

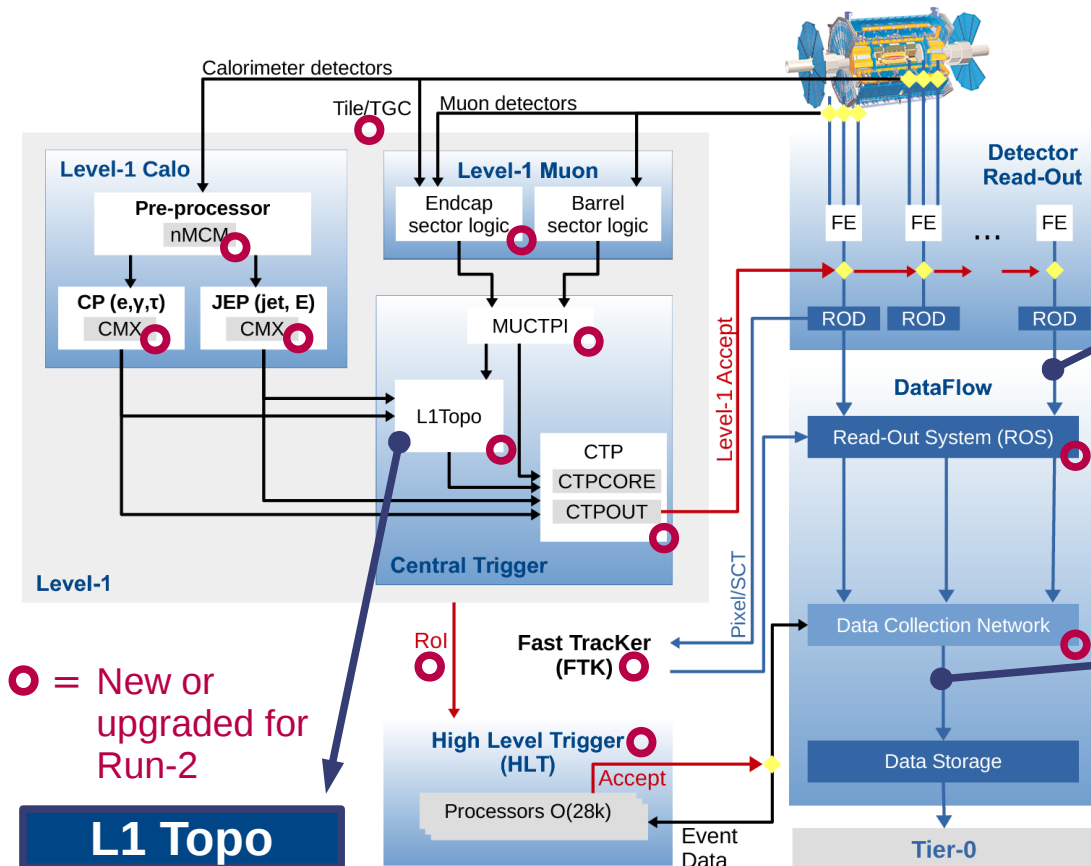
The ATLAS Run-2 Trigger: Design, Menu, Performance and Operational Aspects

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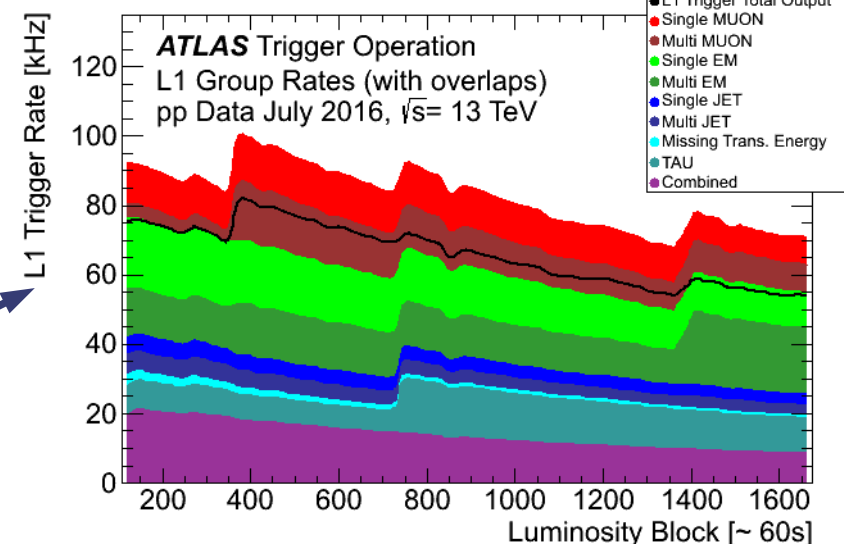
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ATLAS utilises a two-level trigger system. The hardware L1 trigger selects events based on energetic e/y, τ , jets, missing transverse energy and μ signatures, reducing from the interaction rate of 40 MHz to 100 kHz while maintaining high efficiency for physics object selection. The software High Level Trigger further reduces the rate to 1 kHz on average. The trigger menu allocates the available bandwidth to physics groups depending on the instantaneous luminosity.

