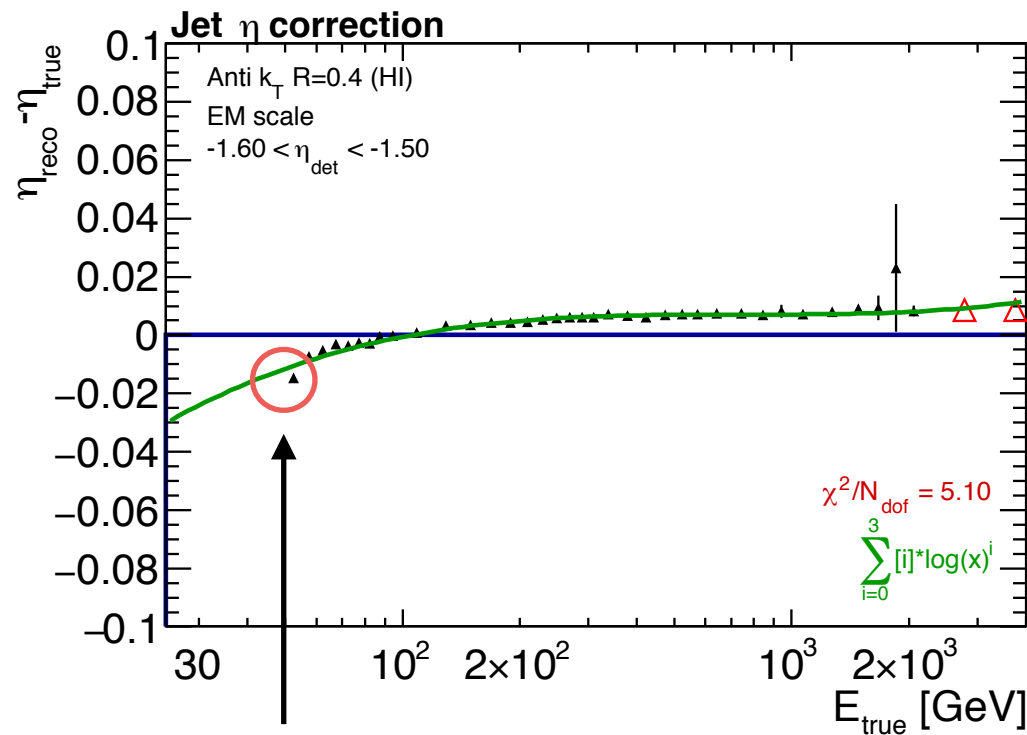
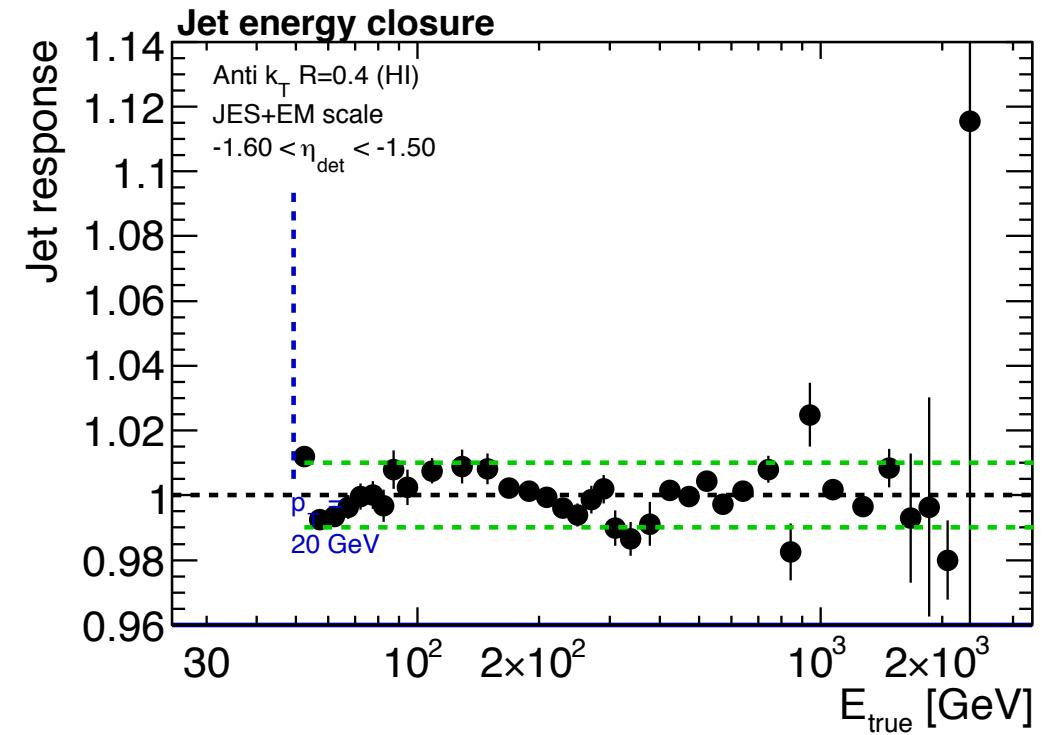
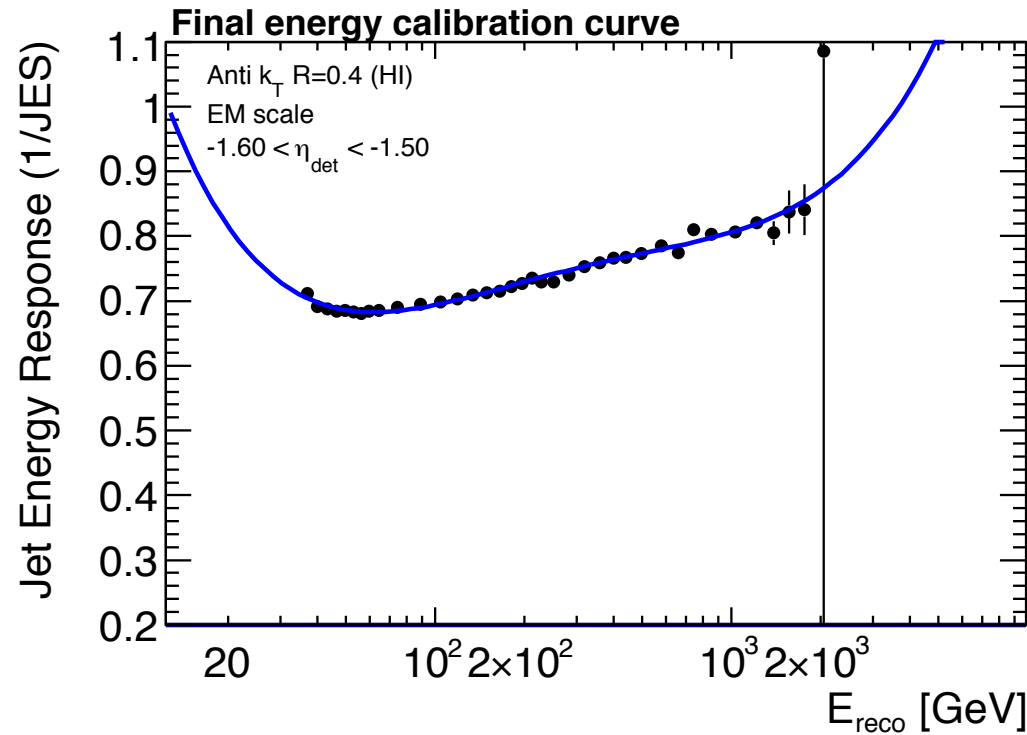
→ Fitting with  $\mu \pm 1.7\sigma$



