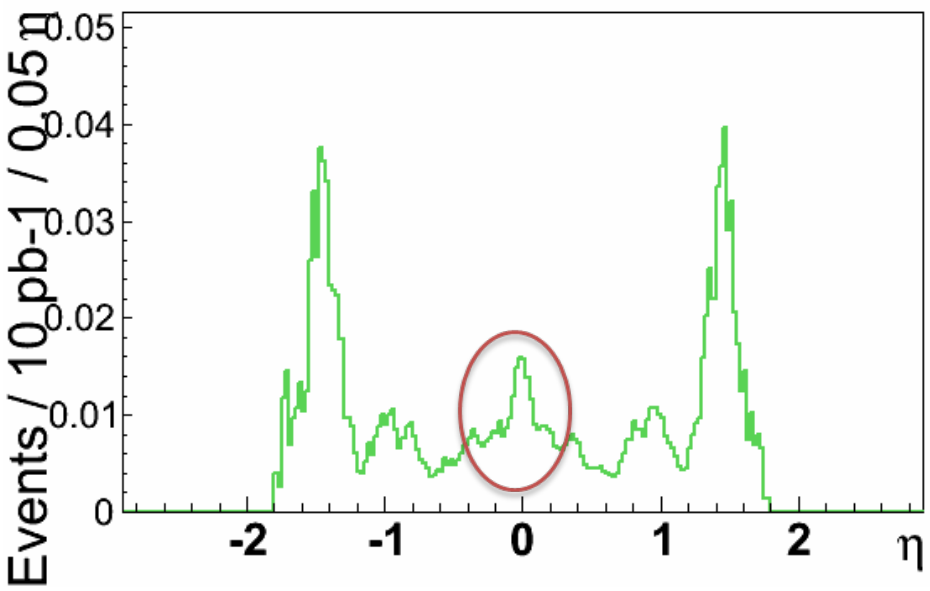
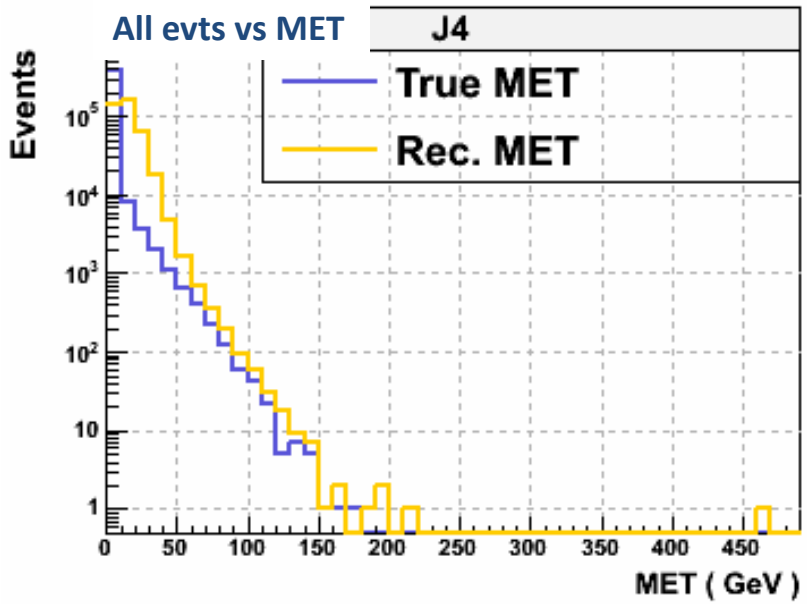
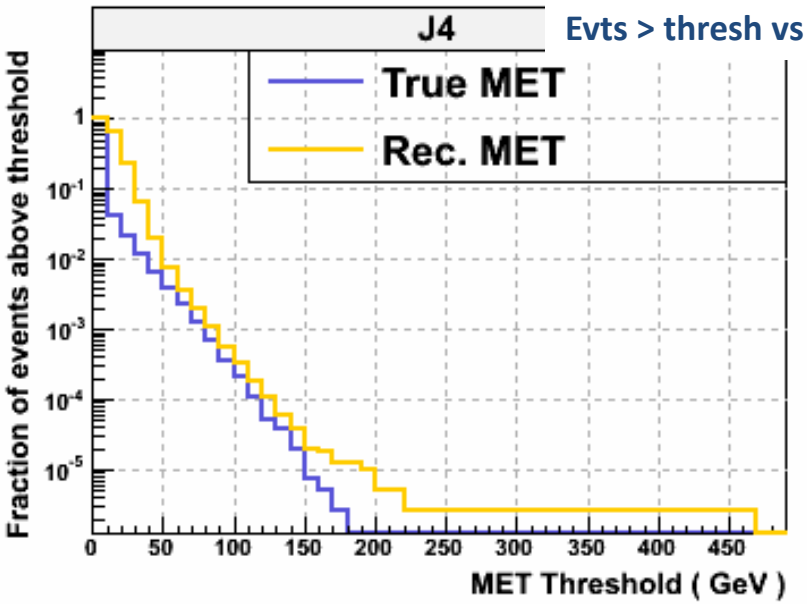
Missing Et tails in the Jx dijet samples

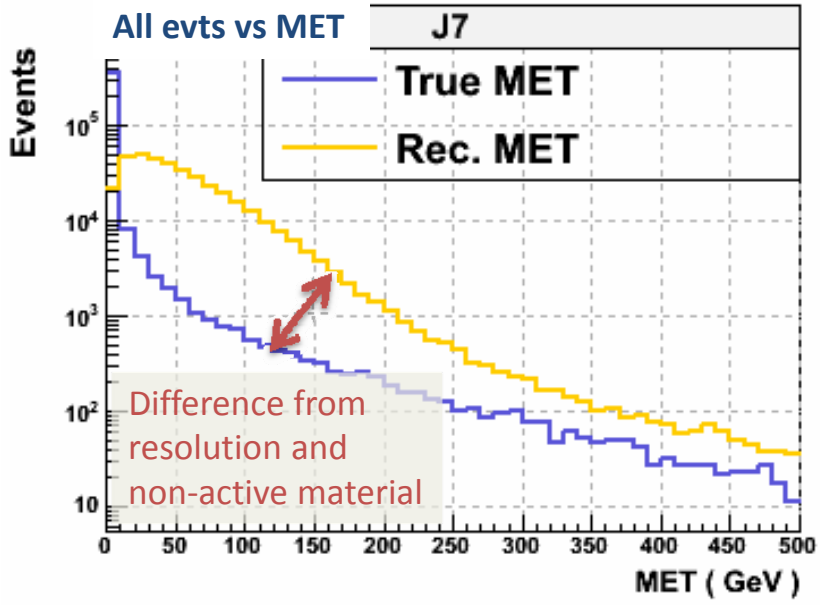
- rel 14.2.20 mc08 samples used (s479_r586)
  - First look at new DPDs reveals the same effects
- Use dijet samples as tool to probe MET resolution, fake MET, tails in MET
- Check how well we understand large fake MET events
- Use H1 Cone4 topo jets