ATLAS Run-2 Trigger & Data Acquisition

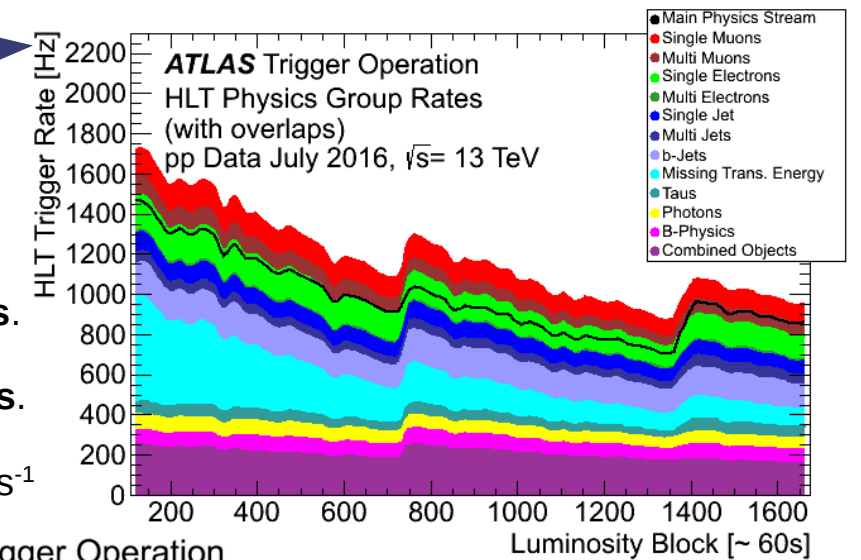


Trigger Rates & Bandwidth



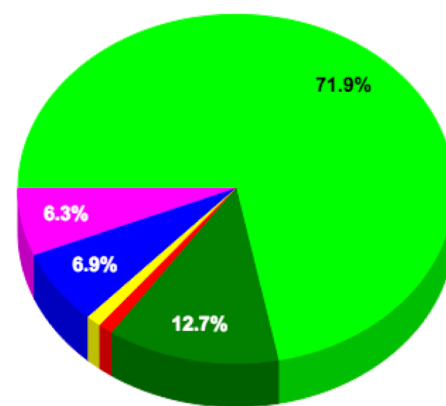
- L1 menu of **512** trigger items & combinations.
- E.g. **MU15, 2EM12**
- Rates are controlled via **prescale sets**.
- Instantaneous **luminosity** [L] from LHC falls with time.
- Prescale sets computed for a set of **fixed values of L**.
- Lower-threshold items are enabled once the L has fallen sufficiently, causing an **increase** in the rate.

- **ATLAS Trigger Menu** of **O(1000)** active chains.
- Each chain is a sequence of **feature extraction & hypothesis testing algorithms**.
- Chains, primary and support, are grouped within **signatures**.
- For 2016, prescale sets are defined up to $L = 1.5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$



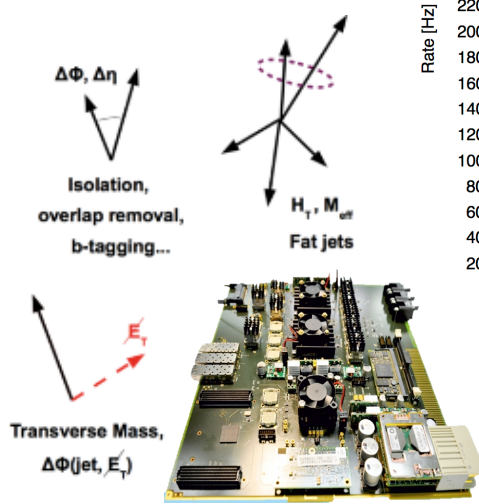
ATLAS Trigger Operation
pp Data July 2016, $\sqrt{s} = 13 \text{ TeV}$

- **Event Building [EB]** denotes if all (full) or partial sub-detector data are recorded for an event.
- Peak rates around **2.75 Gb s⁻¹**.
- **Majority** of chains record to **Main stream with full EB**.
- **Express** reconstructed first, provides calibration data.
- **Delayed** physics reconstructed later, e.g. during end of year stops when less demand on computational resource.
- **Trigger Level Analysis**: high rate (3 kHz) of just the trigger data. Used in dijet resonance searches.

