Barrel and Backward Jets: Delphes 1st Look

Brian Page

Introduction

- Jets which go into the barrel / electron endcap will be low-x and low energy – important for photoproduction as well as other higher order processes

- Evaluate the effect of HCal resolutions on jet reconstruction in barrel / electron endcap

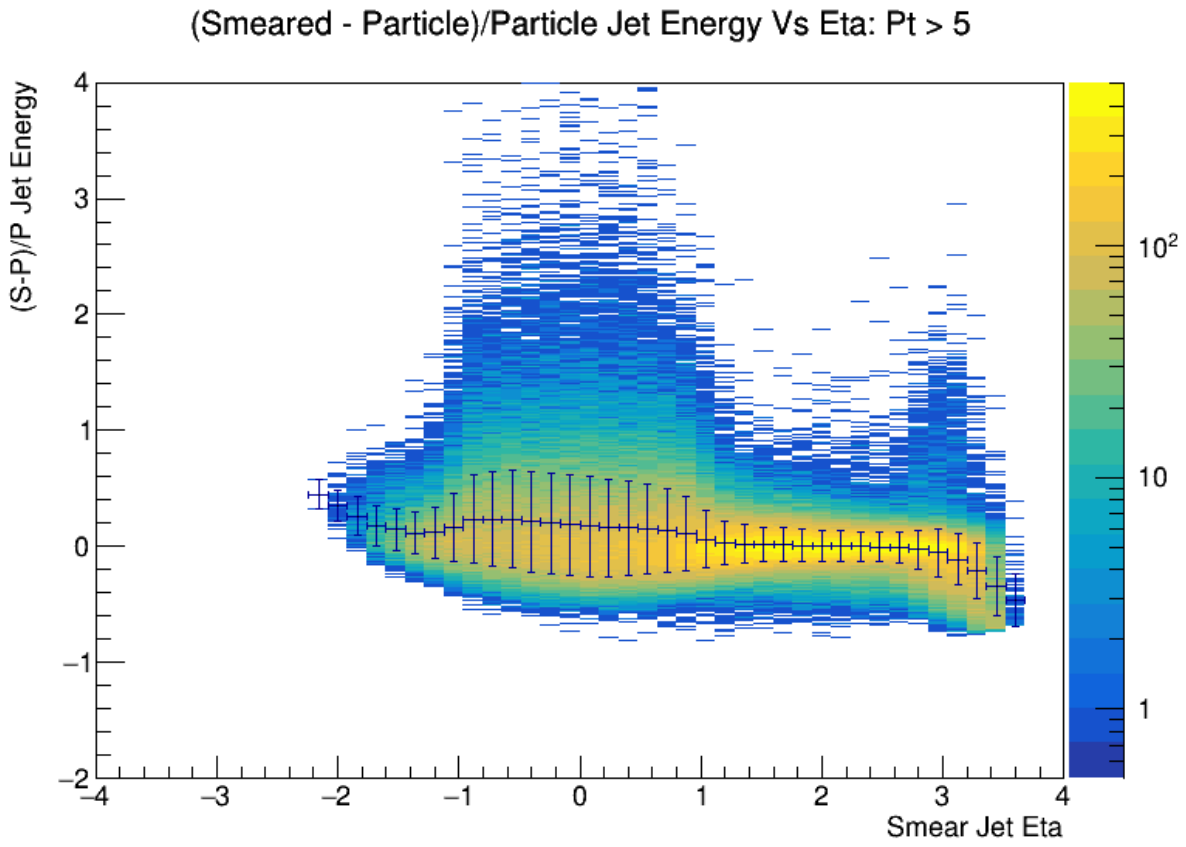
- Default Delphes ATHENA model
  - Barrel: $\sigma E/E = 100\%/\sqrt{E} \oplus 10\%$
  - Electron Endcap: $\sigma E/E = 50\%/\sqrt{E} \oplus 10\%$

- Alternate models: GEANT studies show we can expect a constant resolution for energy ranges appropriate for the barrel with values depending on barrel ECal thickness. Also degrade electron endcap resolution
  - Barrel Mod 1: $\sigma E/E = 27\%$
  - Barrel Mod 2: $\sigma E/E = 35\%$
  - Electron Endcap: $\sigma E/E = 100\%/\sqrt{E} \oplus 10\%$