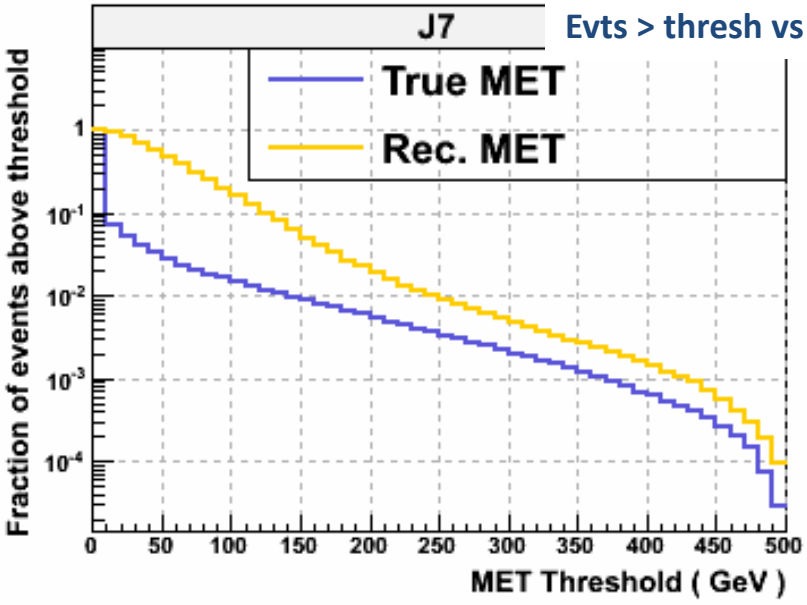


True versus fake missing Et in Jx



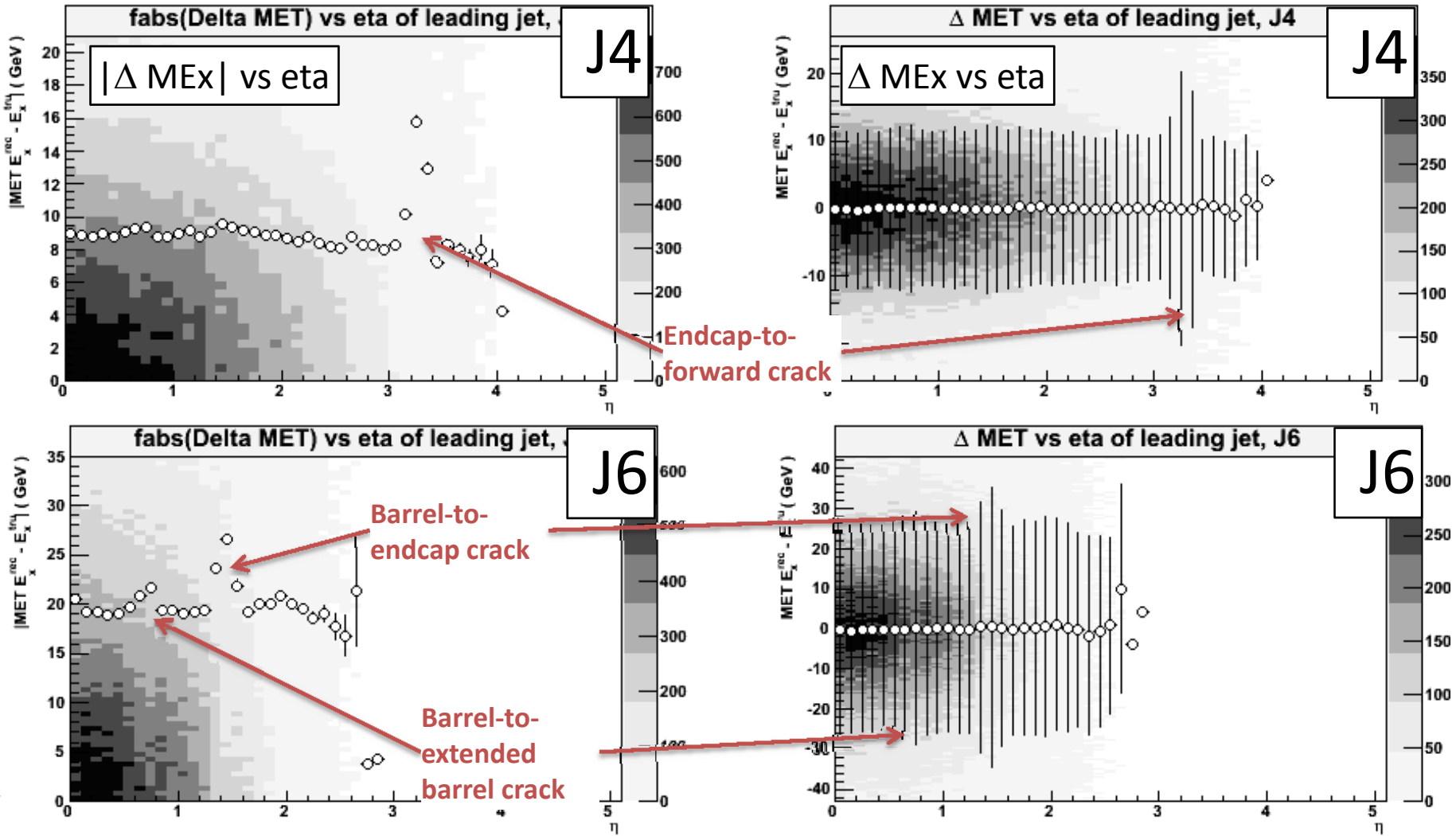






Sources of fake MET

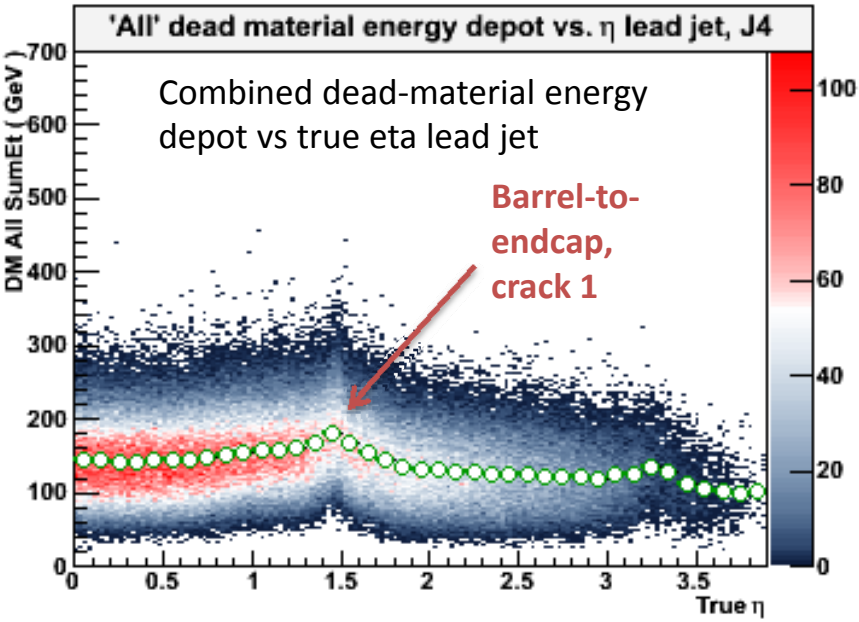
- Inactive service material in the cracks
- Clearly seen in Δ MEx vs jet eta: increased average error, increased scatter



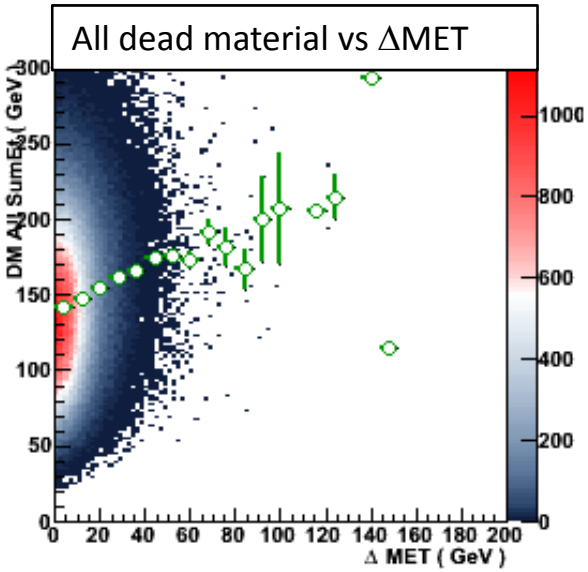
Sources of fake MET: dead material

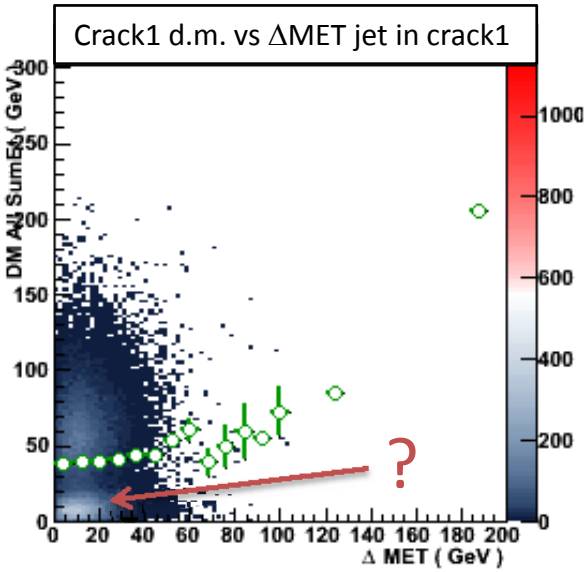
J4

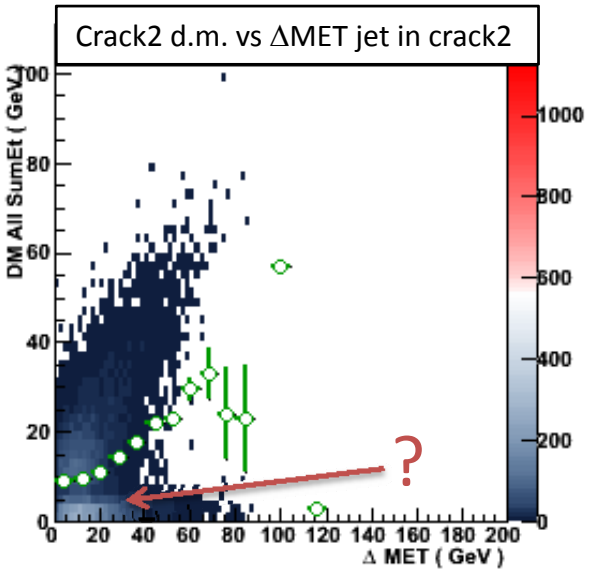
- Look at energy depot in dead material, from true calibration hits, available for crack1, crack2, cryostat, and all combined in AOD
  - d.m. in cracks: [1.1,1.7] and [2.9,3.5]
- Cracks clearly visible, positive correlation of ΔMET and dead-material depot
- Not quite clear why sometimes no dead-material energy depot even though the true jet hits the crack



Correlation energy in dead material vs ΔMET:



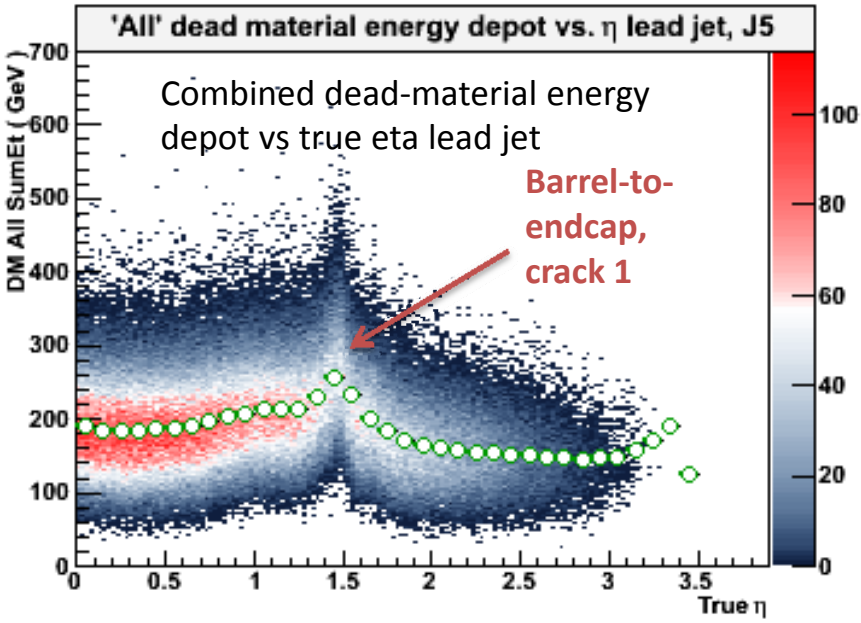




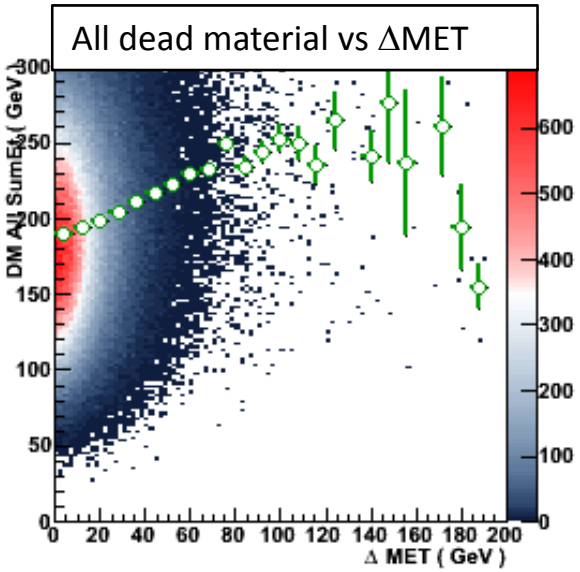
Sources of fake MET: dead material

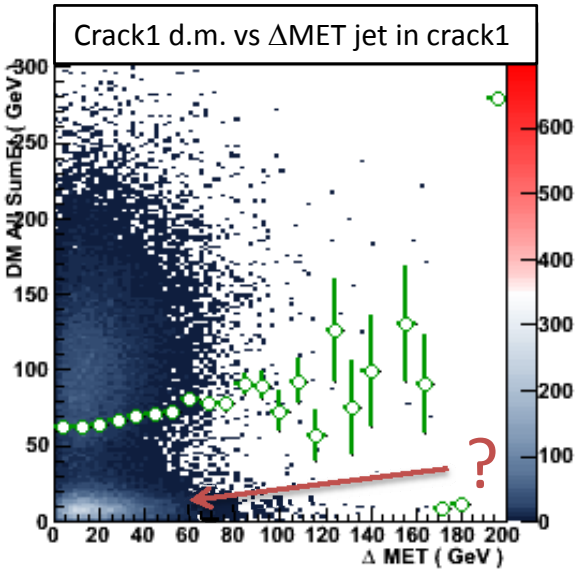
J5

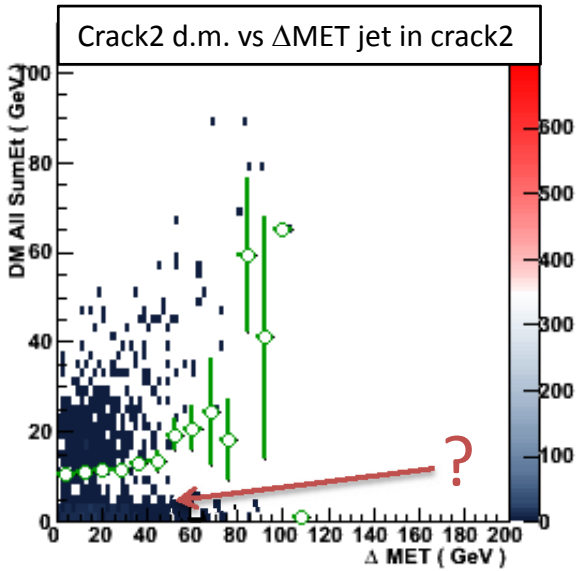
- Look at energy depot in dead material, from true calibration hits, available for crack1, crack2, cryostat, and all combined in AOD
  - d.m. in cracks: [1.1,1.7] and [2.9,3.5]
- Cracks clearly visible, positive correlation of ΔMET and dead-material depot
- Not quite clear why sometimes no dead-material energy depot even though the true jet hits the crack
- Dead material depot increases with increasing jet energy



