



Trigger Menu-aware Monitoring for the ATLAS experiment

Xanthe Hoad (University of Edinburgh) on behalf of the ATLAS Collaboration

CHEP 11/10/16



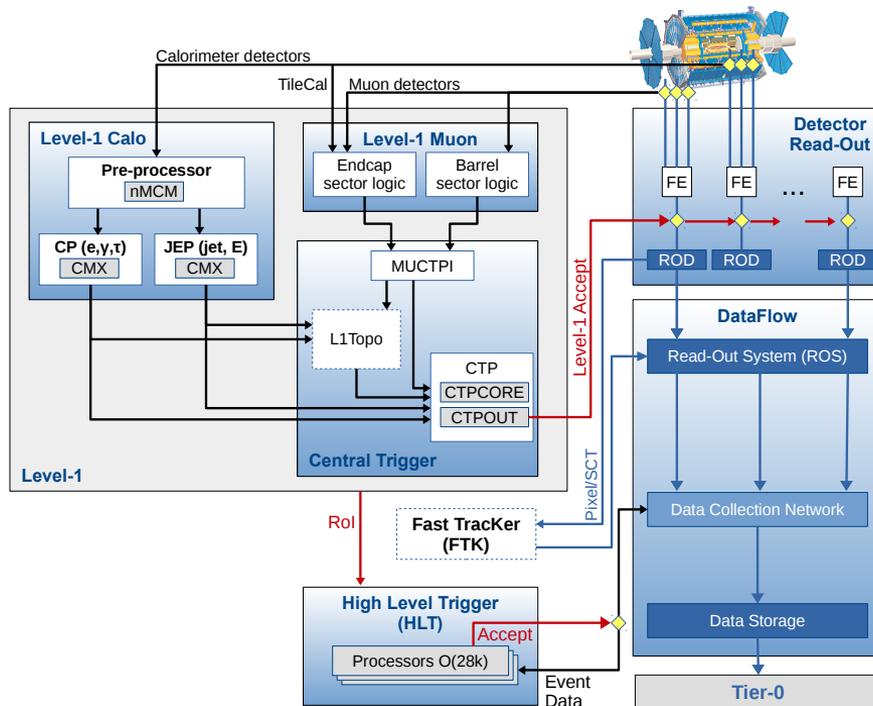
THE UNIVERSITY
of EDINBURGH



Outline

- What are Triggers and why do we monitor them?
- When do we monitor them?
- The ATLAS Offline Trigger Monitoring system
- Why this system needs to change
- **The new ATLAS Offline Trigger Monitoring system, including Menu-aware Monitoring**
- How Menu-aware Monitoring works:
 - Monitoring configuration patches
 - Relating patches to the Trigger Menu
 - Using Menu-aware Monitoring
- Summary

ATLAS Trigger System

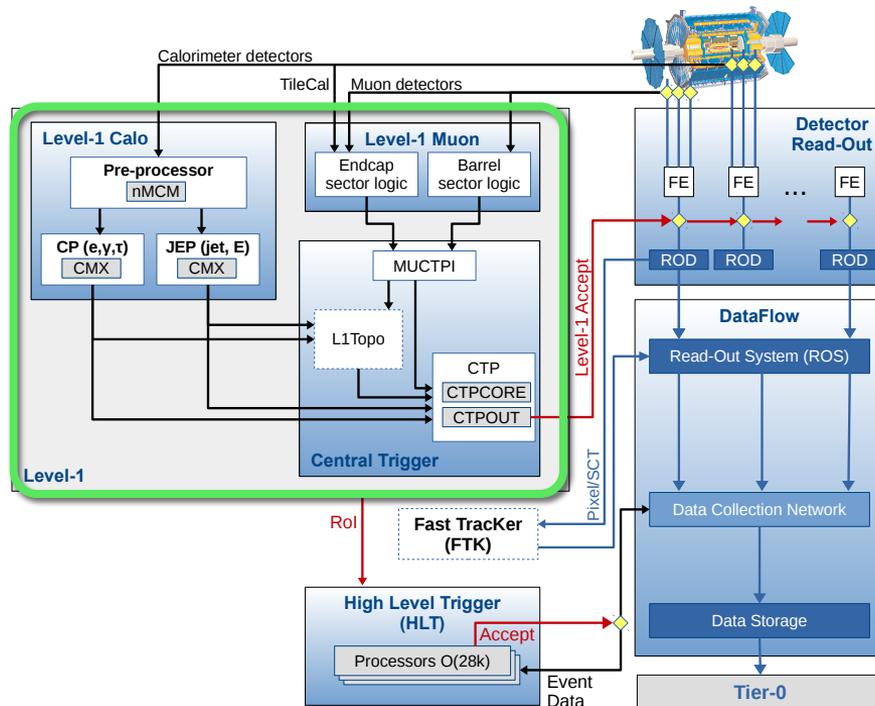


- Needed to reduce data rates to manageable levels
- Triggers are designed to accept potentially interesting events (for example, events containing high momentum muons) and reject background

ATLAS Trigger System

Level 1 (L1):

Fast, custom-made electronics find regions of interest using Calorimeter/ Muon data with coarse info