- Also look at case where we do not include Eflow neutral hadrons in jet-finding

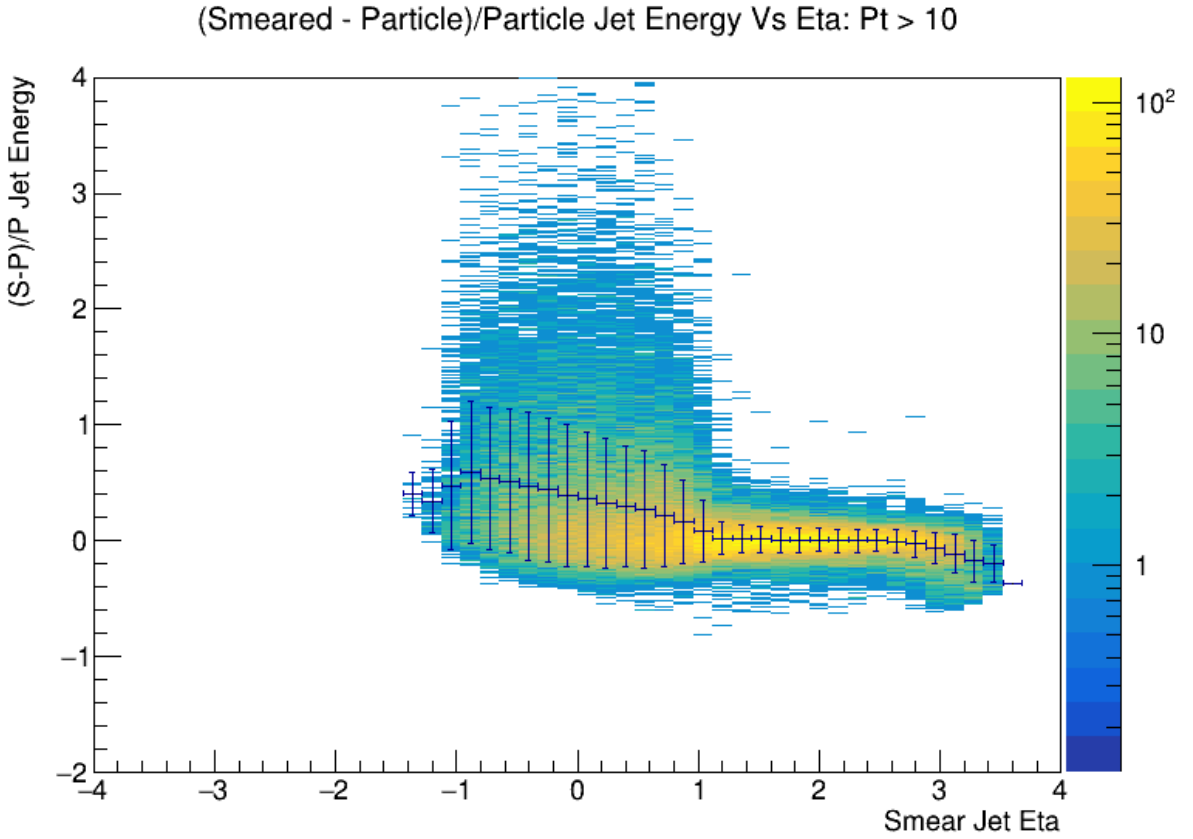
- Simulated 18x275 NC DIS with Q2 > 10 GeV with all beam effects included

