Jet Calibration and Preclustering

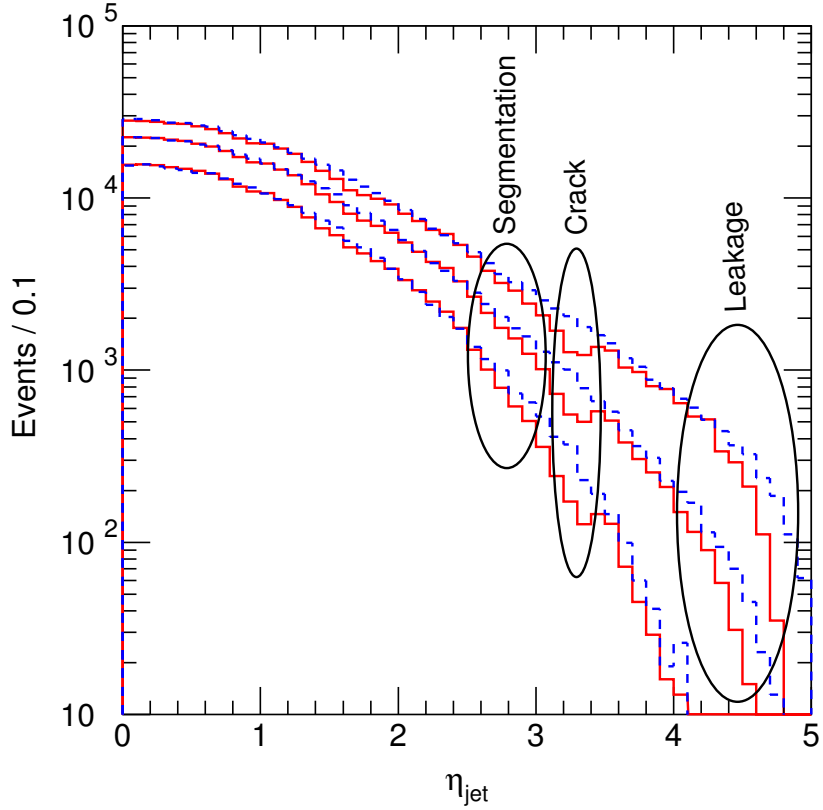
Frank Paige, BNL

Current H1-style calibration has structure in η:

Compare reconstructed and MC jets for $E_T > 25, 50, 100\,\text{GeV}$ in DC1 SUSY events with Athena 6.0.3.

Structure seems to reflect variations in calorimeters.

Similar results with Athena 7.0.2.



Hence have tried to improve fit using same general method.

Strategy is to use weights depending on E_T per cell in each calorimeter type. (Should try E per unit volume, but volumes not yet available in `CaloCell`.)

Introduced separate weights to reflect differing calorimeter regions:

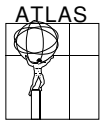
- Divide EM barrel at $\eta = 0.8$.
- Separate tile barrel and extended barrel.
- Divide endcap EM and HEC at $\eta = 2.5$.

Extended cell energy range to 16 bins with

$$i = \mathrm{int}\left[\log E_T / \log 2 + 8\right]$$

Then minimize RMS resolution:

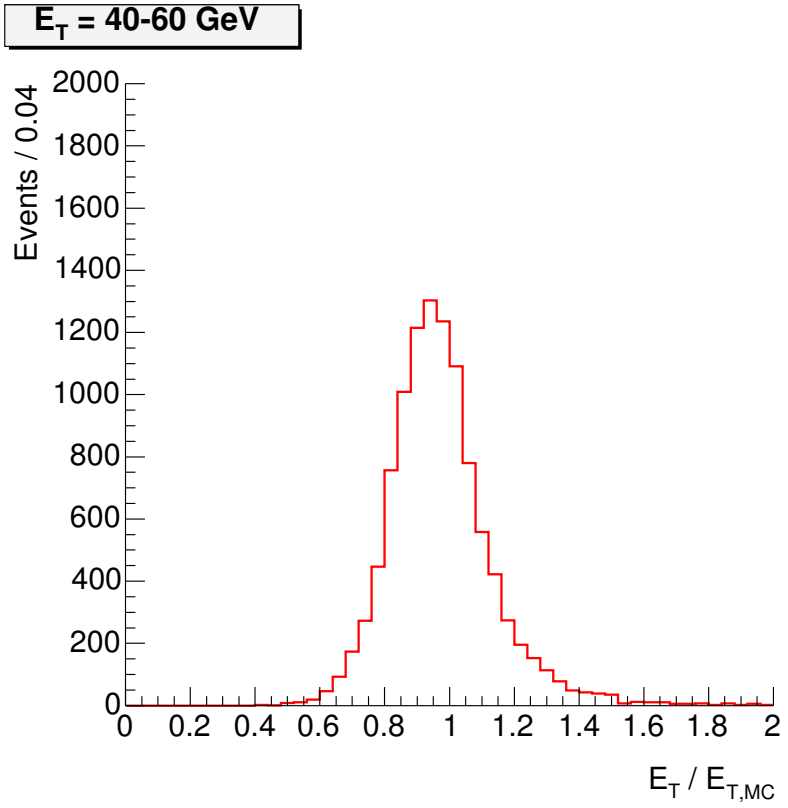
$$\chi^2 = \sum_{\text{events}} \sum_i \left[\frac{w_i E_i}{E_{T,MC}} - 1\right]^2 \left[1 + \frac{100\,\mathrm{GeV}}{E_{MC}}\right]$$

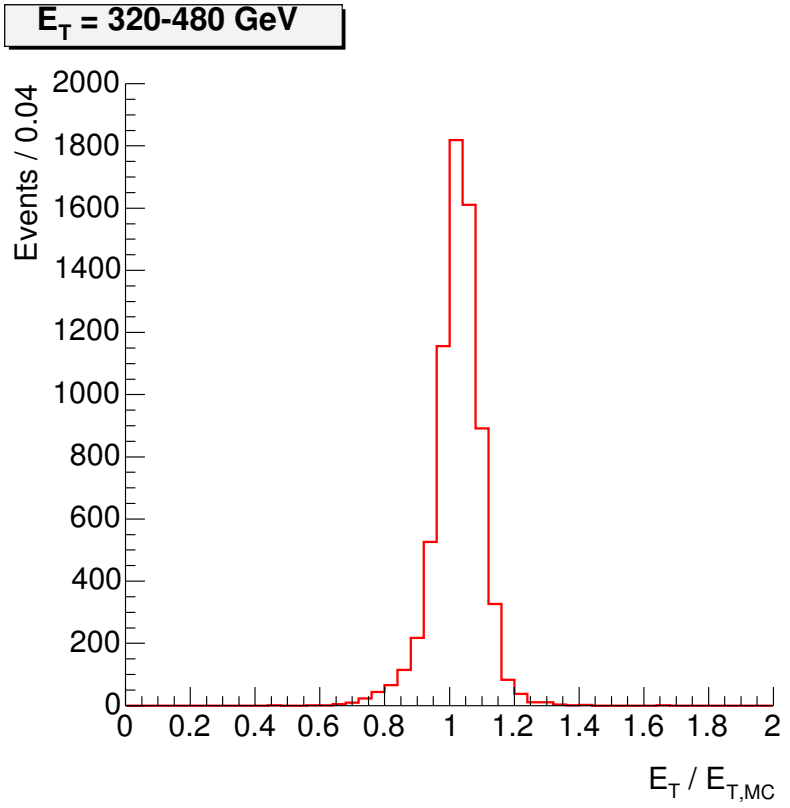


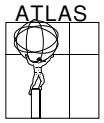
Too many weights — many fits gave negative or otherwise unphysical results. Eventually set $w_1 = w_2 = w_3 = 1$ and fit rest using