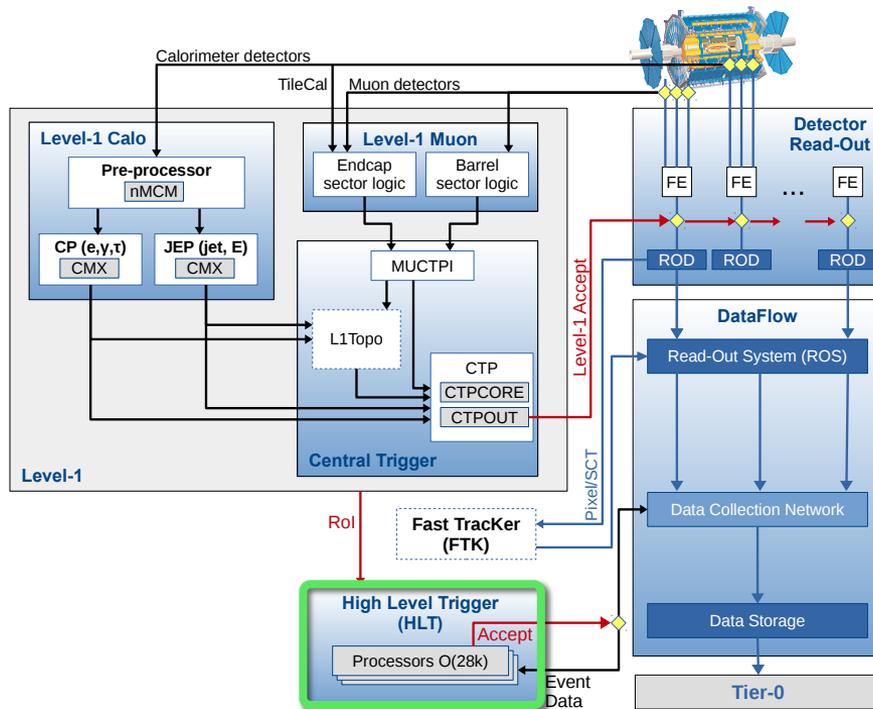


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Fast algorithms in regions of interest or offline-like ones with full event info on PC farm

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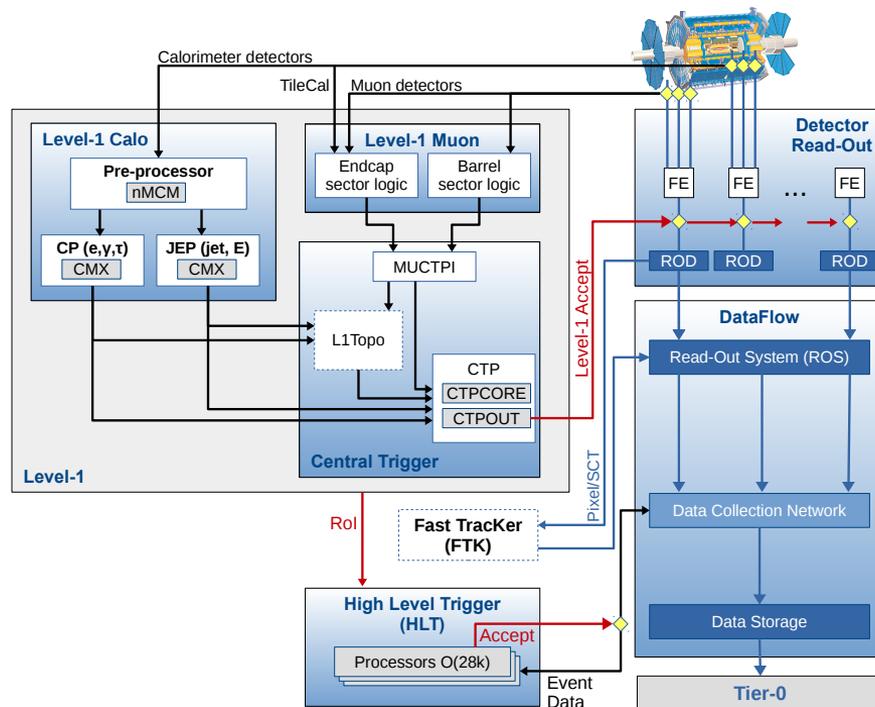
- **Trigger chain:** a series of trigger algorithms that run in sequence
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- **Trigger Menu:** a suite of online selection algorithms
 - A typical Trigger Menu contains several hundreds of trigger chains to meet a large variety of physics goals at the LHC
 - Menus are designed for specific data-taking purpose and LHC beam conditions, e.g. Physics menu, Heavy Ion menu, Cosmics/Standby menu, etc.
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- **Super Master Key (SMK):** An identifier for a unique online trigger configuration, specifying a particular Trigger Menu plus other configurations

ATLAS Trigger System

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- The Trigger Menu defines which trigger chains are available



