Problems With Tower Noise Removal

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Tower Problem Reported In the Past

- Large fraction of constituents at deltaR > 0.4 for Cone
- Seen in all cosmic runs and FDR:
  - DQ plot from cosmics
- Also jets have large number of constituents (>100)
- Is this a problem for other algos and/or Topo?

From DQ plots! They are useful!!!!



Constituents (N) Integral

$\int \frac{dN}{dr} dr / N$
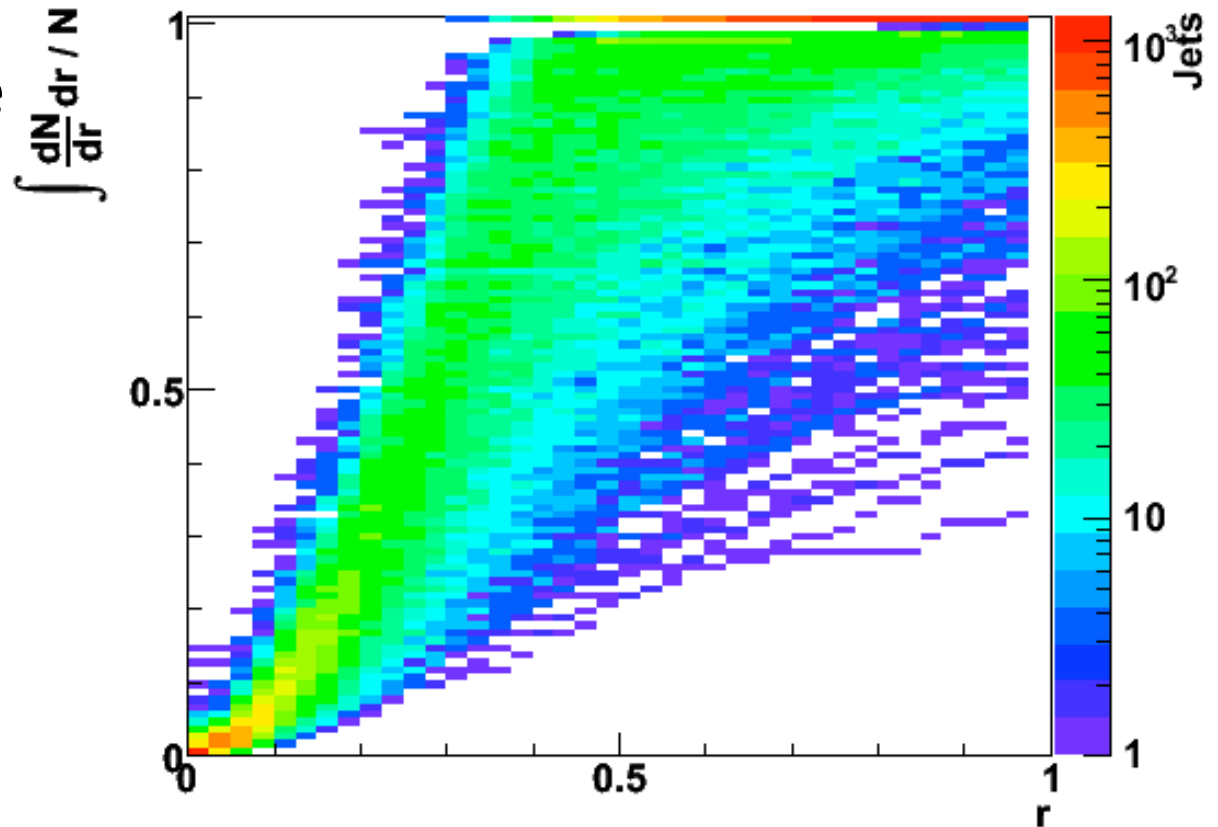
Run 91890, minutes10_2, 4/tmp_physics_L1Calo, LB 11 - 20
/Jets/Cone4H1TowerJets/Expert/JetShapes/ConstituentIntg2D

Look in More Detail

- Selected new run 114700, ESD, ~10K events
- Ran Anti-KT, SISCone (both 0.4) on tower and topo-clusters
  - Cone already in the ESD
- Used default methods to access the clusters associated with the different jet (jet->begin() and jet->end())
- Made some basic comparison plots

