Jet Trigger and QCD Studies for First Jet Measurements in ATLAS

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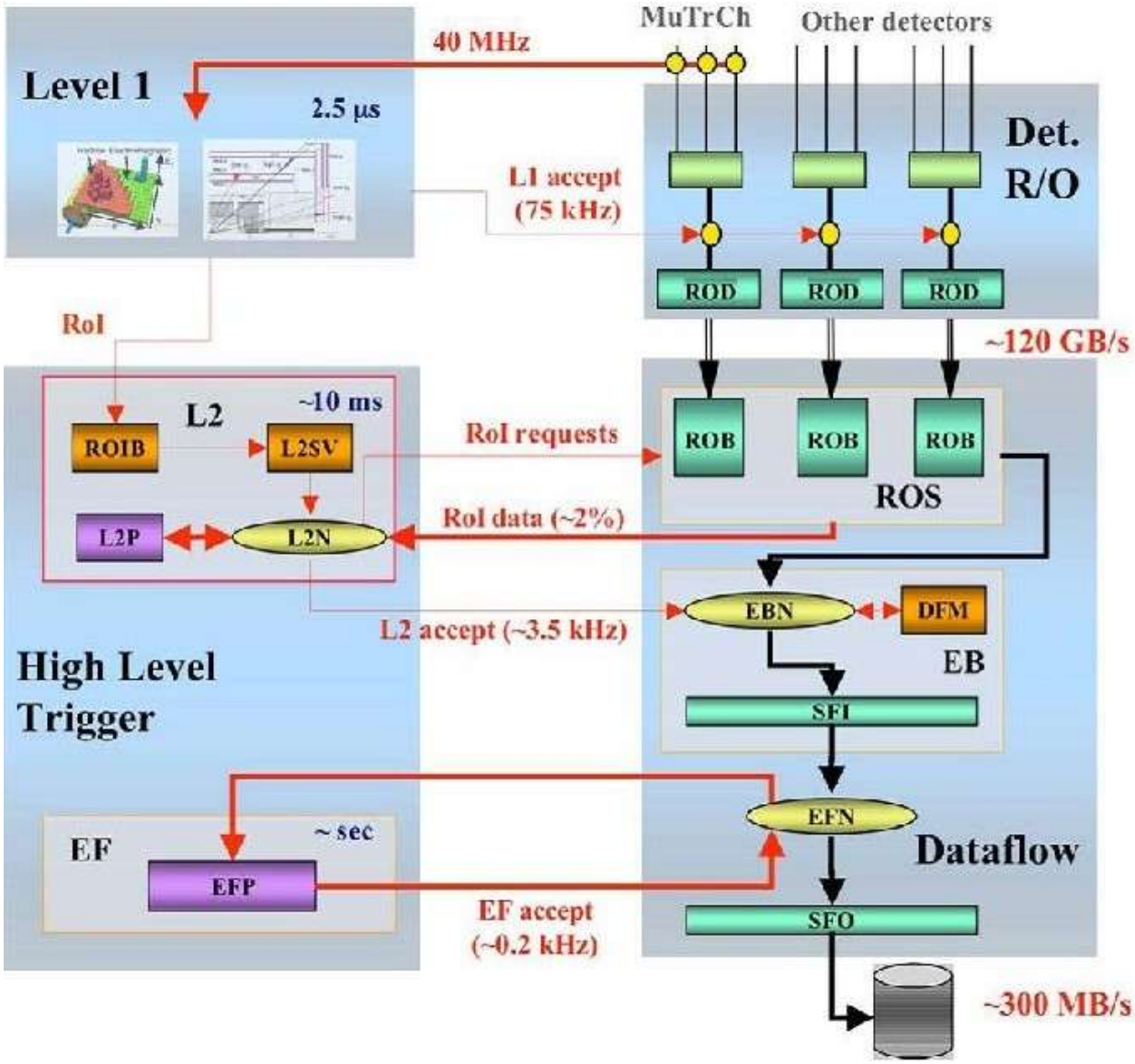
ATLAS Trigger



- Christmas run only had L1 active.
- Need to know how efficient the trigger was.
  - Important for understanding trigger algorithms, towers, splitting, electronics noise, etc.

Jet Trigger Efficiency

- The result shown here is the jet trigger efficiency (not event), and defined as:

$$\frac{\textit{Offline jets matched to L1 Jet passing a trigger}}{\textit{All Offline Jets}}$$