Correlation energy in dead material vs ΔMET:





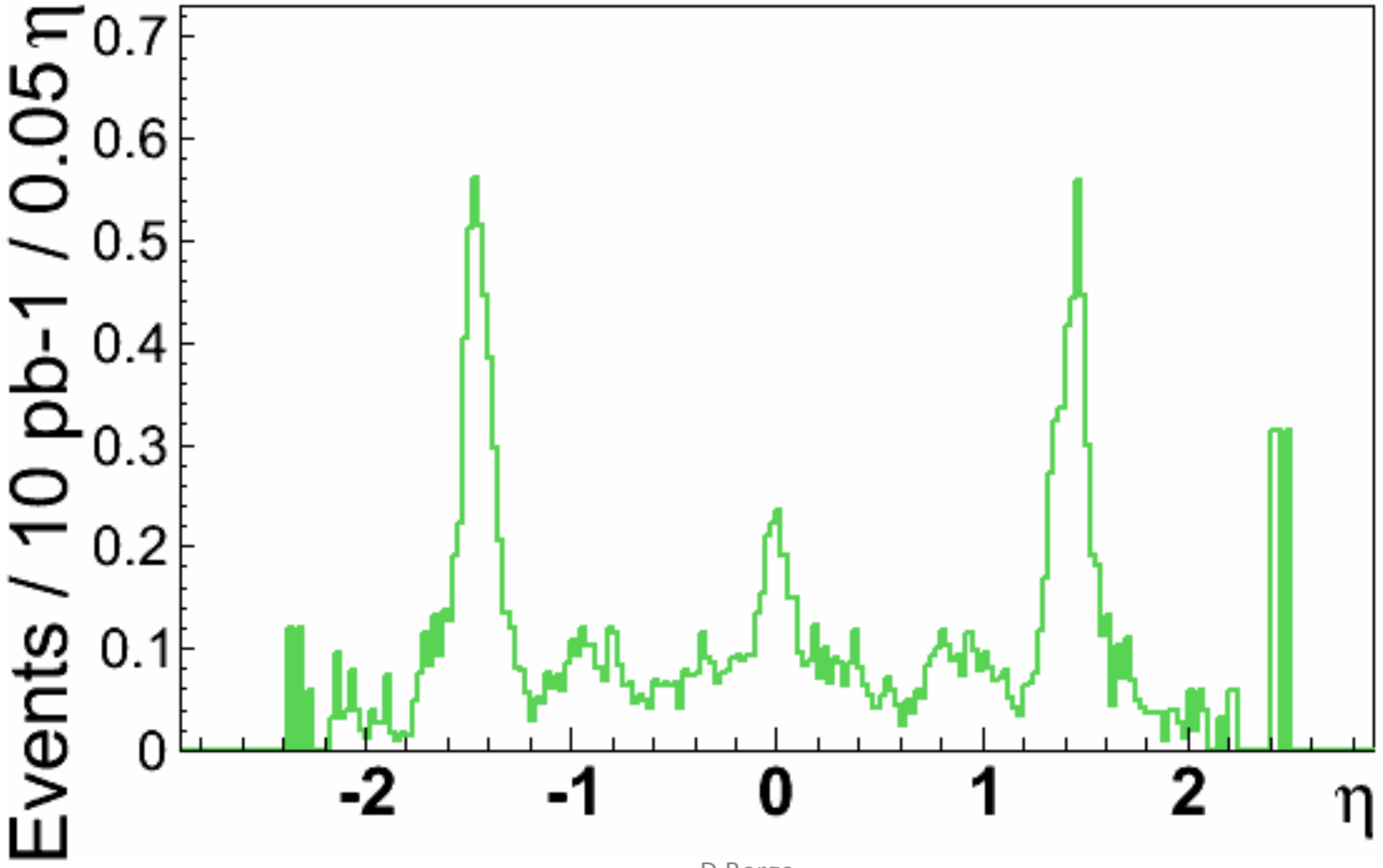


Jet eta distribution for >100 GeV MET

J6

- Cut at 100 GeV reconstructed MET and plot eta distribution of reconstructed sub-leading jet
- Eta-corrected, i.e. account for non-uniform eta distribution of all jets by dividing it out – relative peak heights are comparable
- Only reconstructed quantities used here, same plot can be filled from data!

Total of 20.2 events in $10pb^{-1}$

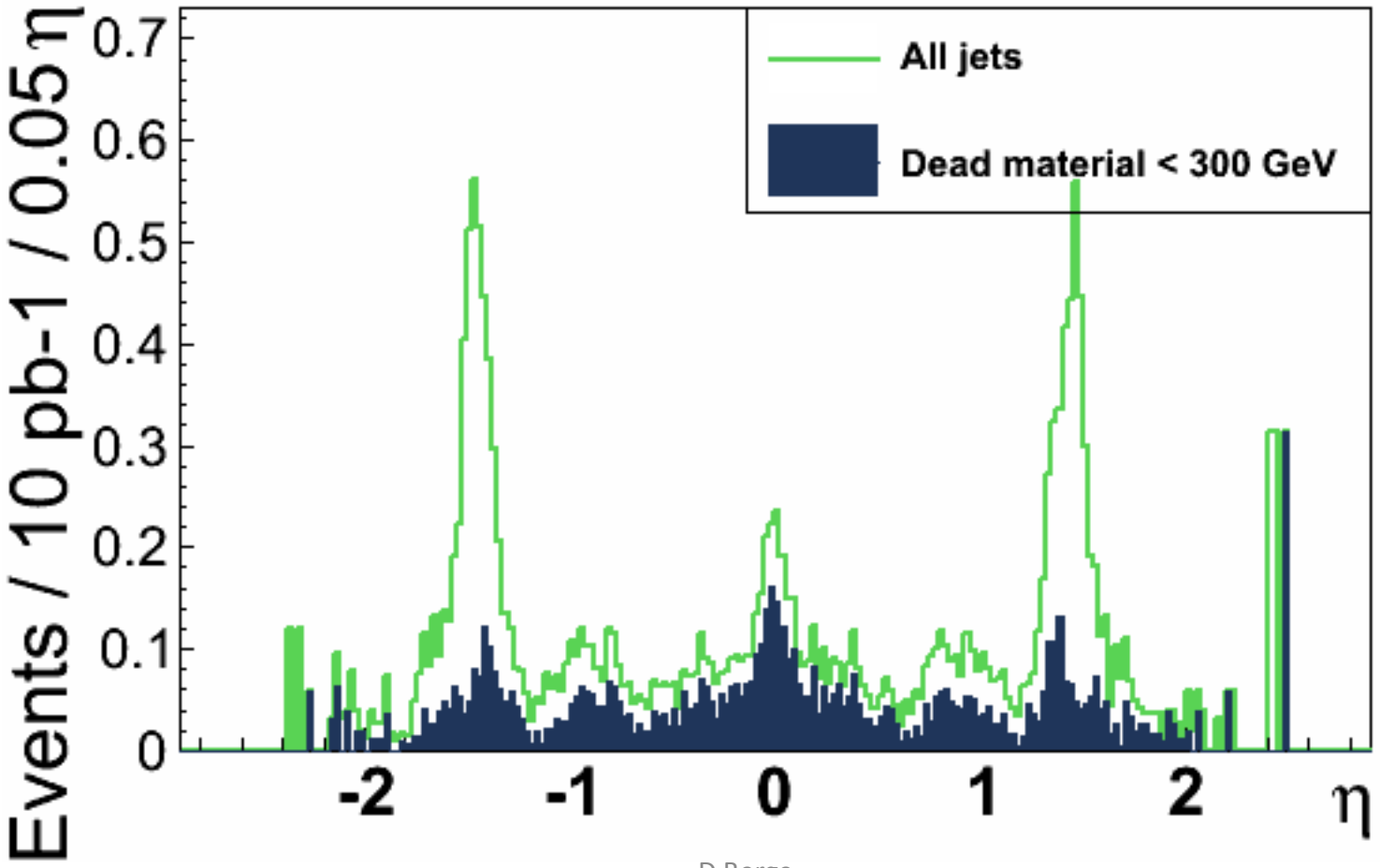


Jet eta distribution for >100 GeV MET

J6

- Cut at true dead-material deposit of 300 GeV
- Remove peak around crack 1, eta = 1.5
- Peak for very central jets (< |0.1|) remains