Jet Energy Resolution & Scale Definitions

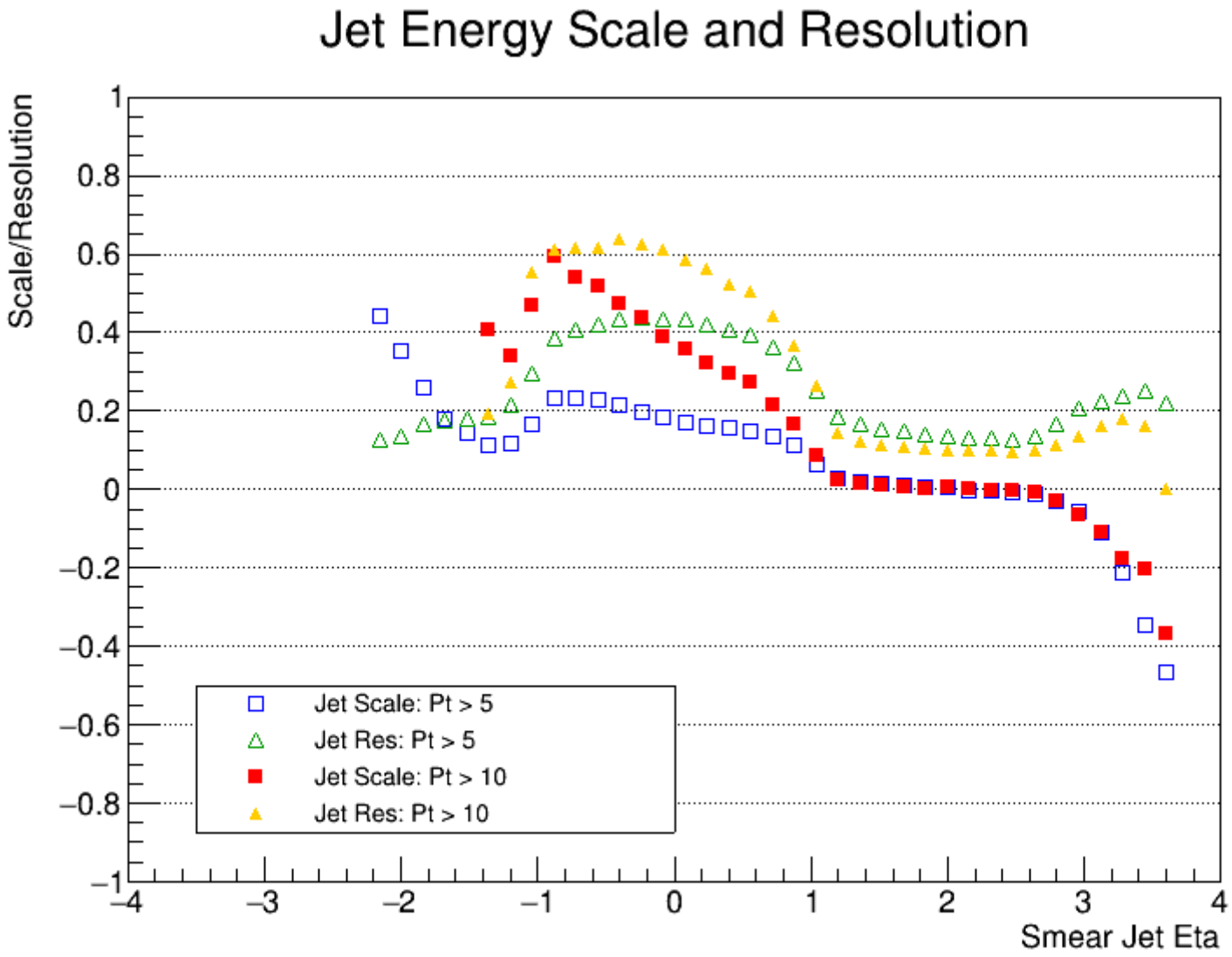


- JER is the RMS of the distribution and JES is the average
- Look at Eflow jets with minimum Pt > 5 GeV and 10 GeV

- Pick the highest Pt Eflow jet – find matching particle level jet (Smallest delta R < 0.5)
- Construct (Eflow-Particle)/Particle Jet energy distribution vs eta