Results for Tower

Anti-KT
Cone
SISCone
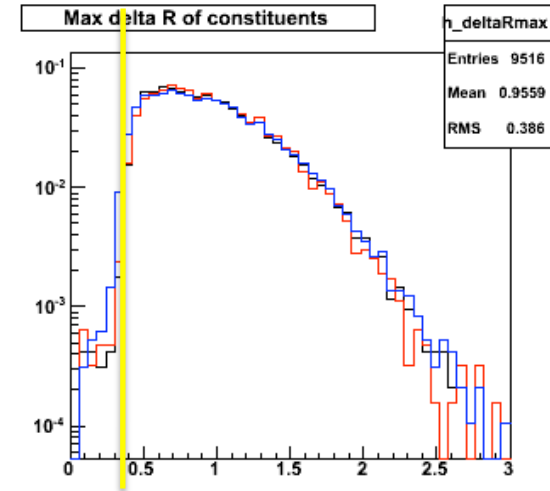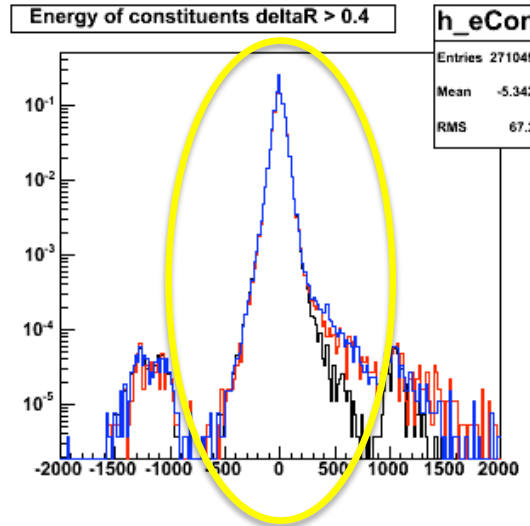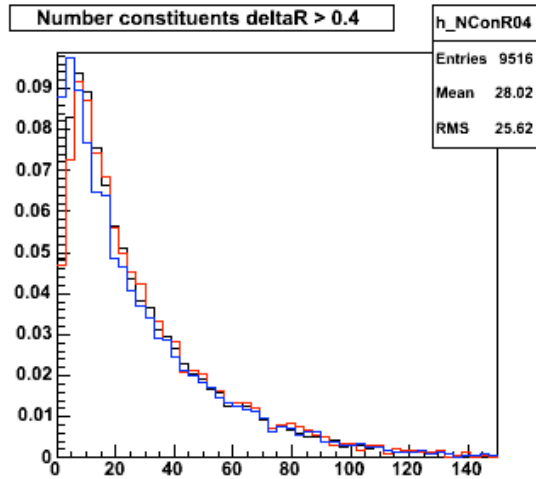