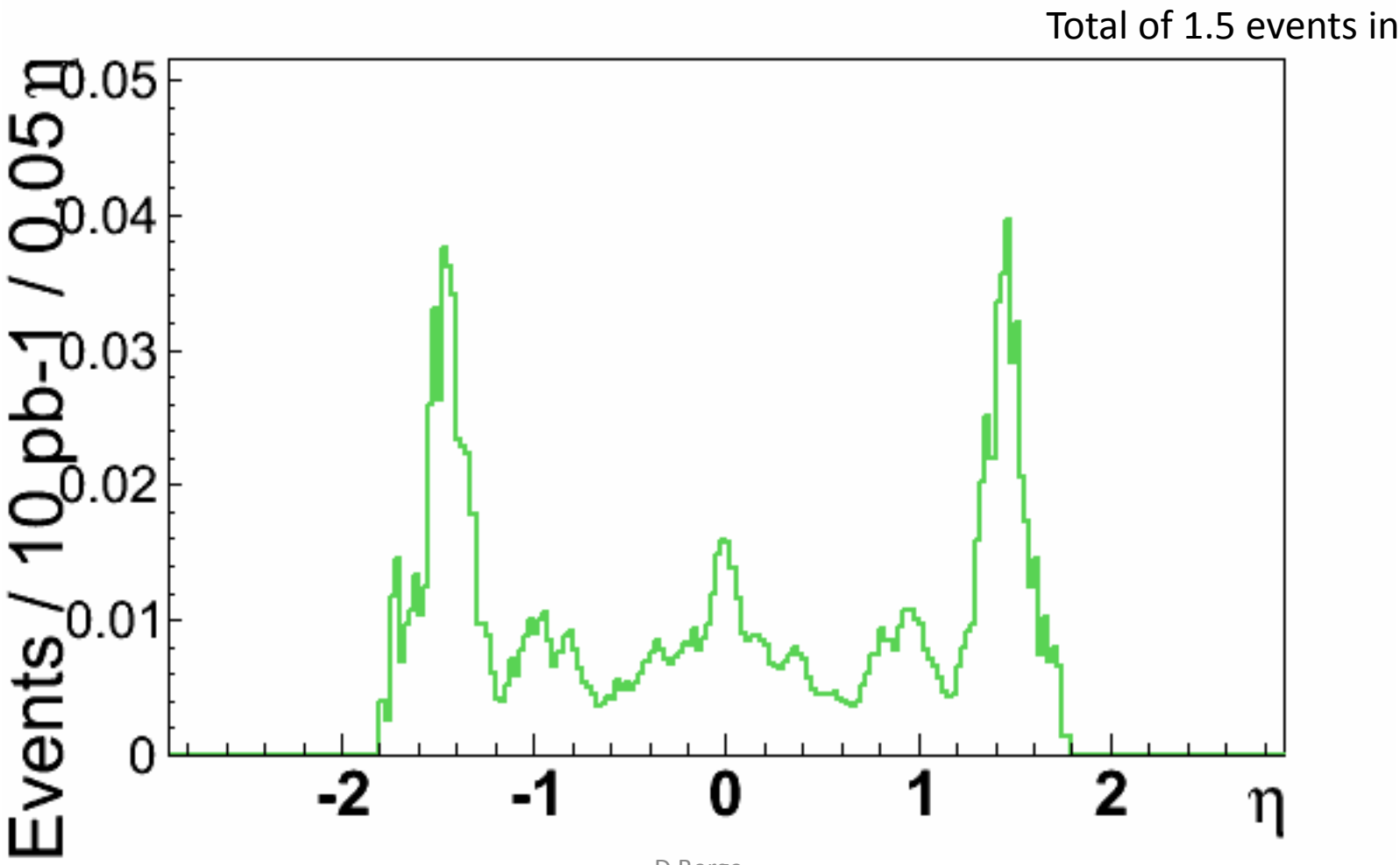
Total of 20.2 events in $10pb^{-1}$



Jet eta distribution for >100 GeV MET

J7

- Same for J7, 1.5 events expected in 10pb-1
- Pronounced peaks at 0 and |1.5|

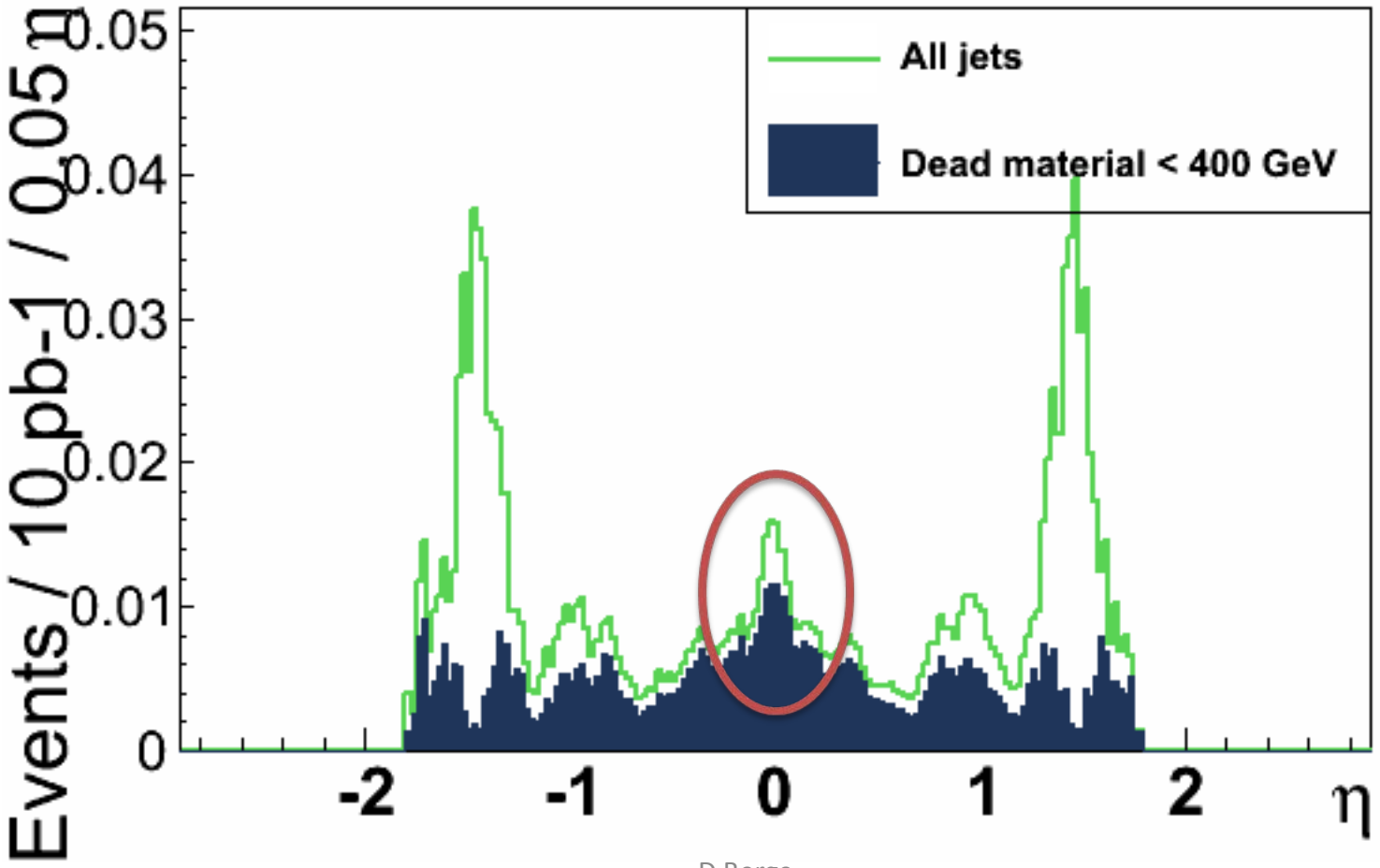


Jet eta distribution for >100 GeV MET

J7

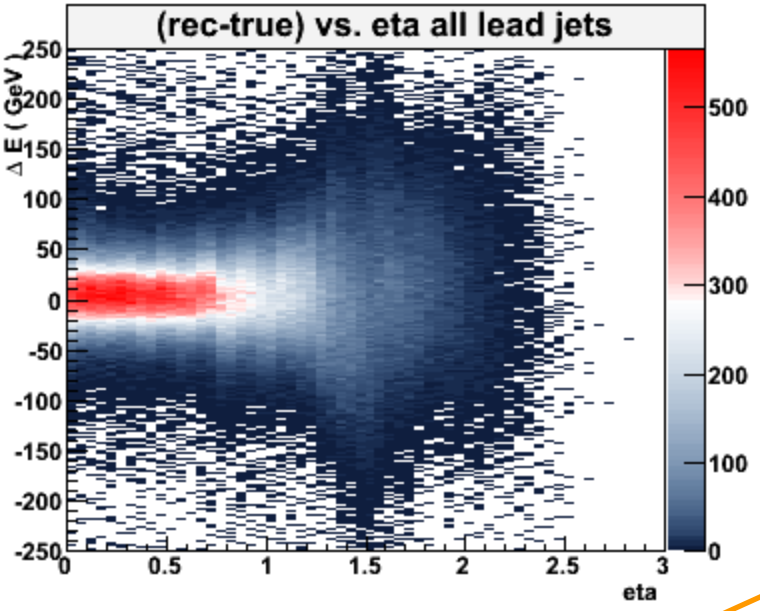
- Same for J7, 1.5 events expected in 10pb-1
- Pronounced peaks at 0 and |1.5|
- As expected peaks in the cracks disappear when cutting on dead material depot

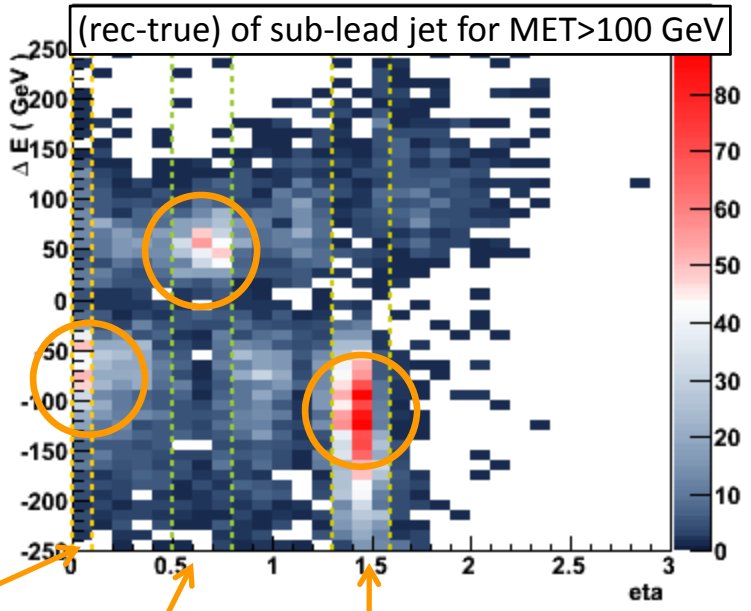
Total of 1.5 events in $10pb^{-1}$

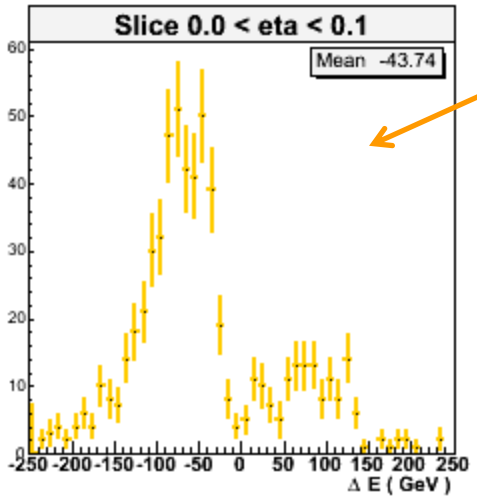


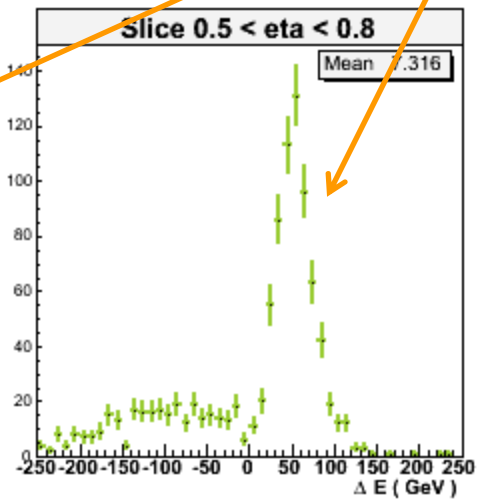
J6 Δ(jet energy) vs eta for MET > 100 GeV

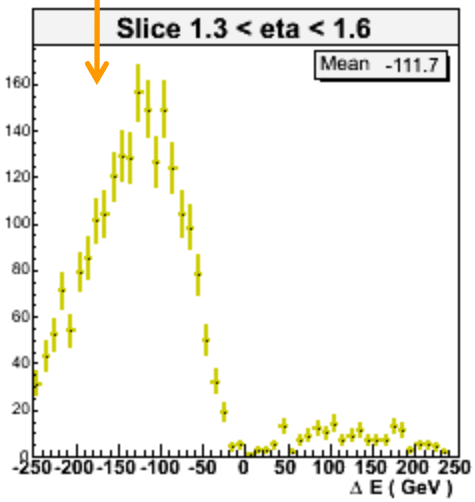
- Cut on large MET projects out the tails in the jet resolution
- These appear to be largely asymmetric
- For eta<|0.1| distribution peaks at 70 GeV underestimation of energy
- Overshoot around eta |0.7|