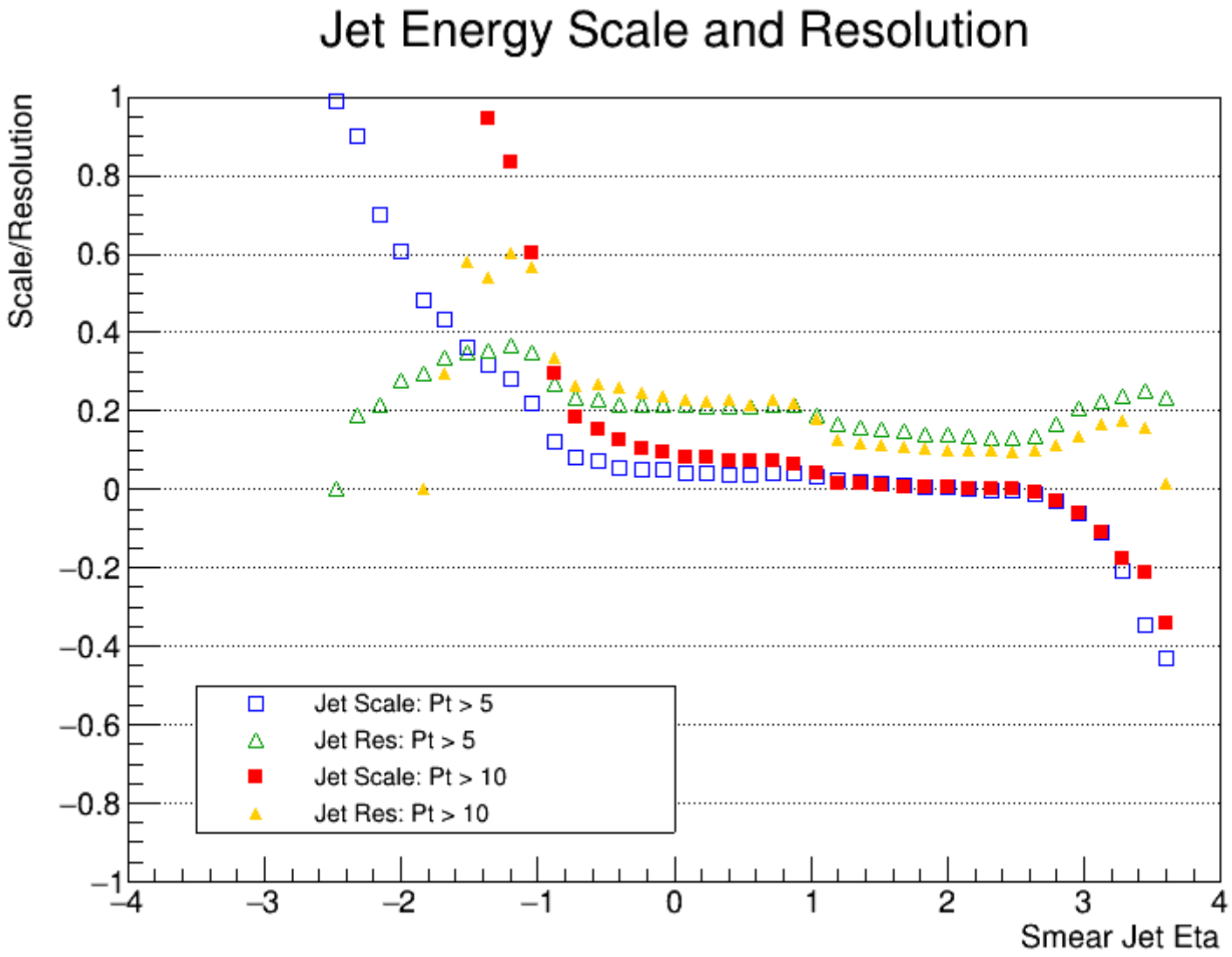


JES / JER Summary: Default ATHENA Model



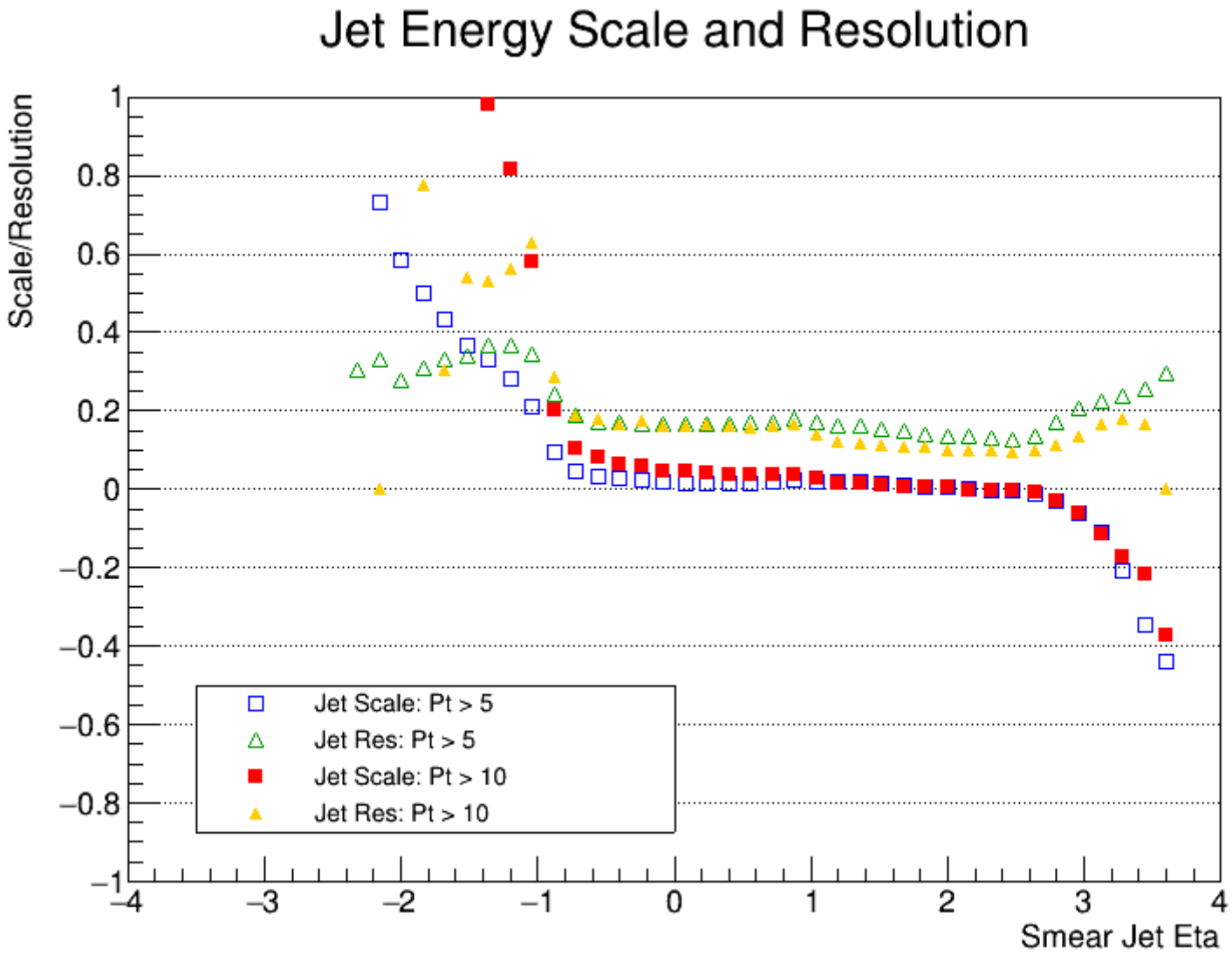
- Jet energy resolutions and scales blow up in the barrel
- Oddly, JES and JER seem to be worse for higher Pt jets
- Believe this is somewhat a phase space effect – for Pt > 10 GeV there is more room for tails (compare pp 8 and 9)