Period B at  
Mid-rapidity  
 $-0.1 < \eta < 0$



c.f. Period B at  
Forward-rapidity  
 $4.4 < \eta < 4.5$

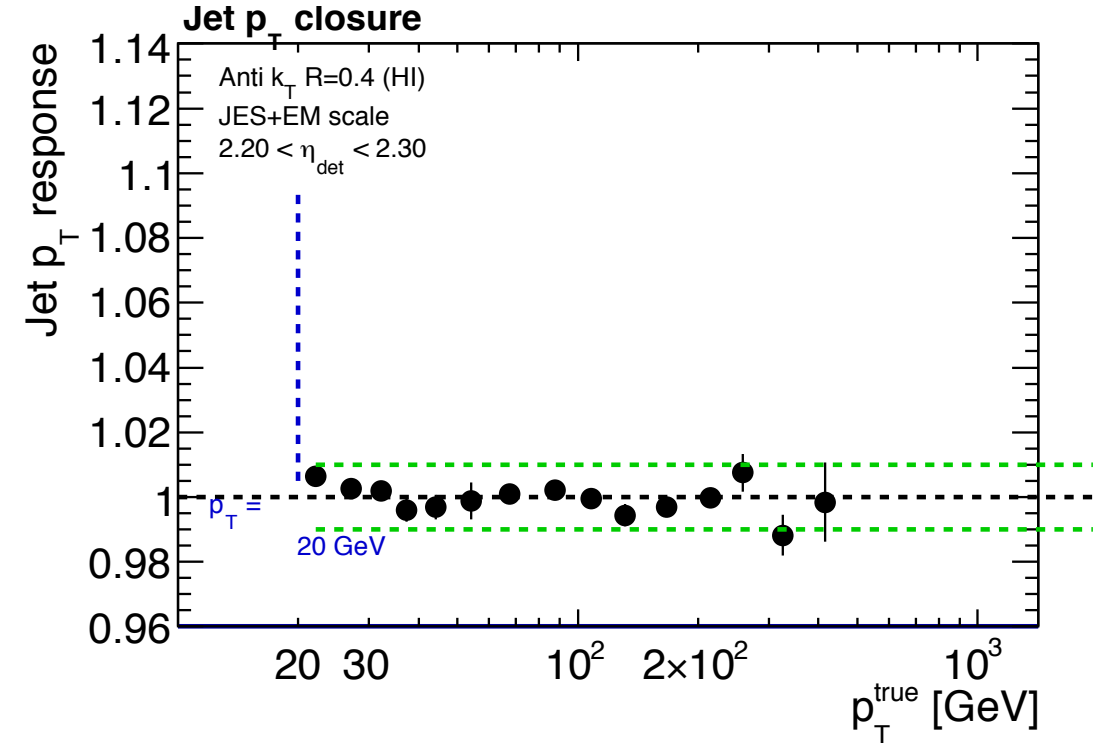
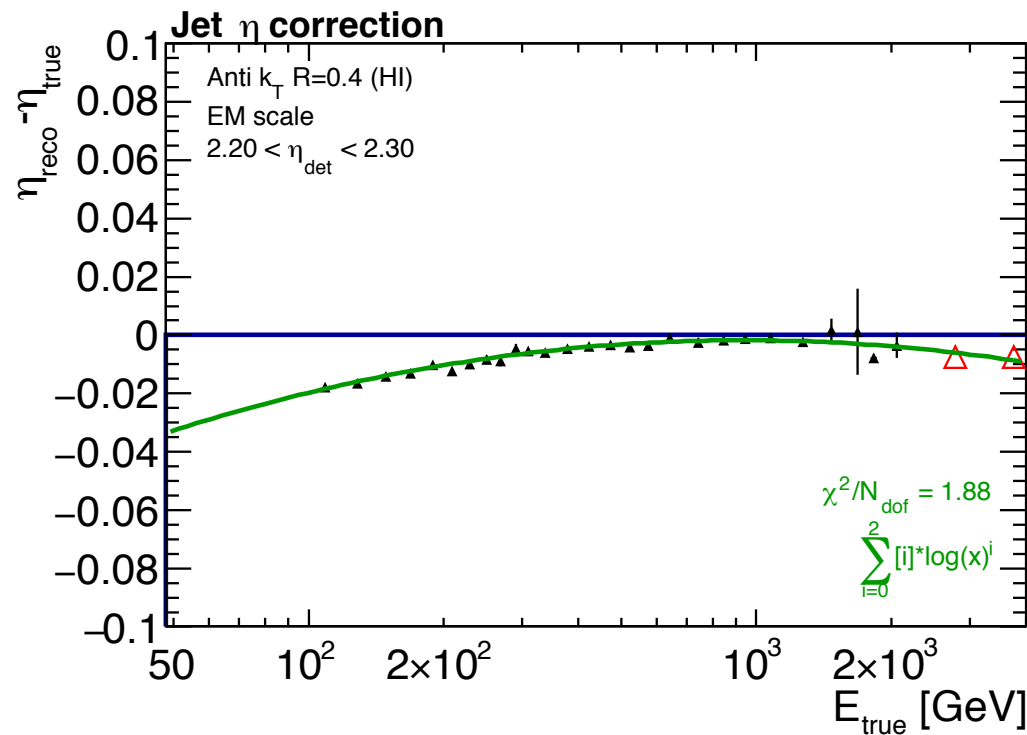
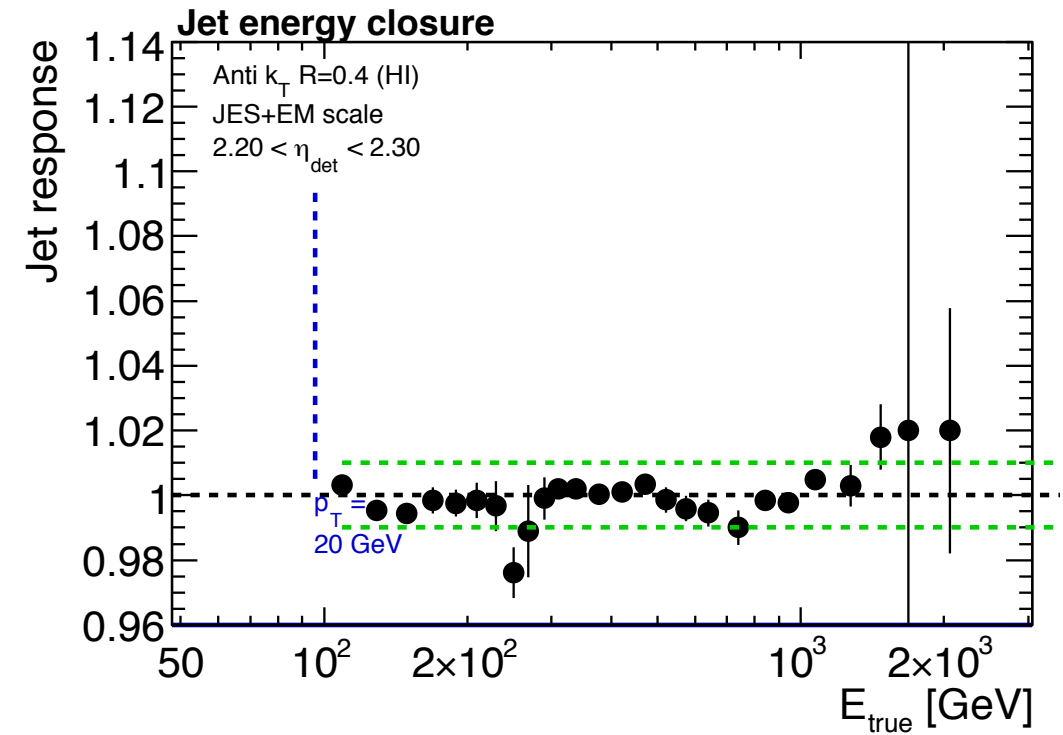
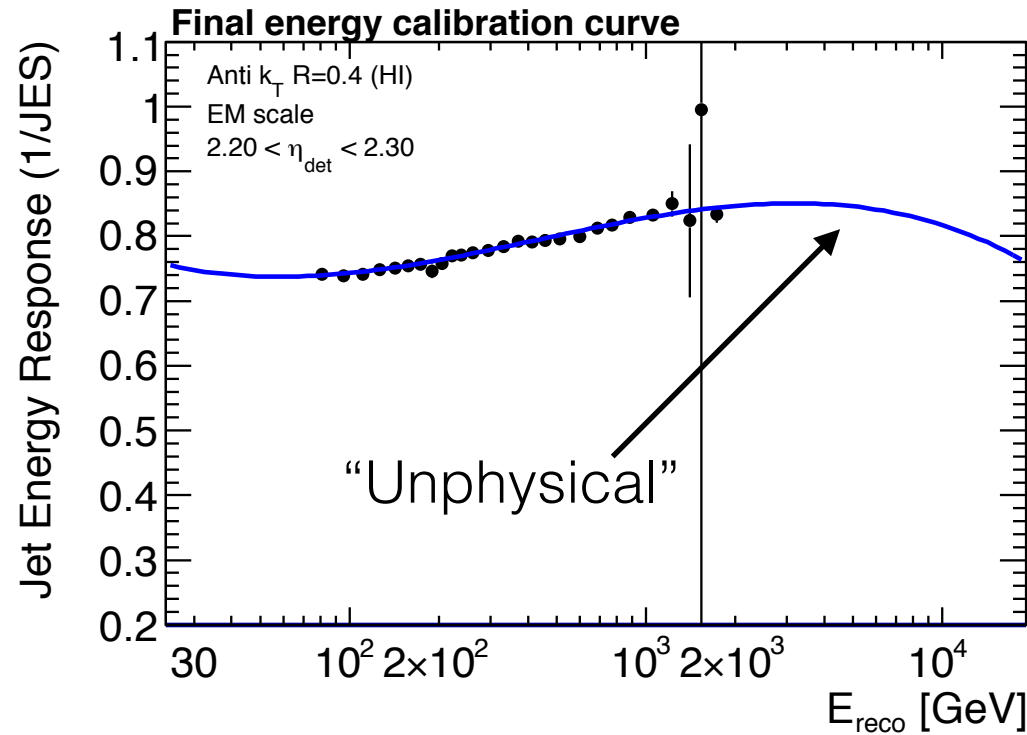


Common trend for lowest datum:

Low truth energy jets are reconstructed are at a more forward  $\eta$

Is there an intuition here?

→ tried raising MinPtForETAJES from 10 to 14,  $\chi^2/\text{ndf}$  didn't change