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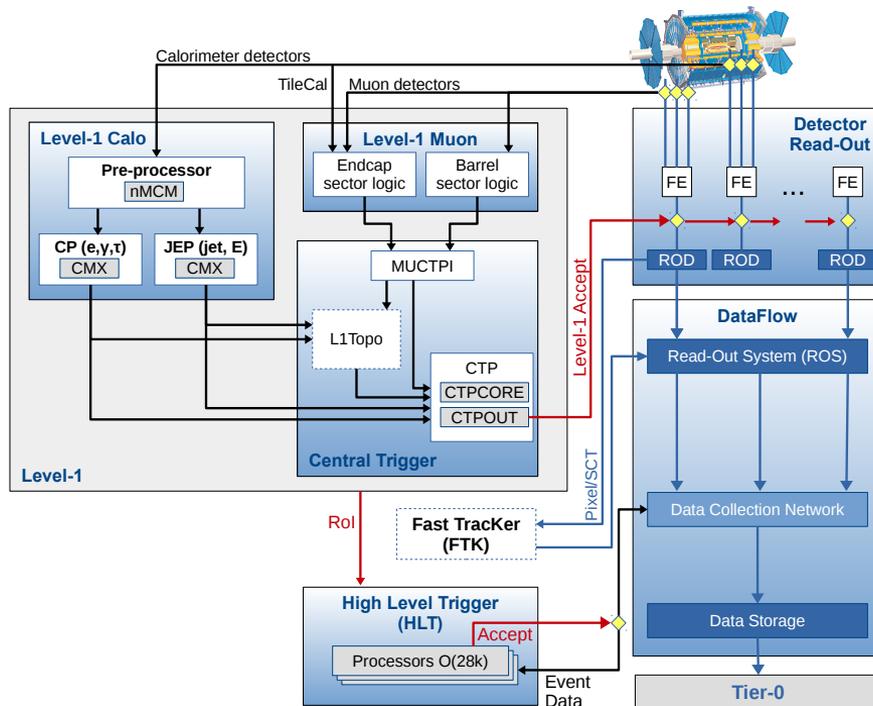
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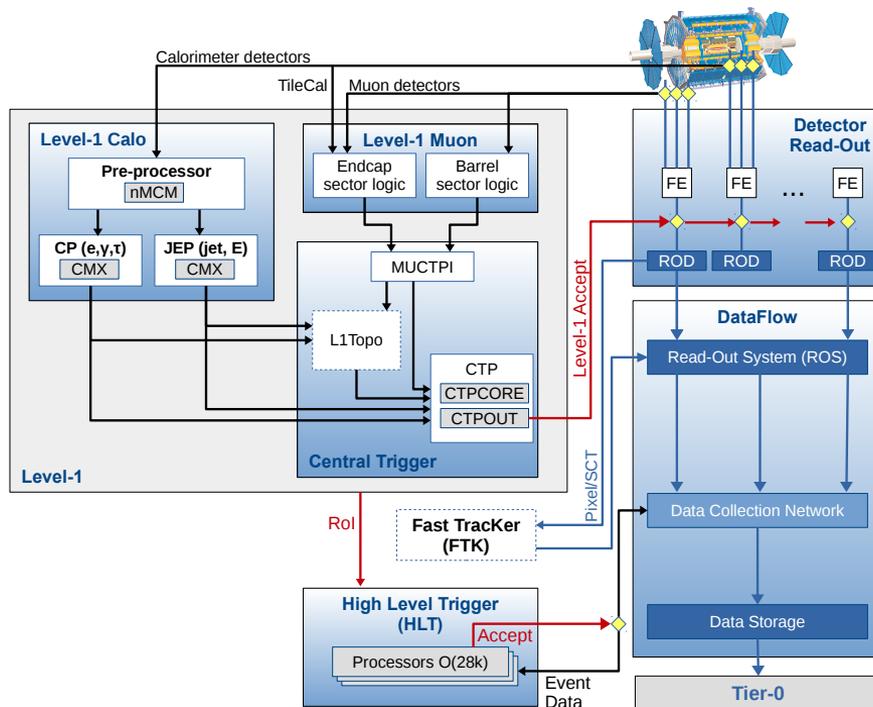
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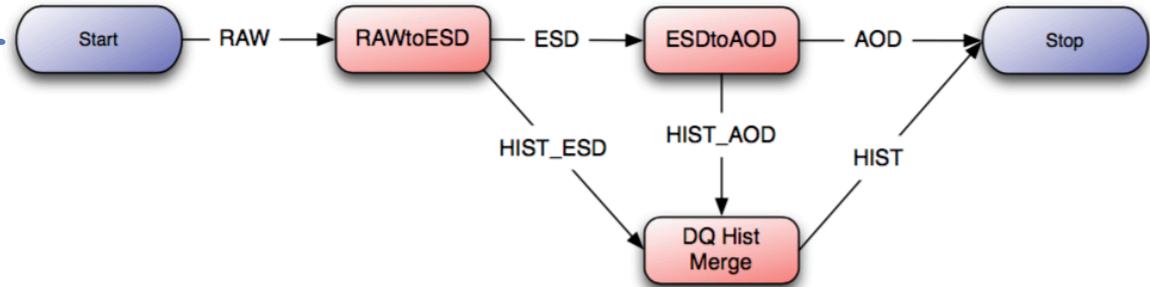
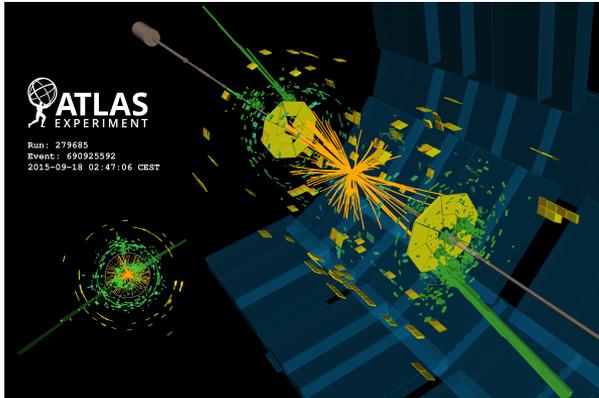