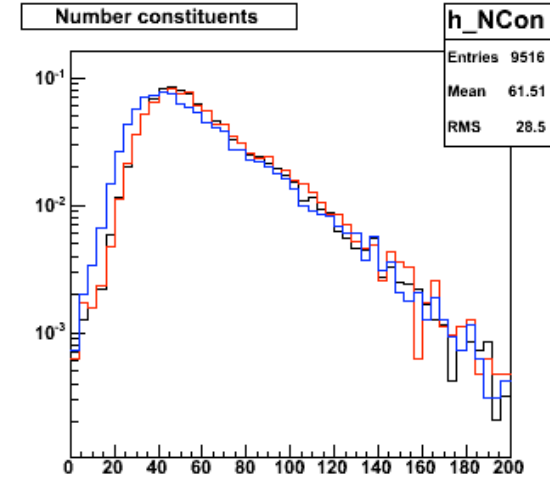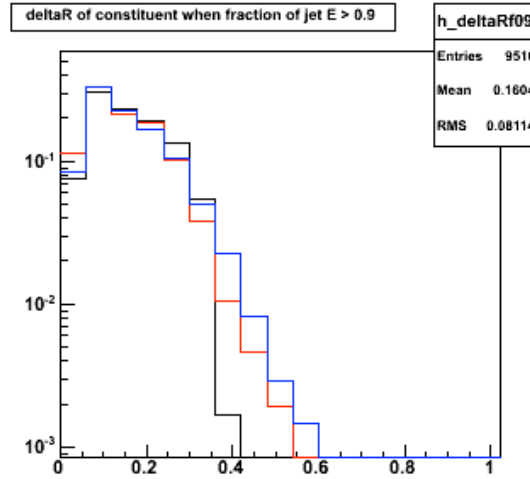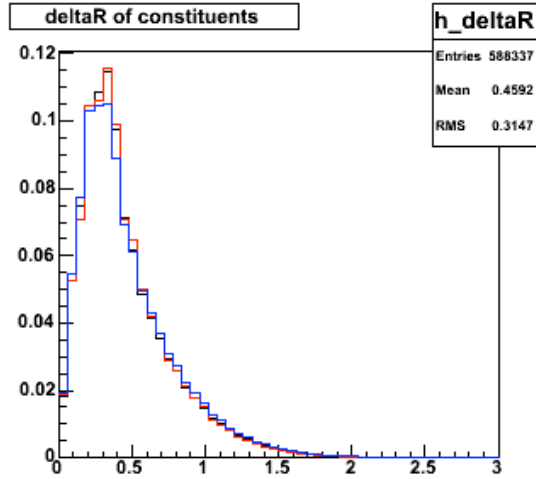
Some Comments