JES / JER Summary: Constant 35% Energy Res



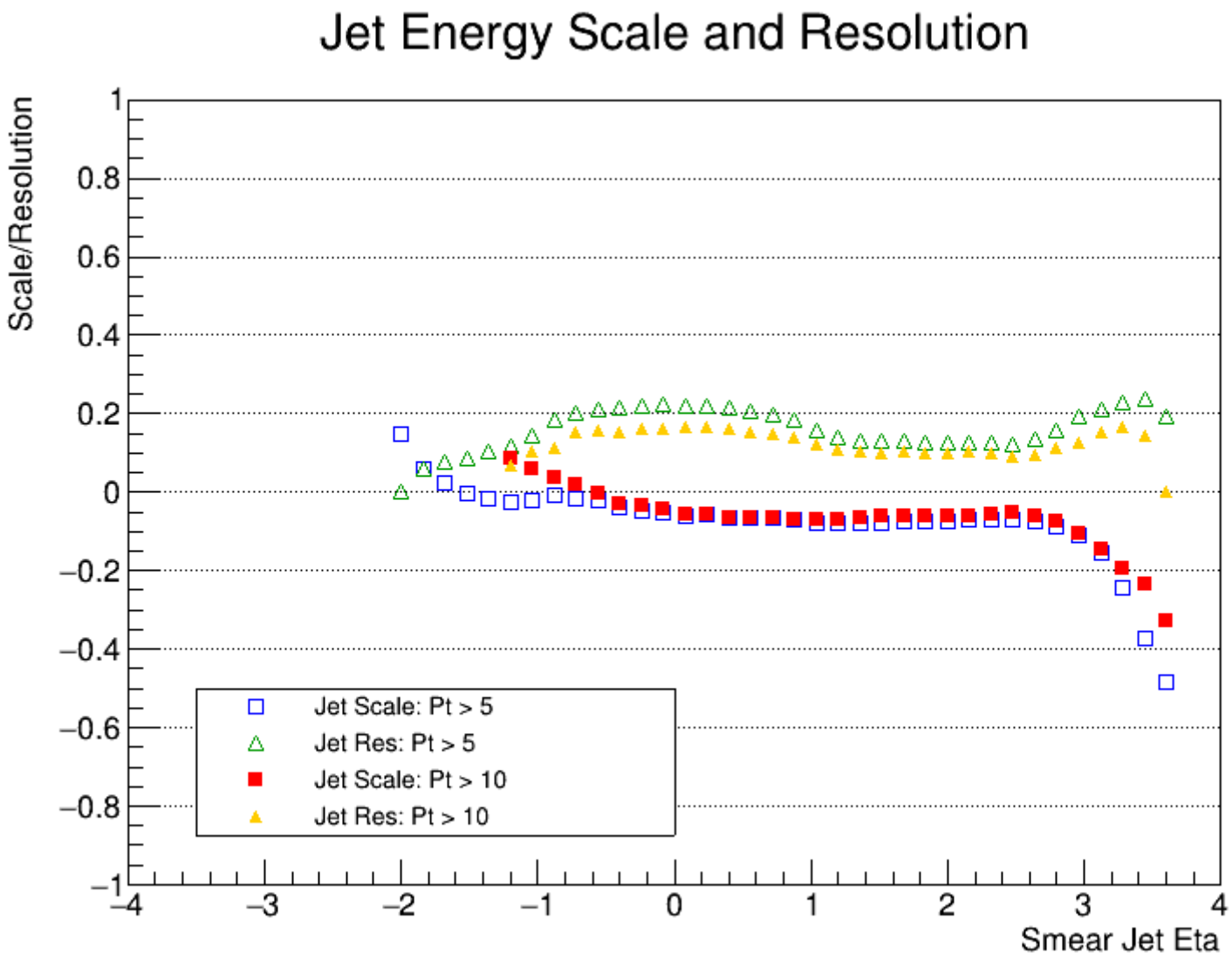
- The constant energy resolution (σE/E = 35%) drastically improves JES / JER in the barrel region
- Significant degradation in the electron endcap due to the switch from 50%/√E ⊕ 10% to 100%/√E ⊕ 10%

