Low Q^2 Jet Smearing: Neutral Bias Update

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EIC WG Meeting

07/09/2020

Simu Details

- Simulation
  - PYTHIA-6 (BNL Instance)
  - E_e = 18 GeV E_p = 275 GeV
  - $10^{-5} < Q^2 < 1.0$ GeV^2

- Jet Finder
  - Anti-k_T
  - Lab frame
  - R = 0.8, 0.4
  - Min Jet p_T = 5 or 10 GeV (unless specified)
  - Particle Level Input: All stable particles with |eta| < 3.5 (not scattered electron)

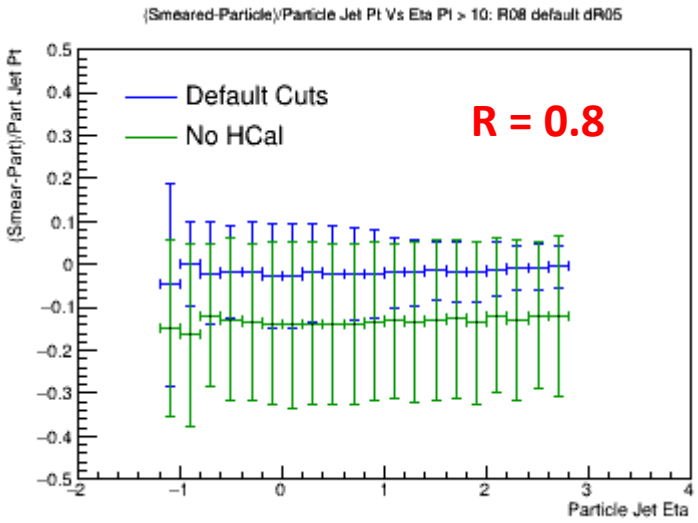
- Smearing
  - Eic-smear: Handbook detector (v1.2)
  - Charged hadron p_T > 250 (500) MeV, Photon Energy > 200 MeV, Hcal Energy > 500 MeV (or infinite to simulate no Hcal)
  - Charged hadrons detected by tracker, photons detected by Emcal, Neutrons, KLongs and untracked charged hadrons detected by Hcal
  - No position smearing!

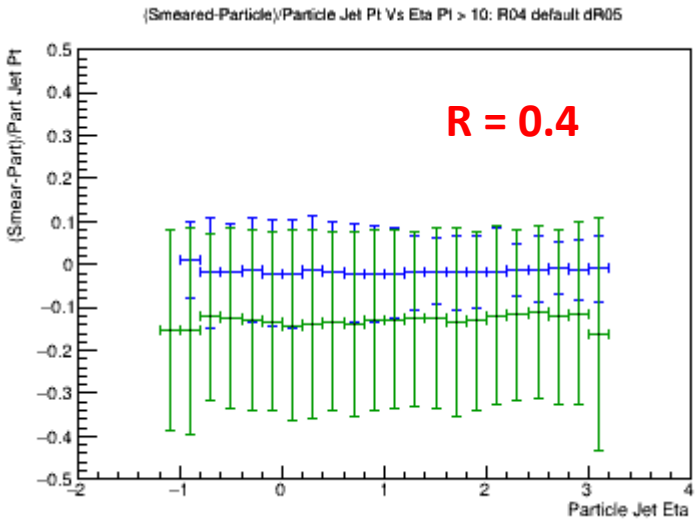
Particle – Smear Correlations

- For each particle (smeared) jet which has p_T and eta within acceptance, loop over all smeared (particle) jets and find the one closest in deltaR
- Require deltaR < 0.5
- Select particle and loop over smear – show how a given particle level jet will be modified
- Select smeared and loop over particle – show potential biases introduced by the detector / selection criteria
- Will show several plots of 'Sigma A vs B' – Sigma is defined as (Smeared quantity – Particle quantity) / Particle quantity; error bars are RMS of sigma distribution

