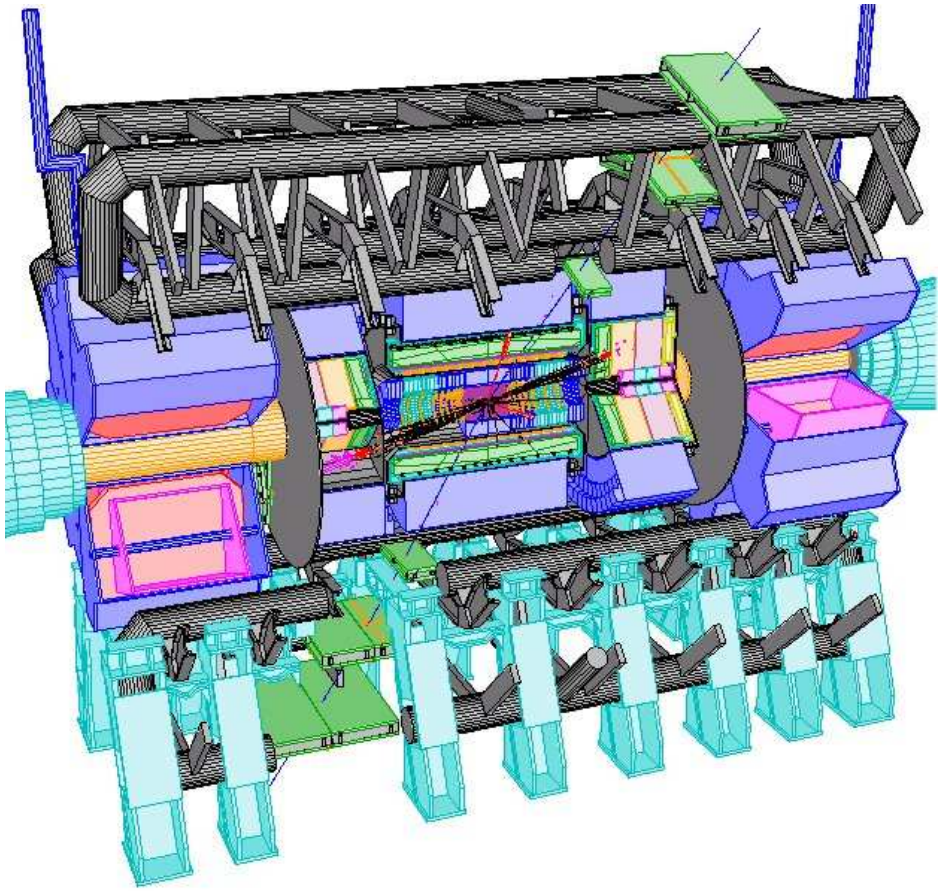

Some Jet Studies

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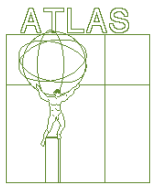
Thanks to Ambreesh Gupta for all his help!

Day One Trigger Questions

- Suppose the LAr shows coherent noise
  - Suppose the whole calorimeter lights up for 5% of the events
  - This makes it untriggerable – but perfectly good for analysis
  - Can we trigger on the Tile alone?
    - Threshold vs. rate
    - Resolution vs. threshold
- Suppose the LAr is noisy in an incoherent way
  - What can we do with just the tile?
  - Again – need to know thresholds, rates, resolution, etc.
- What if it's the reverse: noisy Tile and quiet LAr?
- What if the L1 cluster trigger is flaky?
  - How do/should we back off to something simpler?
  - If we used ΣE_T, how much would this hurt us?

From the May Meeting

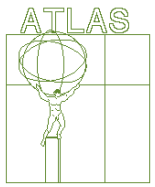


The Plan

- Look at the EM fraction of jets in ATLAS
  - A first step towards understanding the implications of triggering on a less-than-optimal ATLAS in early running
  - An opportunity to see if the jets coming out of reconstruction make sense at a low level
- Get the information from a custom version of JetRec, not the combined ntuple
  - This information is not in the CBNT
    - In fact, the EM fraction is not in the Jet object – more on this later
  - This is good practice for getting experience with both the "guts" of jet reconstruction and more of Athena than just looking at ntuple output

No EM fraction in jets?