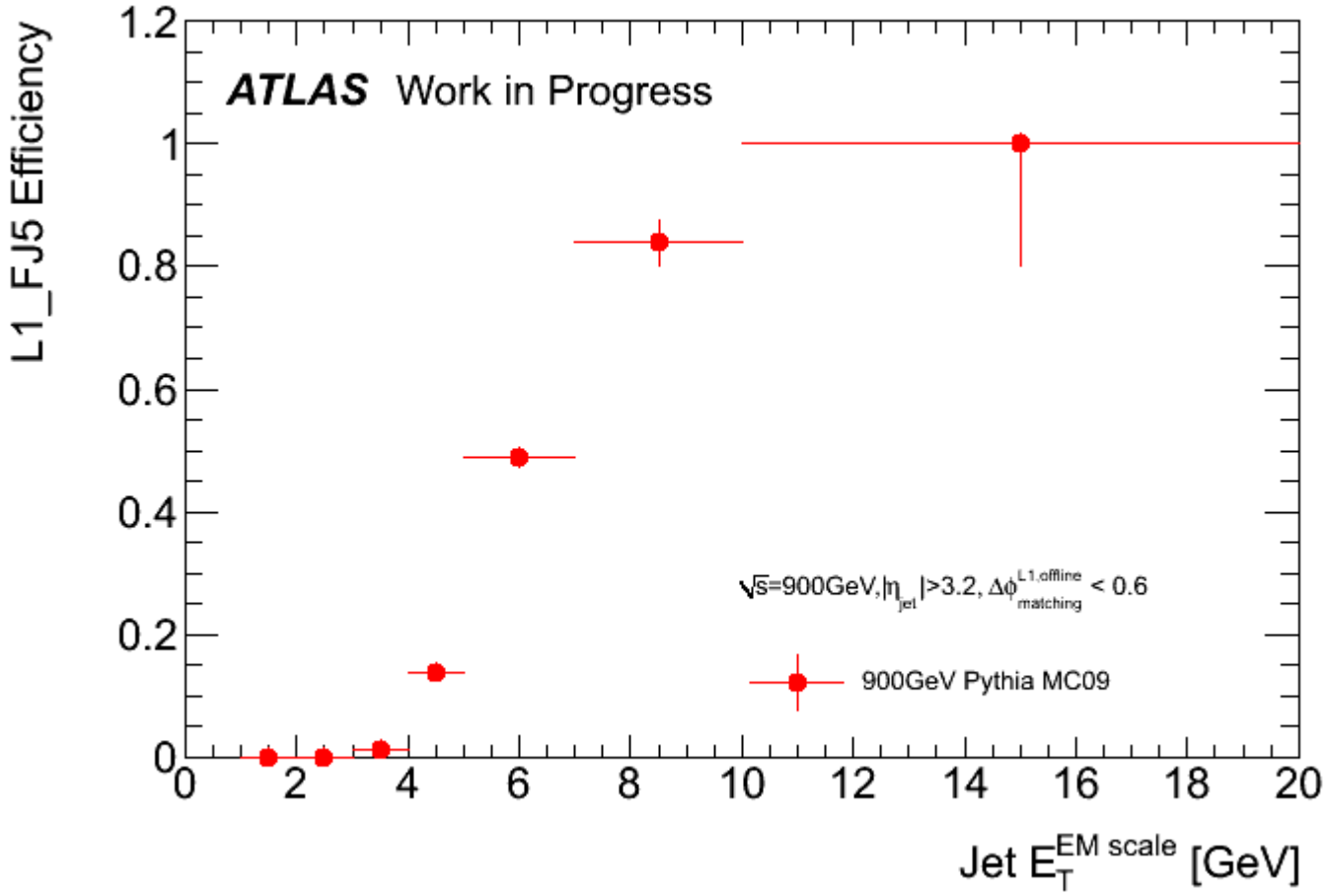
- Offline jets (denominator) = Events taken with Minimum Bias Trigger Scintillators (MBTS).
- MBTS – two detectors mounted at z = +/- 3.156m.
- Signal time difference from two detectors < 10ns.

Jet Trigger Efficiency - Settings

For jet trigger efficiency:

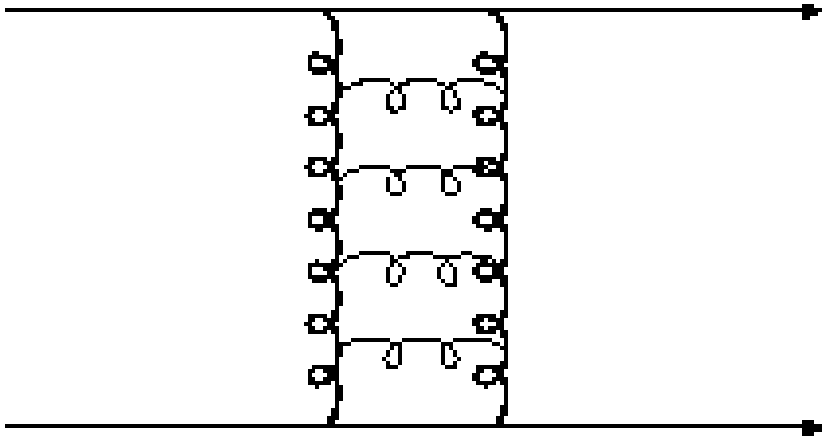
- Offline jets are topological clusters in the anti-kt jet finder algorithm.
- Distance parameter (R) = 0.6
- L1 Region of Interest size: $\Delta\Phi \times \Delta\eta = 1.6 \times 1.6$
- In the central region ($|\eta| < 3.2$), $\Delta R < 0.6$ matching used.
- In the forward region ($|\eta| > 3.2$), azimuthal matching of $\Delta\Phi < 0.6$ used.
- No η resolution at L1, therefore used $\eta_{L1} \times \eta_{Offline} > 0$

Efficiency: Forward Jets 5GeV Threshold



Conference note being prepared, should be cleared for public viewing very soon.