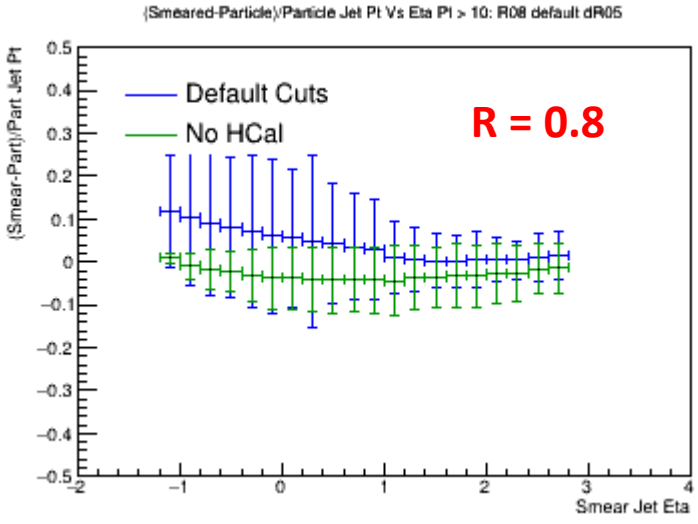
Last Time …

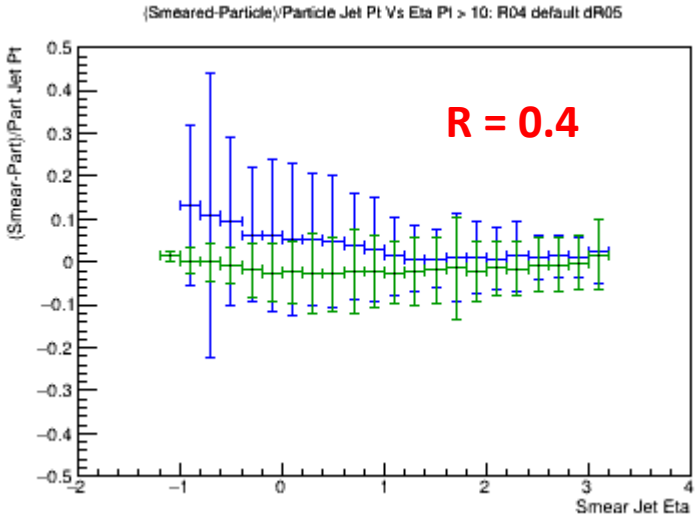
Select Particle



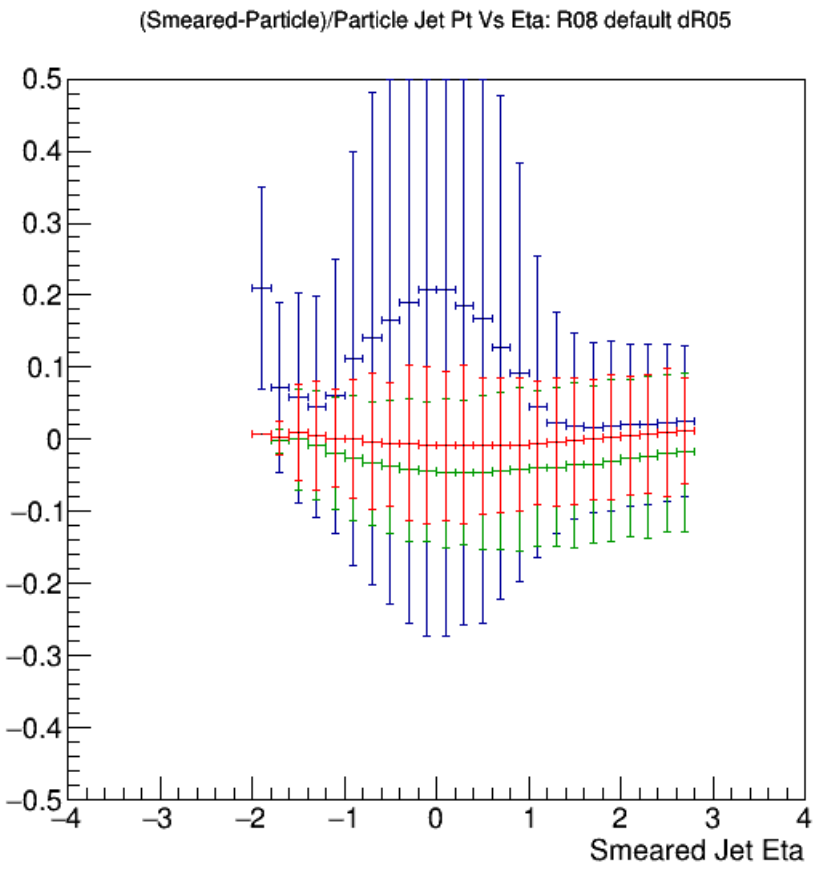


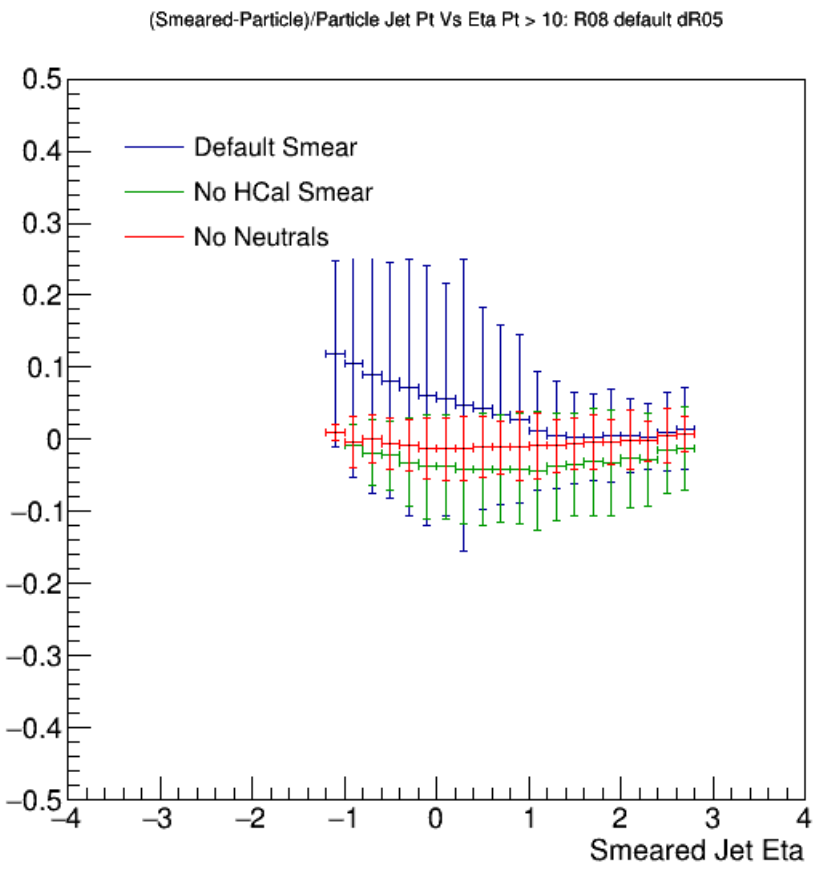
Select Smear



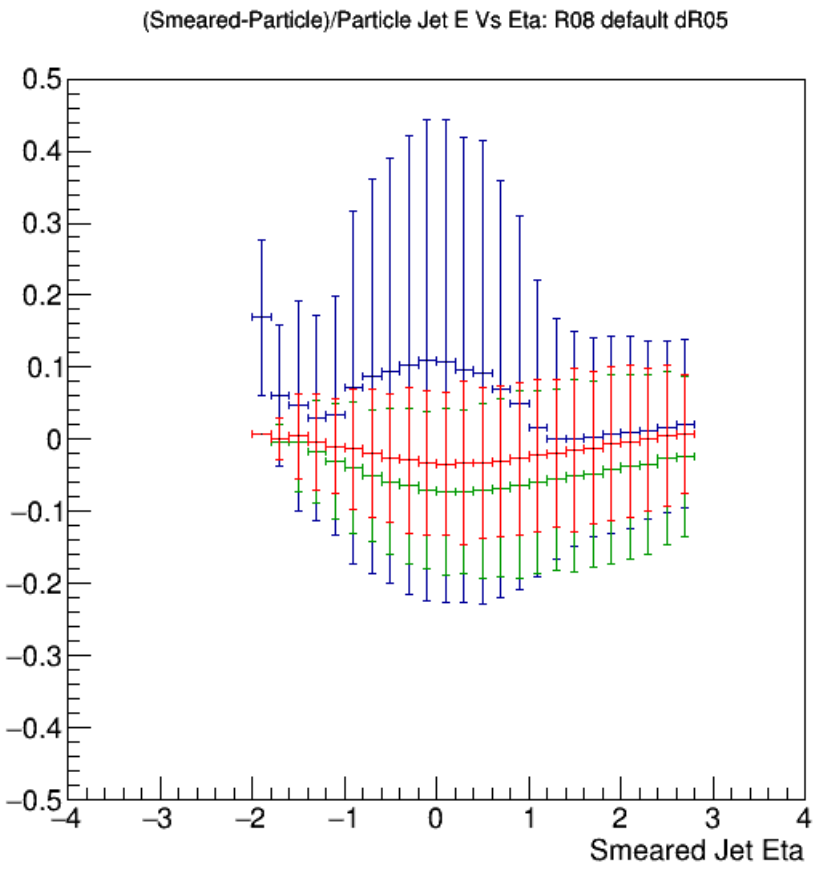


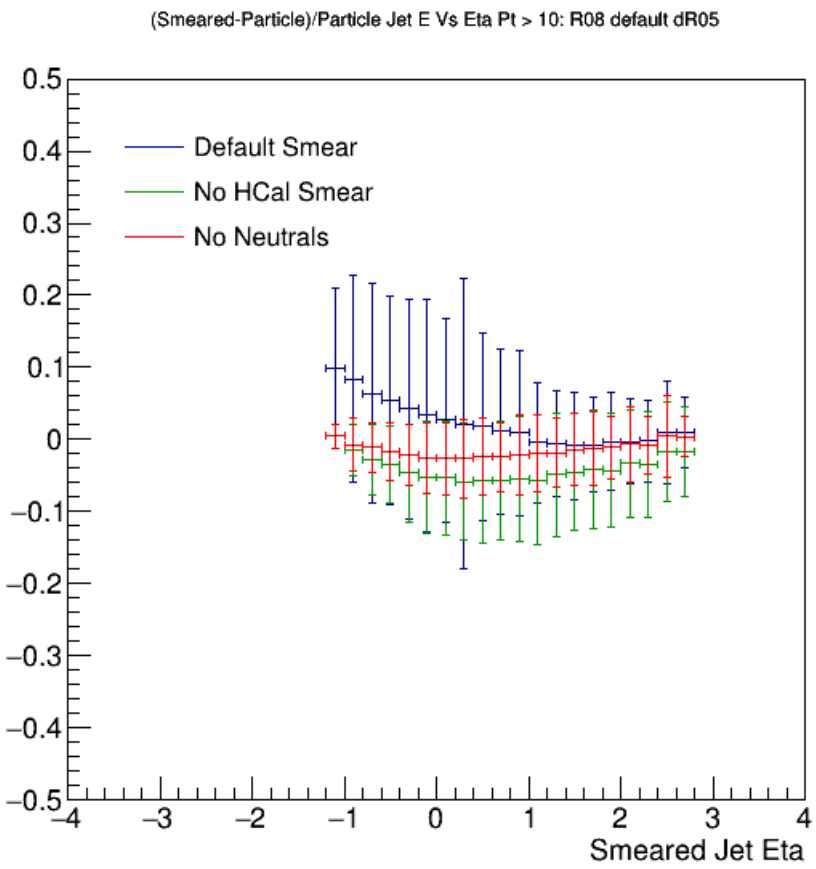
Reconstruction Bias: p_T Vs Eta



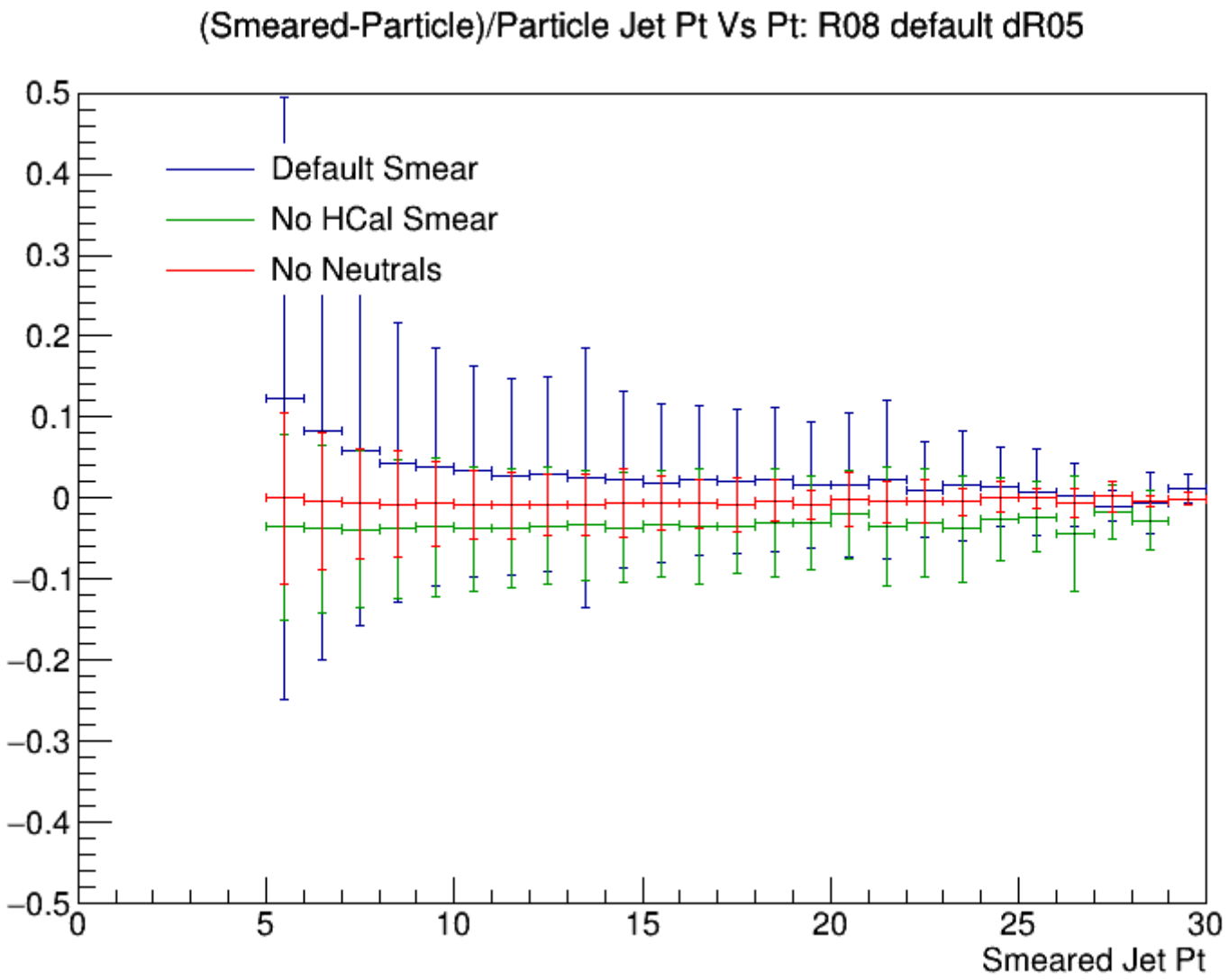


Reconstruction Bias: E Vs Eta

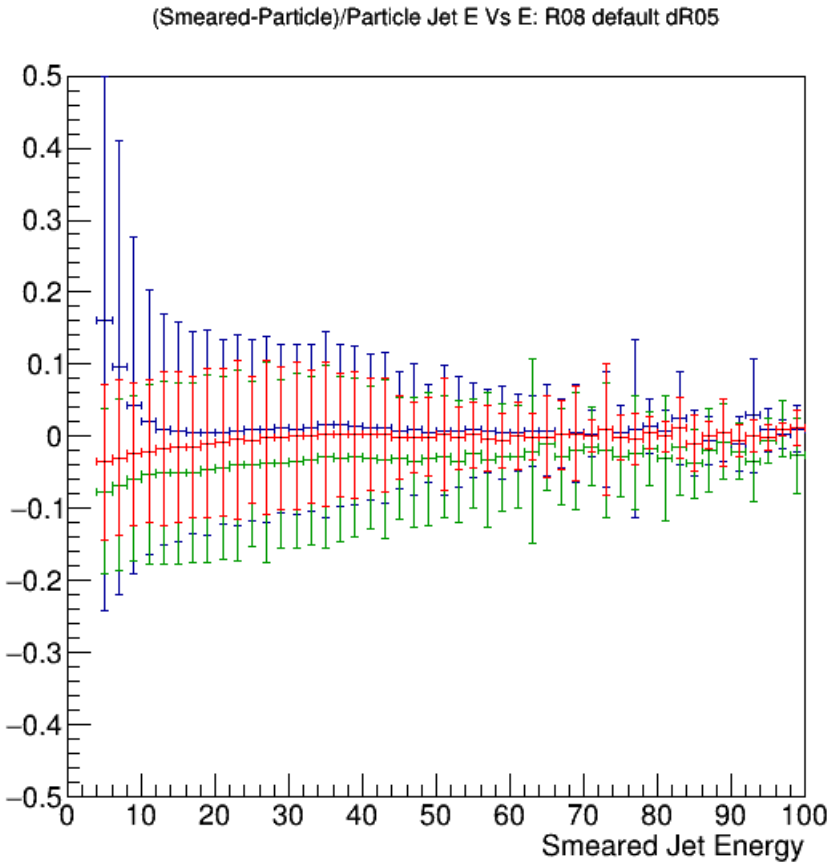