- The far majority of the constituents with $\Delta R > 0.4$ from jet axis are low energy (noise)
- Independent of jet algorithm
  - Problem with the tower noise removal
- Some of the jets are huge (R > 2!)
- Anti-KT does a bit better in containing the majority of the energy of the jet to a smaller radius

What is Going On?

- Problem is believed to be understood:
  - Due to tower noise removal tool
    - Want to add any noise contribution symmetrically
    - Negative energy towers incompatible with 4-mom sum
    - Solution add neighboring towers to create a +ve E tower cluster
  - Each tower is converted to proto-jet:
    - If tower has –ve E, sum with neighbouring towers,
    - Continues till +ve or until a 7x7 grid is reached
  - We see jets with constituents beyond this limit

1-D Example

- Toy 1-D example:
  - Number corresponds to a tower energy
  - To remove –ve towers can add up to two towers either side
    - 1d x5 grid (cf with 7x7 grid in full algo)
  - Start left to right. Add in left then right in an expanding grid
- 3 0 -2 0 -2 0 2
- 3 0 -2 0 -2 0 2
- 3 0 -2 0 -2 0 2
- 0 0 1 0 -2 0 2 (remove left most -ve tower)
- 0 0 0 0 -1 0 2 (add in left +ve E tower, still –ve)
- 0 0 0 0 1 0 0 (add in final tower in x5 grid)
  - Final proto-jet is made up of 7 towers! Before jet finding!
- In 2-D this can really spiral out of control
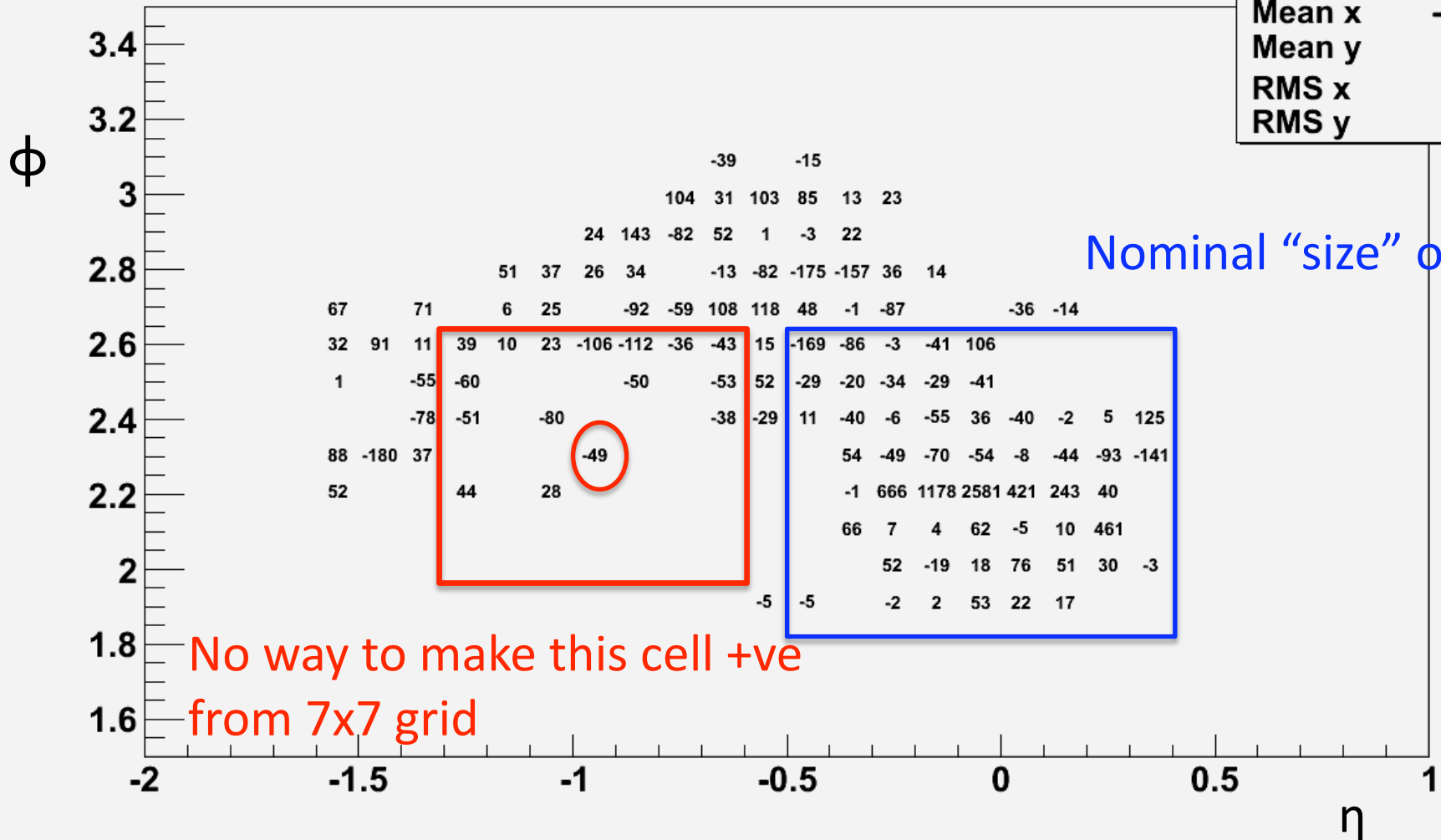- It gets worse… start left to right and add in right then left…

1-D Example (2)