Unphysical responses occur in ~30% of JER curves

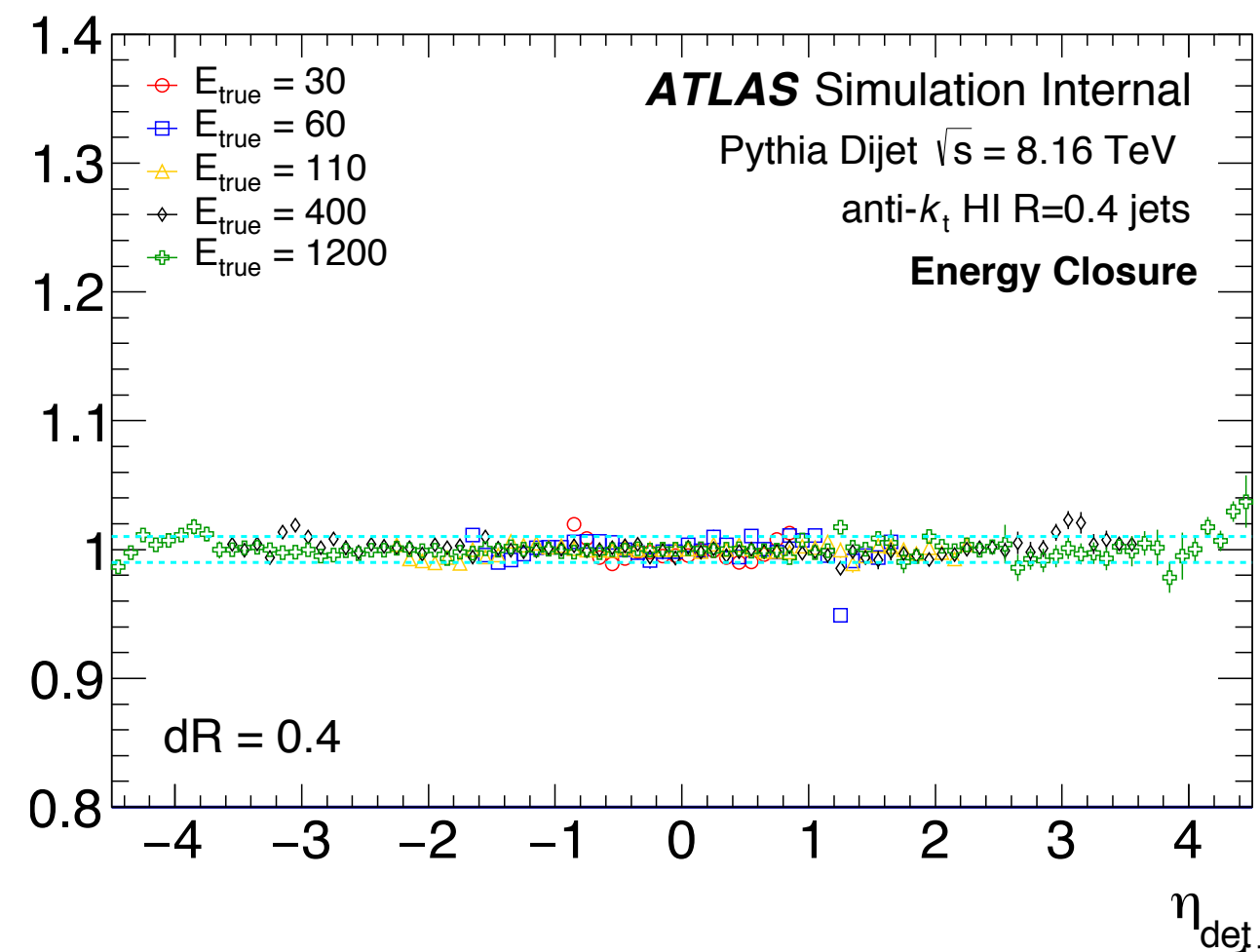
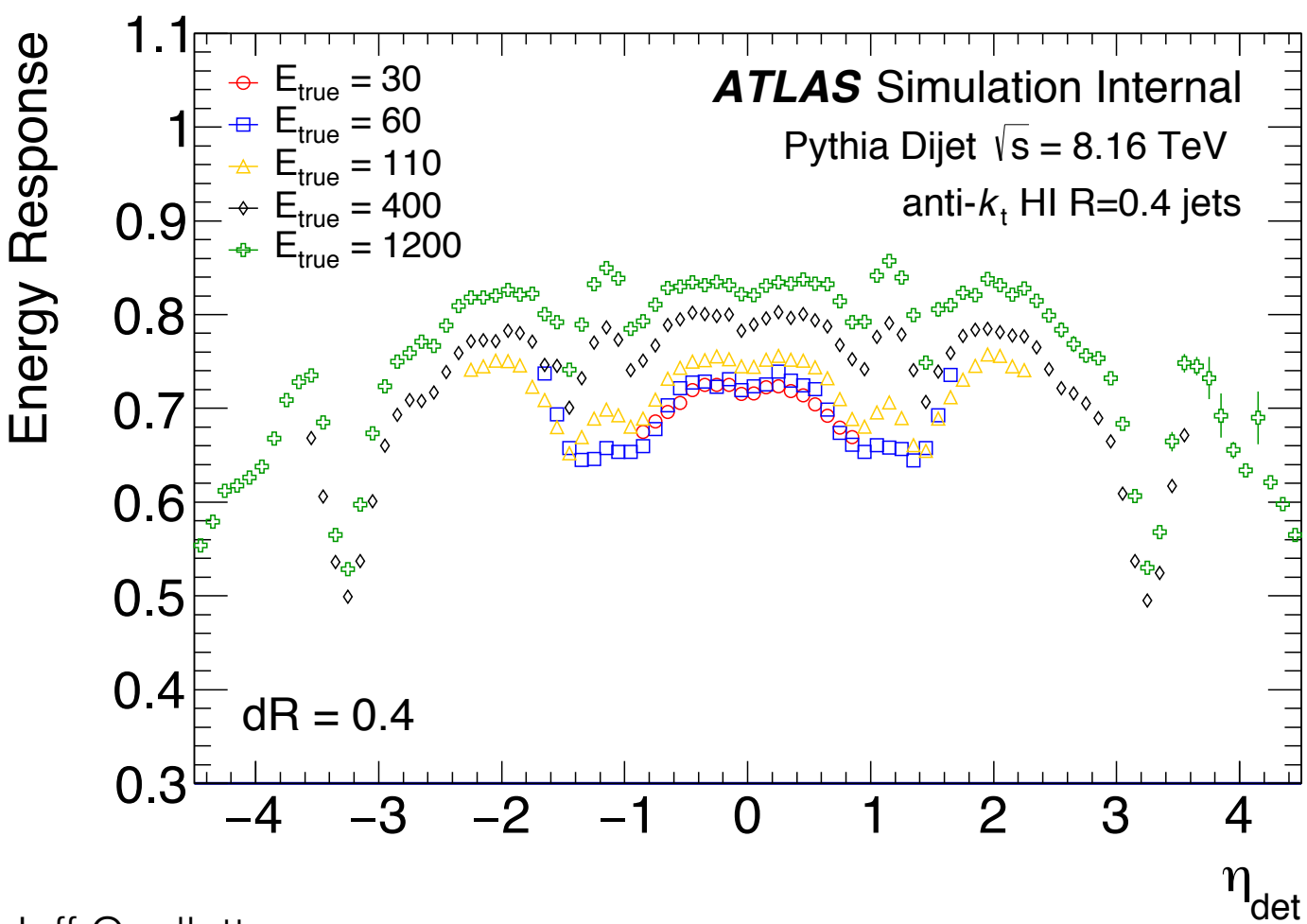
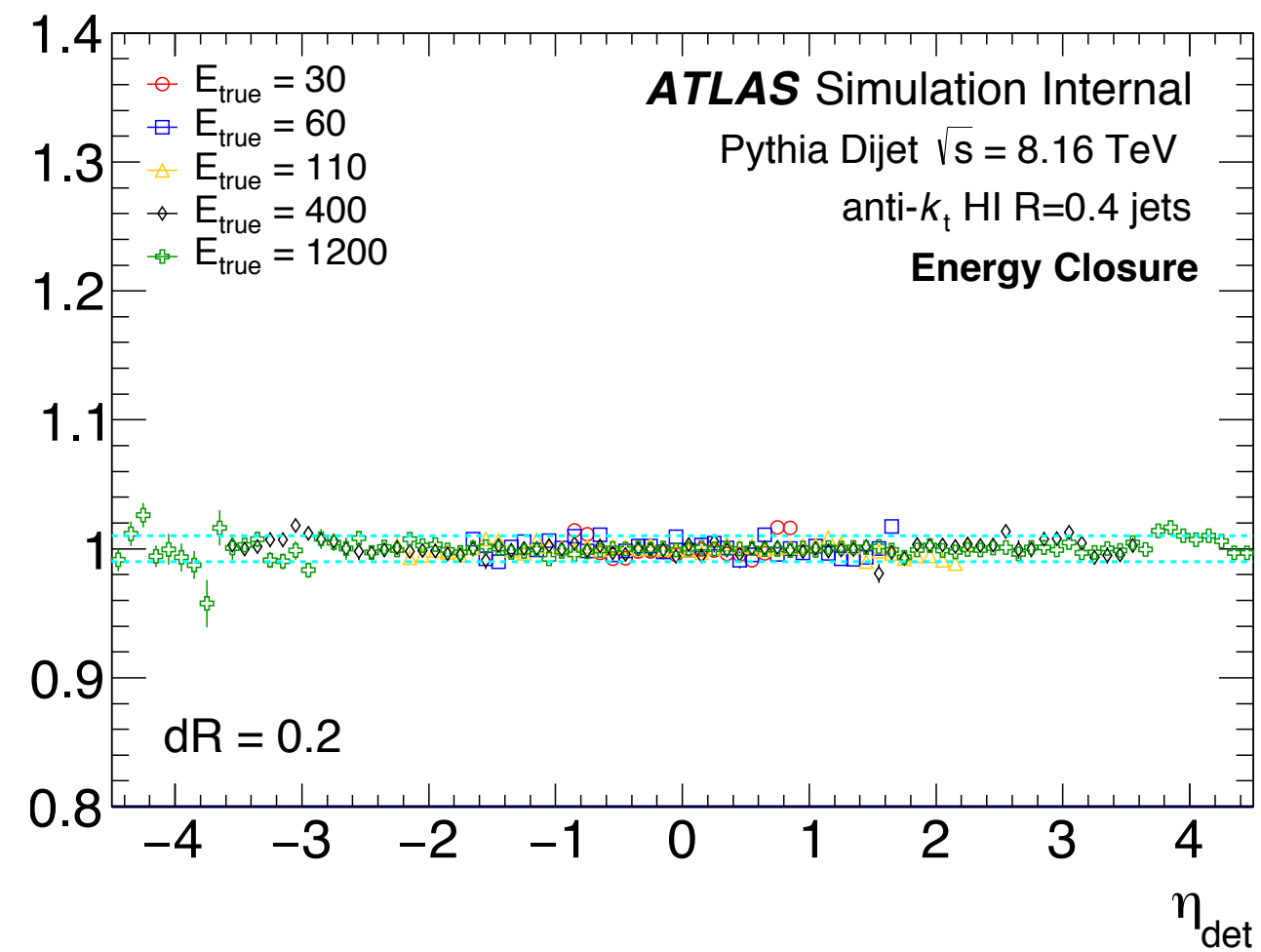
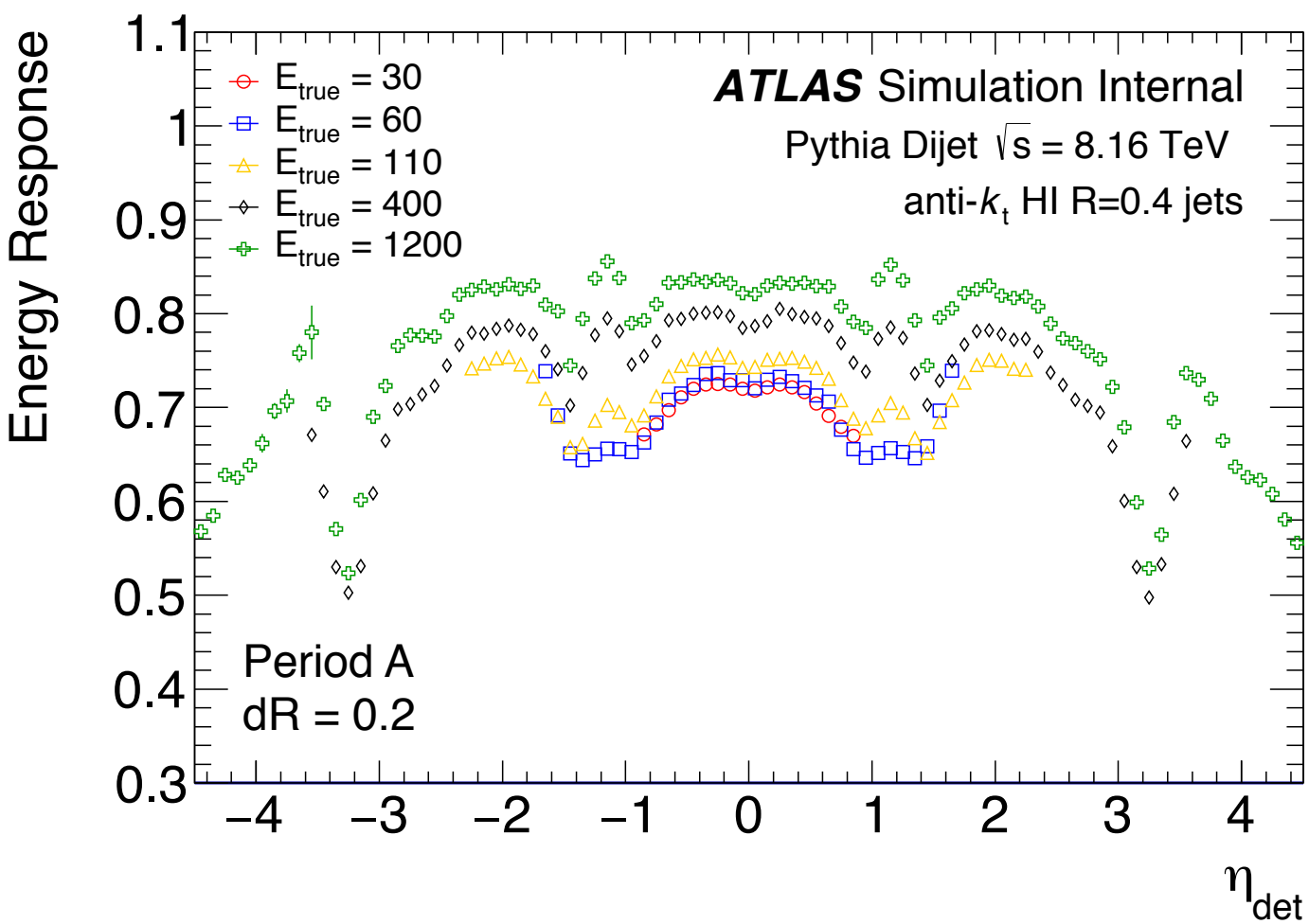
→ solution is to freeze out jets above some threshold  $E_{\text{reco}}$