$$w_i = 1 + a/i + b/i^2 + c/i^3$$

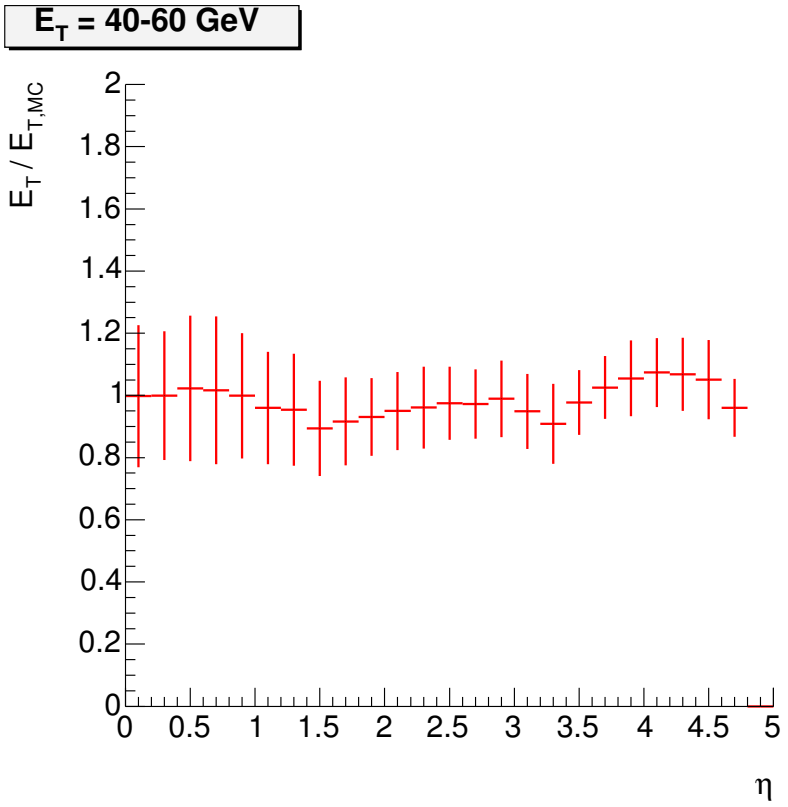
Typical resolution curves for K_T jets with noise but no pileup:

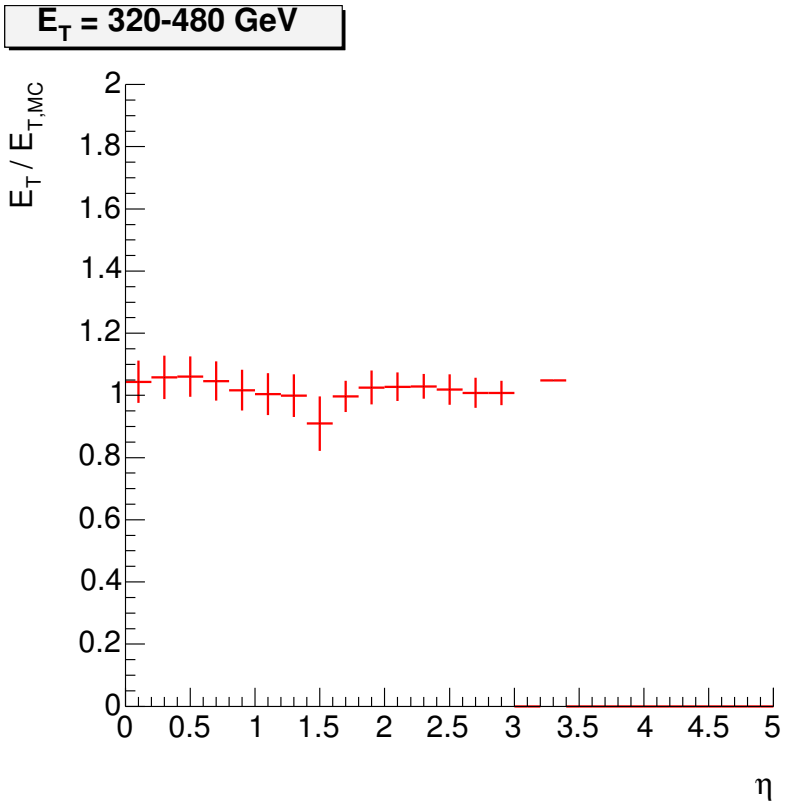






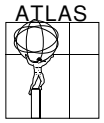
Typical profile curves:



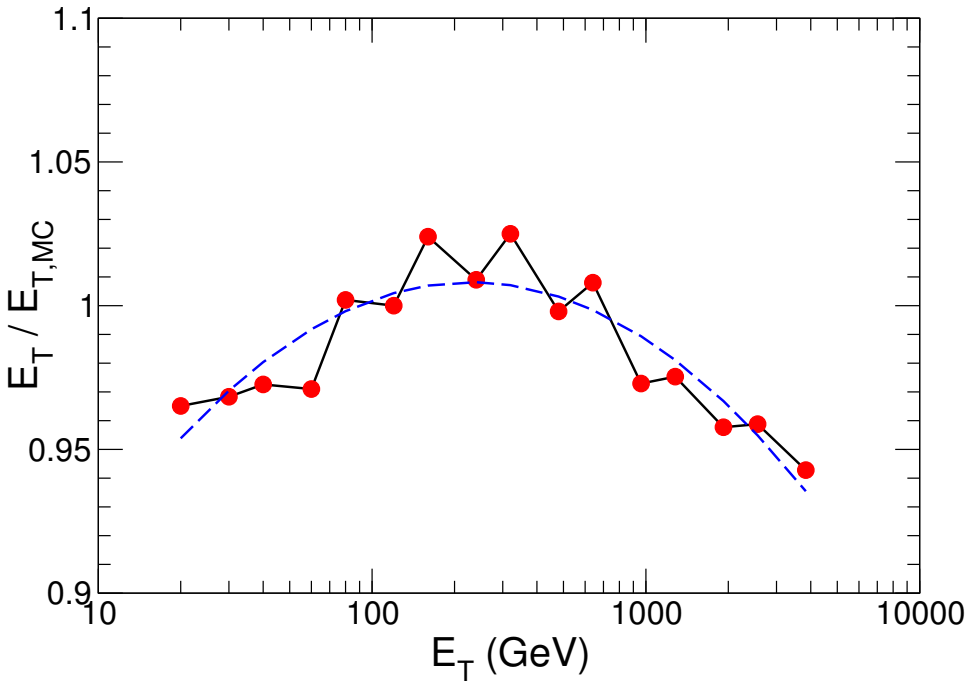


Response is somewhat flatter in η than before.

Resolution tails reduced mainly by requiring $R < 0.2$ match between reconstructed and Monte Carlo jets.

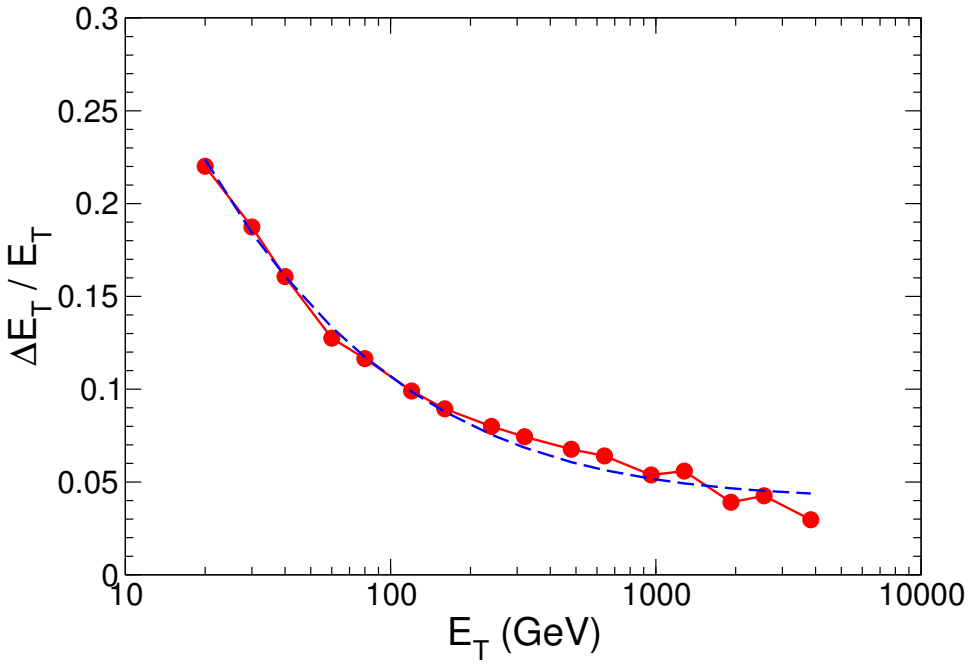


Mean response varies smoothly with E_T:



May have some leakage at large E_T. Would be useful to have E_T for each EM and hadronic sampling.