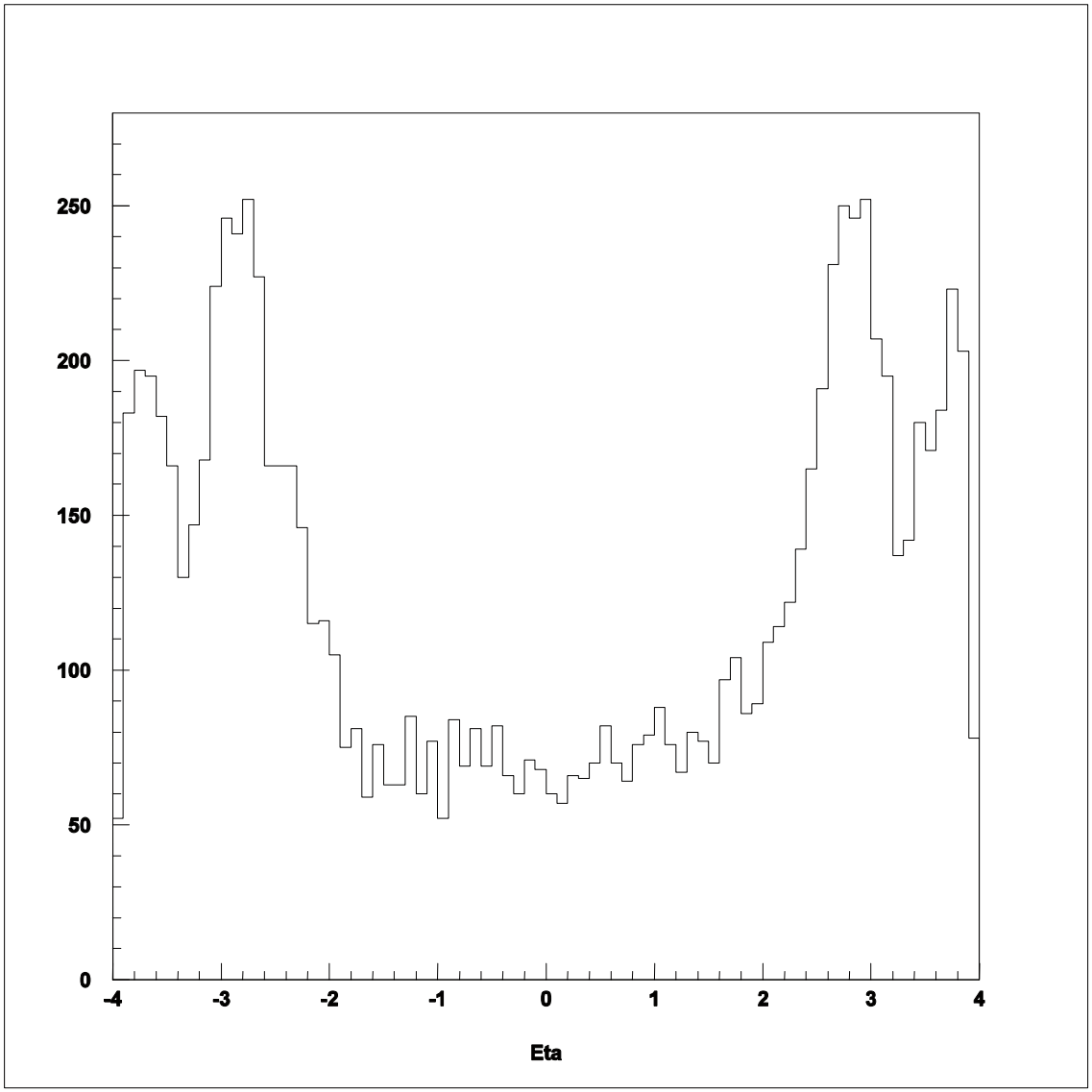
- An ATLAS jet is a very simple and general object.
  - Jets are not calorimeter specific
  - Jets can be built out of **any** object with a 4-vector interface
    - Calorimeter cells
    - Calorimeter towers
    - Tracks
    - Monte Carlo Truth
    - Some combination of the above
- To get the EM fraction, one needs to get the jet, navigate back to the constituent cells and sum their energies
  - Originally, I planned on doing this myself as each jet was being constructed. But…
  - The JetSampling object (filled by JetClassifier) does this for you