- 3 0 -2 0 -2 0 2
- 3 0 -2 0 -2 0 2
- 3 0 -2 0 -2 0 2
- 0 0 -1 0 0 0 2
- 0 0 0 0 0 0 2 (tower still –ve after x5 grid ➔ 0)
- 0 0 0 0 0 0 2 (final proto-jet)
  - cf 0 0 0 0 1 0 0 previously
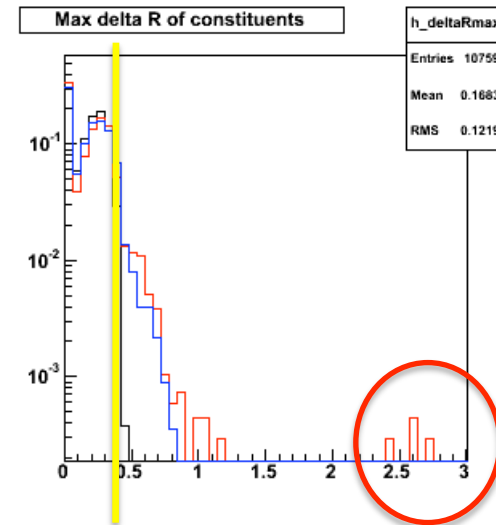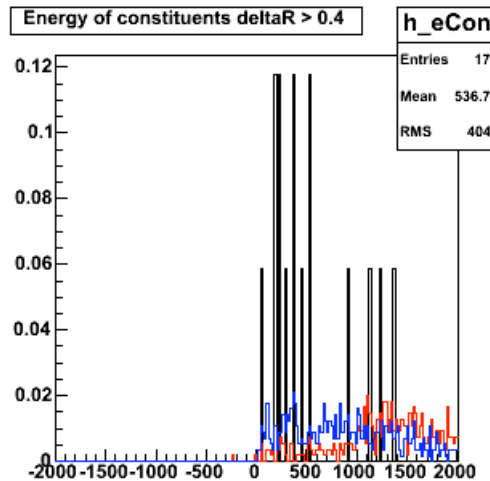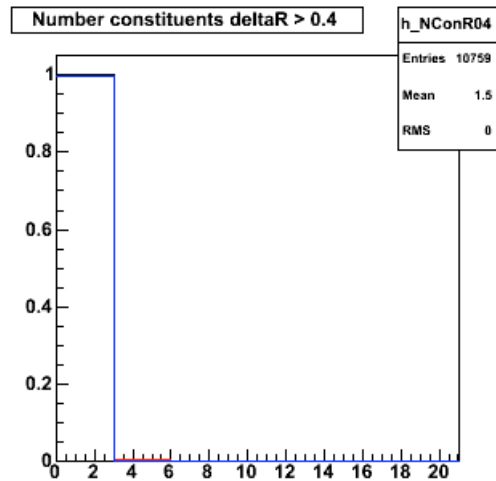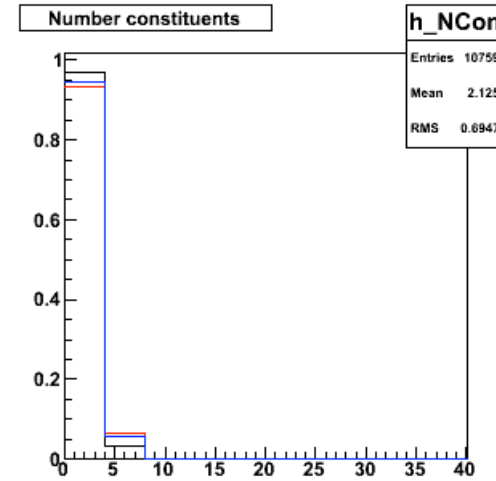
Pathological Anti-KT Jet

How about Topo?

Anti-KT
Cone
SISCone
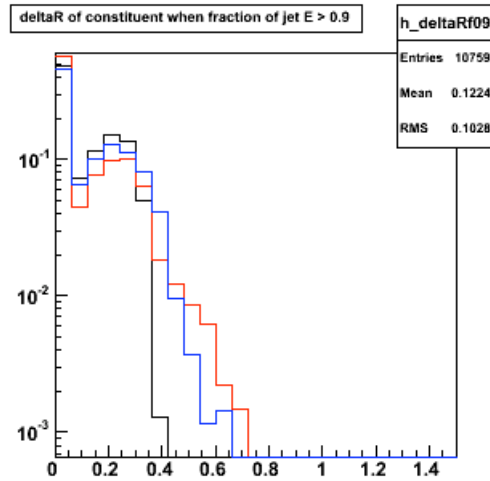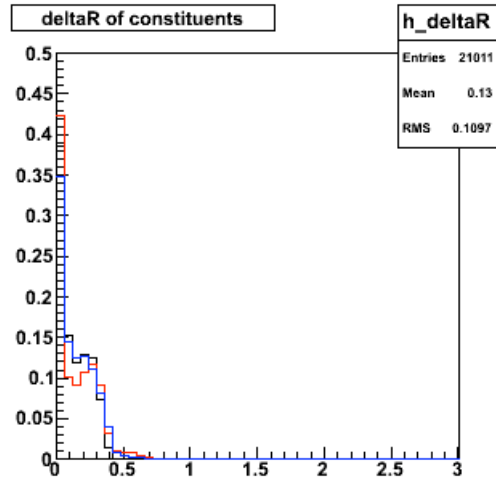
Jet Mass

