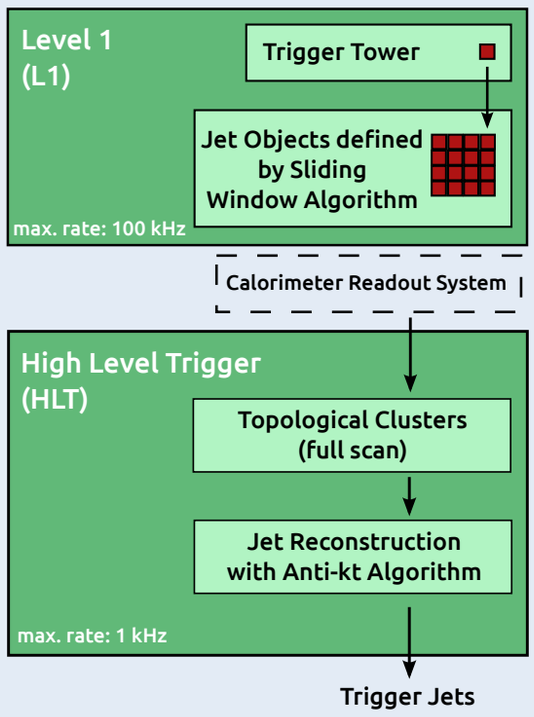
LHCC Poster Session - CERN, 2 March 2016

CHARACTERISING TRIGGER-LEVEL HADRONIC JETS IN 2015 DATA AT ATLAS

The ATLAS experiment at the LHC uses a two-level trigger system to preferentially select events with a predefined topology of interest for future analysis. The efficient selection of events containing hadronic jets requires the characteristics of trigger-level jets and offline jets to be very similar. In this poster, the characteristics of the trigger-level and offline jet objects are compared and found to be in excellent agreement. This opens up the possibility of analysing the ATLAS data using only the objects reconstructed in the ATLAS trigger, which would allow much higher output rates than is possible when recording the information from the full detector.

The ATLAS jet trigger

In the ATLAS detector, jets are triggered using a **two-level** trigger system



Level 1 (L1):

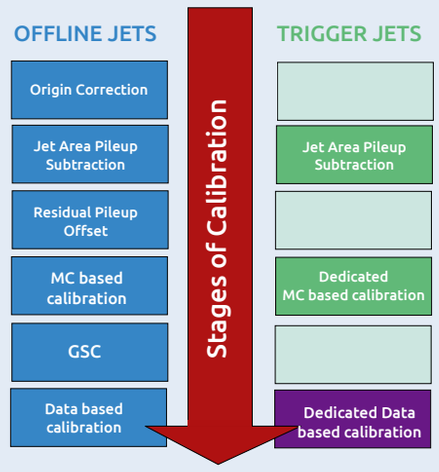
- Trigger Towers are smallest units that measure the energy deposition of penetrating particles.
- Jet objects are defined by a **sliding window algorithm** that runs over all trigger towers (full calorimeter).
- Events in L1 are triggered based on the energy in these jet objects.

High-Level Trigger (HLT):

- The HLT evaluates events in a more advanced procedure using the full information of the calorimeter systems.
- The full calorimeter is read out in **topological clusters** in order to achieve a sufficient noise suppression.
- For the jet reconstruction, a full **anti-kt algorithm** with a radius of 0.4 or 1.0 is applied on the topological clusters.

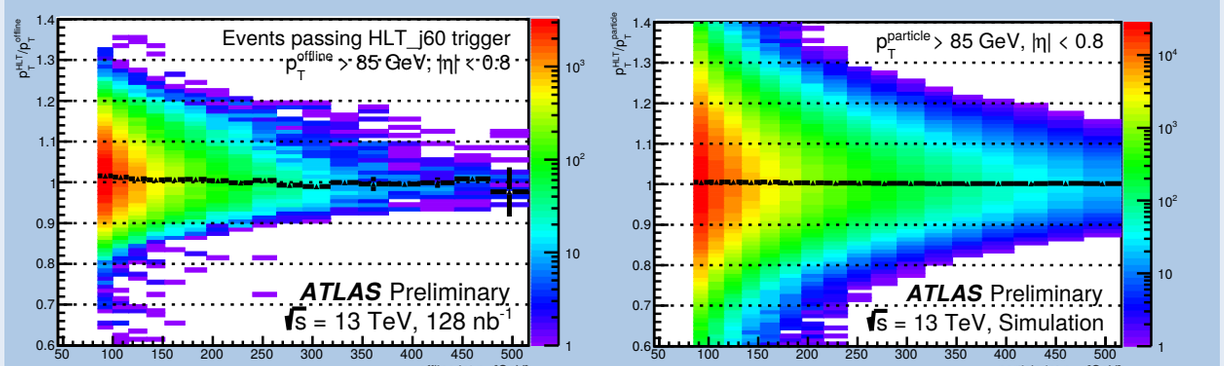
Trigger jet reconstruction and calibration

- The energy of trigger jets are first measured at the electromagnetic scale. A calibration is applied to correct their energy to the **jet energy scale (JES).**
- Similar to offline jets, the calibration of trigger jets consists of several stages. Some calibration steps that require tracking are not applied.
- Dedicated calibrations have been derived for trigger jets after the first data was taken.