Data and Reconstruction

- Dataset
  - Subset of the DC1 560 GeV pythia "dijet" sample
  - Minimum high p_T scatter is 560 GeV. No requirement for exactly two jets
  - 9993 jets processed
    - Only odd numbered events (peculiar bug) analyzed
  - Also have 280 GeV, 140 GeV and 70 GeV samples (similar size)
- Reconstruction
  - Base release is 8.4.0
  - JetSampling and JetEvent from the HEAD as of 29 August
  - Cone algorithm only
    - Cone size changed from 0.7 to 1.0 (mostly because I could)

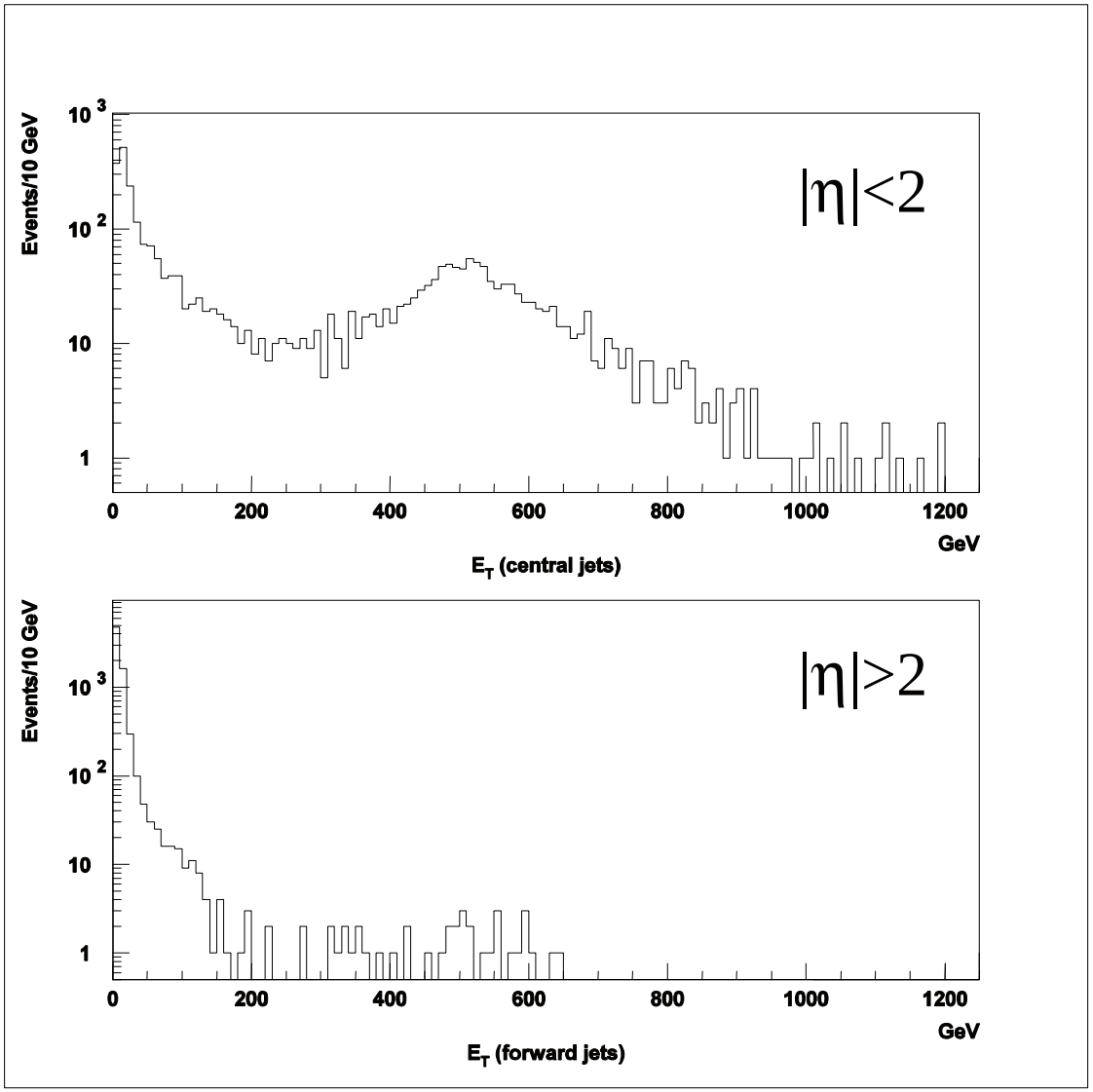
Jet η Distribution



These are all jets found by the reconstruction

(i.e. no cuts)