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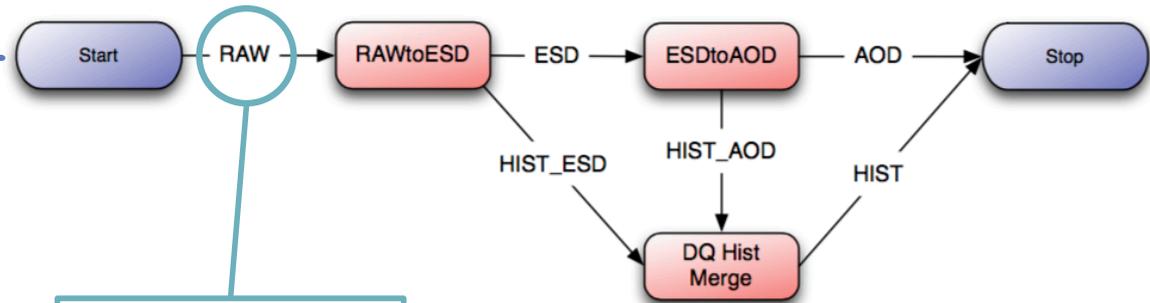
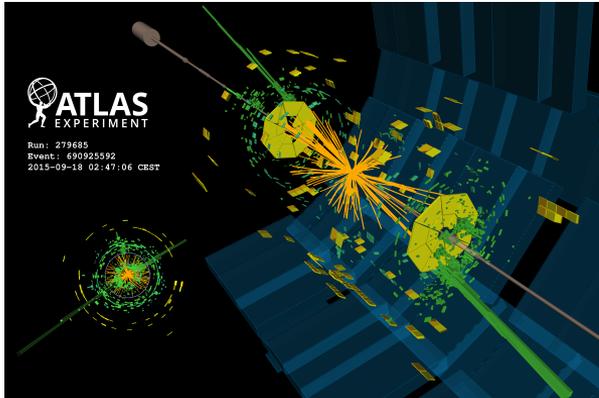
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- Trigger Monitoring occurs online (during data taking) and offline (during reconstruction)

Offline Event Reconstruction

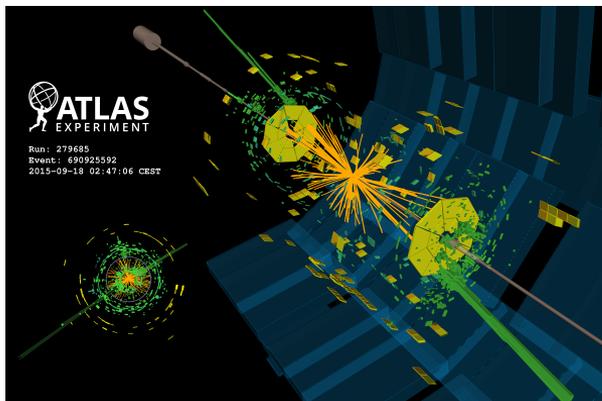


Offline Event Reconstruction

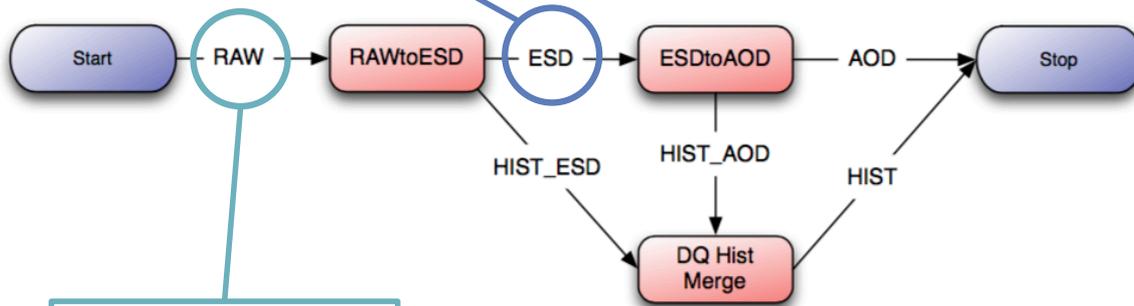


Raw detector data
Hits and energy
deposits in detector
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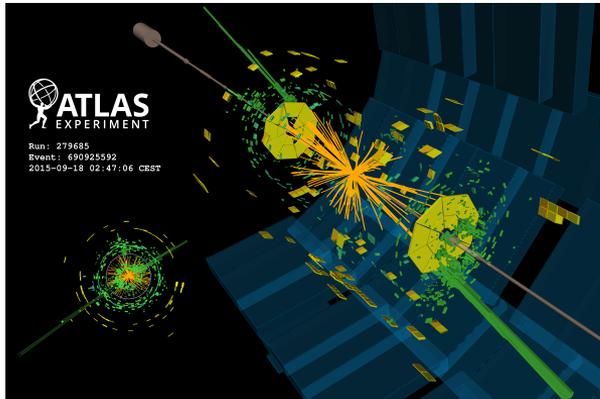