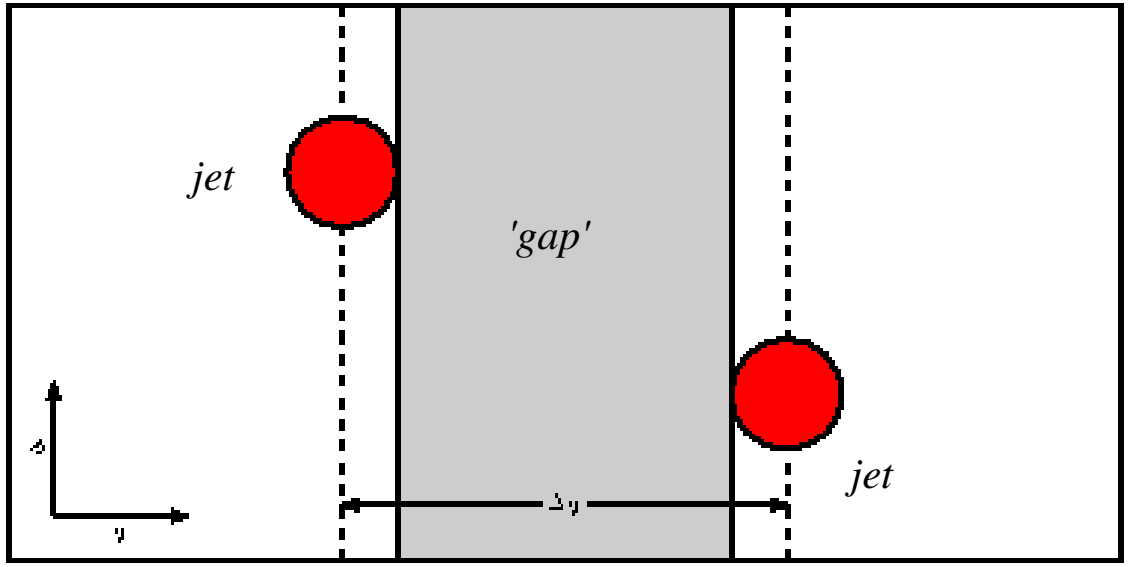
Gaps Between Jets (GBJ)



Gluon 'Ladder' between protons

- Use GBJ events to find colour singlet exchange (CSE) (from BFKL).
- No colour field between protons, therefore no QCD radiation.
- Can use these to study other QCD properties.
- Pure QCD, large cross-section, can do with early data.