Jet E_T Distribution

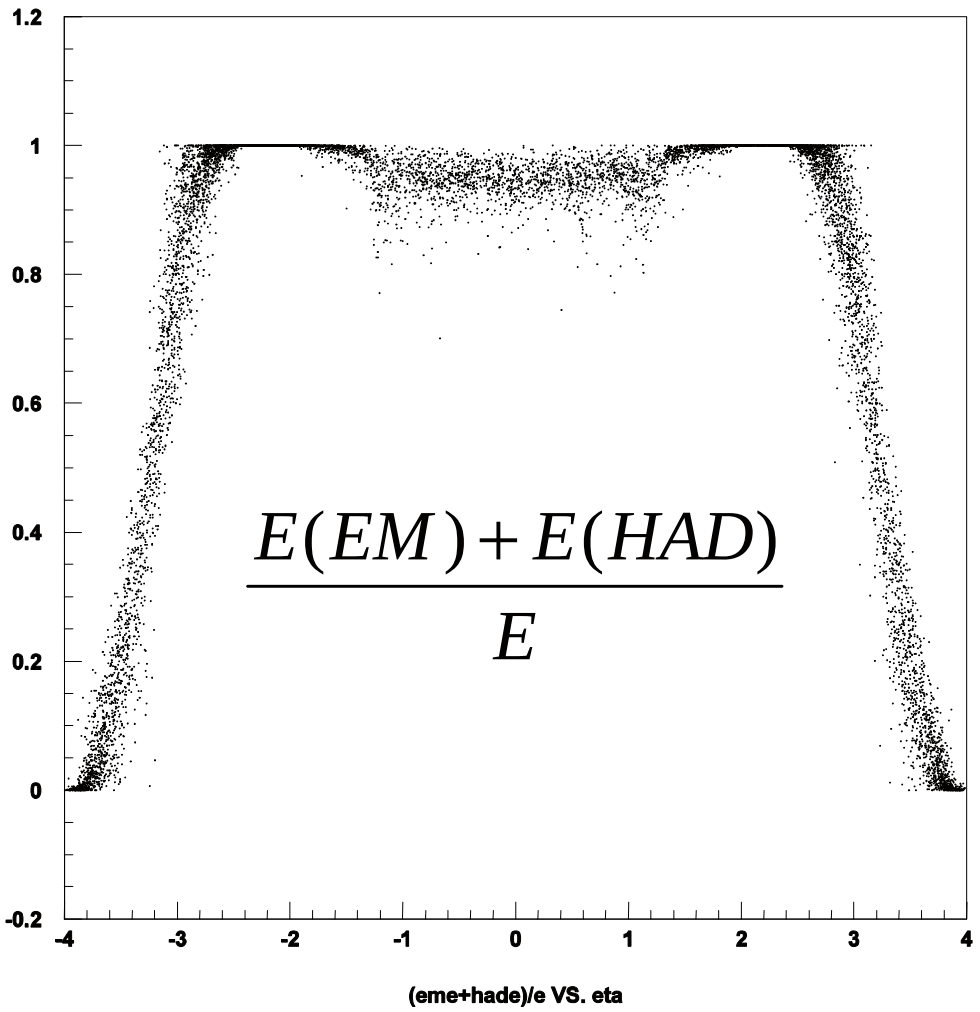


Central jets:
Effect of the generator threshold (560 GeV) is apparent

Forward jets:
Presumably this is large radiation off the hard scatter.

(unless it's junk)