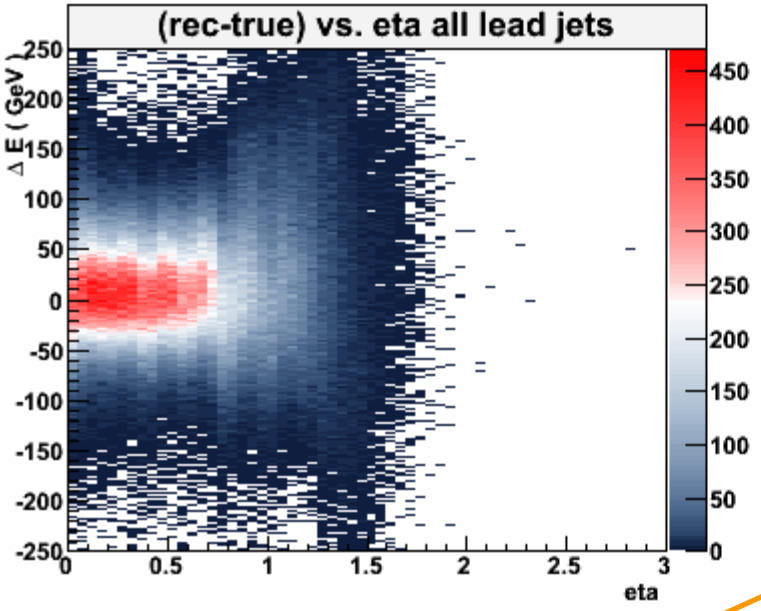


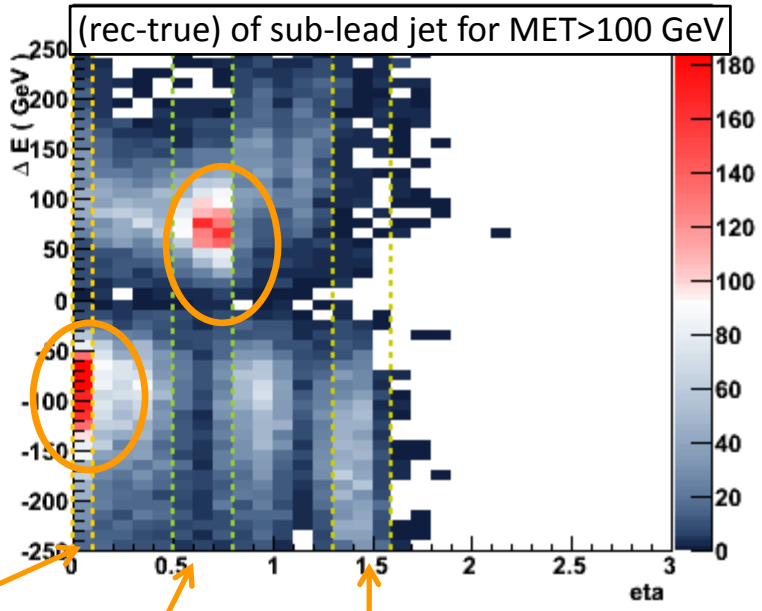


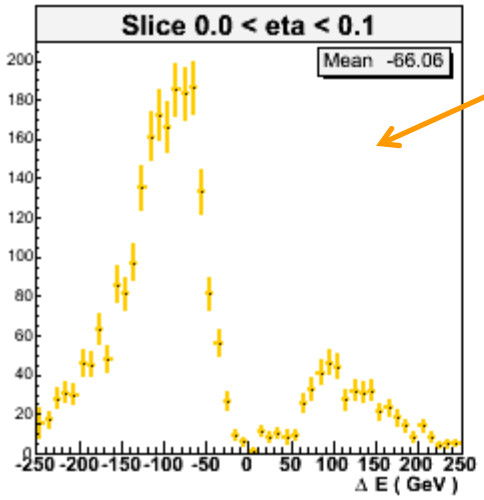


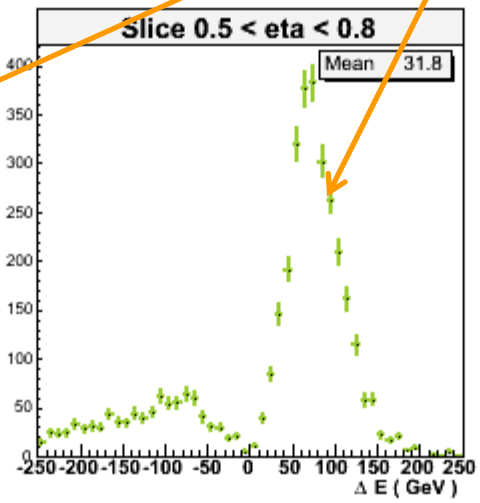
J7 Δ(jet energy) vs eta for MET > 100 GeV

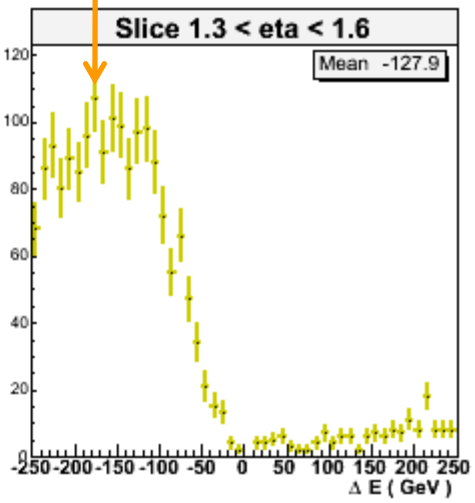
- Cut on large MET projects out the tails in the jet resolution
- These appear to be largely asymmetric
- For eta<|0.1| distribution peaks at 70 GeV underestimation of energy
- Overshoot around eta |0.7|
- Even more dramatic in J7







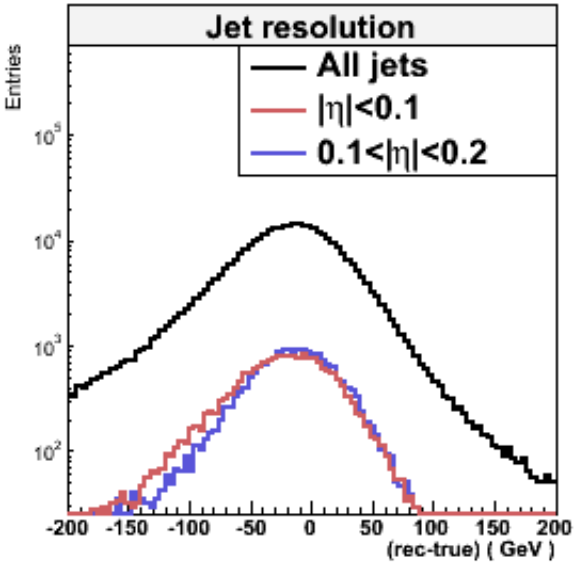


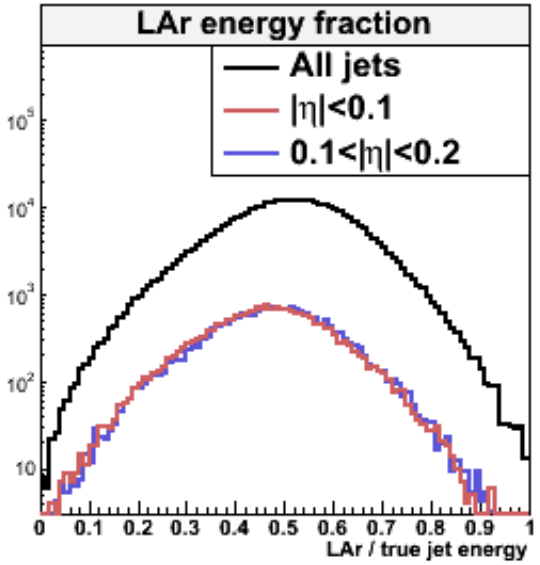


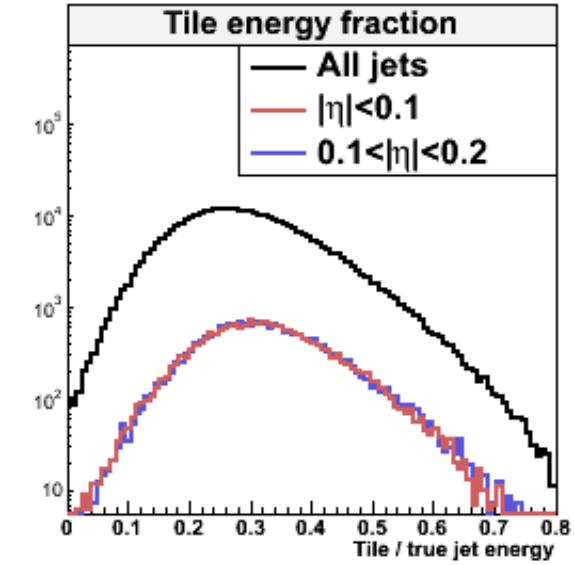
Tails before MET cut

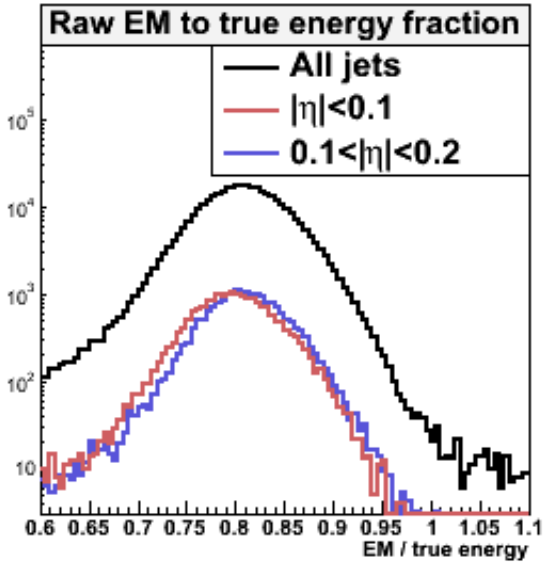
J7

- Look for asymmetric tails in distributions of the sub-lead jet without applying MET cut
- Here asymmetry in jet resolution is apparent, obvious difference between |eta|<0.1 and 0.1<|eta|<0.2
- Also differences in raw EM fraction, not clear whether this gives a clue as to where the cause is, at the level of reconstructed jets or before at the level of the raw jets