JES / JER Summary: Constant 27% Energy Res



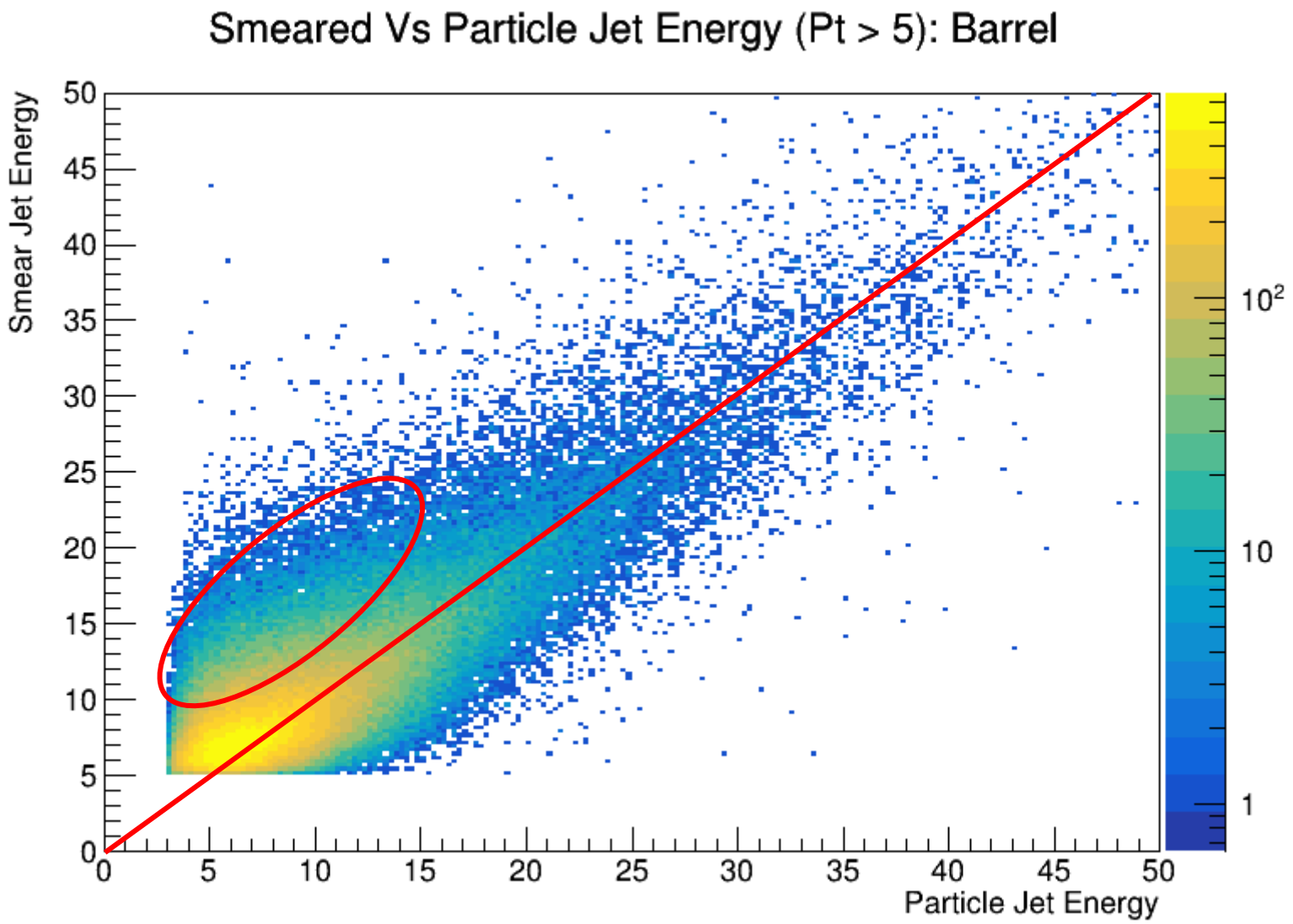
- Better JES / JER for constant energy resolution of 27%

JES / JER Summary: No Neutral Hadrons



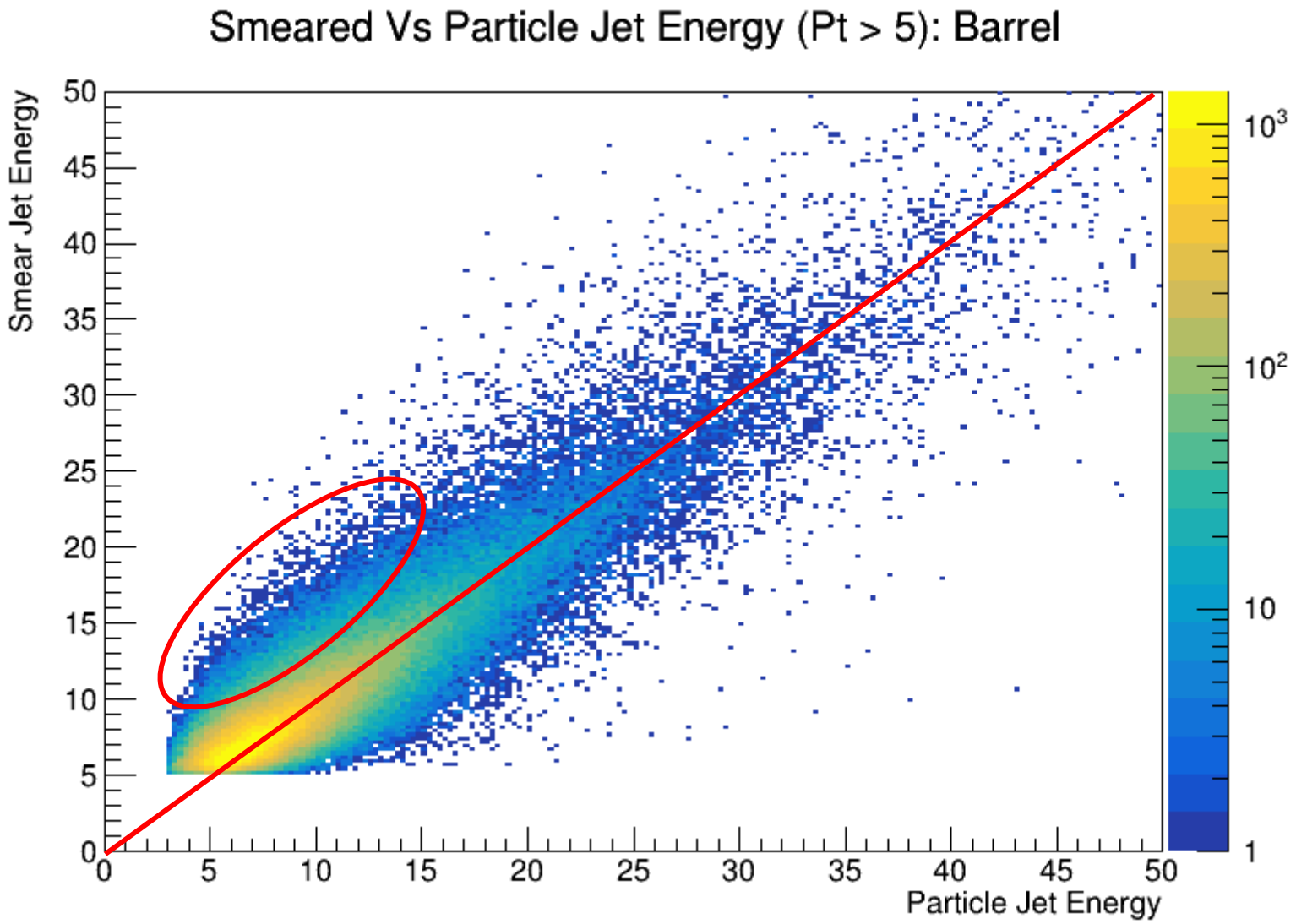
- What happens if we construct jets from only track and photon Eflow objects?
- See slightly worse JES and JER behavior in the barrel but dramatic improvement in the electron endcap
- Back to conclusion that HCal in the electron endcap region may be better as a veto?