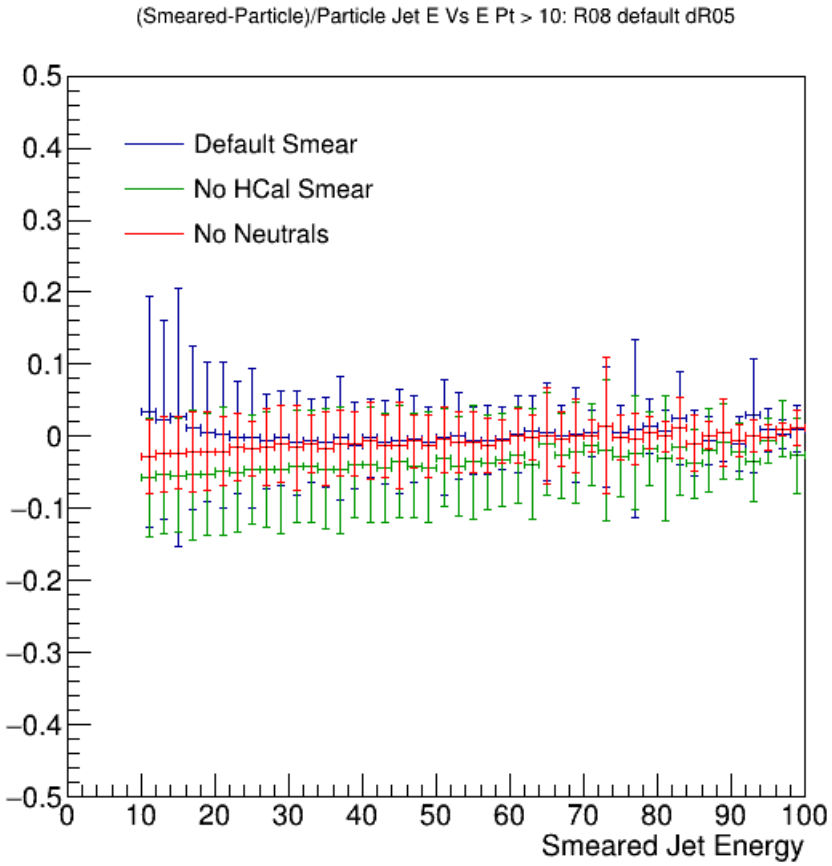


Reconstruction Bias: p_T Vs p_T

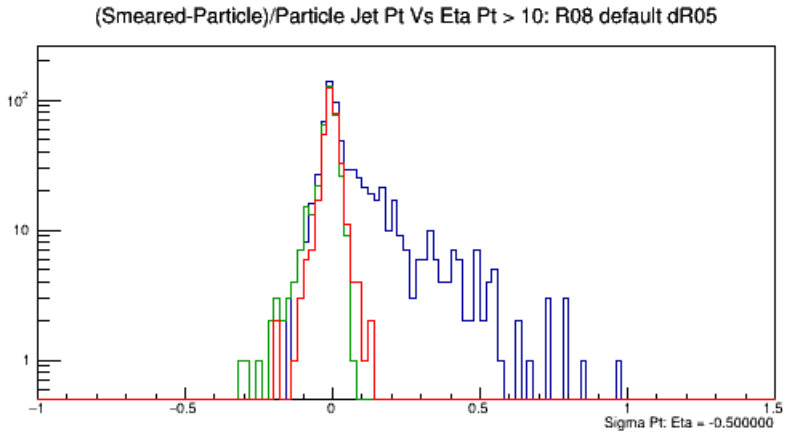


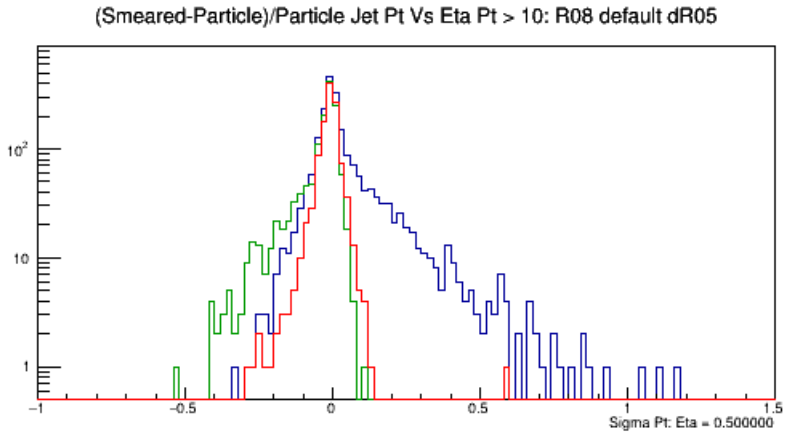
Reconstruction Bias: E Vs E

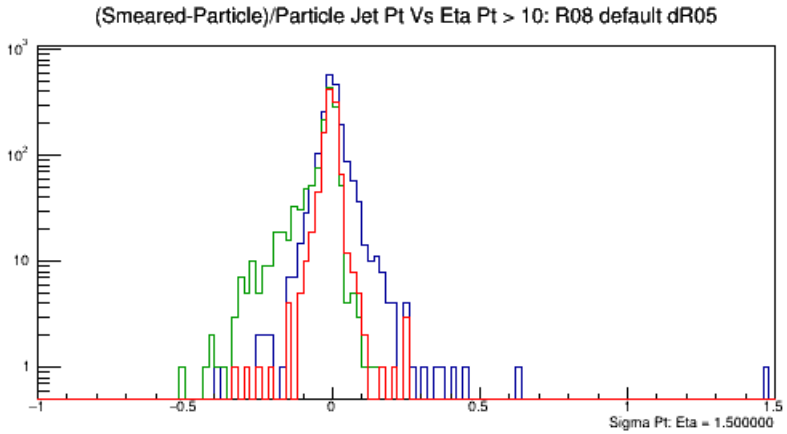


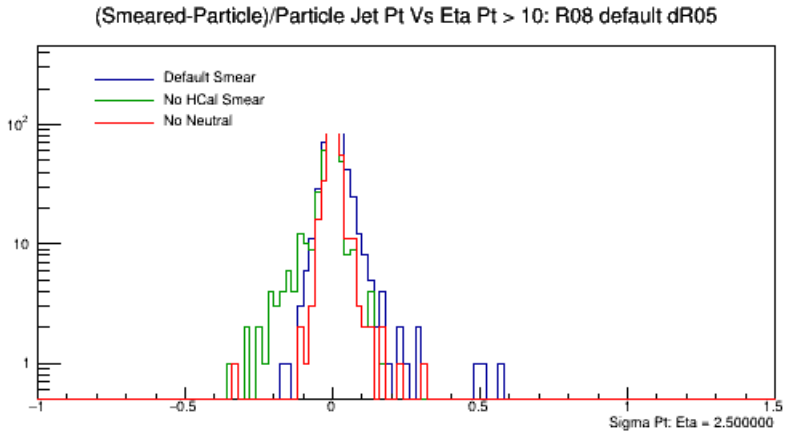


Sigma Projection: p_T Vs Eta

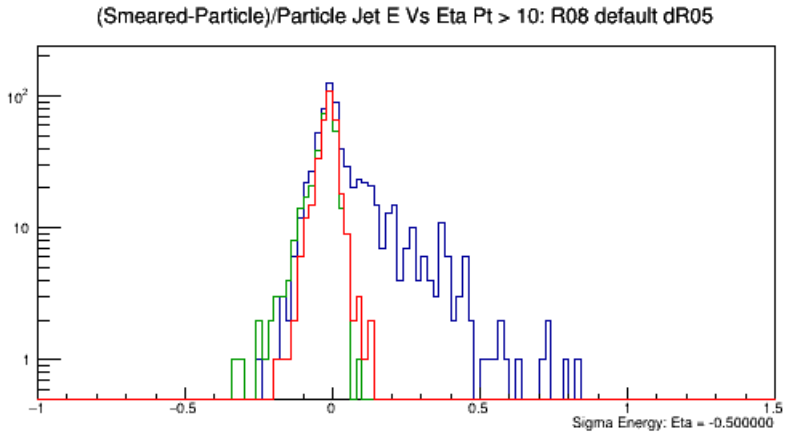


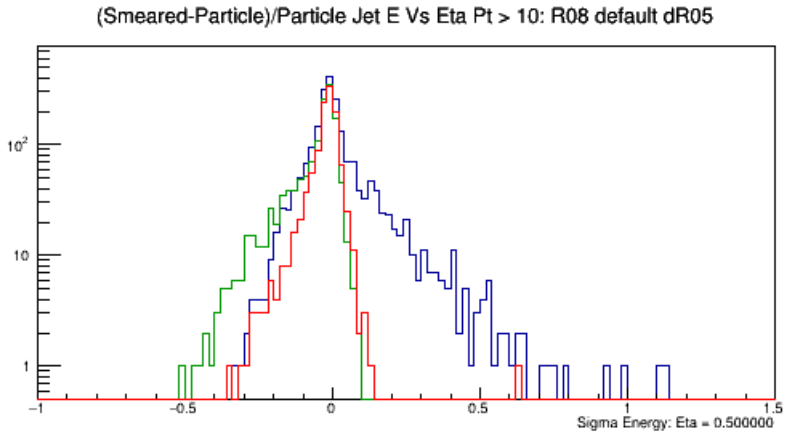


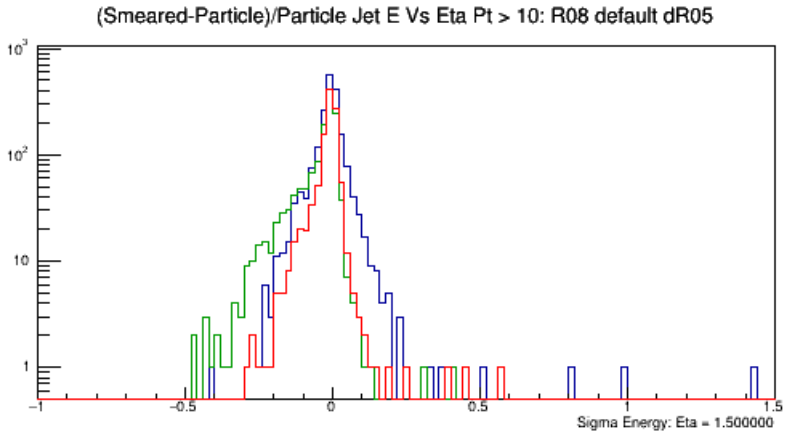