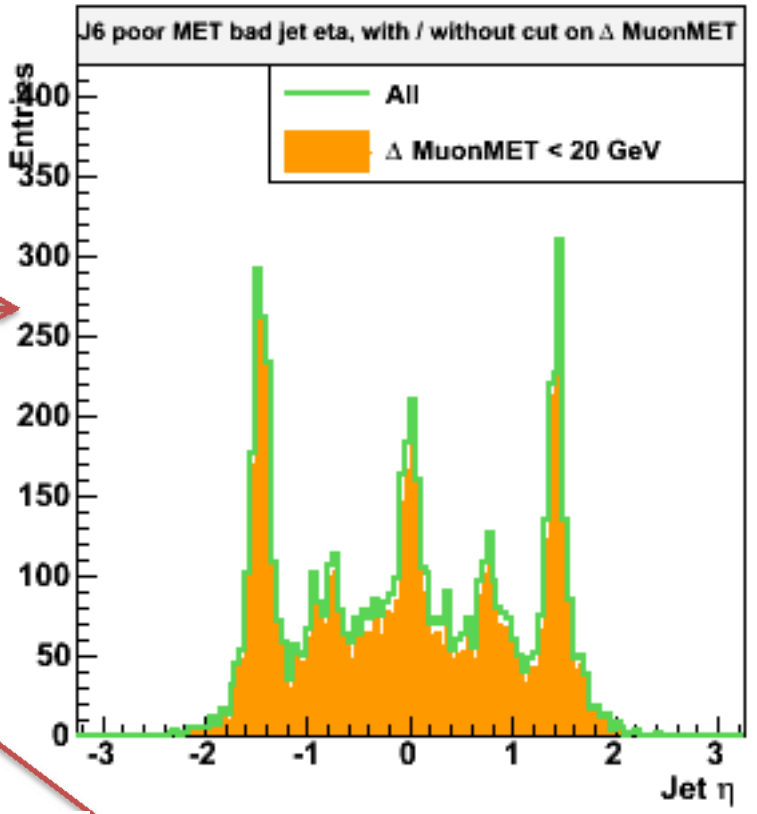




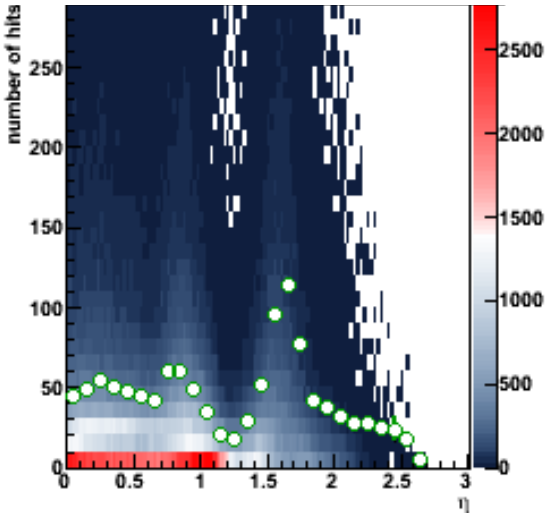


Muon contribution

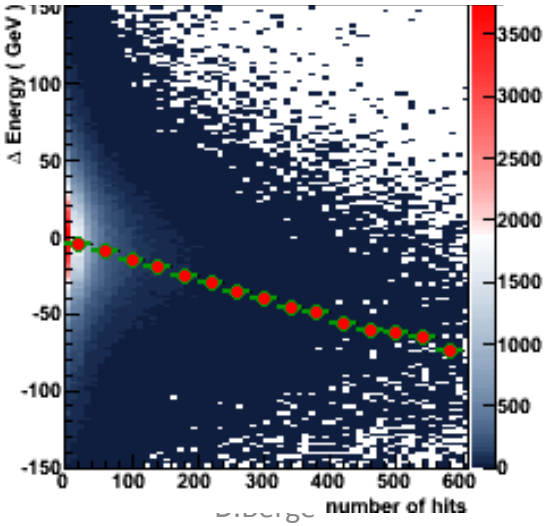
- Peak at 0 not from muons
- Cutting on the difference (reco-true Muon MET) does not change the picture
- Same when cutting on hits in the muon system behind jets ('muon space shower')

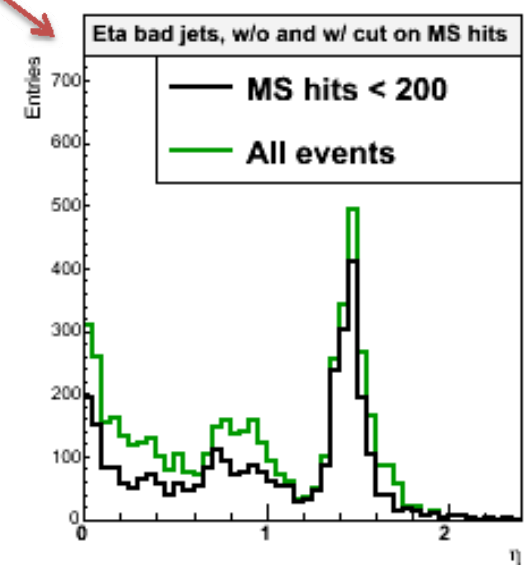


Muon hits vs eta lead jet



Jet resolution vs muon hits





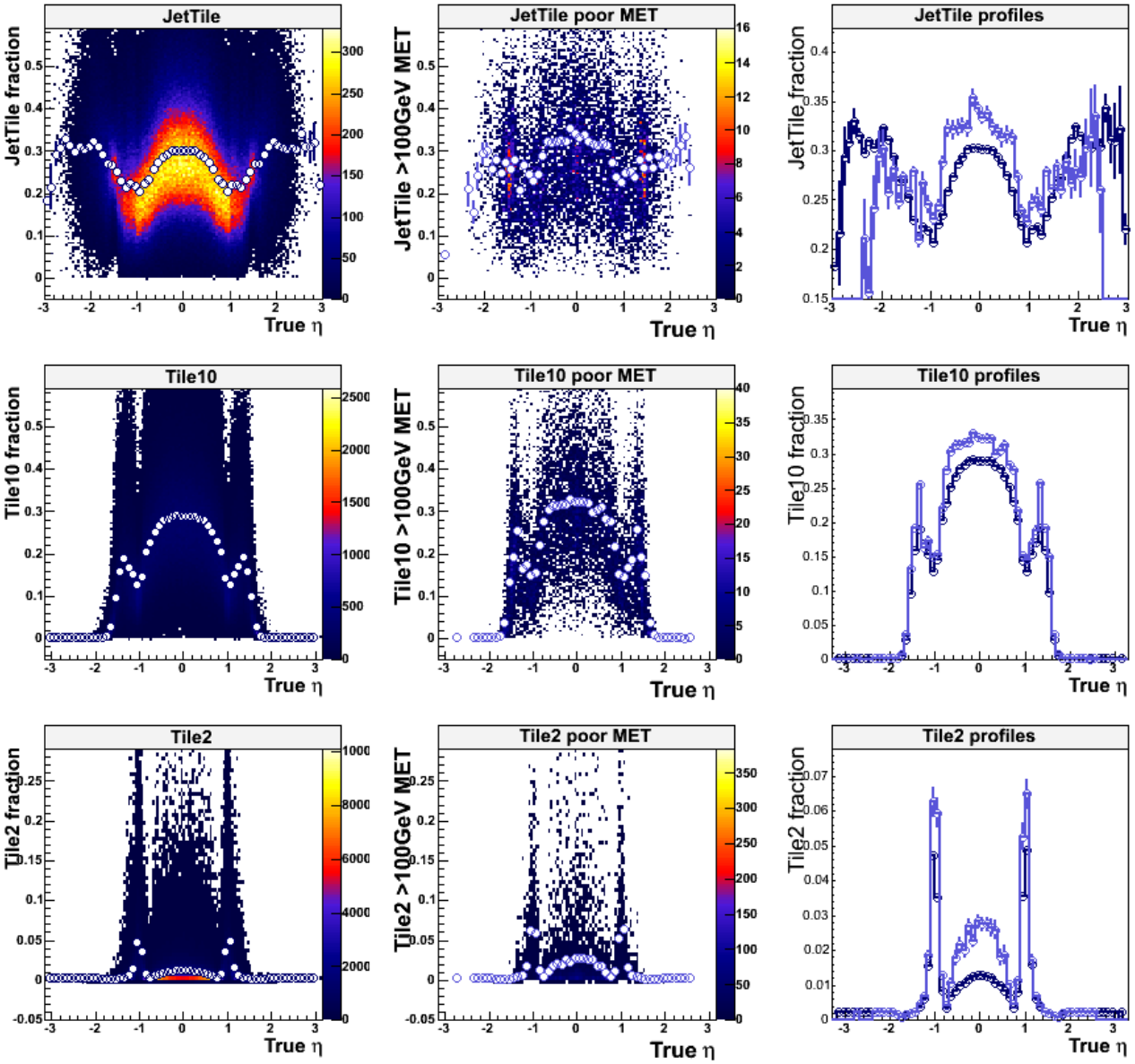
Jet shapes

- By jet shapes I mean energy depositions in the different calorimeter compartments
- Plots in the following will have:
  - Shape ‘JetTile’: Fraction of total energy in the whole of Tile
  - Shape ‘Tile10’: Fraction of total energy depot in the 2 innermost Tile layers
  - Shape ‘Tile2’: Fraction of total energy depot in the outermost Tile layer
  - Shape ‘JetLAr’: Fraction of total energy in the whole of Lar
  - Shape ‘Gap’: Fraction of total energy depot in TileCal gap and crack scintillators
  - Shape ‘Cryo’: Estimation of energy depot in the cryostat between EM and HAD calorimeters, calculated as sqrt(lar_outermost * tile_innermost) = sqrt((EMB3+EME3) * (TileBar0+TileExt0))

Jet shapes J6

- Plotted fraction is the measured energy divided by the true jet energy
- Average difference apparent between all leading jets and those sub-leading jets in events with large MET
- But no visible difference between |eta| < 0.1 and 0.1 < |eta| < 0.2