Jet Energy Fraction vs. η

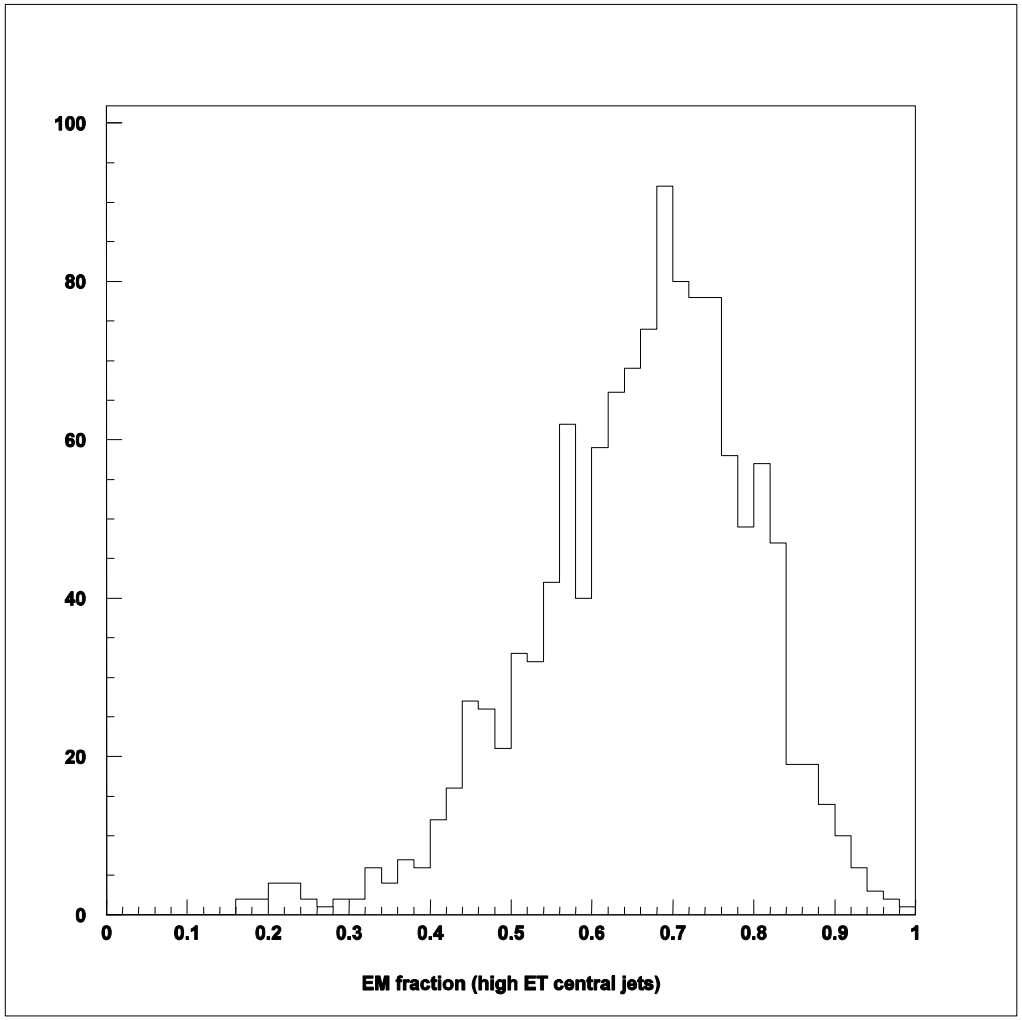


This should be a flat line at 1. It isn't.

The FCAL is not included, which explains some of this – but not the central part.

Is something (maybe even something good) going on with weights and/or calibration?

Inclusive Jet EM Fraction



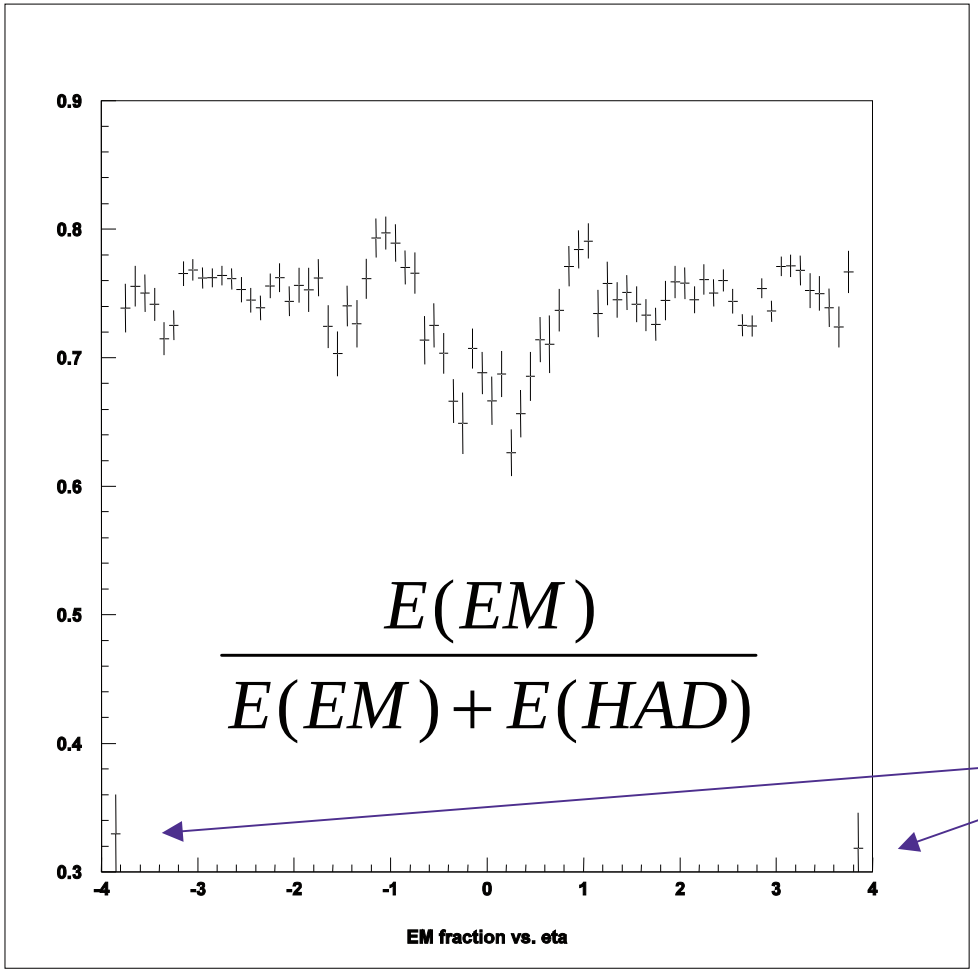
For central ($|\eta| < 2.0$) jets with $E_T > 300$ GeV