Complete reconstructed data
Hits and energy deposits back to
Physics objects



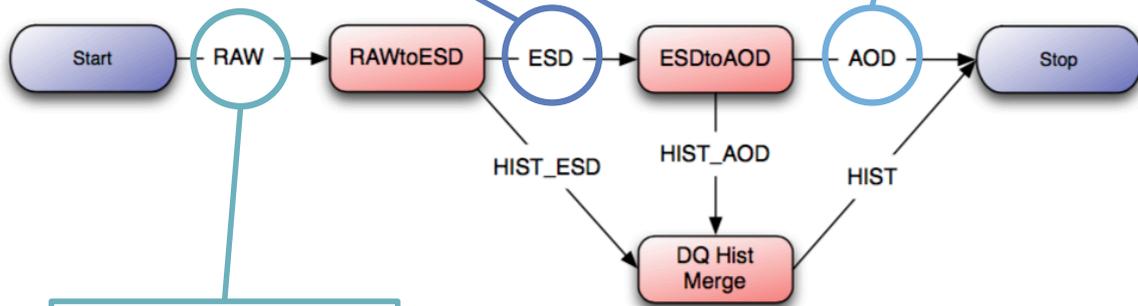
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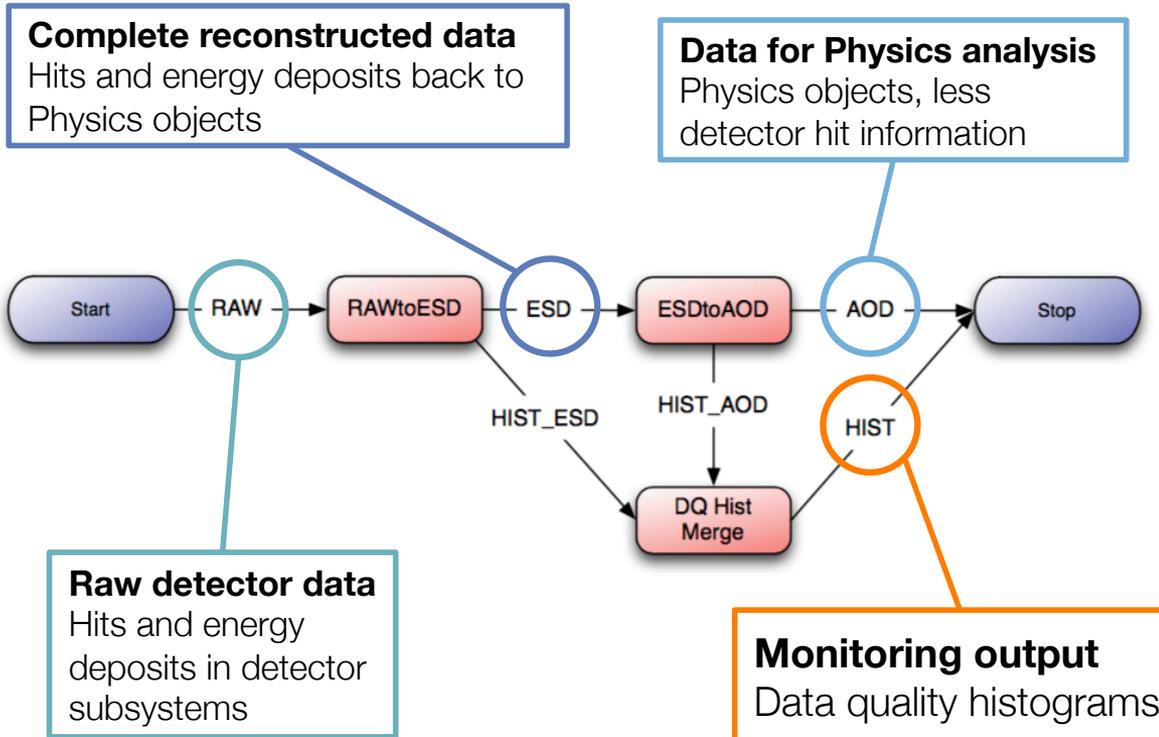
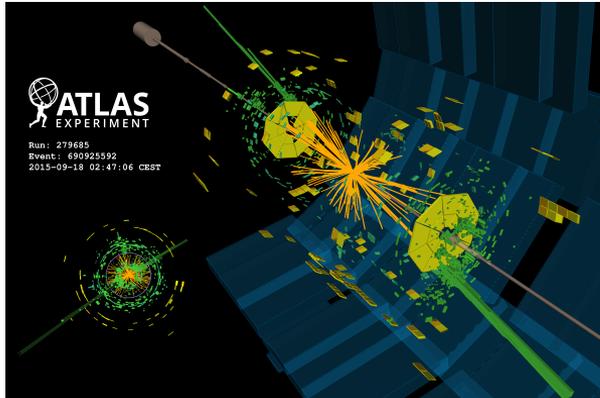
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Data for Physics analysis
Physics objects, less
detector hit information