Eflow Vs Particle Jet Energy (Default): Barrel



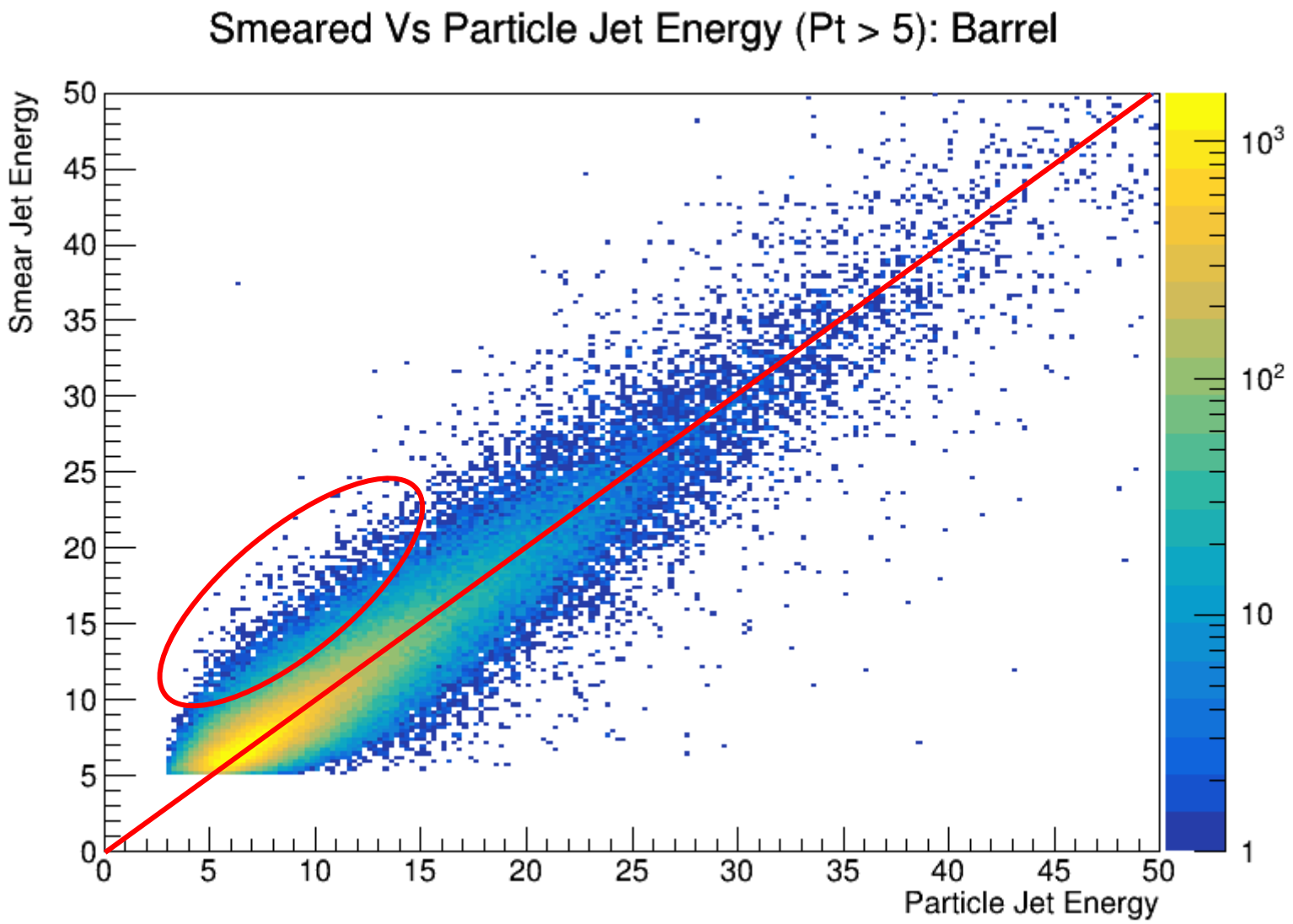
- Default barrel HCal resolution leads to a sizable tail of jets which are reconstructed at much higher energy than they were generated with
- This leads to the large scale and resolution values
- We can also see why scale and resolution are worse for Eflow jet Pt > 10 GeV – there is more phase space at lower particle jet Pt available for a given Eflow jet Pt than at Eflow jet Pt of 5 GeV