- Aside from possible resolution effects and size, only consequence seems to be in the jet mass

Full Monitoring

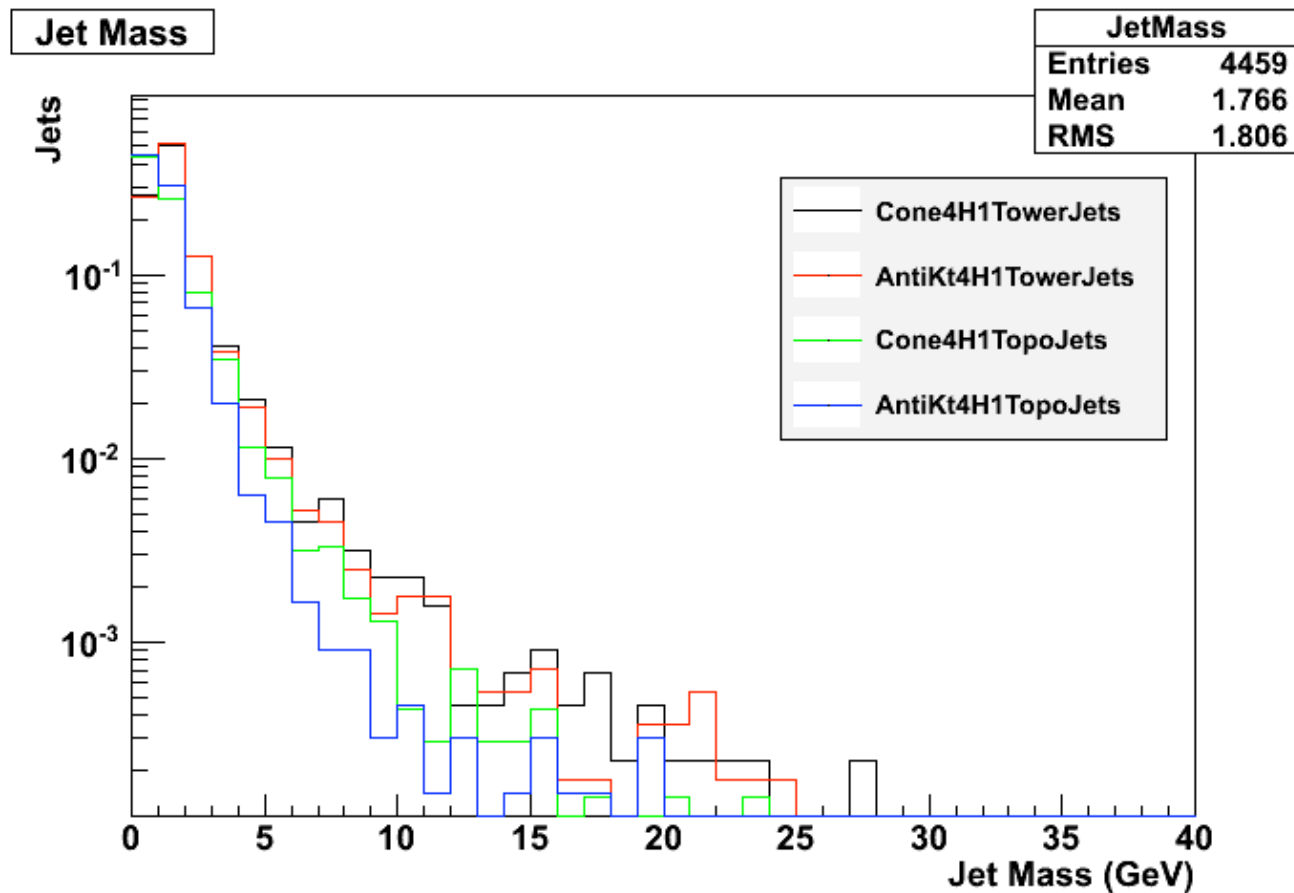- Re-ran full up-to-date monitoring from ESD:
  - Run 114700, L1Calo stream, ~20k events
  - Tower and Topo, Cone and AntiKt
  - http://atlasdqm.web.cern.ch/atlasdqm/test/10/NoStream/run_114700/run/index.html
    - look under full run
- A few minor issues to be understood
  - For cosmics the lumi block segmentation is small
  - Some plots didn't display
  - Problems updating reference file
- Also some interesting features for Topo