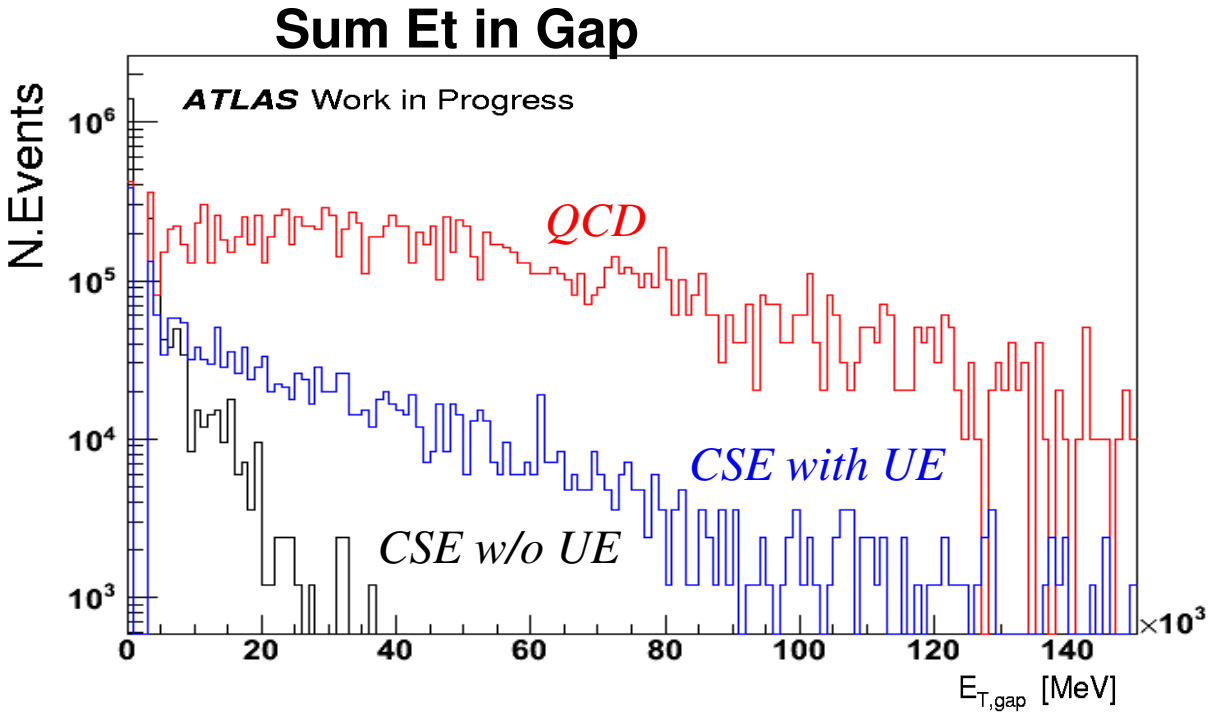
Gaps Between Jets - Topology



- Example selection:
- $jet_{1,2}\, p_T > 40\, GeV$
- $\Delta \eta_{jet\,1,2} > 4$
- $E_{T,\,gap} < 20\, GeV$
- Similar to hadronic part of Vector Boson Fusion (VBF).

Gap Et Sum Method

- CSE has less energy deposition between the jets than Colour Octet.
- At HERA/Tevatron, the sum of the Et in the gap was used.

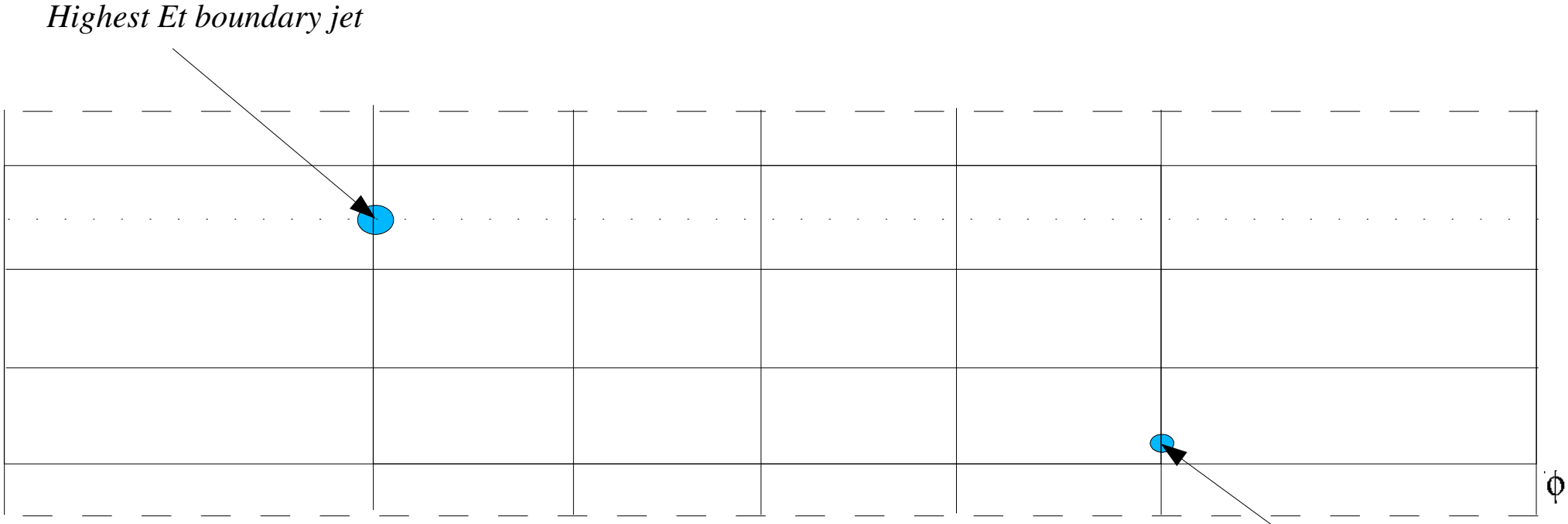


- Other 'soft' interactions (Underlying Event, UE) fill gap.

- Also sensitive to uncertainty in the UE, noise, pile up, etc.