Resolution is somewhat disappointing:



$$\left(\frac{\Delta E_T}{E_T}\right)_{\text{rms}} = \frac{98.3\%}{\sqrt{E_T}} \oplus 4.1\%$$

Different definition than before: RMS rather than width containing 90% of events. Need more detailed comparisons. . . .

Isolation Preclustering

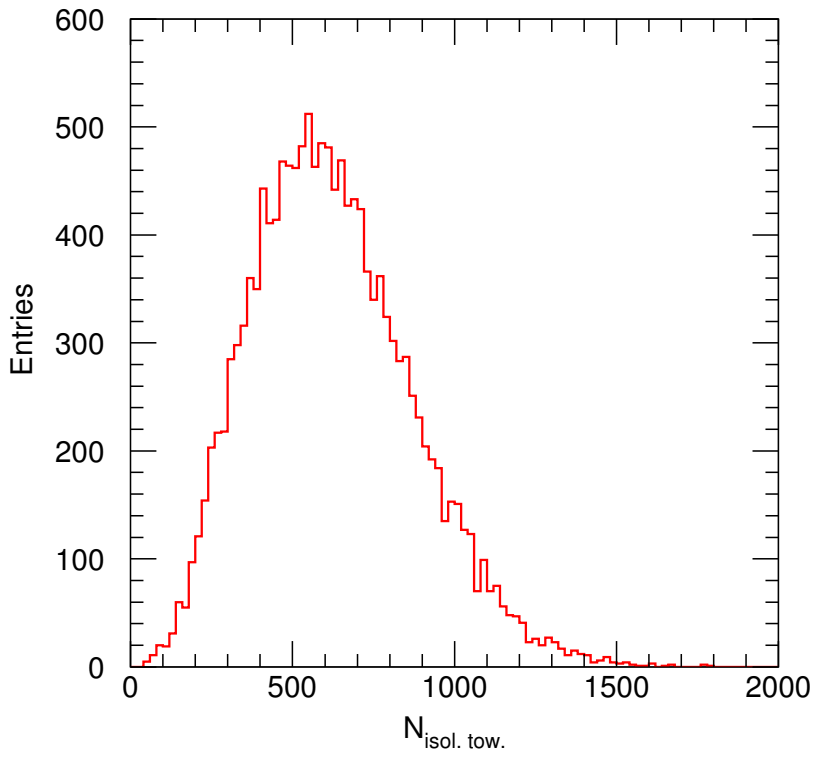
Time for K_T algorithm scales like $N^3 \Rightarrow$ need preclustering. Currently precluster towers with $R = 0.2$ and cut $E_T < 50\,\text{MeV}$.

Alternative: discard towers far from high-E_T ones. [Loch; Bosman]