Raw detector data
Hits and energy
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Offline Event Reconstruction



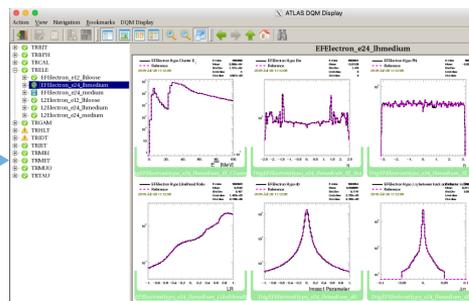
ATLAS Offline Trigger Monitoring

Offline Monitoring

C++ monitoring code with
hard coded configurations

Histograms

DQ Web Display



- Offline Trigger Monitoring:
 - Occurs during event reconstruction
 - Lives in the ATLAS offline software release
 - **Hard coded configurations including which trigger chains to monitor**
 - Outputs histograms

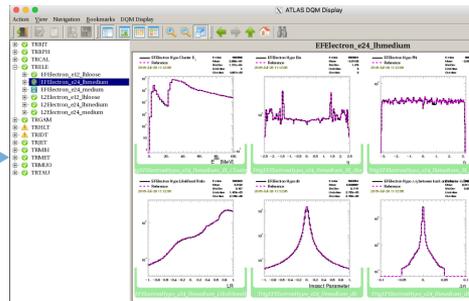
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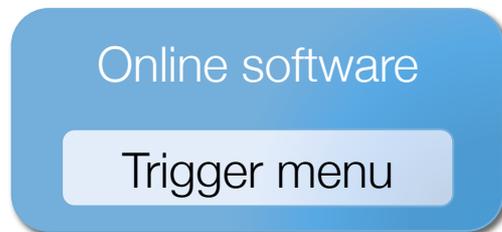
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 - Performs checks on histograms (for example, comparisons to reference histograms)

The Problem



- The Trigger Menu used online changes depending on various factors including the type of collisions (proton-proton or heavy ion), luminosity, and the desires of physics analysers