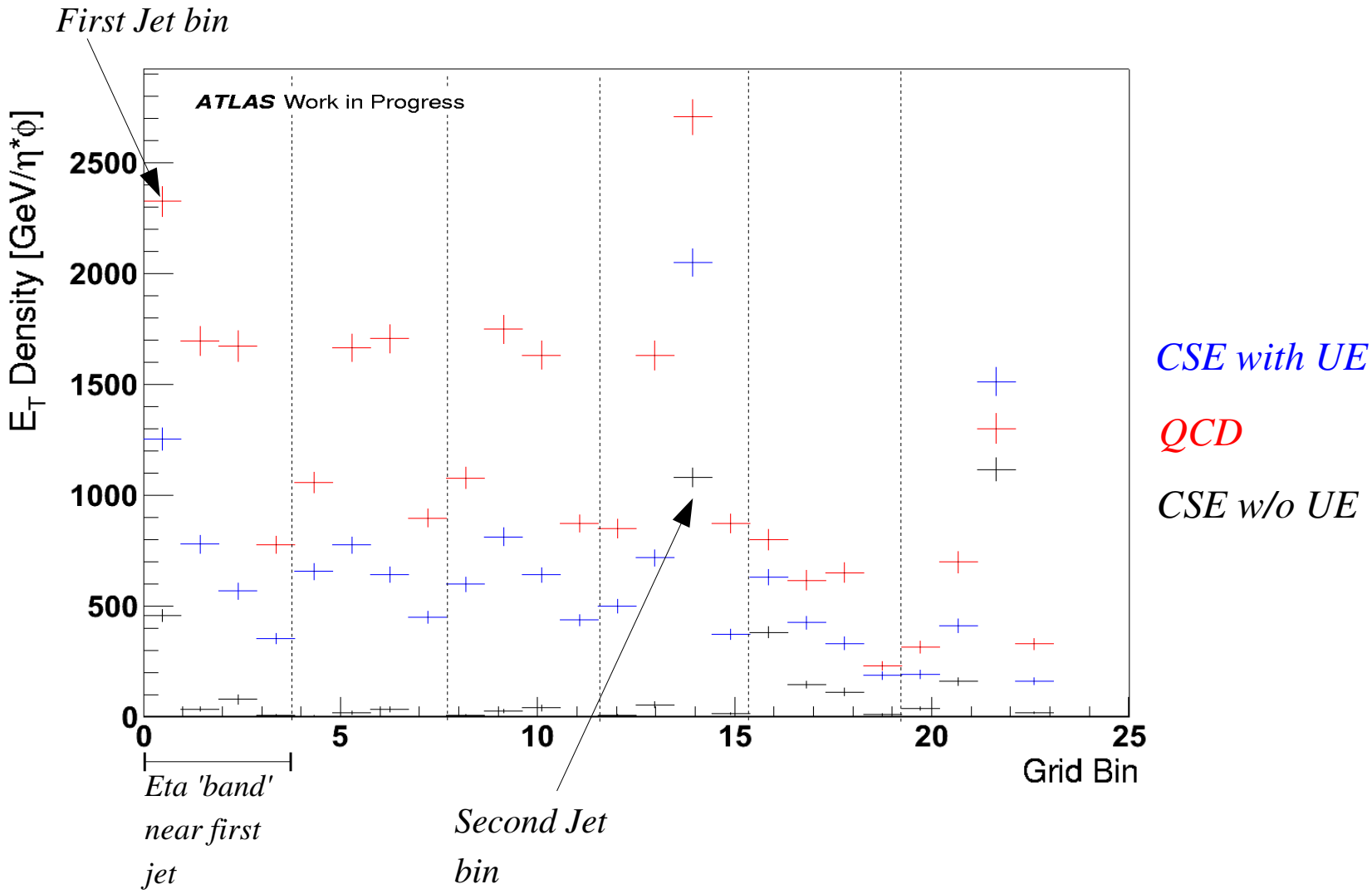
The Gap Grid

- Try to distinguish CSE energy deposition from Colour Octet.
- ATLAS divided into 24 bins in $\eta - \Phi$ plane.
- Average energy density found for each bin.



- Extension of study by Rick Field of radiation distribution in the event.