$\langle EM_{frac} \rangle = 67\%$

$\sigma(EM_{frac}) = 12\%$

This means that using only the TileCal will have a jet energy resolution of ~36%

Jet EM Fraction vs. η

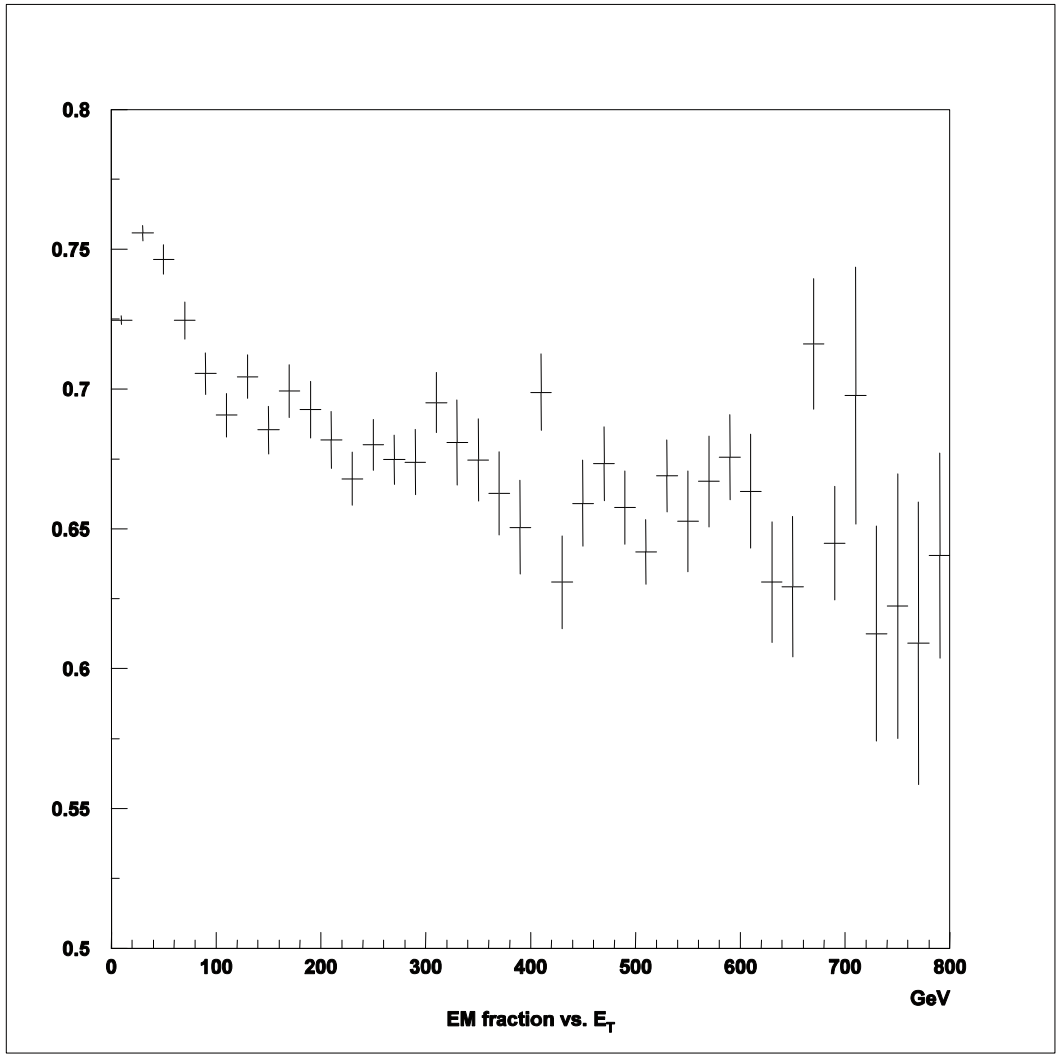


$$\frac{E(EM)}{E(EM)+E(HAD)}$$

Structure here too.

Apart from the obvious dip at the centerline, the EM fraction falls in the far forward region.

Jet EM fraction vs. Energy



More energetic jets penetrate deeper in the calorimeter

This includes data from the Jet560, Jet280 and Jet140 samples

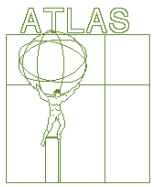
Non-Optimal Triggering

- Suppose there is coherent noise in the LAr making it untriggerable, but usable for reconstruction.
  - What would be our response?
  - What would be the impact on the JET350 sample? (assuming the bandwidth is fixed)
- The solution shouldn't surprise anyone
  - Set the hadronic energy trigger threshold to 150 GeV
  - This reduces the rate enough to run unprescaled
    - Rate is 1.4x the original JET350 rate
  - The hadronic component of these triggered jets jumps from ~30% to ~50%
  - 12% of jets between 325 and 375 GeV pass this requirement
- We lose ~an order of magnitude in triggerability

I am not **predicting** this will happen. This is an exercise involving the kinds of difficulties one runs into during an early running period. The specific problems ATLAS will face may very well be different.

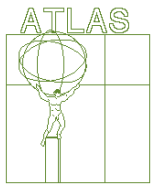
Lessons Learned (I)

- Jimmy is wrong to blame Athena. There's lot to be critical of, but Athena is an innocent bystander
  - I don't care much for CMT
    - It has broken in mid-session for no apparent reason
      - changed architectures to GCC 2.3, which is obsolete
    - The dependencies/requirements file behavior is inexplicable
      - RecExCommon depends on JetRec which depends on KtJet
      - Out of the box, `cmt broadcast gmake` will rebuild RecExCommon and KtJet but not JetRec