Energy of Topo-Jet Constituents

Constituents Energy
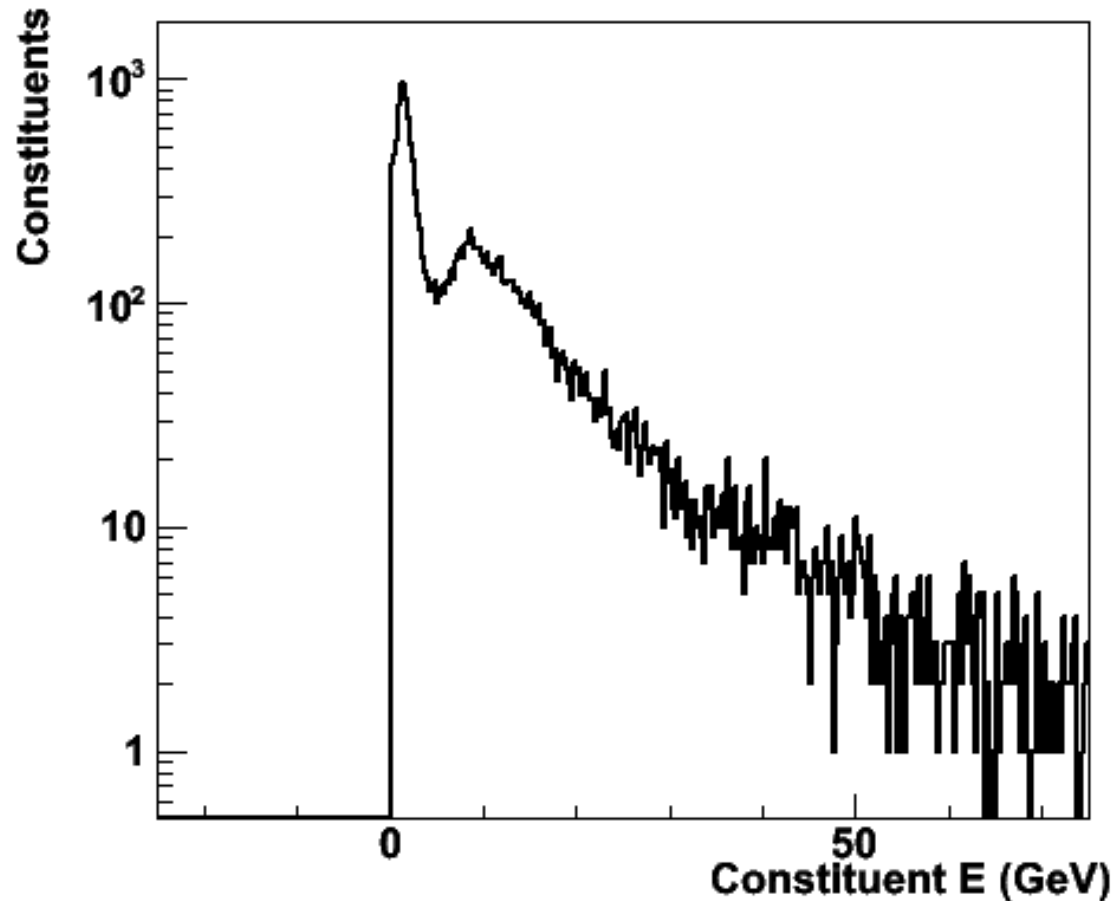
Run 114700, 10/NoStream
/Jets/AntiKt4H1TopoJets/Expert/JetShapes/ConstituentEnergy

- Seem for both Anti-Kt and Cone
- Is this just a distinction of noise to real hits?

Conclusions

- Problems in noise removal for tower jets
  - Independent of jet algorithm
  - Problem known and understood
- Topo-cluster jets do not have this problem
  - Some residual shape issues for cone jets to be investigated
- Discussion is needed on how to solve this issue:
  - Just ignore towers E < 0 and correct energy bias via offset?
  - New algorithm?
  - …..