Eflow Vs Particle Jet Energy (35%): Barrel



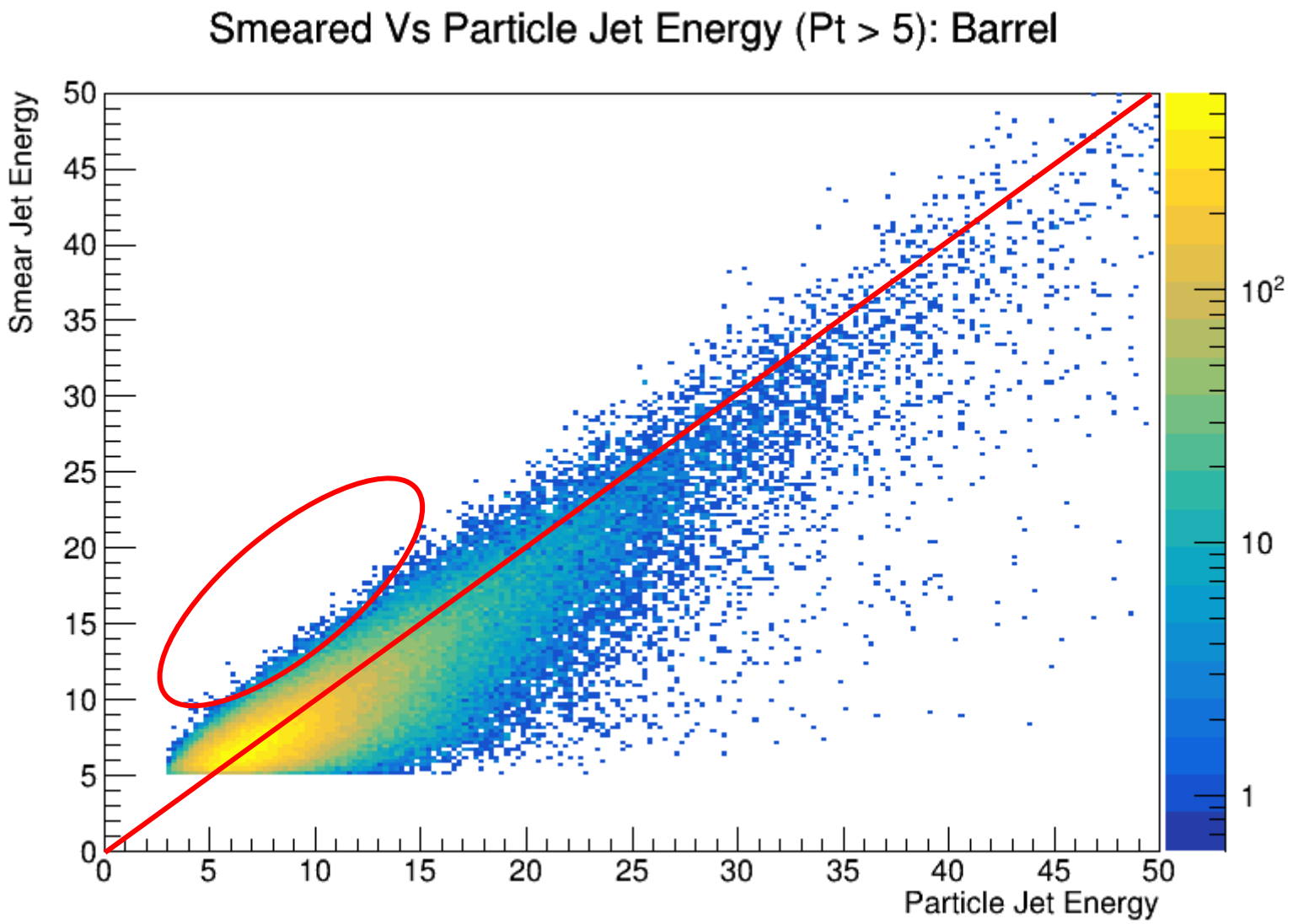
- The population of this tail region is significantly reduced for the constant HCal resolution case
- Leads to better overall JES / JER and less severe discrepancy between low and high Pt curves

Eflow Vs Particle Jet Energy (27%): Barrel



- The behavior of the 27% resolution is even better
- Better resolutions are better ;)

Eflow Vs Particle Jet Energy (No Neutral Had Eflow): Barrel



- Removing Neutral Hadron Eflow objects from the jet finder dramatically reduces the number of particle level jets which get reconstructed at significantly larger energies
- In the barrel, we pay the price in missing the neutral component of jets leading to an excess to the lower right of the plot
- Leads to the negative JES seen above

Conclusions and Next Steps

- Took a look at jet energy scale and resolution as a function of pseudorapidity with a focus on the barrel and electron endcap regions
- Flat barrel HCal resolutions give much better performances compared to default resolution
- 50% -> 100% resolution for electron endcap HCal leads to much worse performance
- Neglecting Neutral Hadron Eflow objects in electron endcap led to reasonable behavior
- Want to start looking at this in full simu – calorimeter / track matching and subtraction
- Continue to explore issues using fast simu