The Problem

Online software

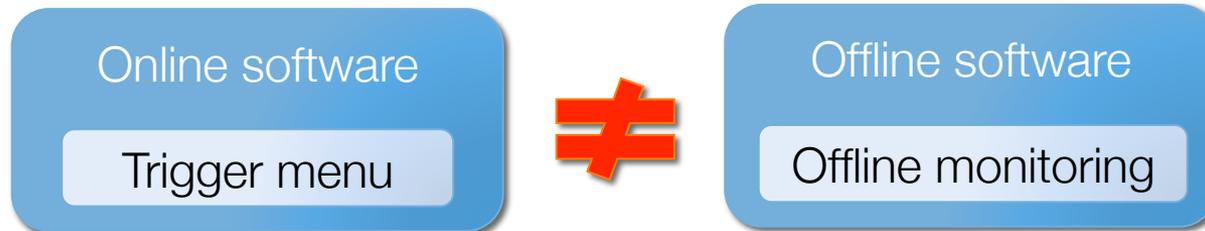
Trigger menu

Offline software

Offline monitoring

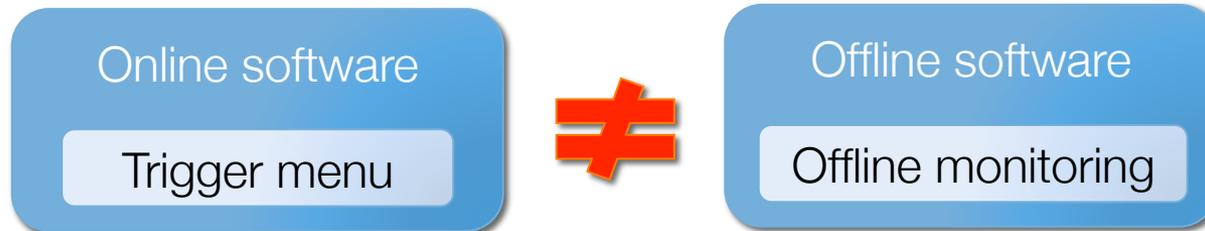
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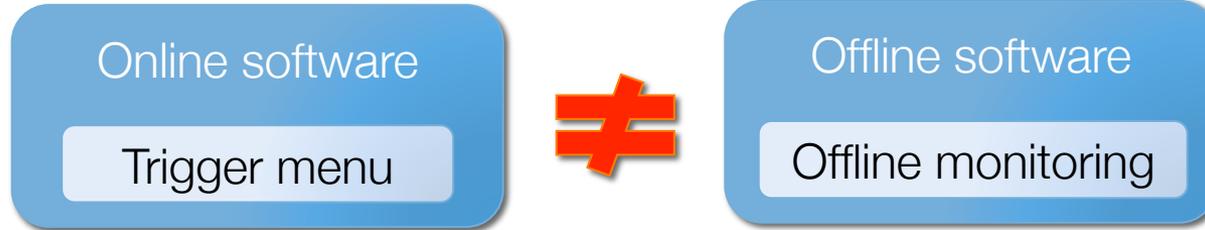
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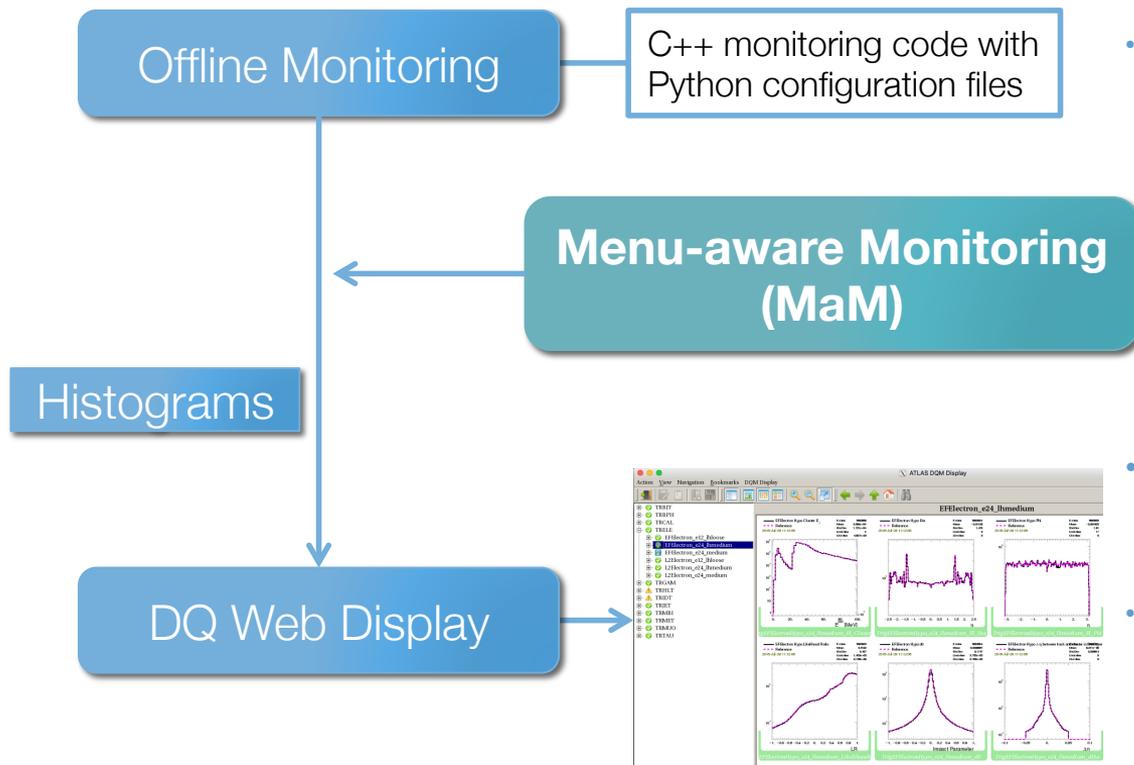
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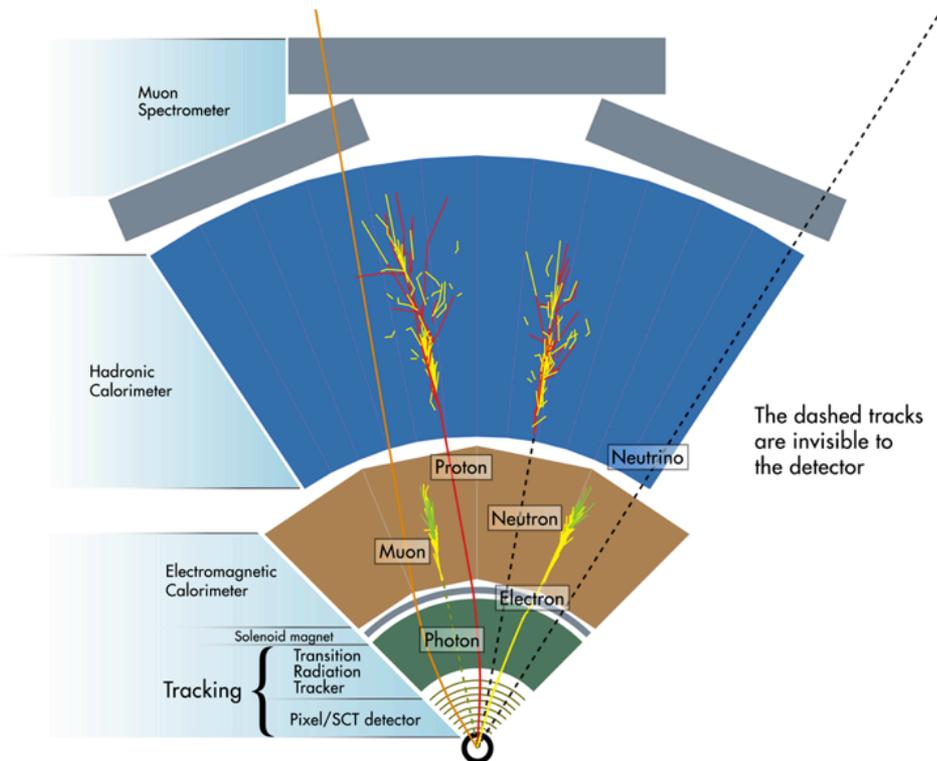
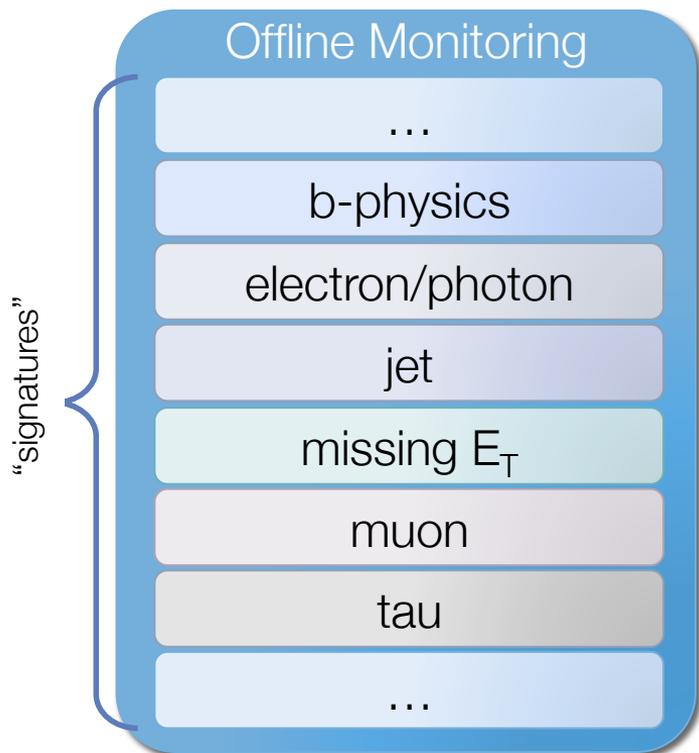
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- Offline monitoring updates require a new offline software release – this takes time
- **When there is a delay in updating offline monitoring configurations, irrelevant monitoring histograms are made resulting in difficulty checking data quality**
- Delays are mainly a problem during commissioning phases