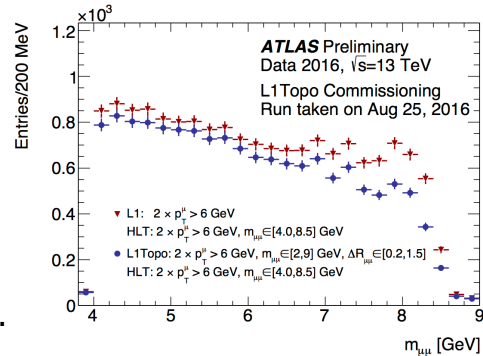
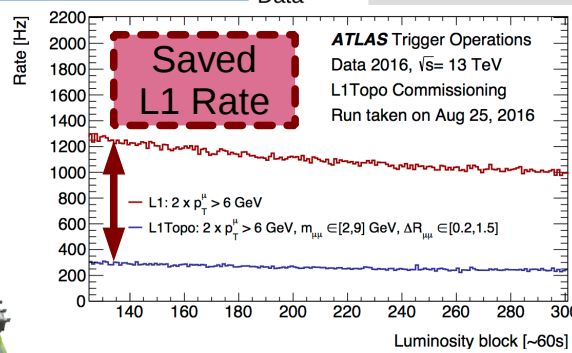


- Main Physics (full EB)
- Delayed Physics (full EB)
- Express stream (full EB)
- Trigger Level Analysis (partial EB)
- Detector Calibration (partial EB)
- Other Streams (full EB)

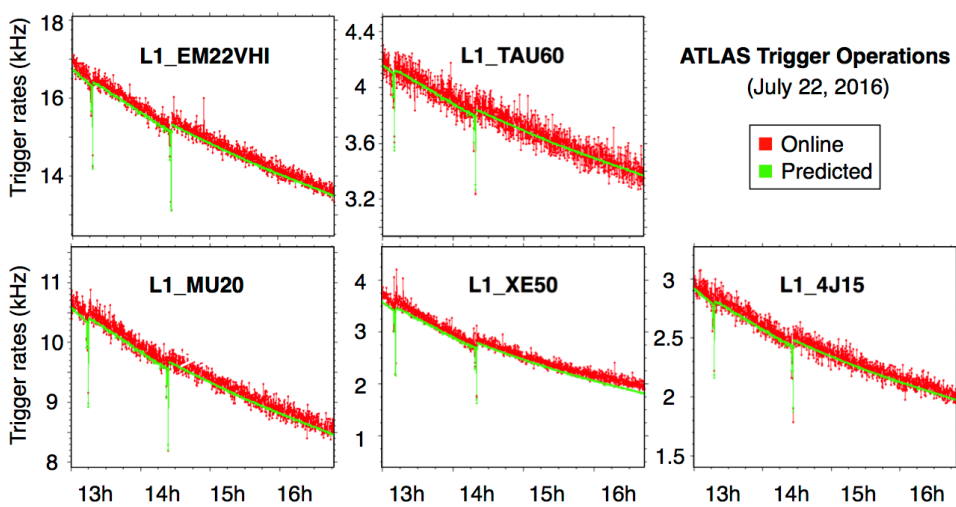
L1 Topo



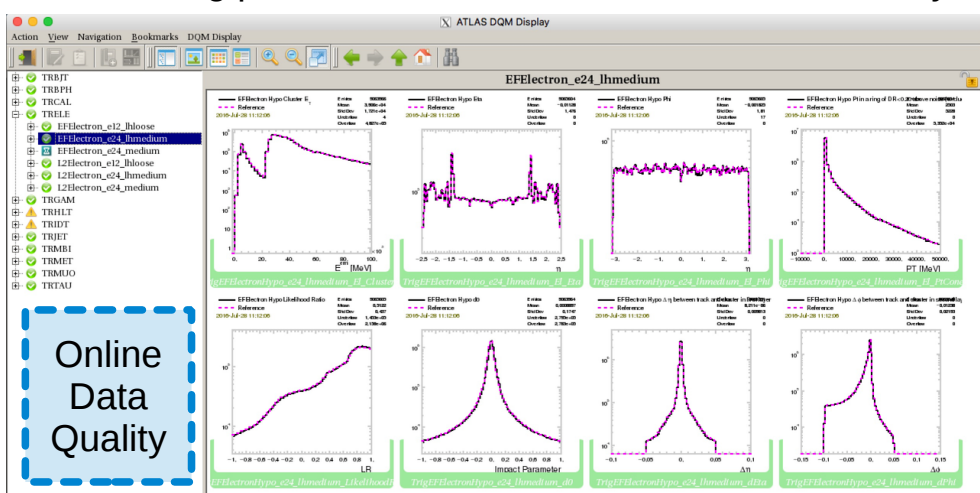
- Topological trigger greatly reduces L1 rates with minimal impact on physics.



Trigger Rate Predictions & Monitoring



- Per-chain parametrised form factors provide real time monitoring predictions based on the current luminosity.



Online Data Quality

High Level Trigger Physics Performance