      - This is actually a side effect of making RecExCommon work with AtlFast without changing a requirements file. In the attempt to make things simple for beginners, the behavior for intermediate users is incomprehensible
  - I don't care much for StoreGate
    - When you want a jet, what do you get?
      - A jet? A pointer to a jet? A collection of jets? A pointer to a collection of jets? A container of jets? A list of jets? A list of pointers to jets? An iterator over a collection of jets? Pointers to the above?
      - The developers' habit of changing StoreGate a week after the core code freezes and just before the release is infuriating. (Why debug the code yourself if you have 2000 collaborators to do it for you?
  - We're stuck with both of these on political grounds, so we better just get used to them.



Lessons Learned (II)

- Our documentation varies from terrible to non-existent
  - Software feature sets are held to be more important than documentation
    - A release will be delayed while code features are added.
    - A release will not be delayed while documentation is added.
  - This comes straight from the top (as in Peter Jenni)
  - I've been using Google instead of the ATLAS web pages to find datasets and documentation
- Look at the objects that make ntuples
  - This is sample code that reads just about all of the objects, and can provide a useful roadmap
- Doing it again, I'd do it differently
  - I would have written a separate Athena module to take the jets that were already built and analyze them. My only modification of JetRec would be the cone size change.
  - Essentially, this is what I do now – my code is in a single place in JetRec



Conclusions

- Some (slow) progress is being made
- The EM fraction of jets shows structure
  - Some of it is obvious
  - Some of it is not
- I could use help – I think/hope I have cleared enough brush away that the next person will have at least a slightly easier time of things
- ATLAS software is not without problems
  - I disagree with Jimmy over what's most at fault
  - Most of these problems are self-inflicted