Level 1 Jet trigger for the ATLAS detector

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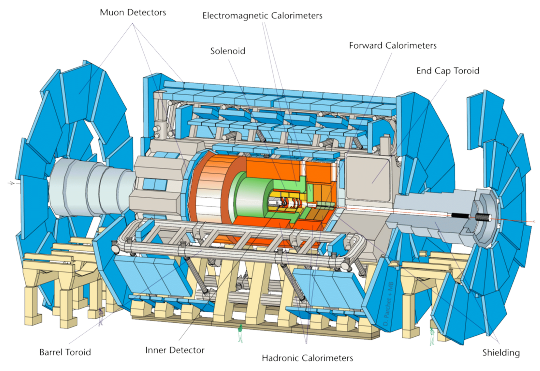
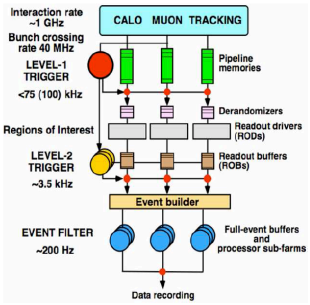
The ATLAS detector



The ATLAS Trigger System

The ATLAS detector comprises about 90 million channels with an output rate of ~60 TeraByte per second. Since this by far exceeds the technological feasibility of data storage, the selection of *interesting events* has to be performed during data taking and it has to be done extremely fast. This is the task of the ATLAS Trigger System, which consists of many components.



1. The Level-1 Trigger
- Dedicated, custom-built hardware
- Latency: **< 2.5μs**
- Data reduction: **> 400**
- Provides **Regions of Interests** (RoI)

2. The Level-2 Trigger
- 500 CPUs, high-capacity network
- Investigates RoIs at full granularity
- Data reduction: **30**
- decision time: **~40ms**

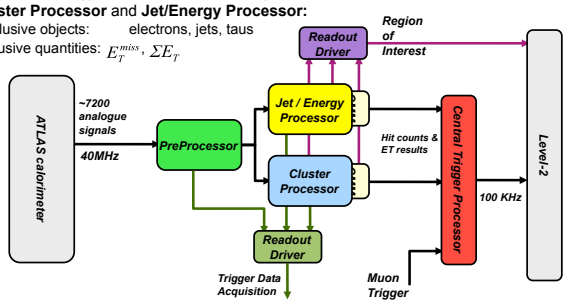
3. The Event Filter
- Full event reconstruction, **~ 1event / s**
- 1600 CPUs
- Output: **~ 200 events/s**, **300MByte/s**

Final data reduction is of a **factor of 10^7**

Level-1 Calorimeter Trigger

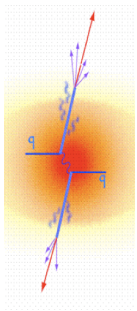
Two stages of processing:

1. **PreProcessor:**
   Digitization, energy calibration, bunch crossing identification.
2. **Cluster Processor** and **Jet/Energy Processor:**
   - Exclusive objects: electrons, jets, taus
   - Inclusive quantities: E_T^{miss}, ΣE_T

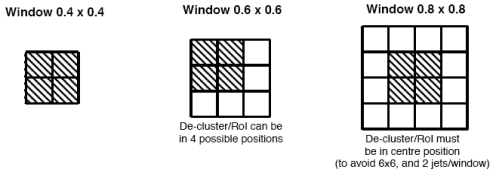


What's in a jet?

- The hadronisation of partons results in highly collimated particle clusters called *jets.*
- The LHC being a p-p collider will be rich in jet phenomenology.
- Both SM and BSM physics signals are expected to have monojet, dijet or multijet events.
- Hence, monitoring the jet trigger performance forms a vital part at all trigger levels.
- Here, the jet trigger efficiency for Level 1 Calorimeter (L1Calo) is studied for monitoring purposes.



Jets in L1Calo



- The basic units of the jet trigger algorithm are **jet elements** which are formed by summing 2 x 2 trigger towers in η x Φ.
- **Jet windows** are used to measure the E_T. The windows are summed over 2 x 2, 3 x 3 or 4 x 4 jet elements.
- A region of interest (**RoI**) comprising the η-Φ location is generated for each jet trigger candidate.

Matching Jets

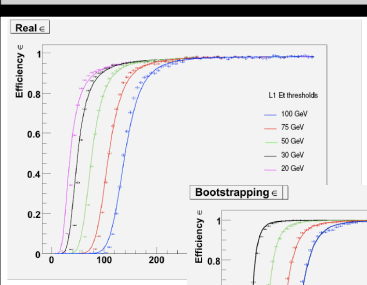
- In MC simulated samples, L1Calo jets are contained separately to the offline jets.
- Hence, a level 1 jet needs to be *matched* to the corresponding offline jet on an event to event basis.
- The matching criteria used is dependant on the **RoI** information obtained at Level 1.

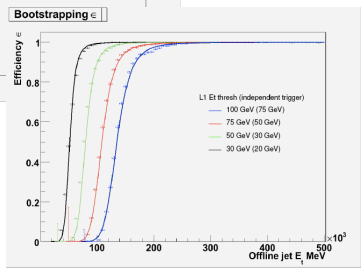
$$\Delta R = \sqrt{(\phi_{offline} - \phi_{L1})^2 + (\eta_{offline} - \eta_{L1})^2}$$

A jet is considered to be matched when **ΔR < 0.2**

In the current study, the cone algorithm is used for the offline reconstructed jets.

Turning on the trigger efficiency





- Real trigger efficiencies for matched jets are plotted as, $\varepsilon = \frac{\#\, offline jets \quad where \quad L1E_T > thresh}{total \#\, offline jets}$
- Another technique is implemented for the trigger efficiencies known as *bootstrapping*.
- Bootstrapping efficiencies are plotted using the lower E_T threshold trigger as an independent trigger to study higher thresholds.
- It is desirable to know the η-Φ response in different parts of the detector.
- The efficiency plots are fitted with a Fermi function.
- One of the fit parameters ~ efficiency (colour palette) is plotted along with it's error (number) in blocks of 0.8 x 0.8 (η x Φ).