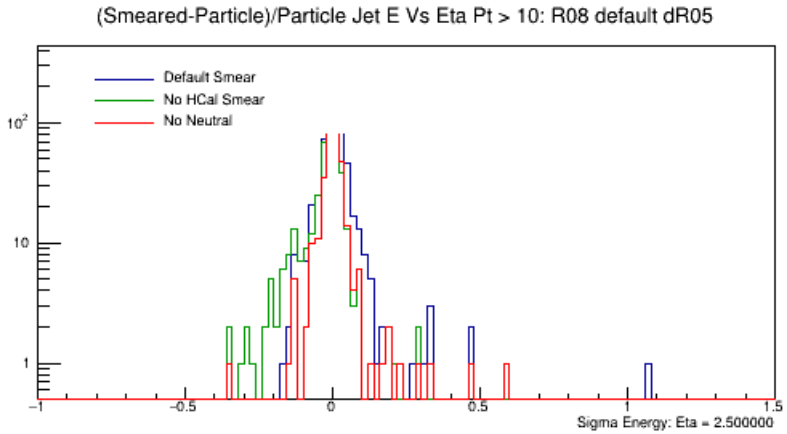


Sigma Projection: E Vs Eta

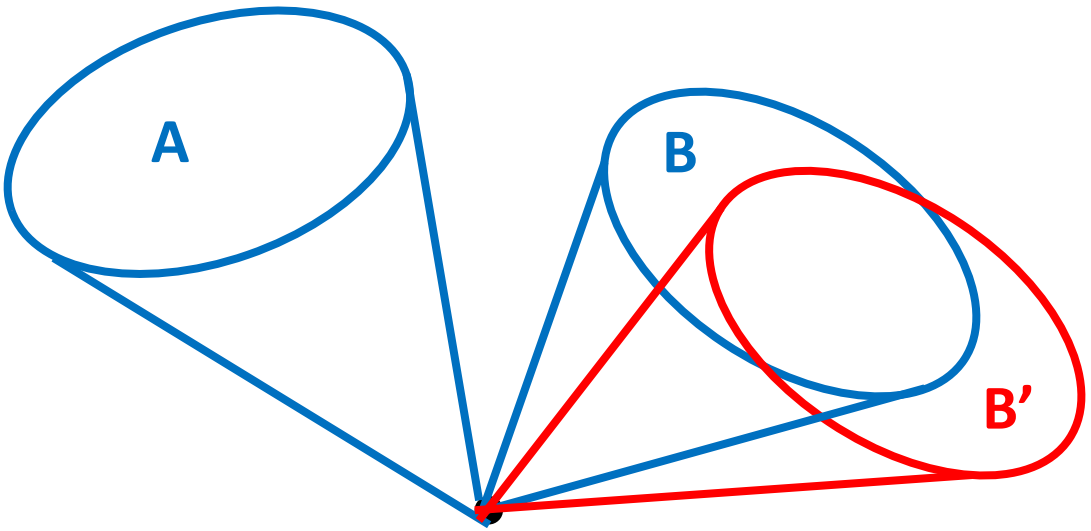








Selection Bias

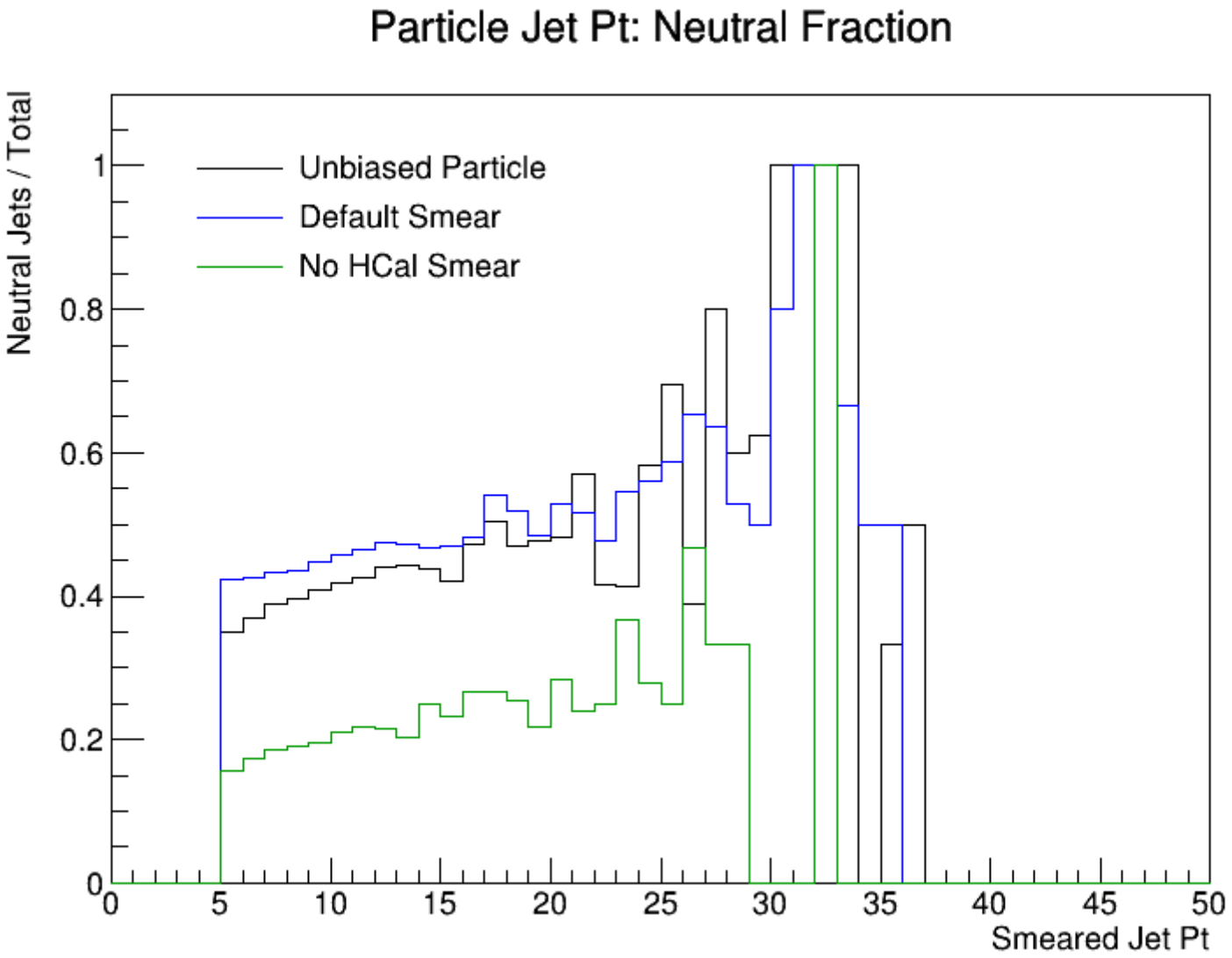


Particle Level Jet

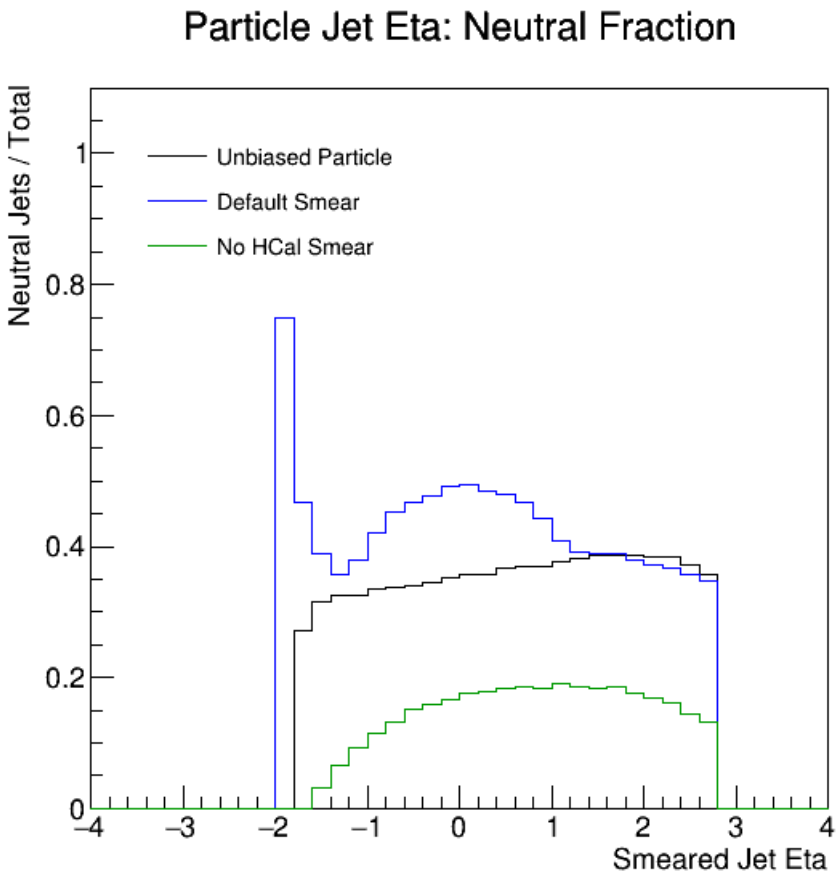
Smeared Jet

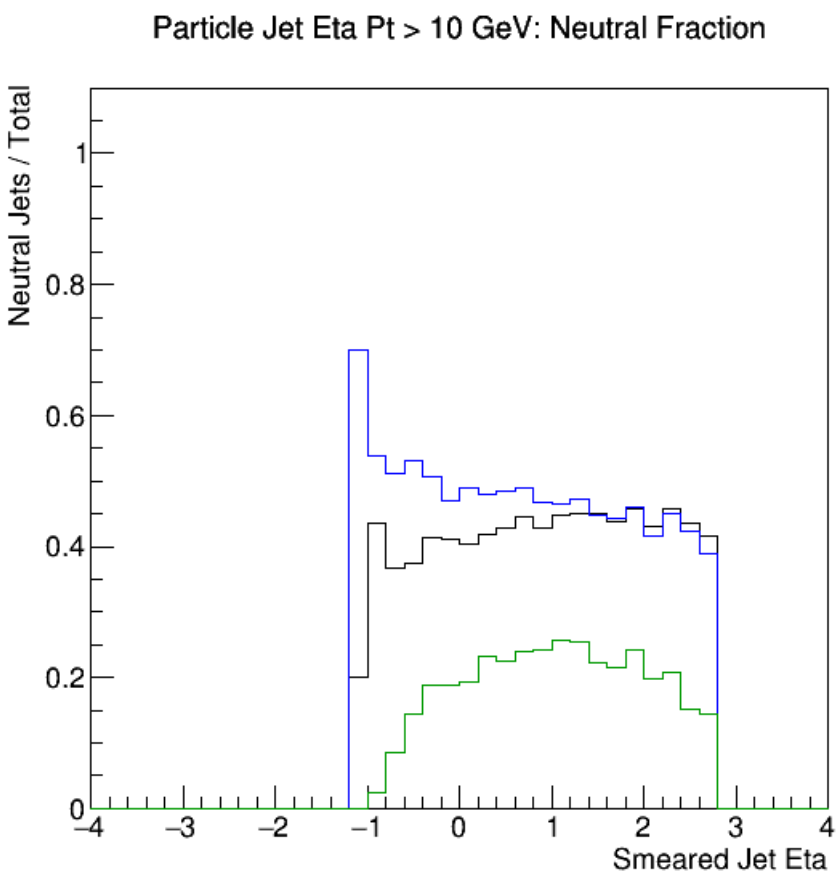
- The set of all particle level jets (A+B) which pass selection (p_T & eta) criteria make up the unbiased sample
- A smeared jet B' will have an associated particle level jet B – the set of all matched particle level jets (B) can have different properties than the unbiased set (A+B) – this is selection bias
- We will look at the ratio of jets containing a neutral hadron to total jets in the unbiased sample (A+B), the biased sample B associated with B' found using default smearing, and the biased sample B associated with B' found ignoring HCal information