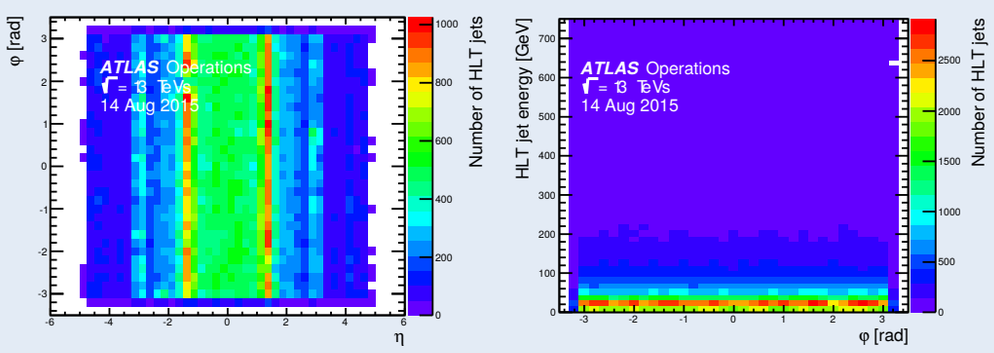
Monte-Carlo based calibration

- Calibration constants are derived from Monte Carlo simulations matching particle jets to offline jets.
- In the central region of the detector and for jet p_T>85 GeV, the **jet energy scale** of trigger jets and offline jets agrees to within 2% (left plot) and the MC-based corrections correctly reproduce the particle-level in simulation (right plot).



Jet trigger monitoring

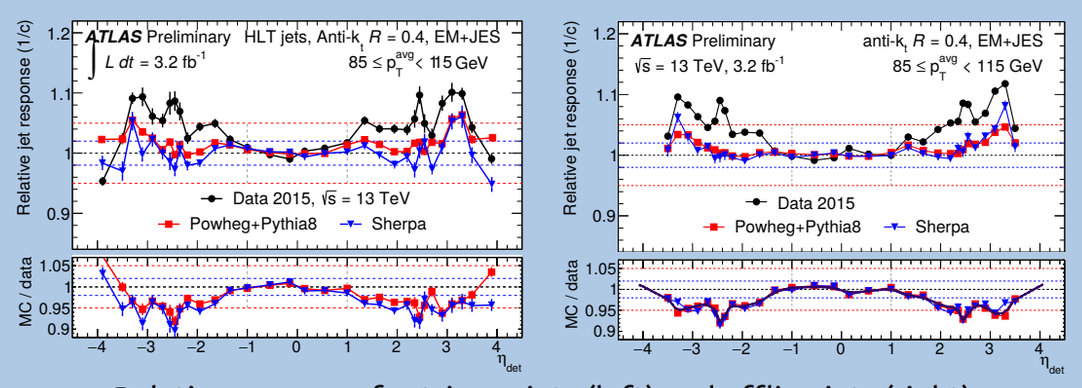
- Online and offline monitoring are essential in order to guarantee and crosscheck the correct functionality of jet triggers.
- **Online monitoring:** simple kinematic plots provide fast information about the status of the triggers such that problems can be observed by the shifter
- **Offline monitoring:** more complex kinematic and efficiency plots



Example plots for monitoring

Data based calibration

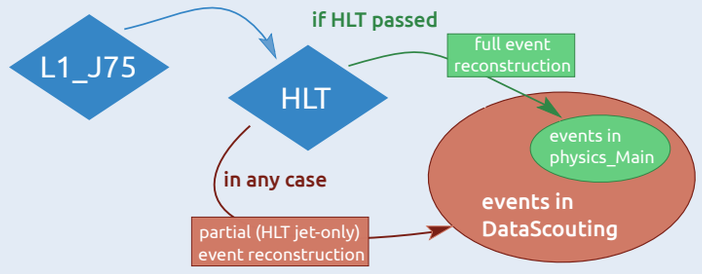
- Relative jet energy scale calibration constants are derived by balancing central jets and forward jets within the same event.
- Good agreement of calibration constants derived from trigger and offline jets.



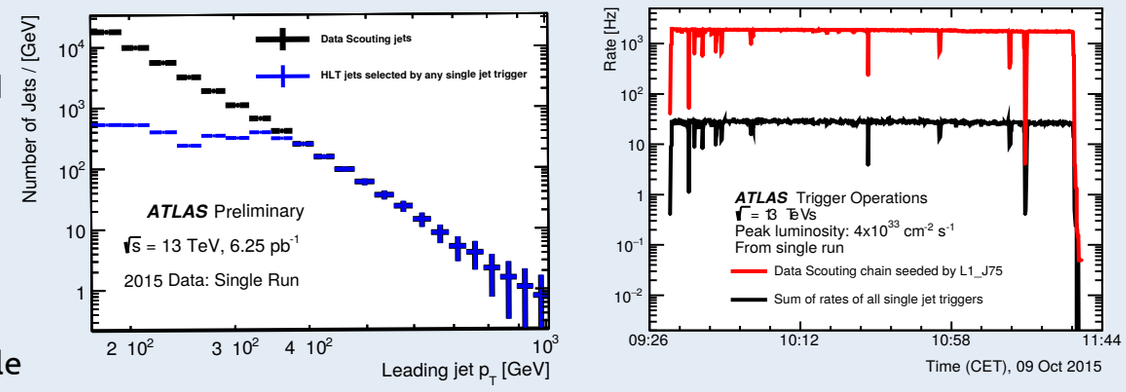
Relative response for trigger jets (left) and offline jets (right)

Jet data scouting

- The HLT is the crucial step deciding whether or not an event is **fully reconstructed** and saved to the **physics_Main stream.**
- In any case, events are also saved in the **DataScouting stream** in a **partially reconstructed** format, i.e. only jet information is stored.



- The DataScouting stream offers much larger statistics for lower-pT jets with respect to the standard physics stream.
- The calibration of trigger jets and the observed excellent energy scale agreement is a crucial step towards use of trigger jets for physics analysis.



Comparison between jets in the DataScouting and physics_Main stream (left) and the rates of the data scouting chain with the sum of the rates of all single jet triggers (right)

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