Jets and topo-clusters with pile-up

*A **brief** synopsis of dealing with jets and topo-clusters in events with pile-up*

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Aims and content of this synopsis

Everything and more in this TWiki page: JetsWithPileup (link)

We are making great progress and it's important to do it right

Many more people have started looking at the effects of pile-up on jets, jet constituents, and other physics objects in ATLAS. This is also in part do to the **validated** and **centralized** production of pile-up datasets, which has started in earnest.

Several things to keep in mind:

- We have a calorimeter (LAr) which has the issue of pile-up and how to deal with it built into in it's very design
- This design renders most the *average* pile-up component as noise
- The topo-clustering technique is meant *not only* to represent the particle energy depositions better but also to suppress such noise
- We must therefore estimate the level of this noise correctly in order to maintain efficient and accurate topo-clustering, and indeed for jet reconstruction generally

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Some details and background that I will assume

Everything and more in this TWiki page: JetsWithPileup (link)

Several things to keep in mind:

- Most of this discussion pertains *mostly* or *only* to simulated pile-up
- A lot of work is ongoing and making huge steps to provide the full capability to overlay real pile-up data, taken from minimum bias triggers, to our simulated signals.
  - OverlayValidation for ID (id: atlas; pw: atlas08)
  - LArPileUpRandomEvent
- **That** is the real goal...but for now, we are learning a lot from the simulation anyway.
- The LAr calorimeter is optimized for 25ns bunch spacing, so pay attention to the bunch spacing used in your sample!
  - this topic is *very* difficult to deal with...more people should look into this.
- The number of overlaid minimum bias is Poisson distributed...fluctuations are important
- Get used to looking in AMI for information about datasets

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Making sure noise calculations take pile-up into account

Everything and more in this TWiki page: JetsWithPileup (link)

1. Know your dataset:
   - It is good practice to always check the conditions under which your data were produced/collected (this will become even more important with real data)
   - Use AMI!!!
   - Check the `jobConfig` for the digitized input to your dataset
   - If you see something like `Lumi010DigitConfig_75ns.py` or `Lumi020DigitConfig.py` then the sample was digitized with pile-up
   - Real data overlay is not yet in production, but you can expect something similar will apply there
   - From the file `Lumi020DigitConfig.py` you can obtain the assumed bunch spacing and number of collisions simulated
   - `digitConfig.bunchSpacing = 25` and `digitConfig.pileupCollisions = 4.6` for example
2. Set the options in your re-recontstruction job:
   - `from AthenaCommon.BeamFlags import jobproperties`
   - `jobproperties.Beam.numberOfCollisions = 4.6`
   - `jobproperties.Beam.bunchSpacing = 25`
3. Verify the options worked:
   - You'll see something like this:
   - `ToolSvc.CaloNoiseToolDefault INFO N events of Minimum Bias per bunch crossing = 4.6`

Re-making topo-clusters

Everything and more in this TWiki page: JetsWithPileup (link)

There are actually instructions on the JetsWithPileup (link) page. This is what you need to do to re-make them from ESD

```
doCaloTopoCluster = True
from CaloRec.CaloRecFlags import jobproperties
jobproperties.CaloRecFlags.Enabled.unlock()
jobproperties.CaloRecFlags.Enabled = True
jobproperties.CaloRecFlags.Enabled.lock()
jobproperties.CaloRecFlags.doCaloTopoCluster.unlock()
jobproperties.CaloRecFlags.doCaloTopoCluster = True
jobproperties.CaloRecFlags.doCaloTopoCluster.lock()

from AthenaCommon.BeamFlags import jobproperties
jobproperties.Beam.numberOfCollisions = 4.6
jobproperties.Beam.bunchSpacing = 25

include ("RecExCommon/RecExCommon_topOptions.py")
```

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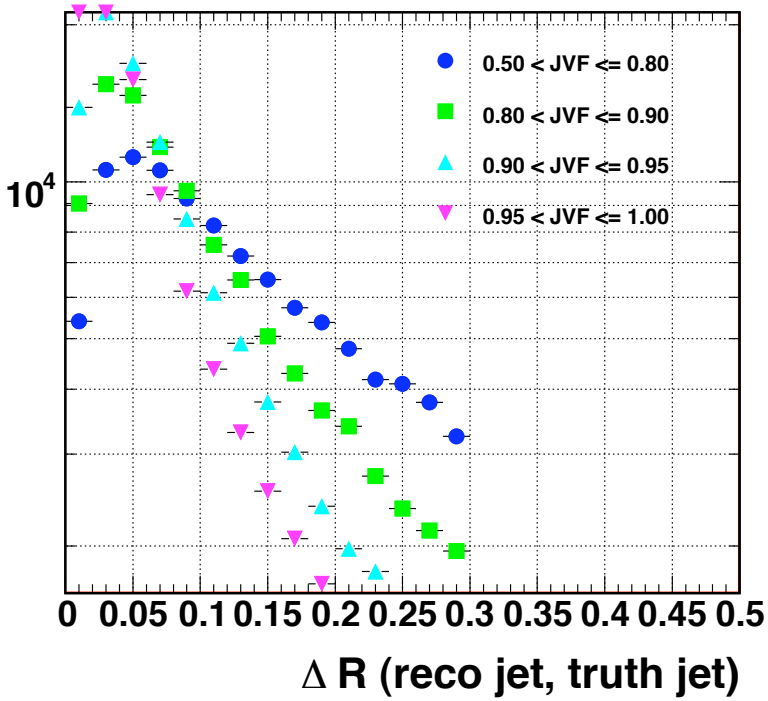
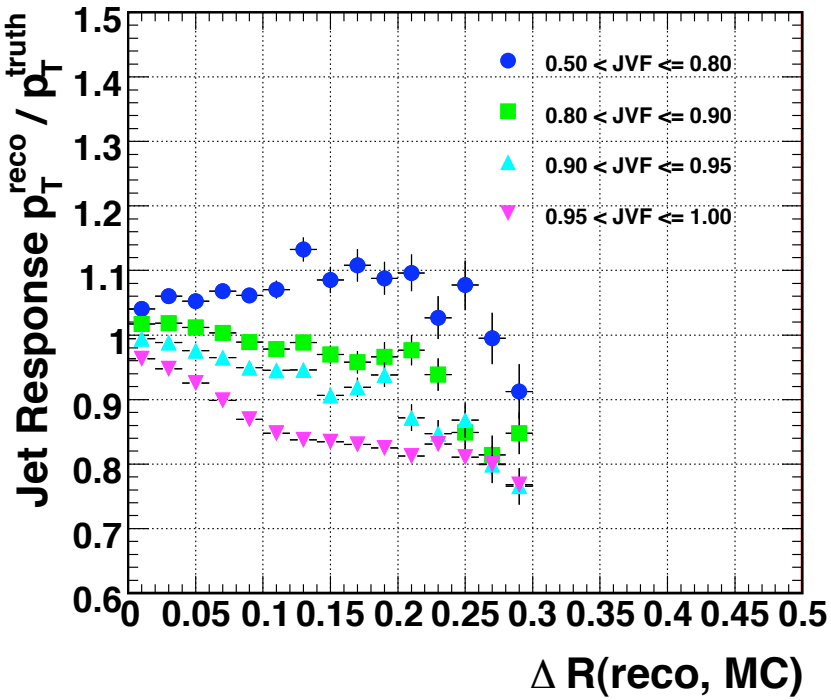
Truth matching in events with pile-up

A follow-up to David's talk



Angular resolution vs. pile-up contribution



Jet response vs. matching radius

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