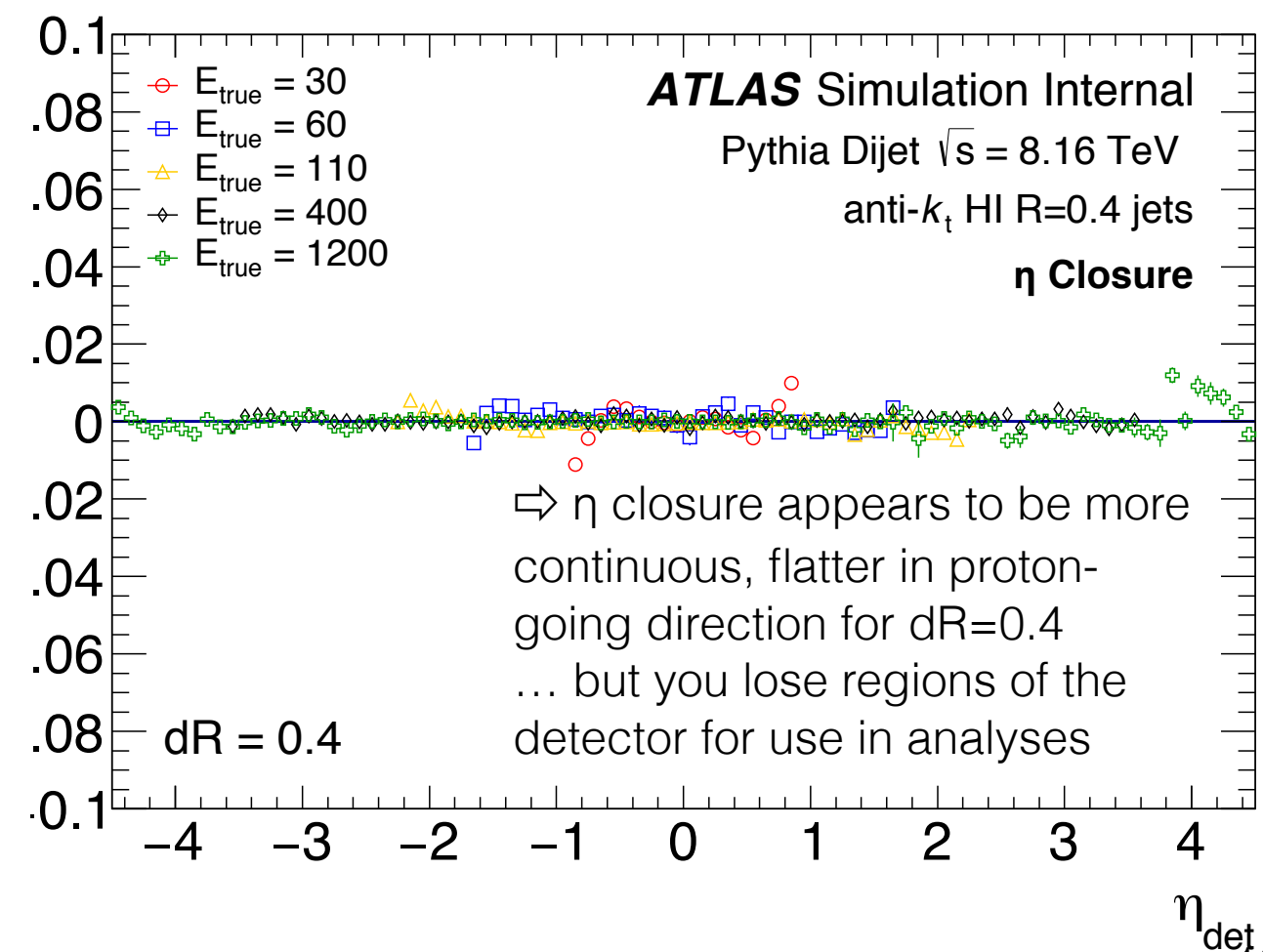
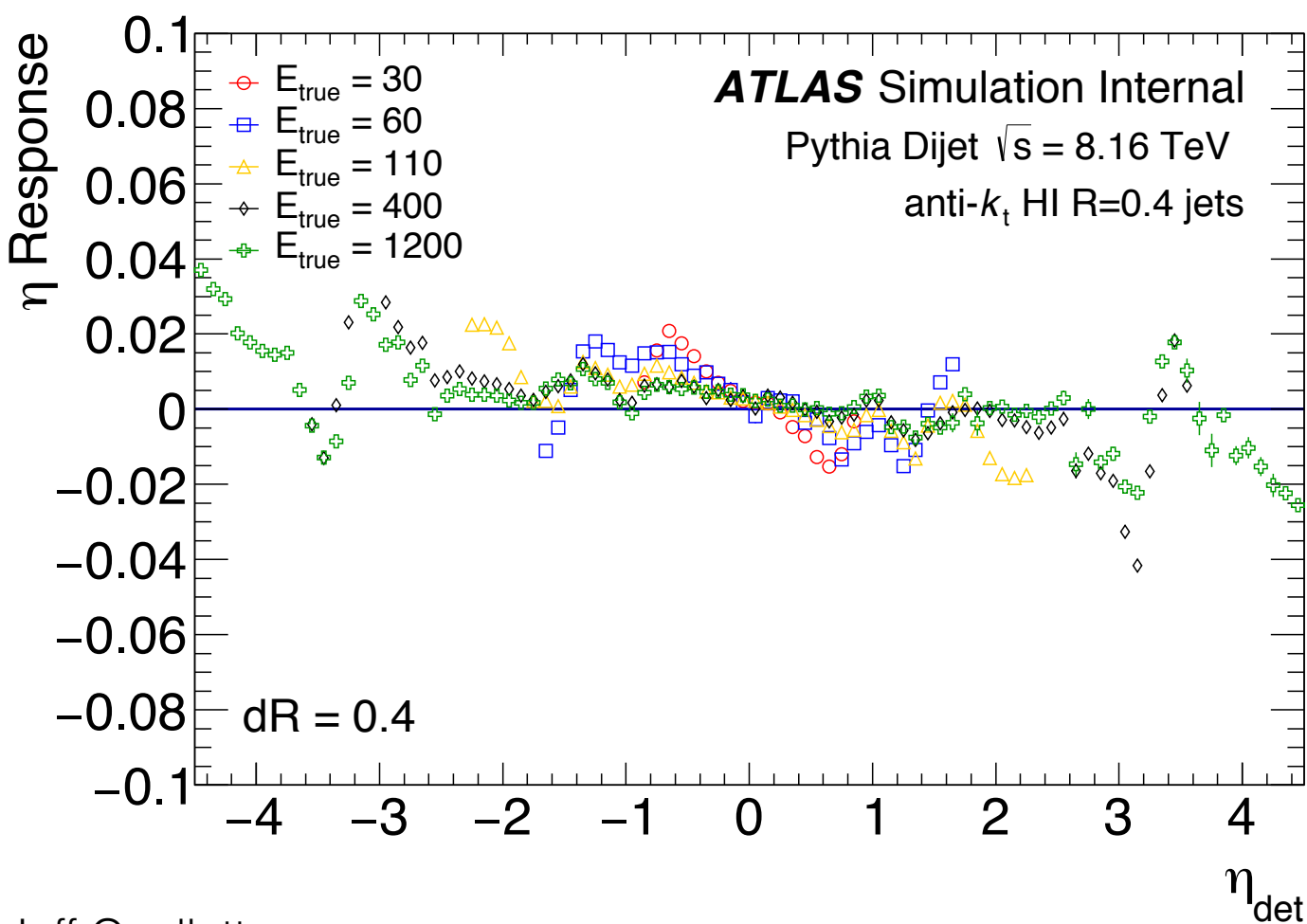
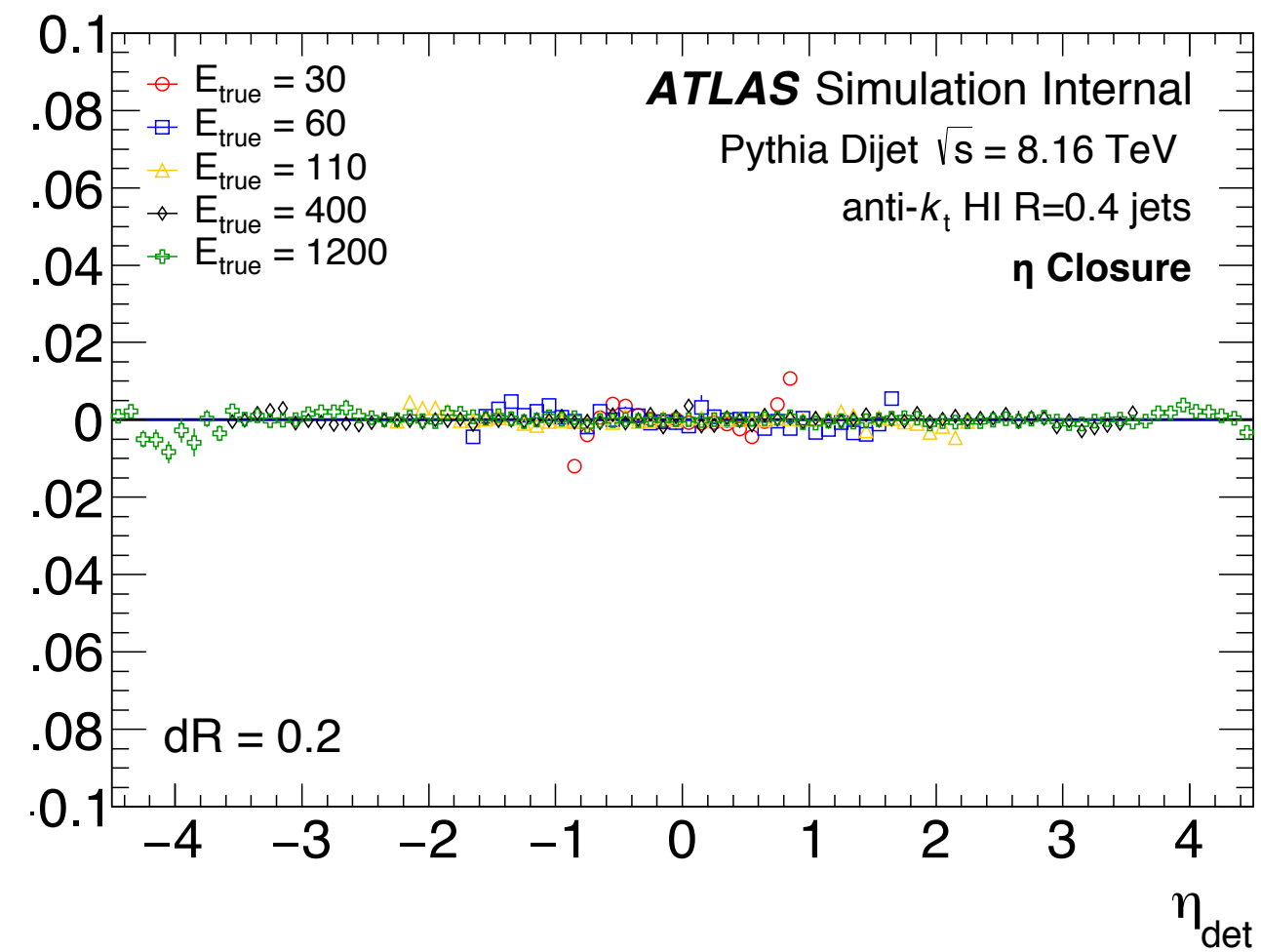