Selection Bias: p_T

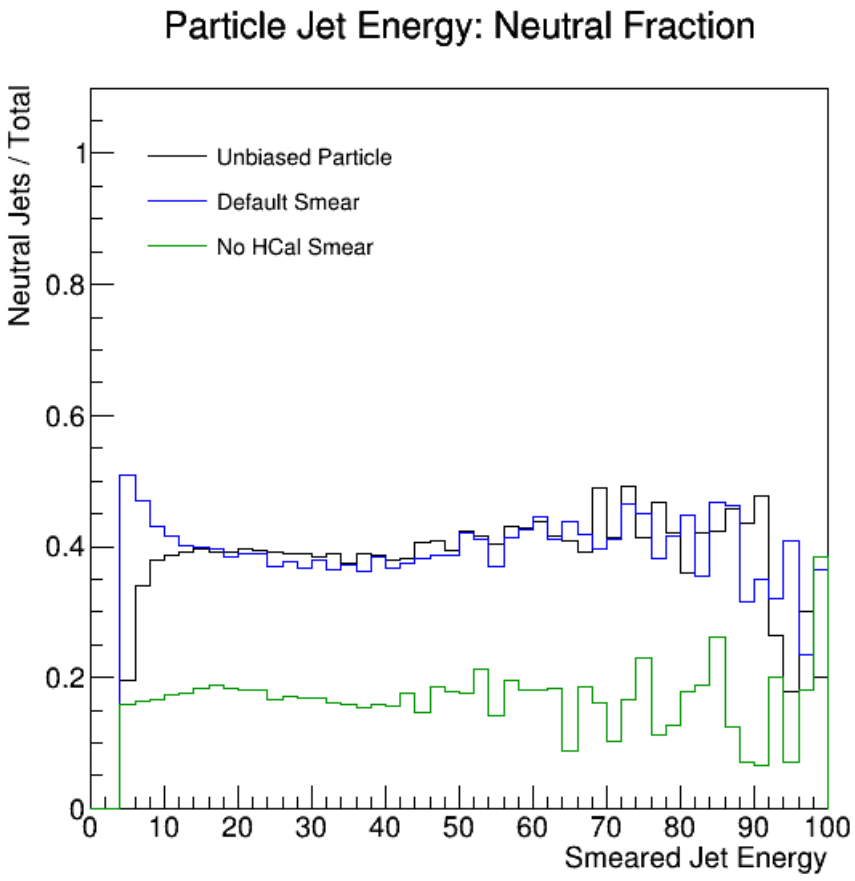


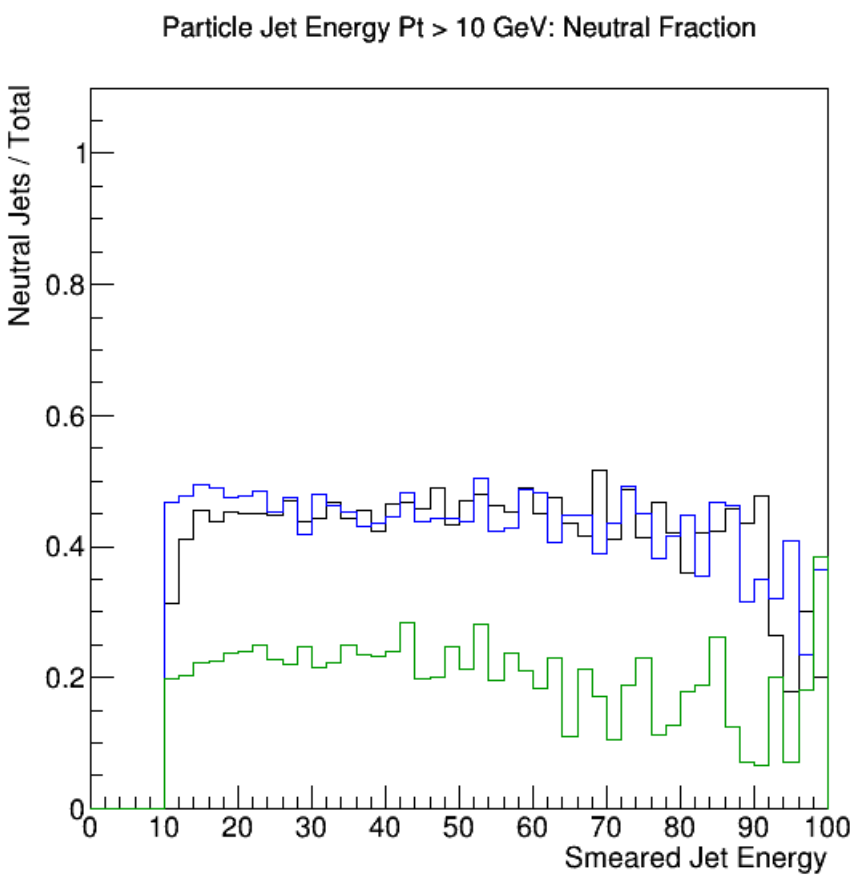
Selection Bias: Eta



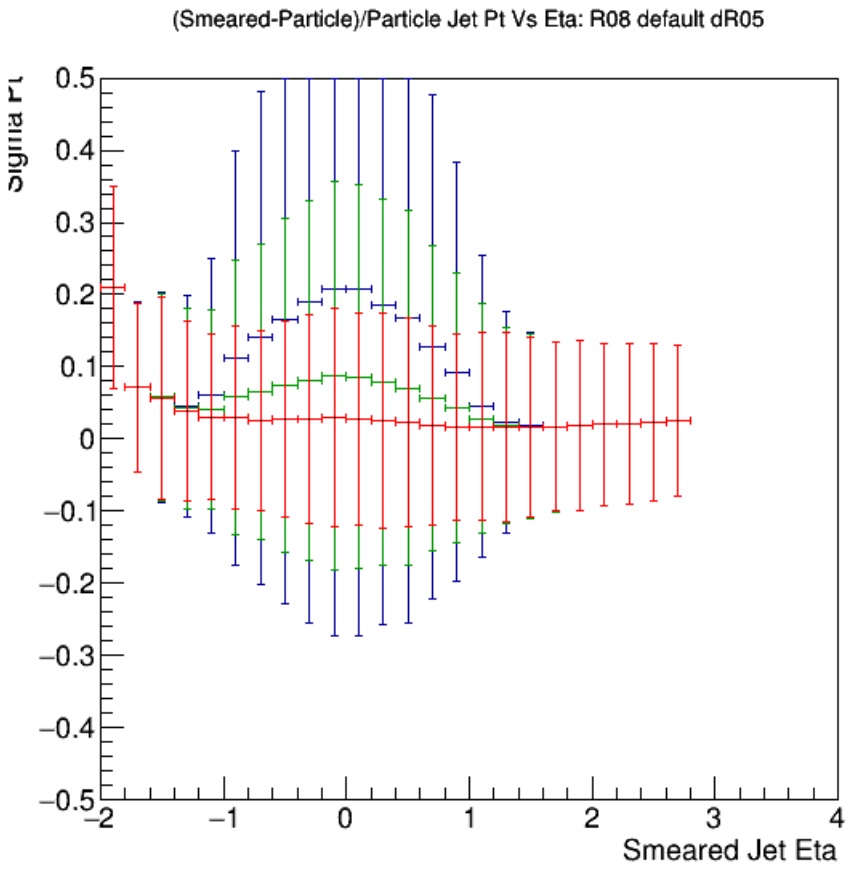


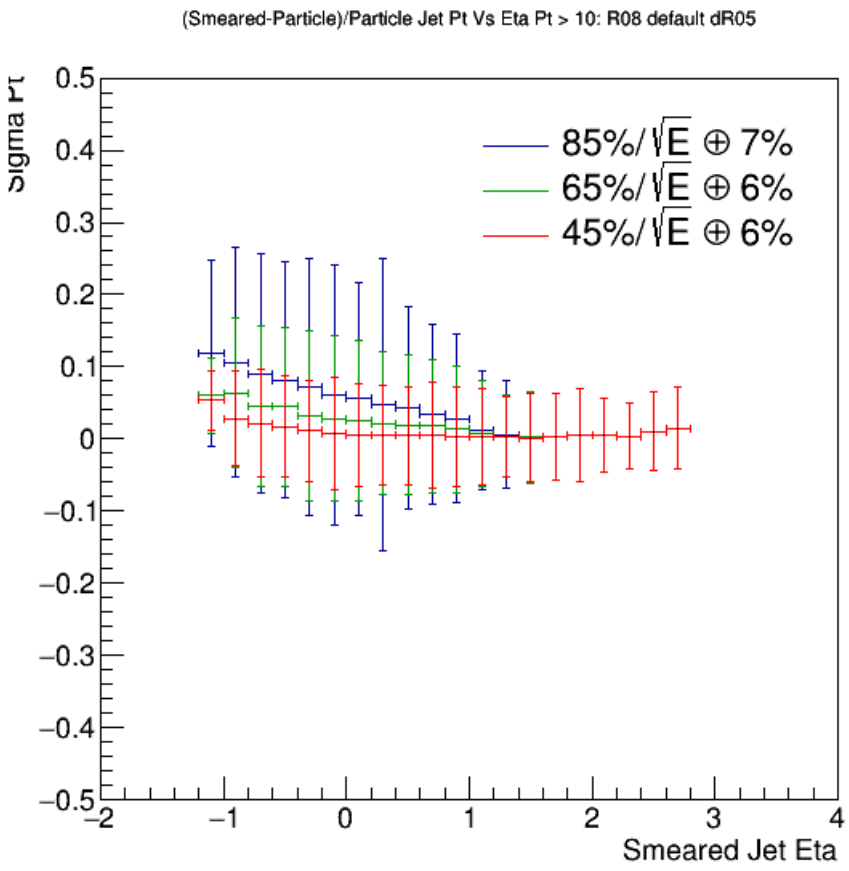
Selection Bias: Energy



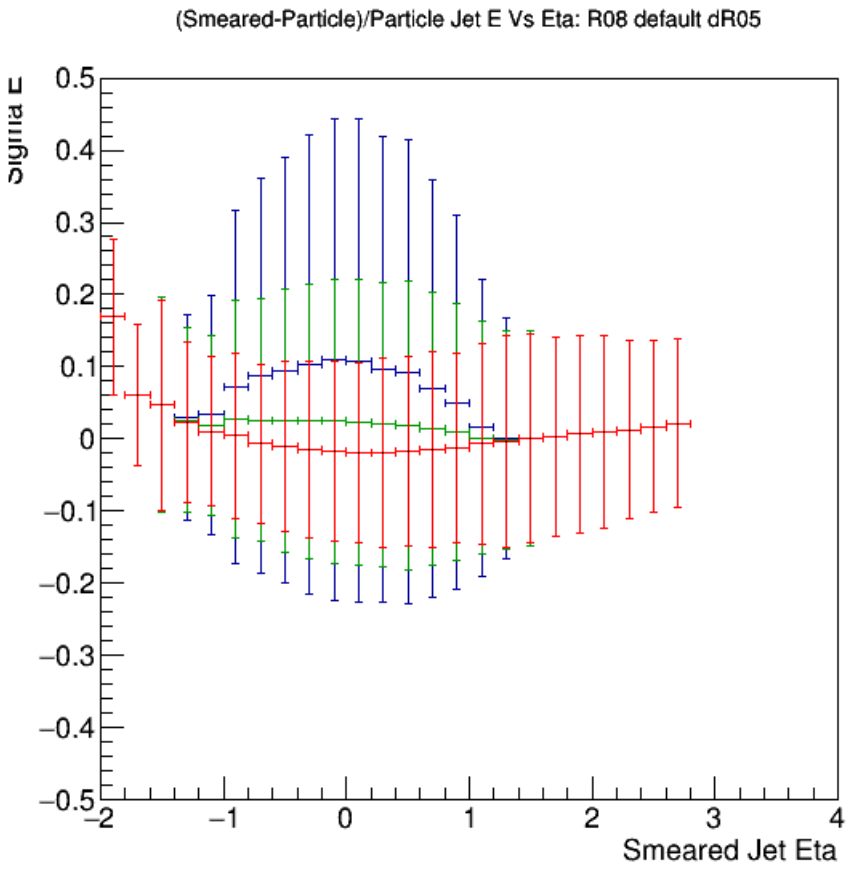


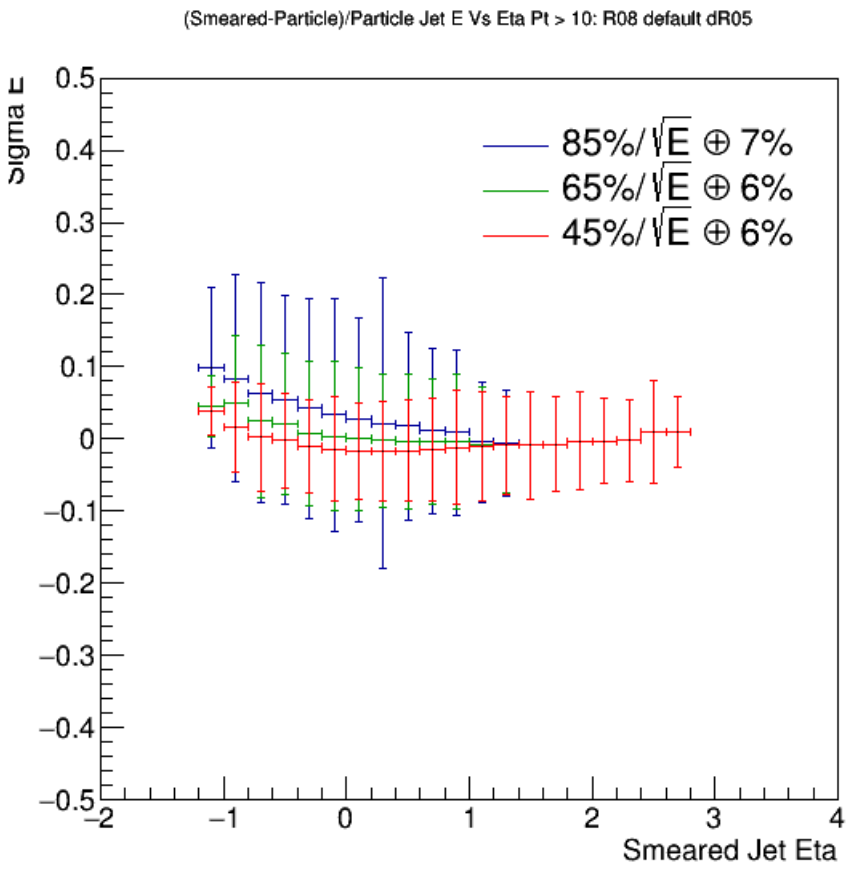
Barrel HCal Res: Sigma p_T Vs Eta



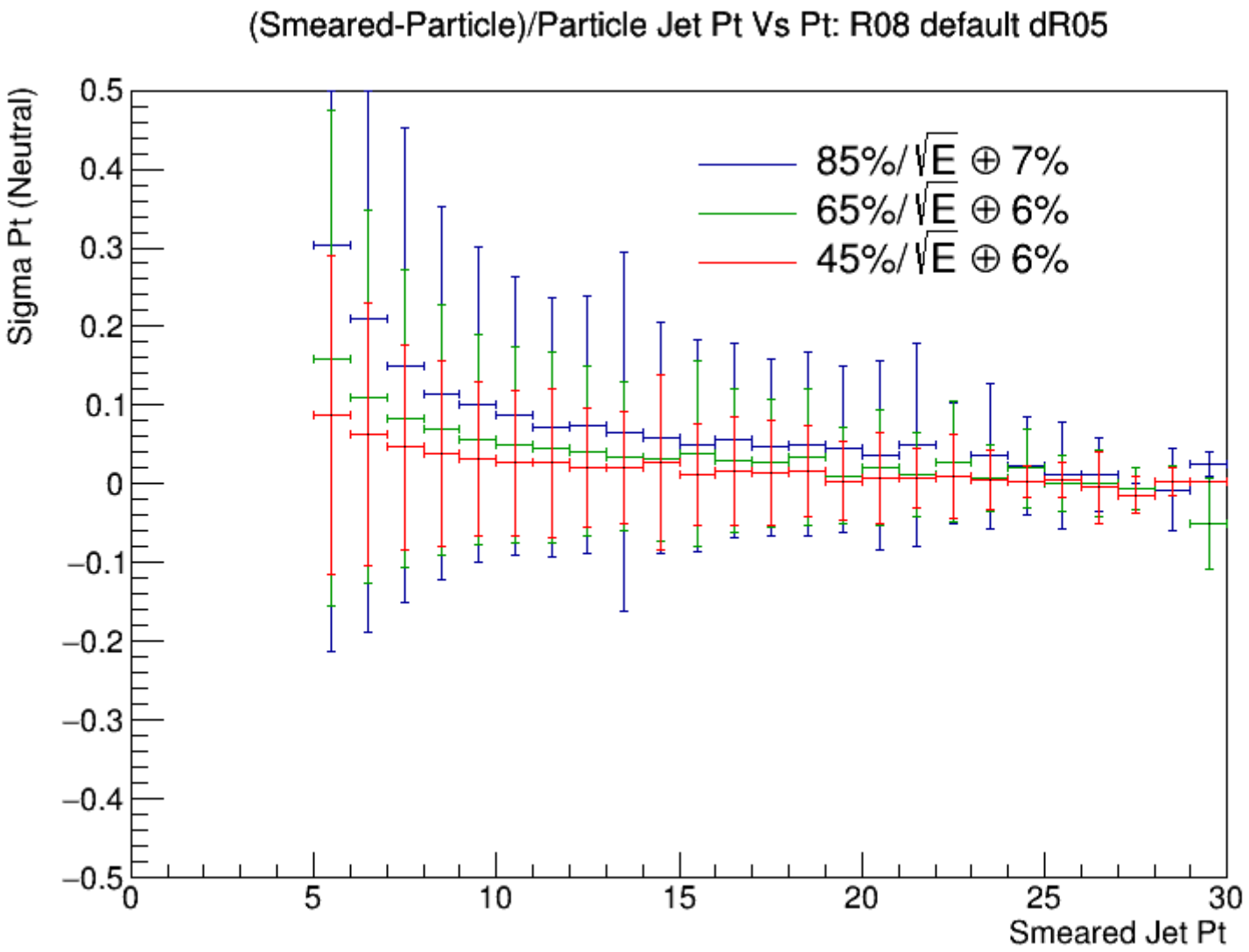


Barrel HCal Res: Sigma E Vs Eta

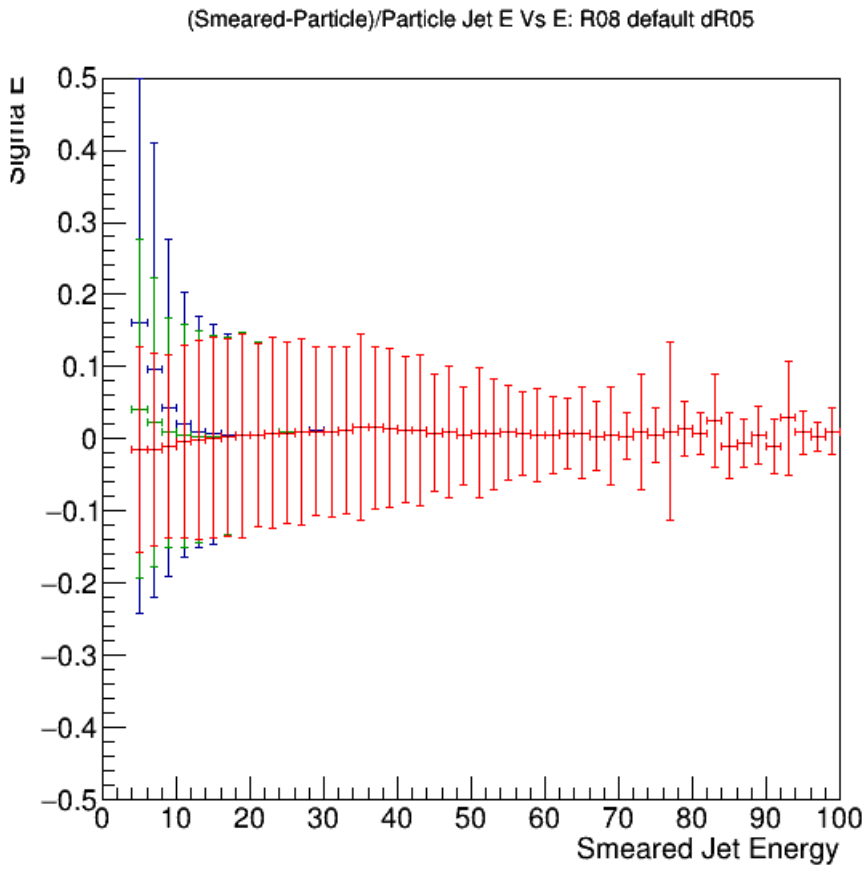


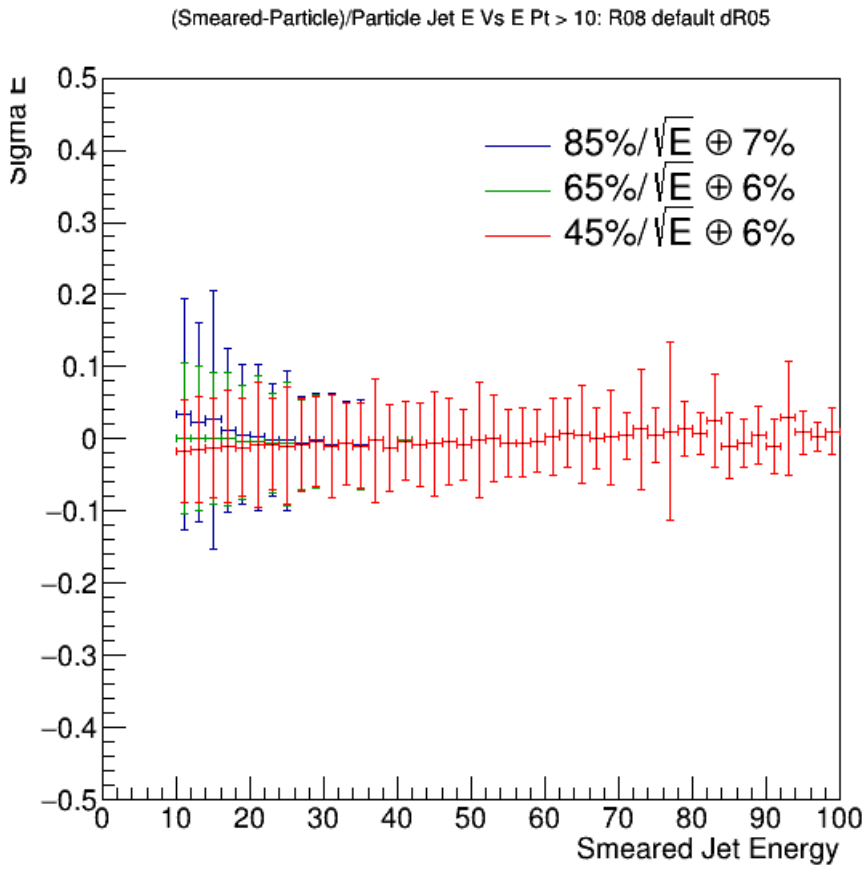