All lead jets | Sub-lead jets large MET | All vs sub-lead jets



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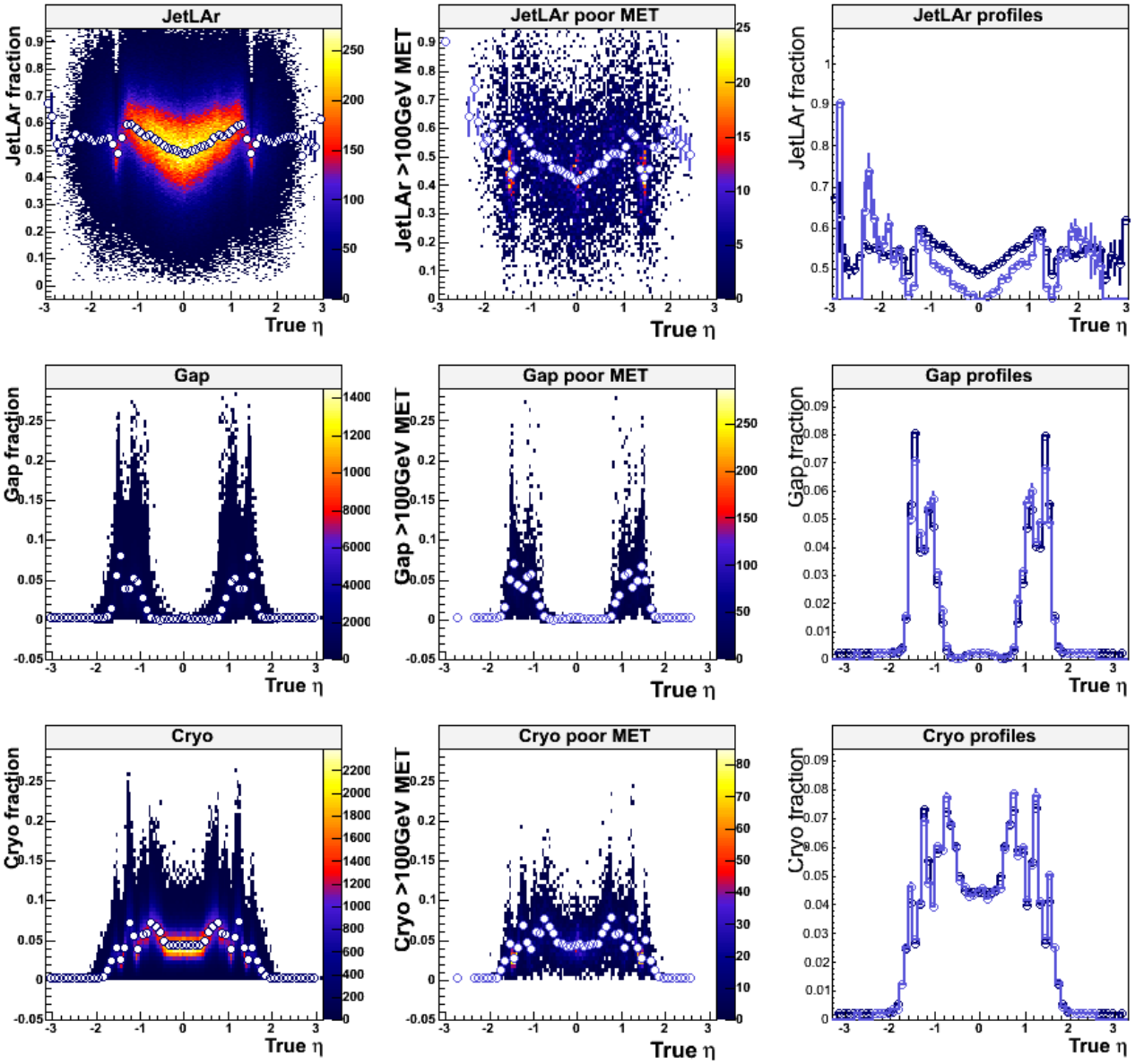
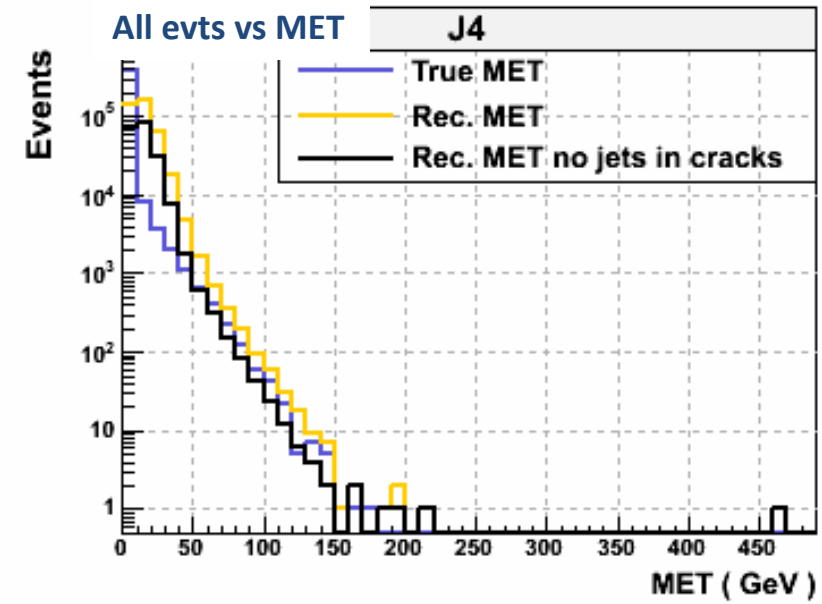


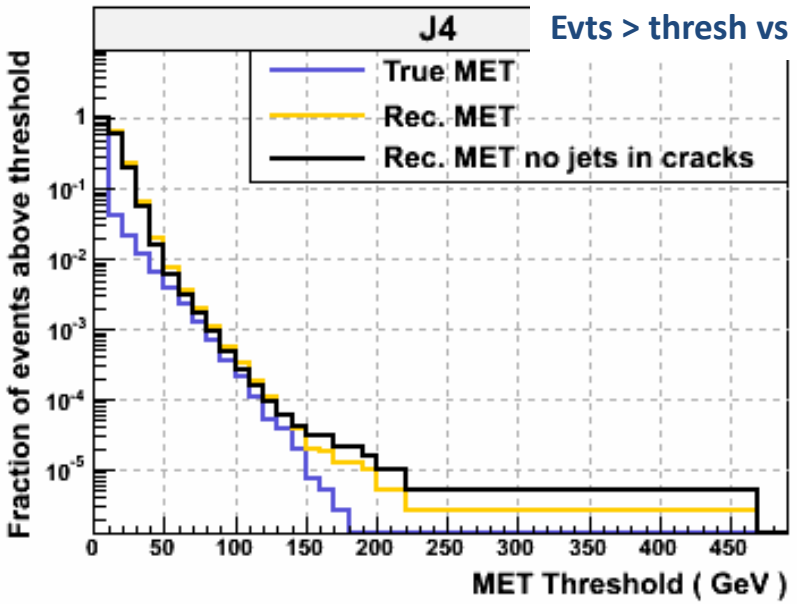
Summary

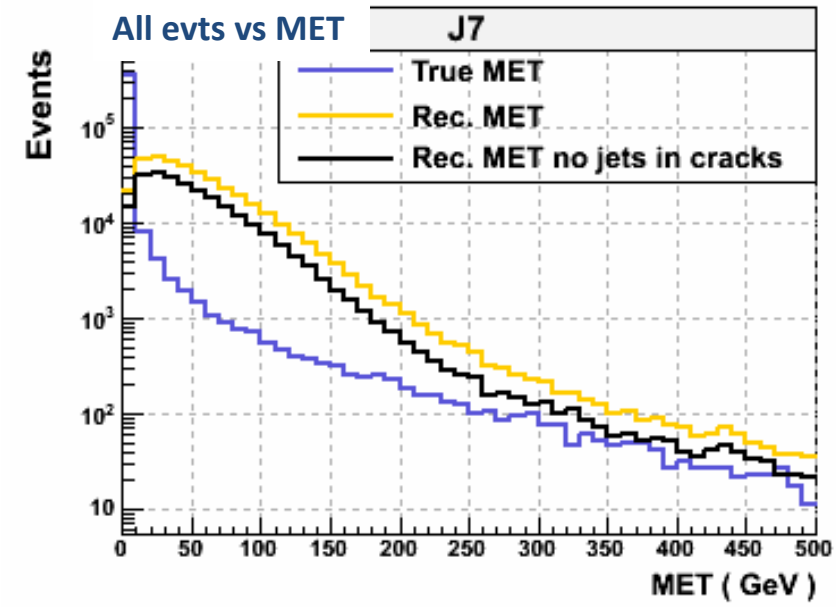
- MET tails in dijet samples map out our inefficient regions
- Not clear where the peak at eta=0 comes from
- Jets largely underestimated in these events
- Went through various possible explanations:
  - LAr gap of a few mm at eta=0
  - Variation in Tile sampling fraction
  - Missed muons
  - Punch throughs
  - Weirdly shaped jets
  - Non-isolated jets as opposed to the isolated ones for which the calibration was done
- Better access to calibration weights and signal states in rel15 and comparison with LC jets hopefully helps

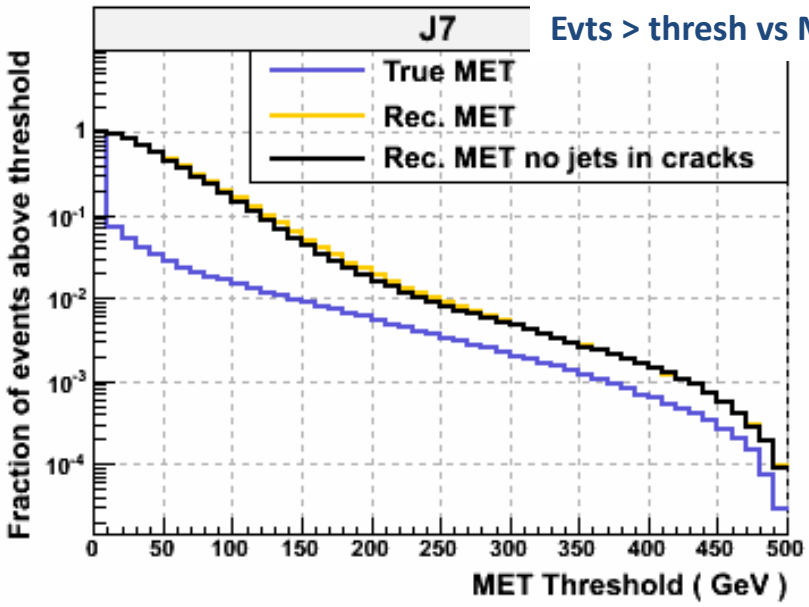
Backup material

Again: true versus fake missing Et, exclude cracks





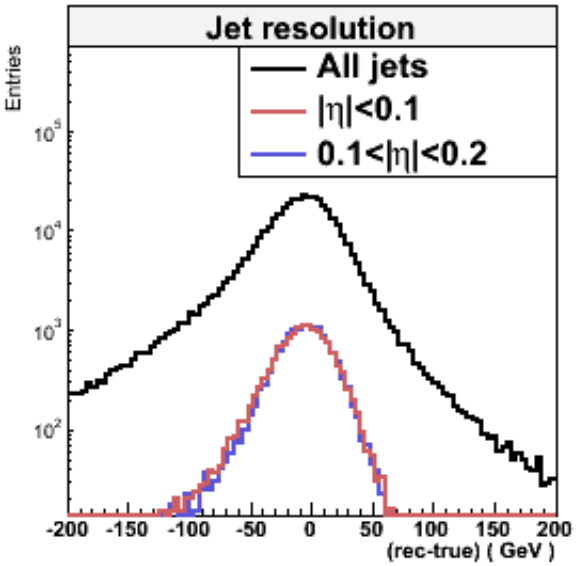


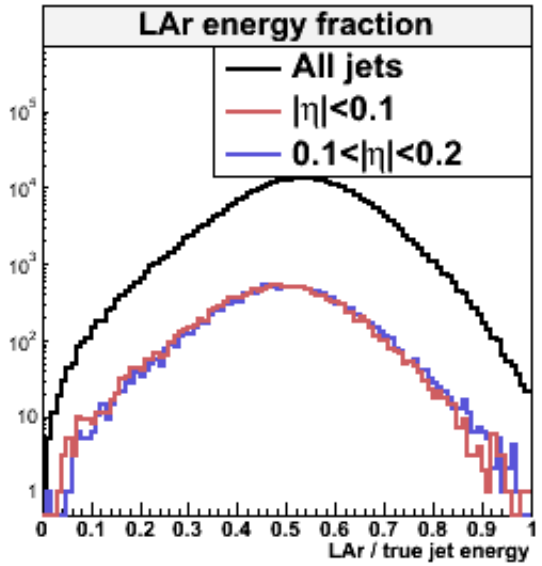


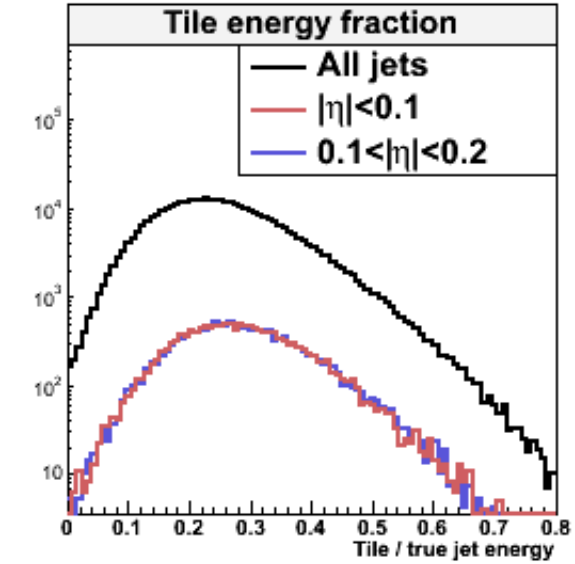
Tails before MET cut

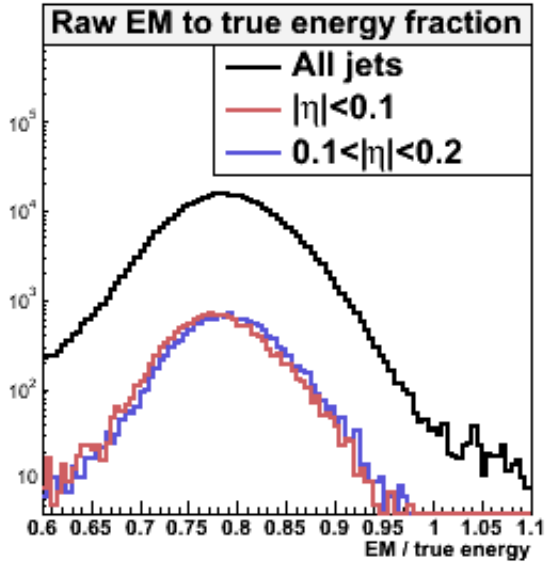
J6

- Look for asymmetric tails in distributions of the sub-lead jet without applying MET cut
- Not clear whether this gives a clue as to where the cause is, at the level of reconstructed jets or before at the level of the raw jets