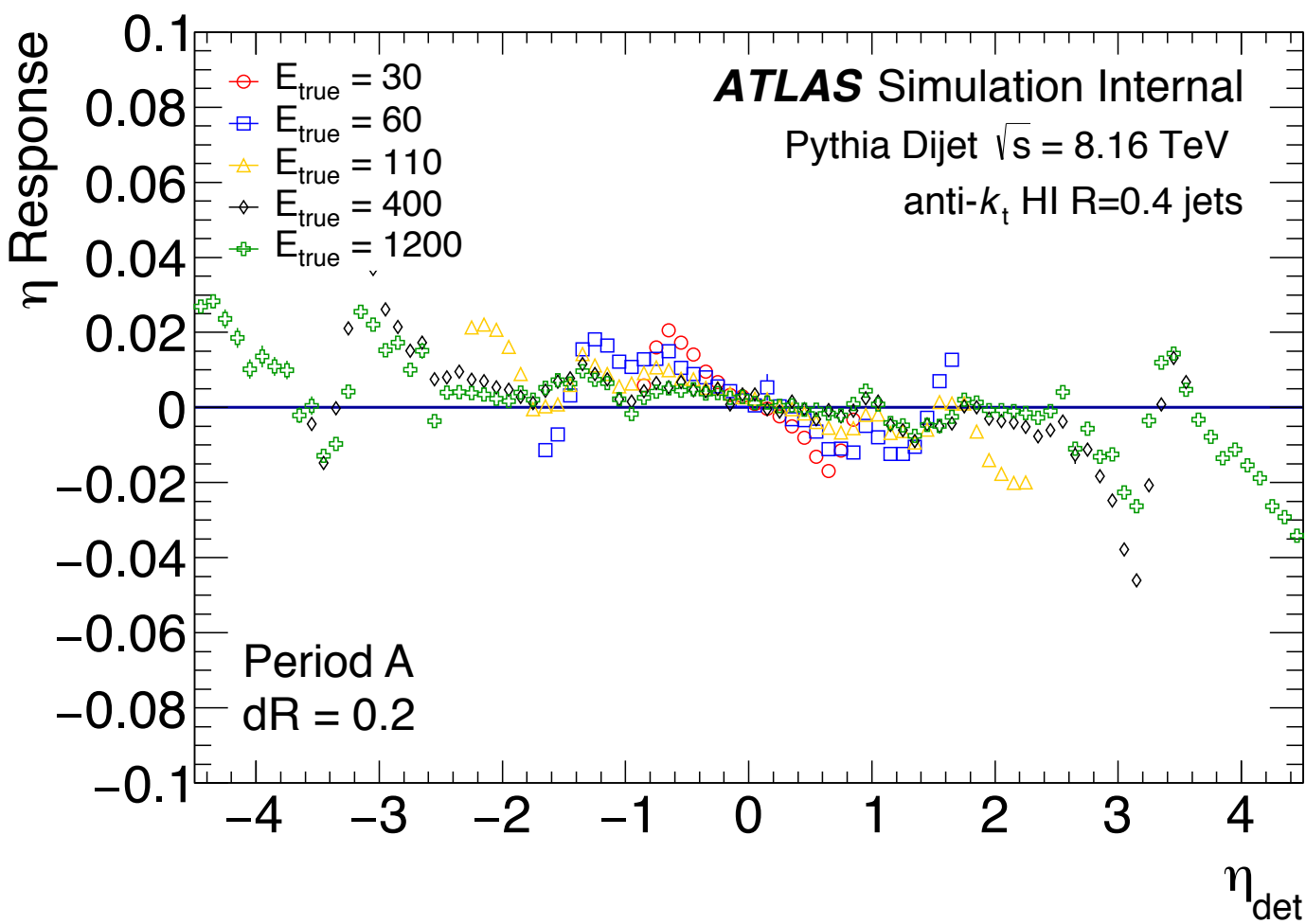
→ generally occurs above ~2TeV, so EtaJES should not be sensitive to choice