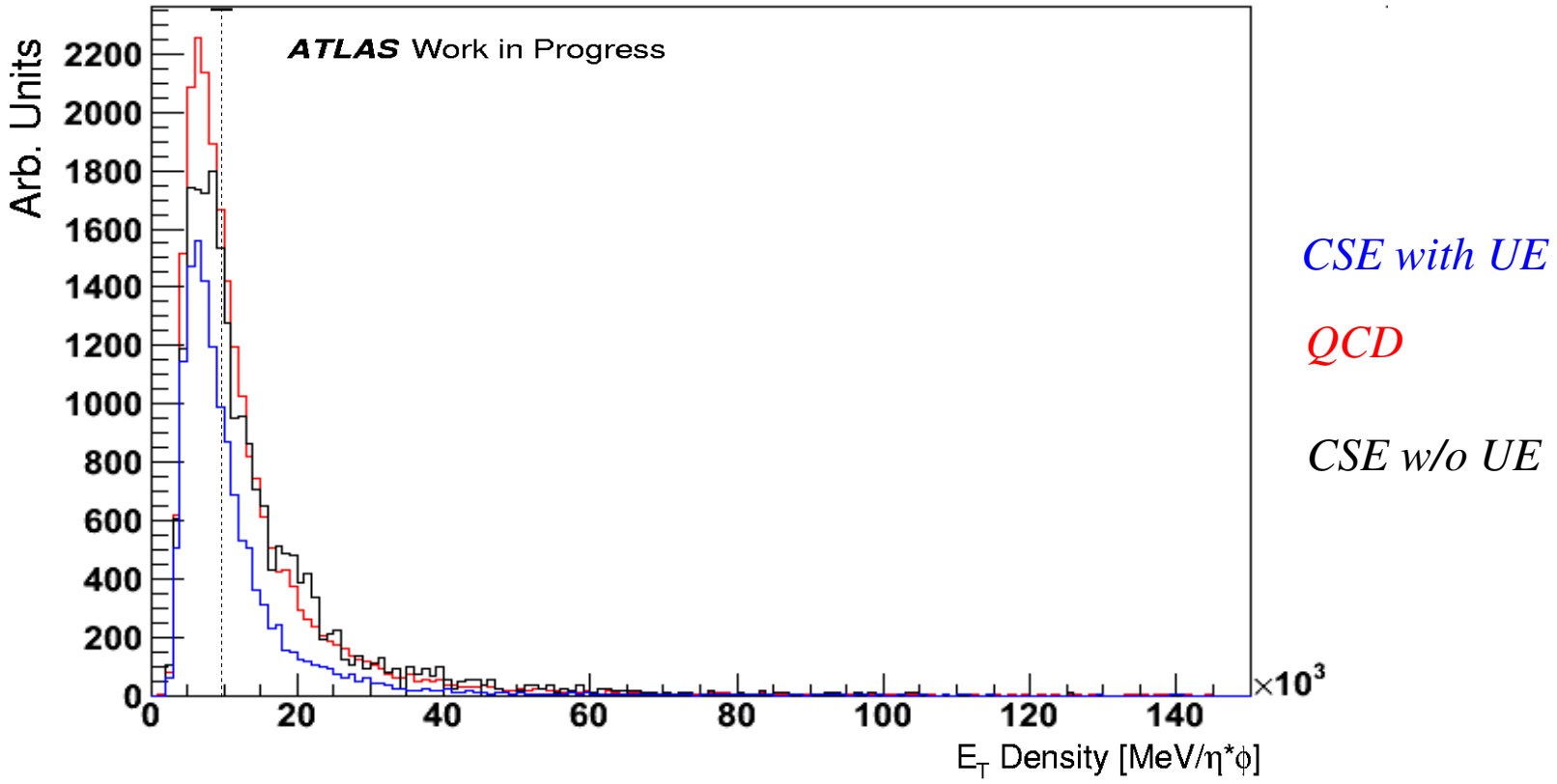
Average Density for Different Detector Regions



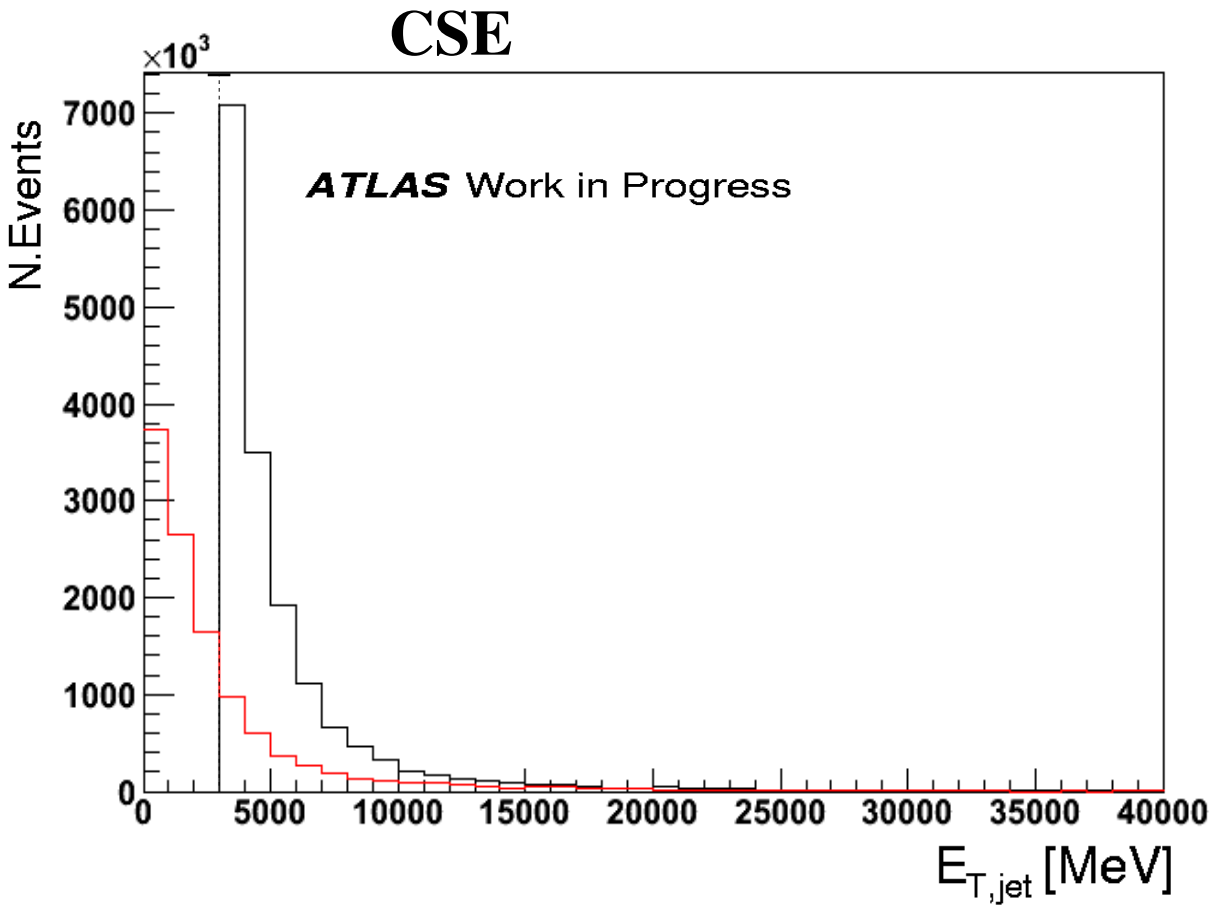
- Energy Density greater for QCD than CSE, as expected.