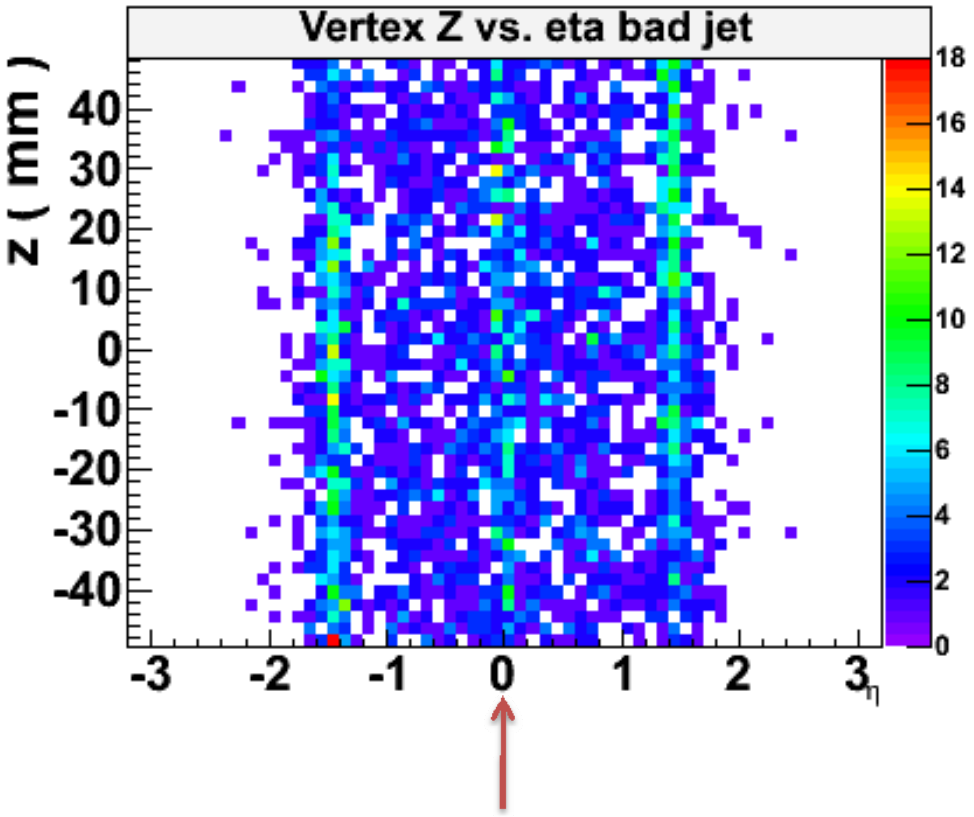






Correlation with hard vertex position

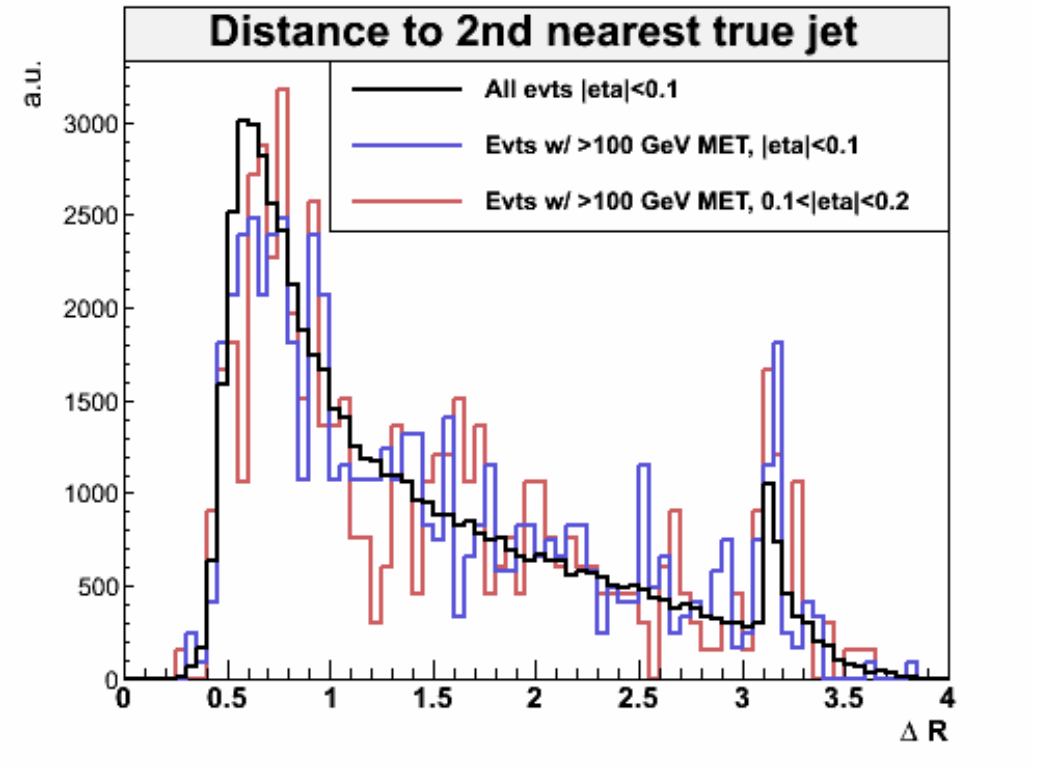
- If the LAr gap of a few mm at eta=0 was the cause of the problem, events with vertex displaced in z should suffer less
- Plotting the z position of the vertex versus eta of the sub-lead jet in events with large MET does not show any correlation…



Events with central jets are broadly scattered in z

Distance to 2nd nearest true jet

- H1 calibration is done for isolated jets
- Maybe the largely underestimated jets near eta=0 are non-isolated jets with another jet close by? … No, no apparent difference in ΔR distributions in different eta regions



Jet shapes J7

J7

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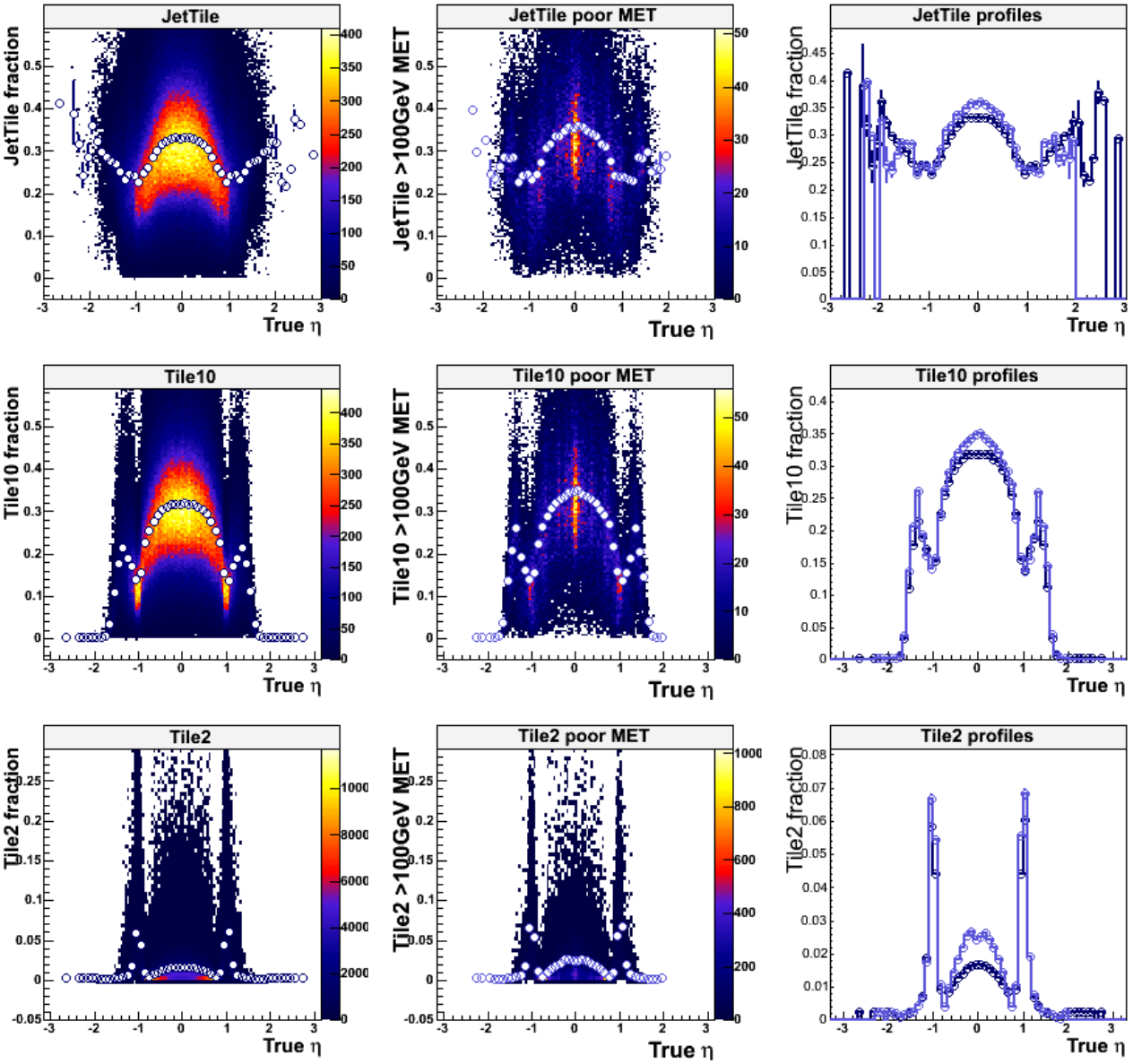
- But no visible difference between |eta| < 0.1 and 0.1 < |eta| < 0.2

All lead jets | Sub-lead jets large MET | All vs sub-lead jets



Jet shapes J7

J7

- Plotted fraction is the measured energy divided by the true jet energy
- Average difference apparent between all leading jets and those sub-leading jets in events with large MET
- But no visible difference between |eta| < 0.1 and 0.1 < |eta| < 0.2

All lead jets

Sub-lead jets large MET

All vs sub-lead jets