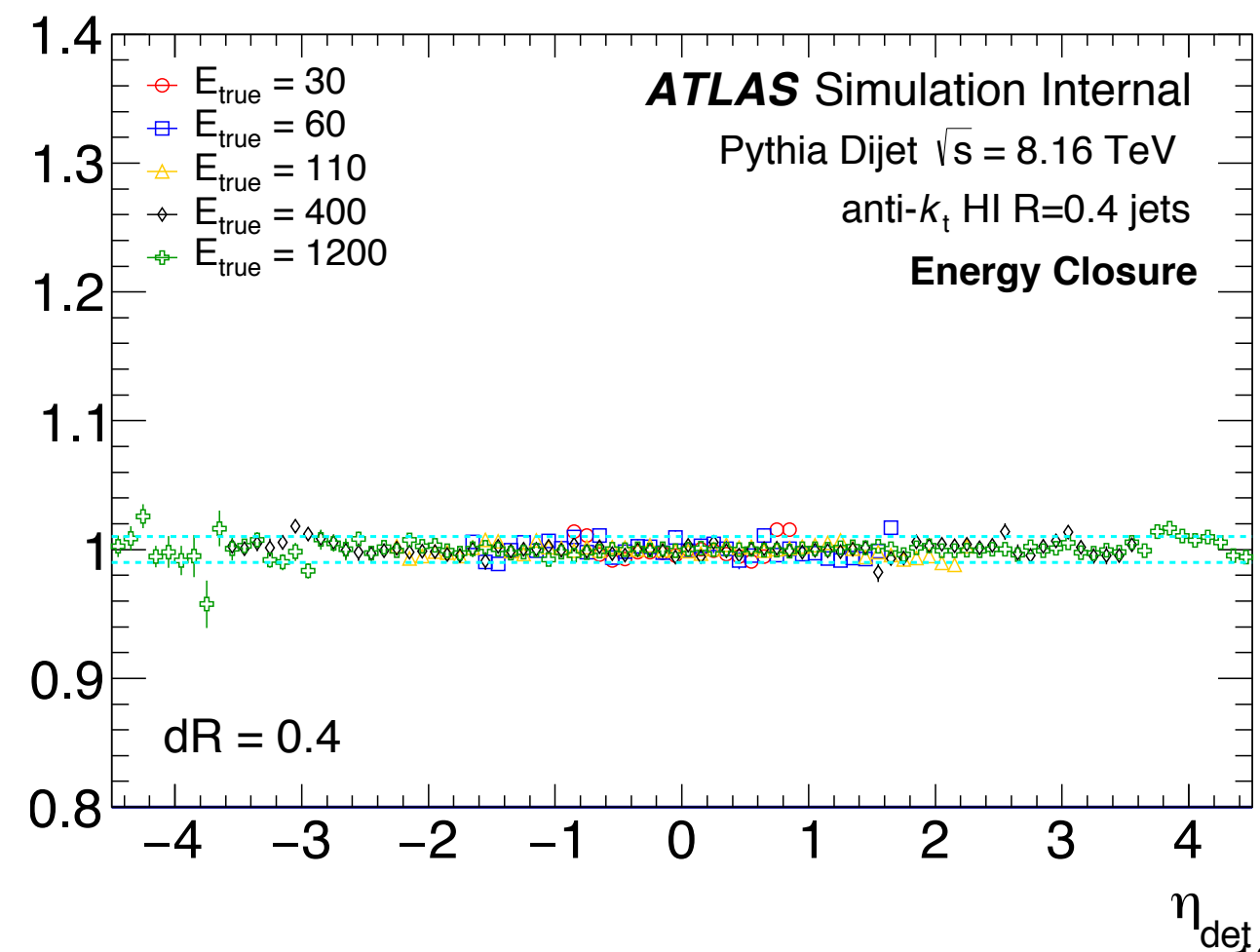
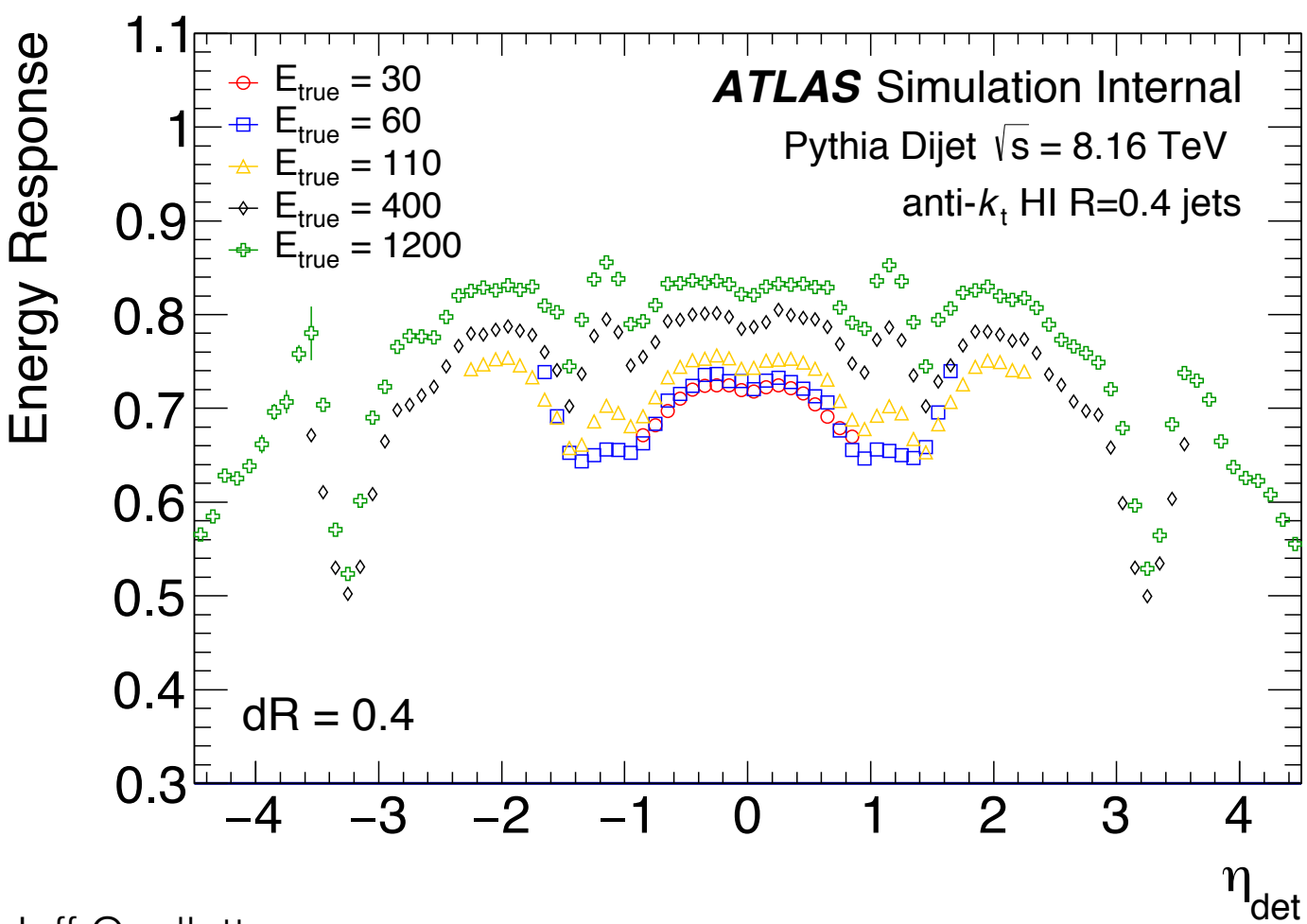
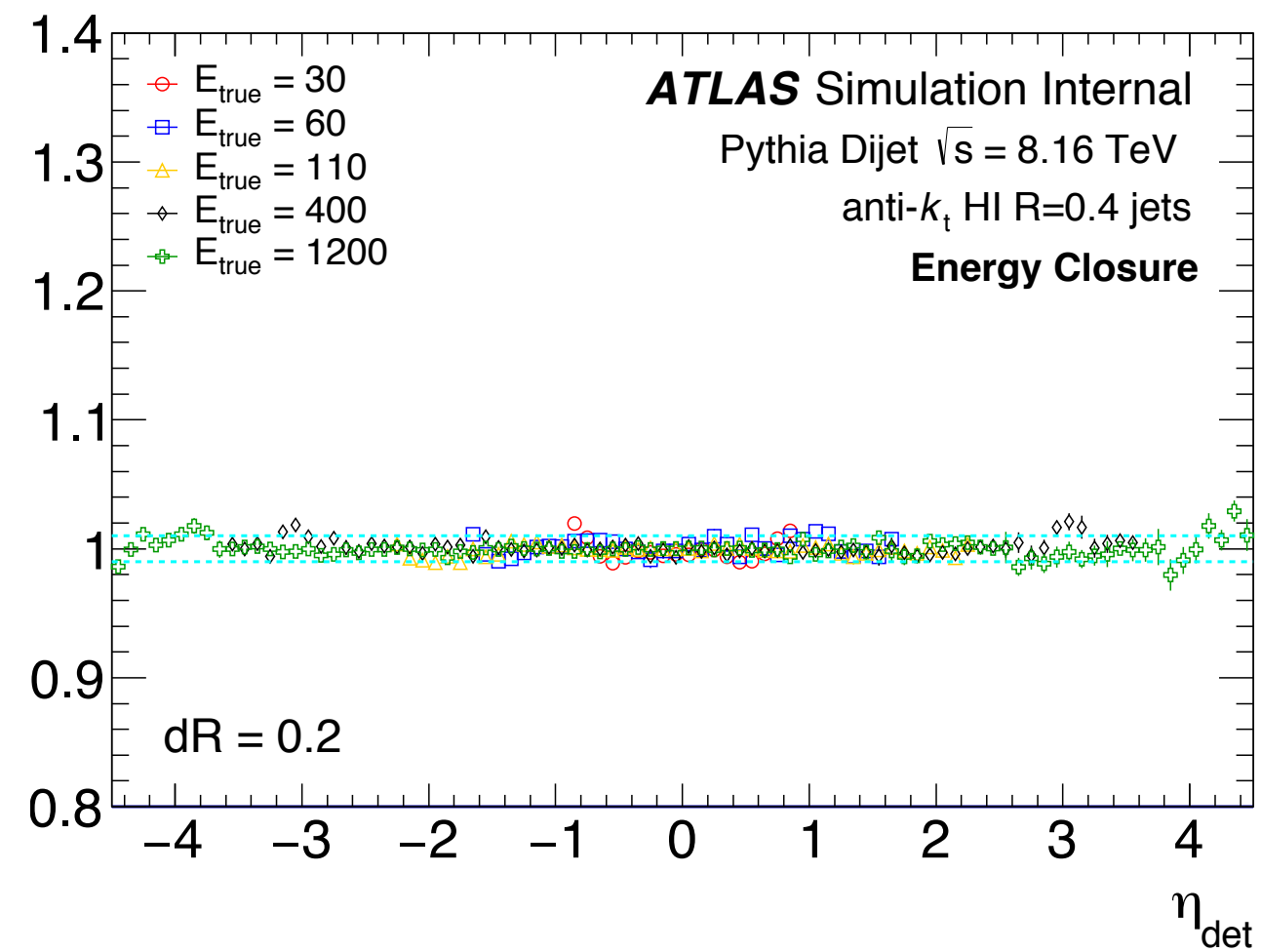
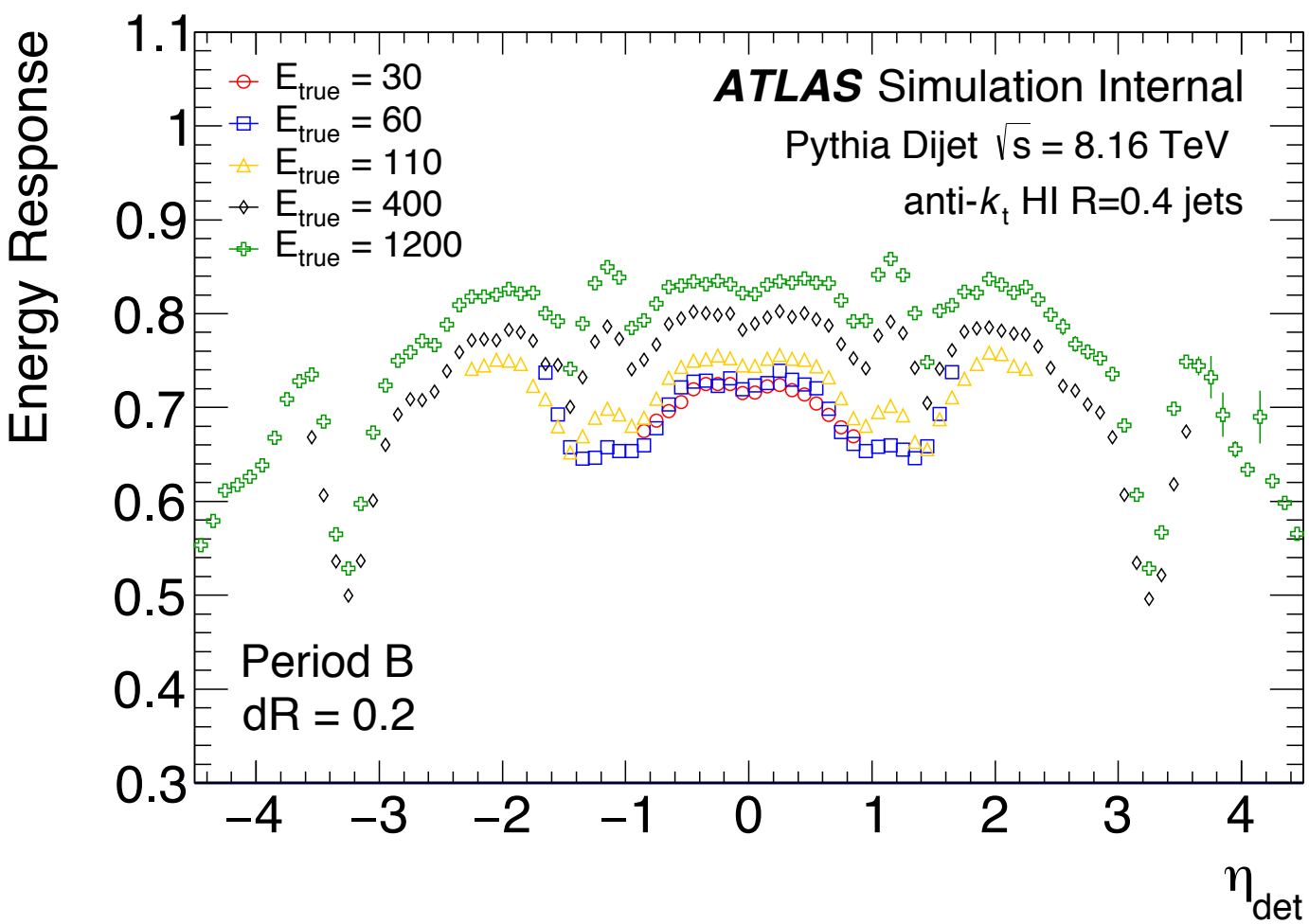
→ no “rhyme or reason” - freeze out energy not piecewise continuous in  $\eta$ ?