Dealing with UE

- UE jets have lower density than hard scattering ones.
- In effect, lowers mean energy density of jets.
- Correct by doing: $E_{jet} = E_{jet\,orig} - (Area_{jet\,orig} \times Density_{soft\,jets})$ (Cacciari and Salam).
- Mean density determined event by event because fluctuations are large.



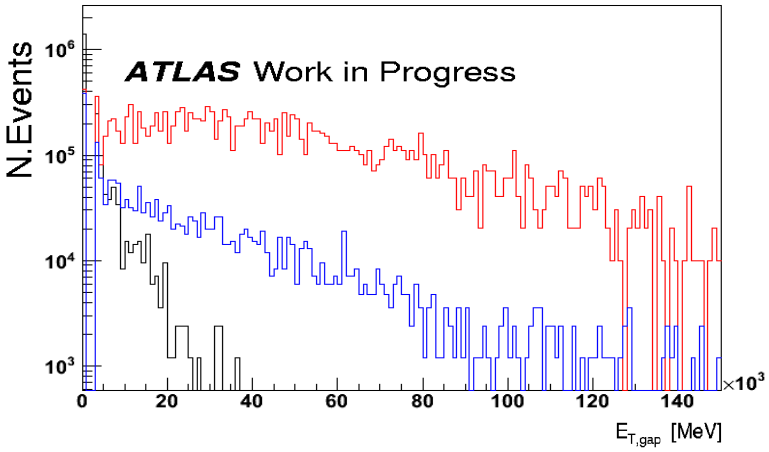
Dealing with UE - Jet Et



Black – before density correction, red - after.

- Cut at 3GeV to remove UE jets.

Gap Et Sum - With Density Correction



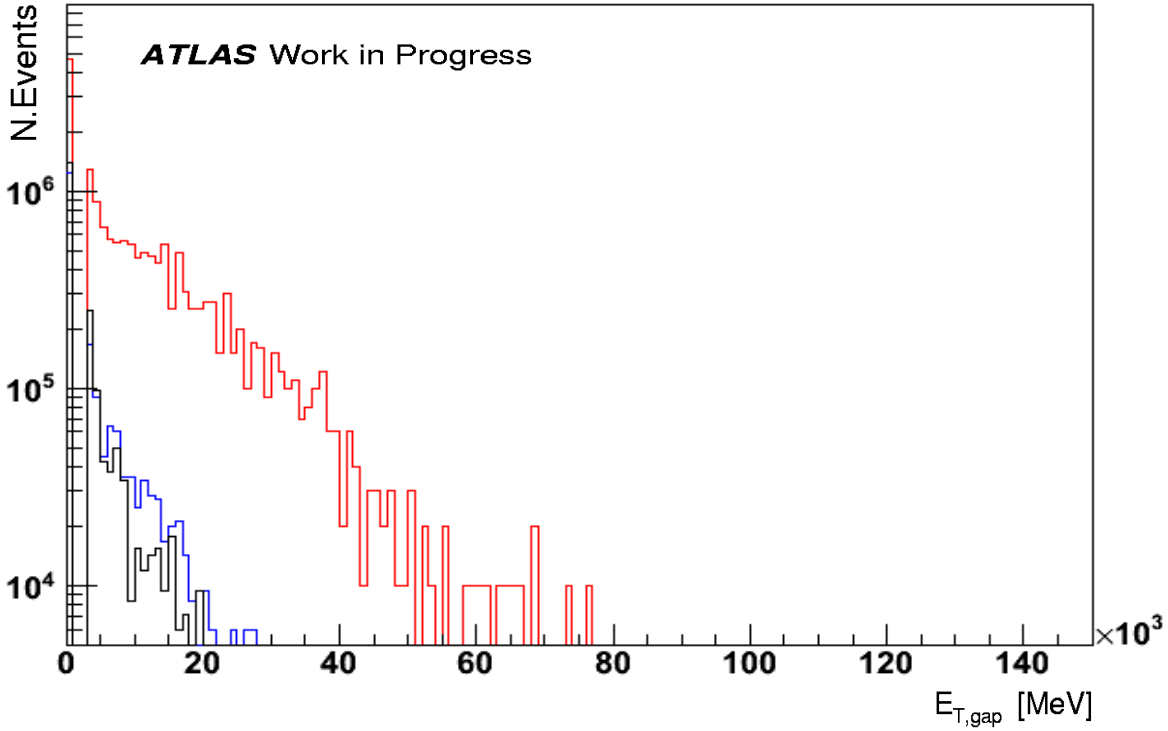
- Before density correction.