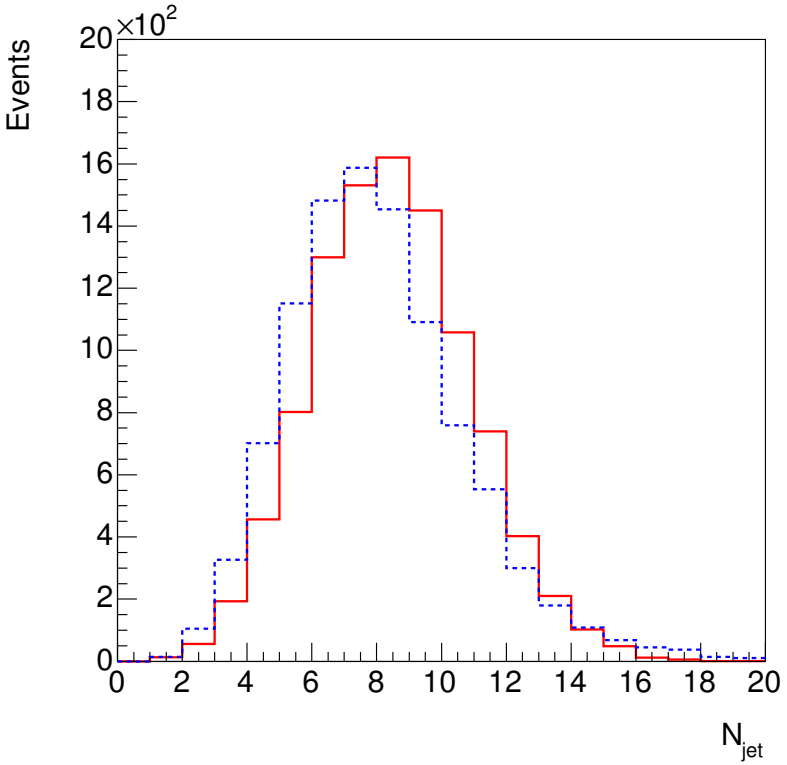
`JetsFromTowerPJ`: drop towers having no tower with $E_T > 0.5\,\text{GeV}$ in $R < 0.7$.

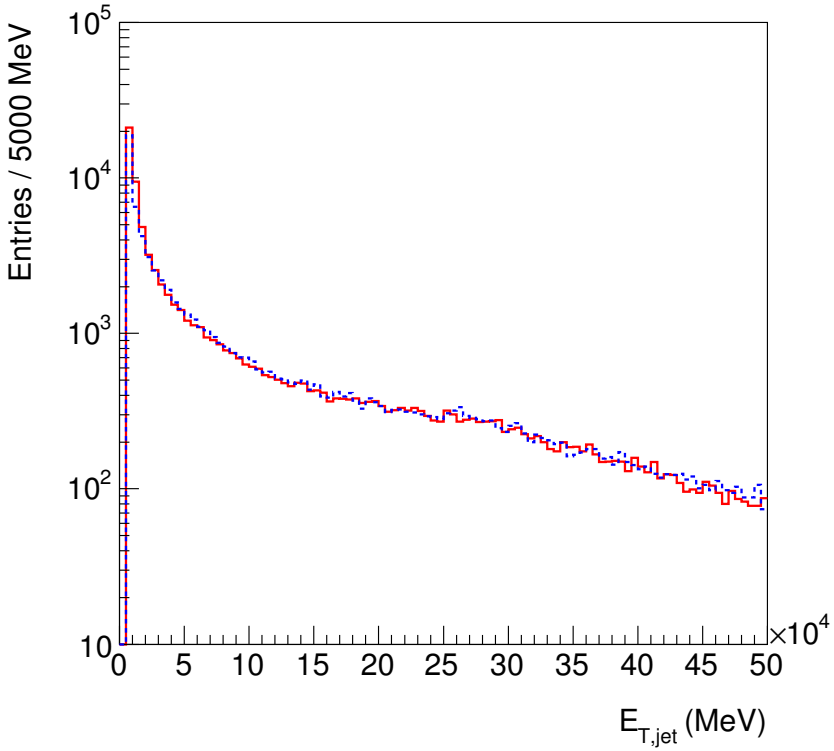
Reduces number of towers from 6400 to ~ 600 for DC1 SUSY events.

K_T algorithm without any preclustering takes $\sim 10\%$ of total reconstruction time.