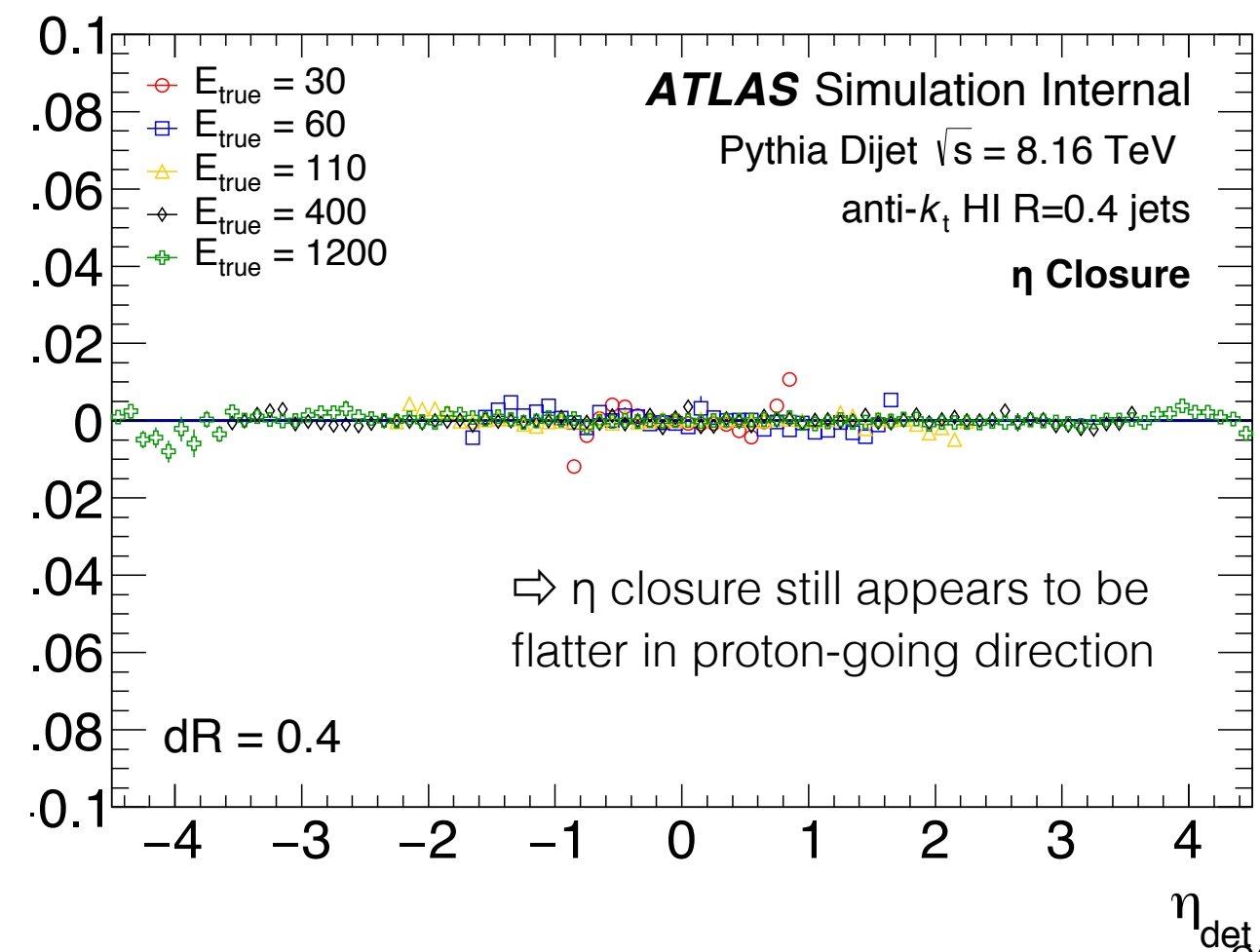
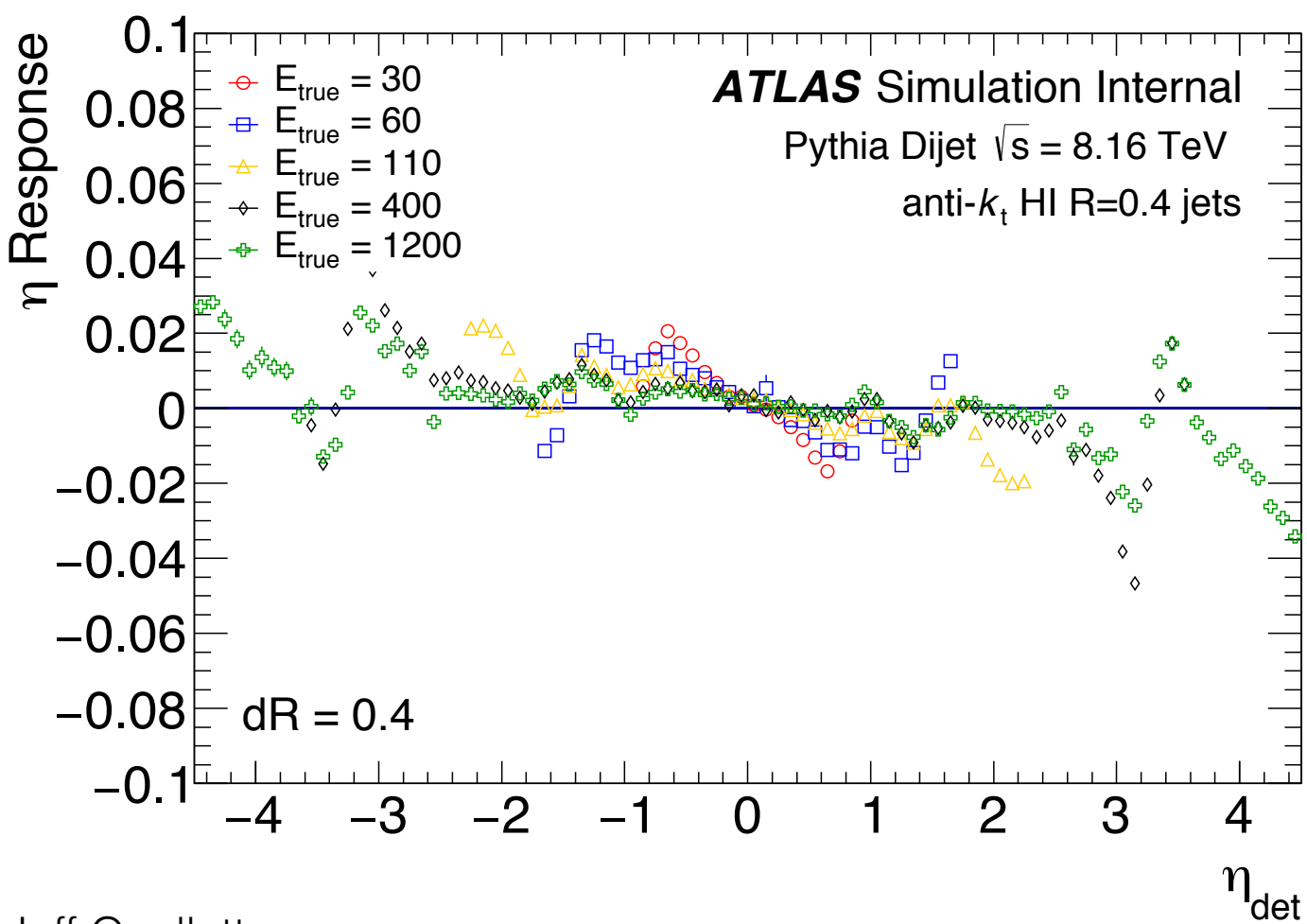
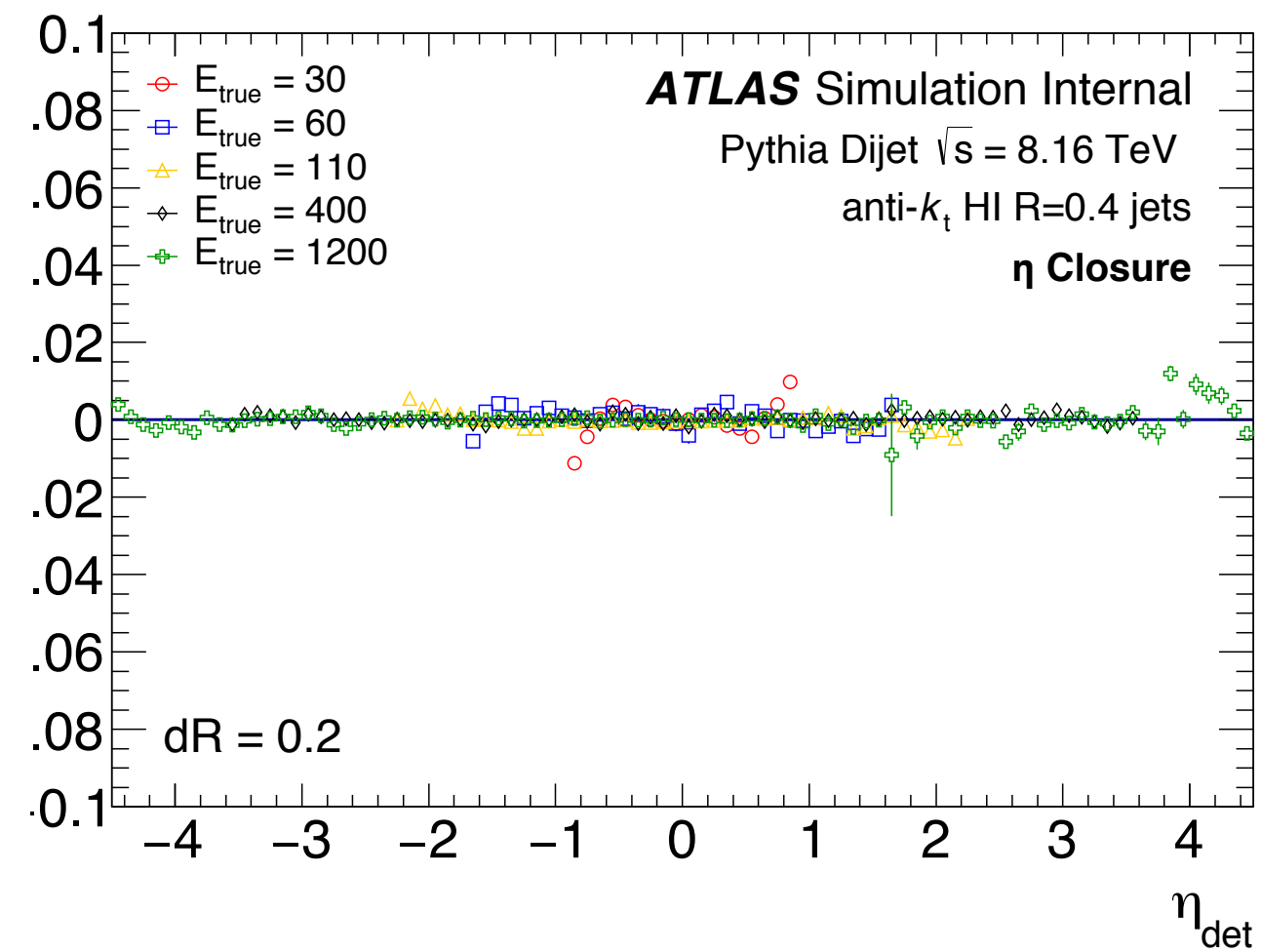
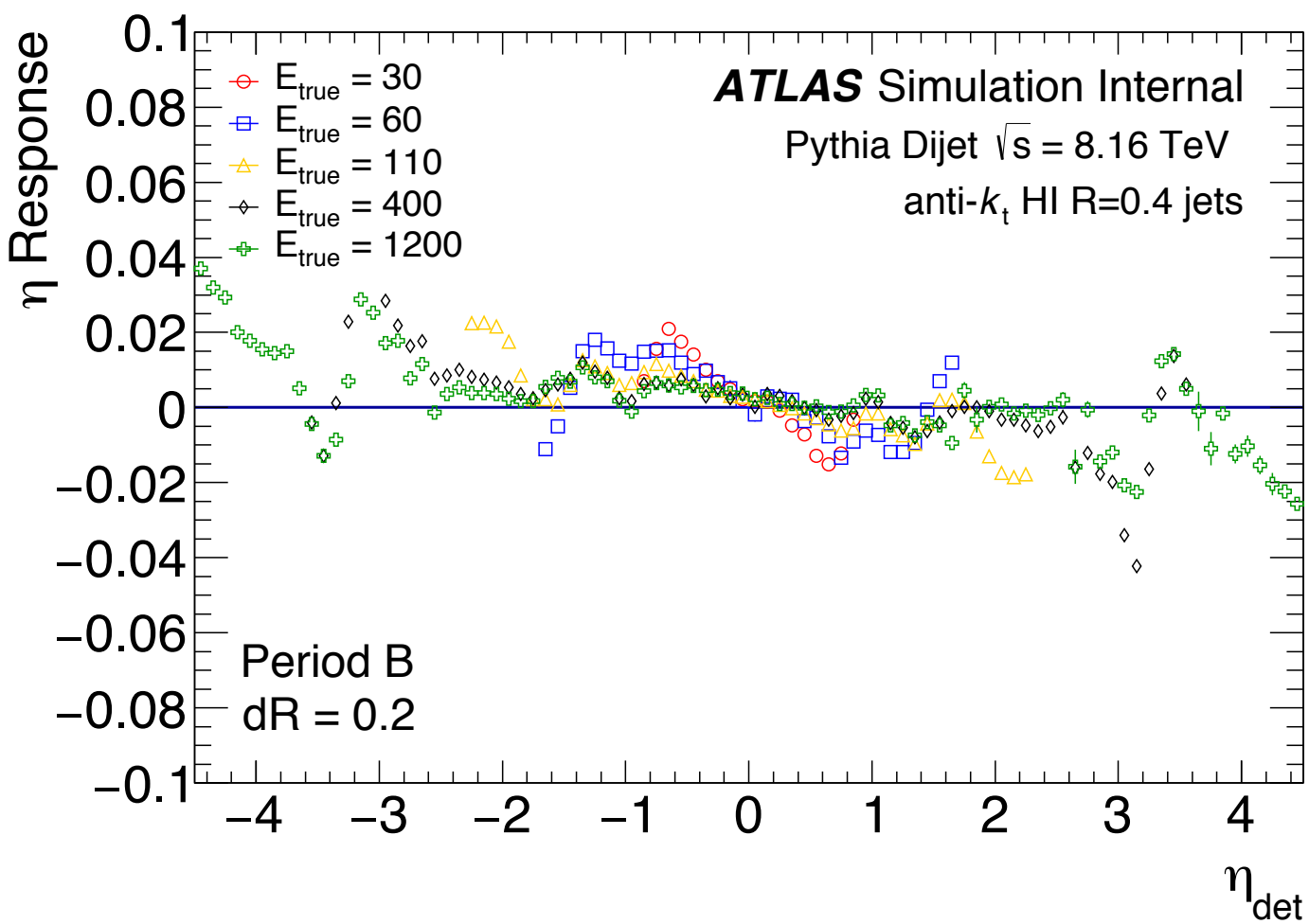
# III. Comparison of HEC cuts (no grooming)