Barrel HCal Res: Sigma p_T Vs p_T



Barrel HCal Res: Sigma pT Vs Eta





Conclusions

- Biases seen in previous presentation explored in more detail
- Low p_T / negative eta jets will be challenging
- Biases seen driven entirely by fluctuations, peak of smeared – particle distribution remains at zero
- Moderate improvement in HCal resolution can reduce observed biases

Next Steps

- ❑ Look at different Q^2 ranges
- ❑ Determine effect on angularity measurement
- ❑ Think about implications for calorimeter requirements / complementarity

Handbook Parameters

Tracker	Eta Range	Resolution
	-3.5 to -2.5	2%/Sqrt{P} + .1%
	-2.5 to -1.0	1%/Sqrt{P} + .05%
	-1.0 to 1.0	.05%/Sqrt{P} + .05%
	1.0 to 2.5	1%/Sqrt{P} + .05%
	2.5 to 3.5	2%/Sqrt{P} + .1%

EM Cal	Eta Range	Resolution
	-4.5 to -2.0	1%/Sqrt{E} + 1%
	-2.0 to -1.0	8%/Sqrt{E} + 2%
	-1.0 to 4.5	12%/Sqrt{E} + 2%

HCal	Eta Range	Resolution
	-3.5 to -1.0	45%/Sqrt{E} + 6%
	-1.0 to 1.0	85%/Sqrt{E} + 7%
	1.0 to 3.5	45%/Sqrt{E} + 6%