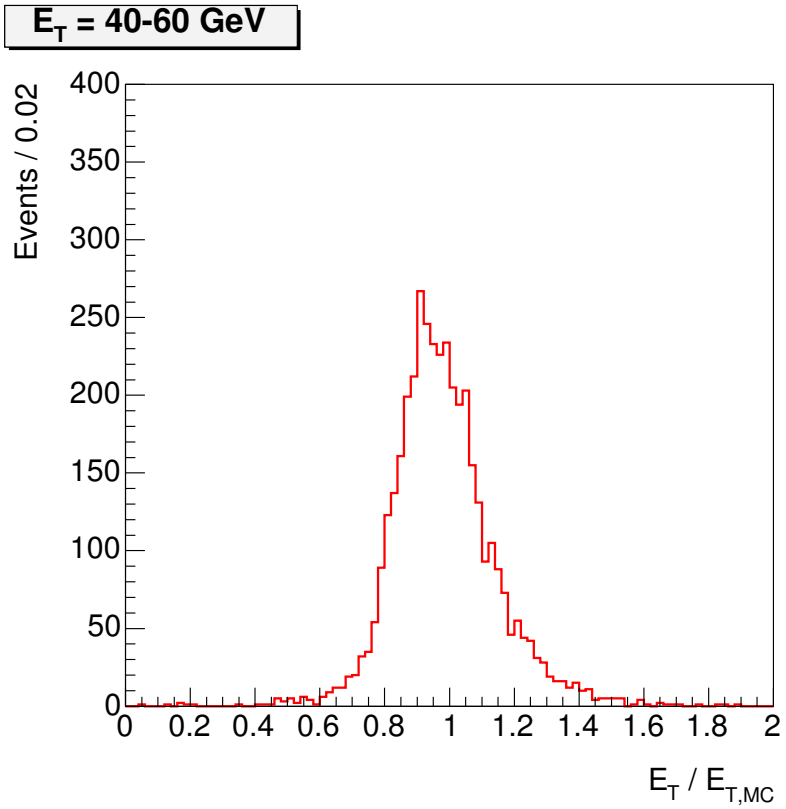
Results look similar to standard preclustering. Good agreement with Monte Carlo except for very low E_T:

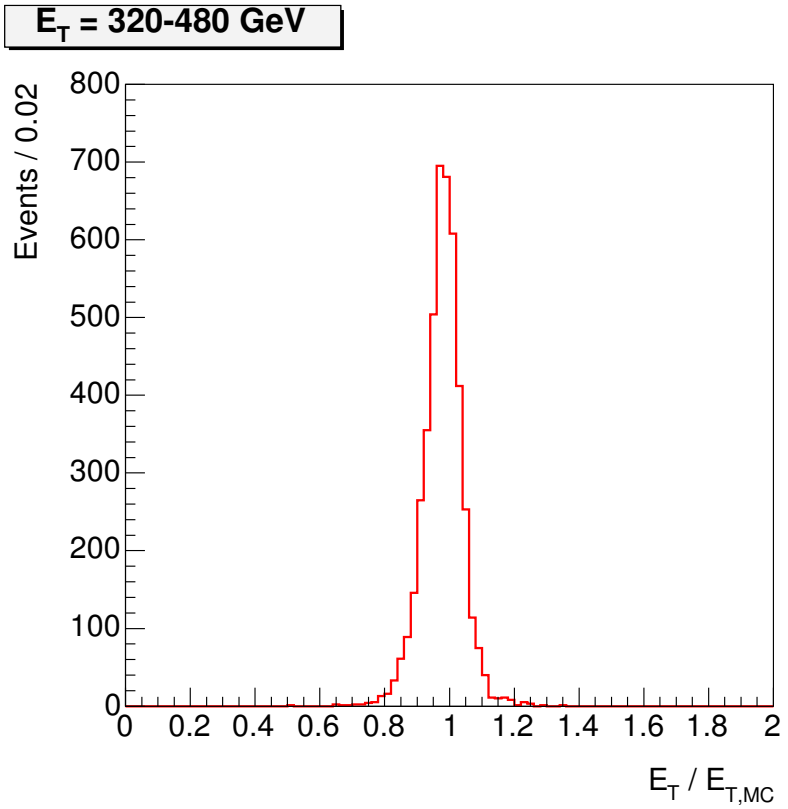




Jet multiplicity is for default $E_T > 5\,\text{GeV}$ cut.