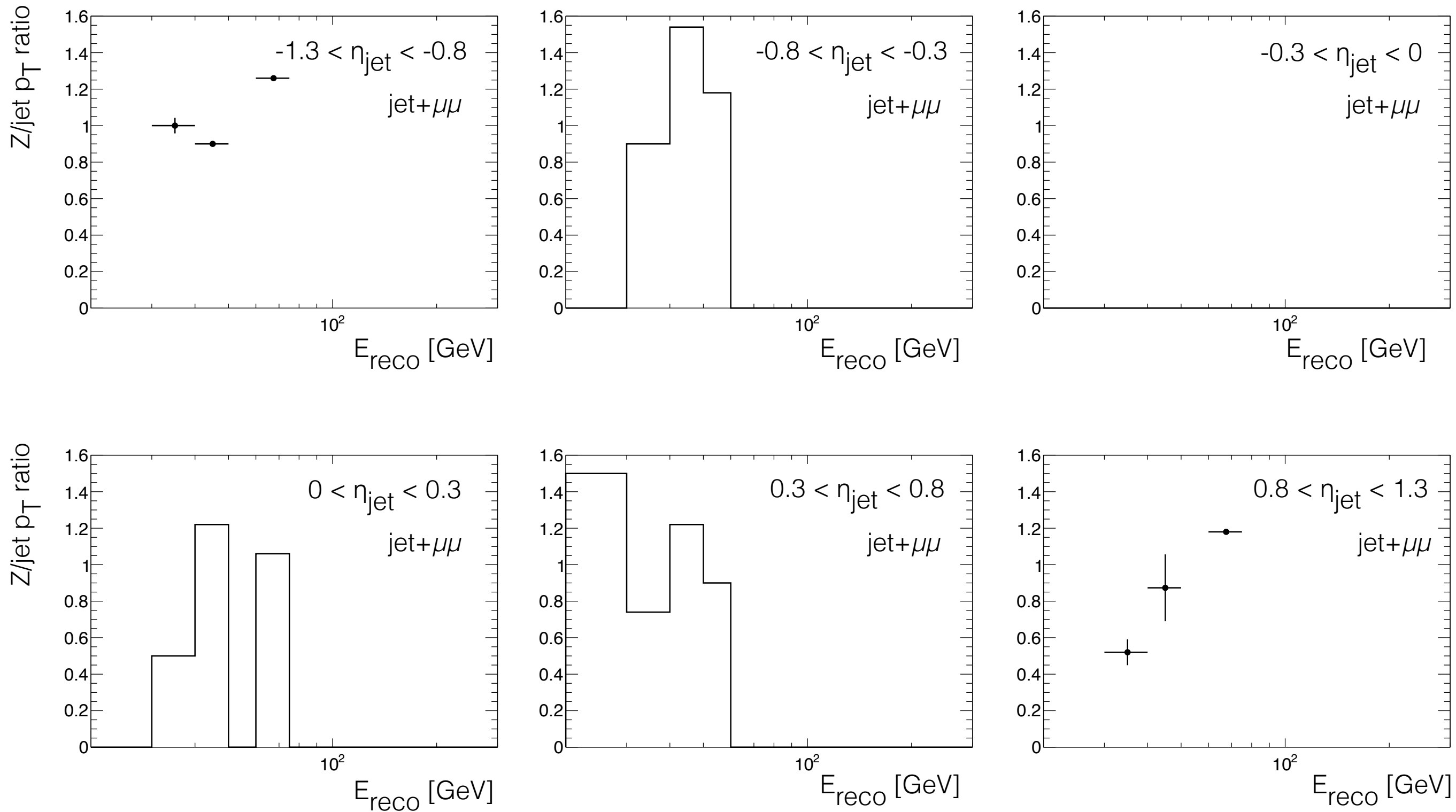


# Next steps

- Rerun with possible changes to DeriveJES configuration
- Begin study of cross-calibration by using derived JES code on  $Z+\text{jet} \rightarrow ll+\text{jet}$ ,  $\gamma+\text{jet}$  events
- Current strategy: use standard  $\mu$ ,  $e$ ,  $\gamma$  criteria (will discuss with ATLAS members here at CU, though additional input is welcome)

# Backup

# (Very) Early look at Z+jet events



Some difficulties currently with pPb egamma calibration, so focusing on  $Z \rightarrow \mu\mu$   
 ... (clearly) still writing macro for cross-check, but results aren't "ridiculous" so far!