CSE with UE

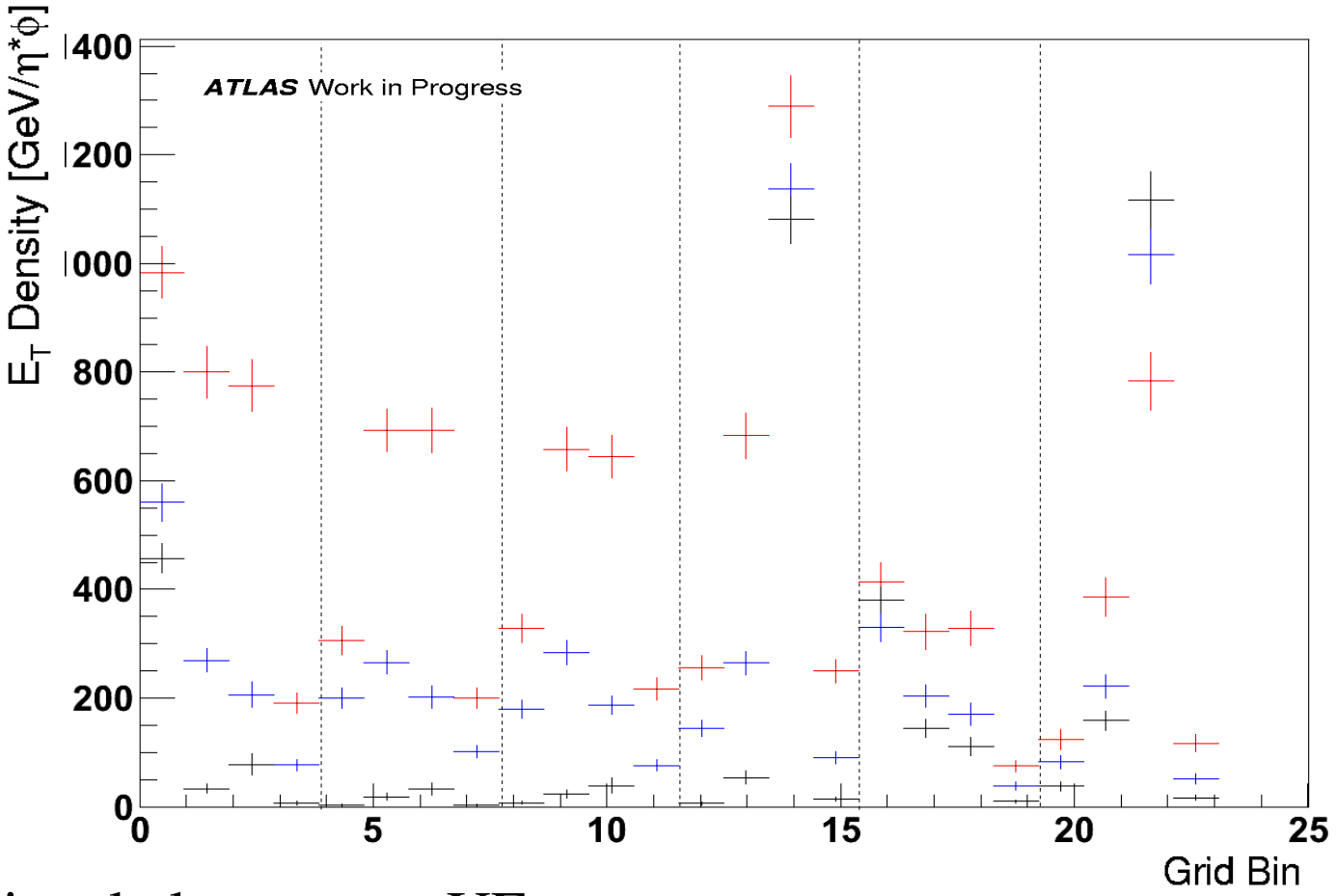
QCD

CSE w/o UE

- After density correction.
- Signal much closer to no UE case.



Average Density for Different Detector Regions with Density Correction



- Again, signal closer to no UE case.
- Easier to see features, such as boundary jet contribution, plus peak outside gap.

Conclusion

- Forward jet efficiency will be official ATLAS curve for the Spring conferences when approved.
- Opportunities to test QCD early in data-taking (cross-sections large).
- Goal is to produce GBJ measurement by Summer.
- Will use sum Et, gap grid (if there is enough data) and gap jet veto for selection and measurement.