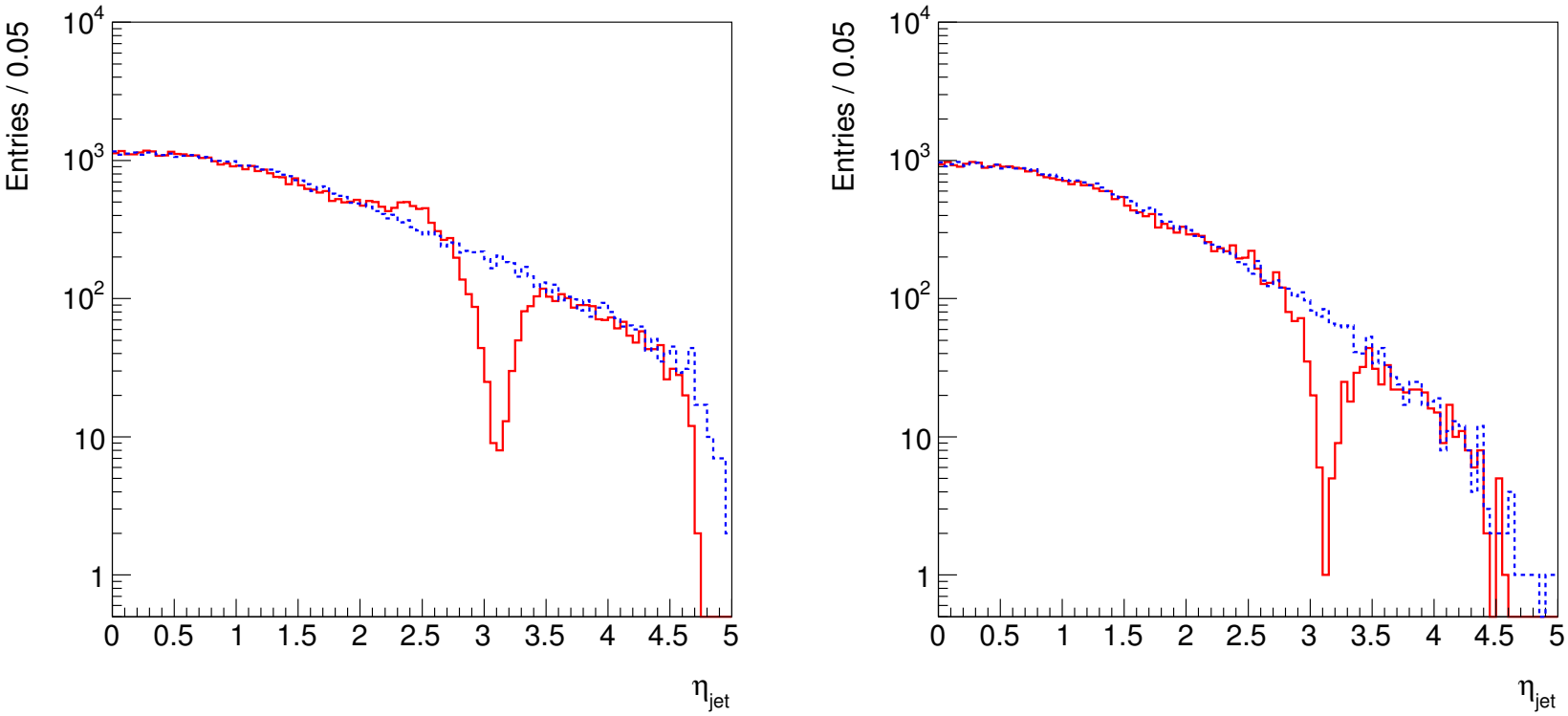
Resolutions look qualitatively similar:





No detailed comparisons yet.

Problem with η distribution in 7.5.0/7.6.0 is unchanged. For $E_T > 20, 50\,\mathrm{GeV}$:



Much worse than in 7.0.2. Not understood — no obvious bugs found.

Application to ESD?

Have ~ 600 non-isolated towers for SUSY events. Corresponding number of EM + tile cells:

$$600 \times (16+16+8+3) \approx 25800$$

Need 8 bytes/cell for ID plus energy $\Rightarrow$ about 200kB. Would be less for simpler events.

Could use ESD to redo both jet clustering and H1-type jet calibration.

Larger than 100kB target size for ESD, but SUSY events are complicated and selection is not optimized.

Would presumably be better to use energy clusters when available rather than towers. . . .