ATLAS Offline Trigger Monitoring

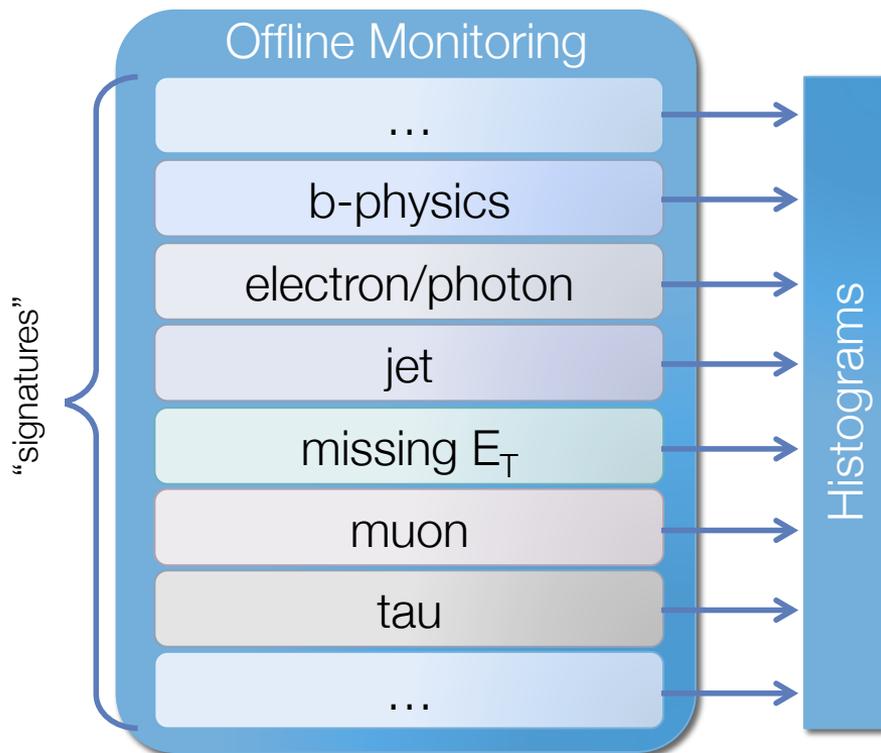


- Offline Trigger Monitoring:
 - Occurs during event reconstruction
 - Lives in the ATLAS offline software release
 - **Python configuration files including the trigger chains to be monitored and other parameters**
 - Outputs histograms
- **Menu-aware Monitoring:**
 - **Updates TrigMonitoring configuration files on-the-fly**
- Data Quality (DQ) Web Display:
 - Performs checks on histograms (for example, comparisons to reference histograms)

Monitoring configuration patches

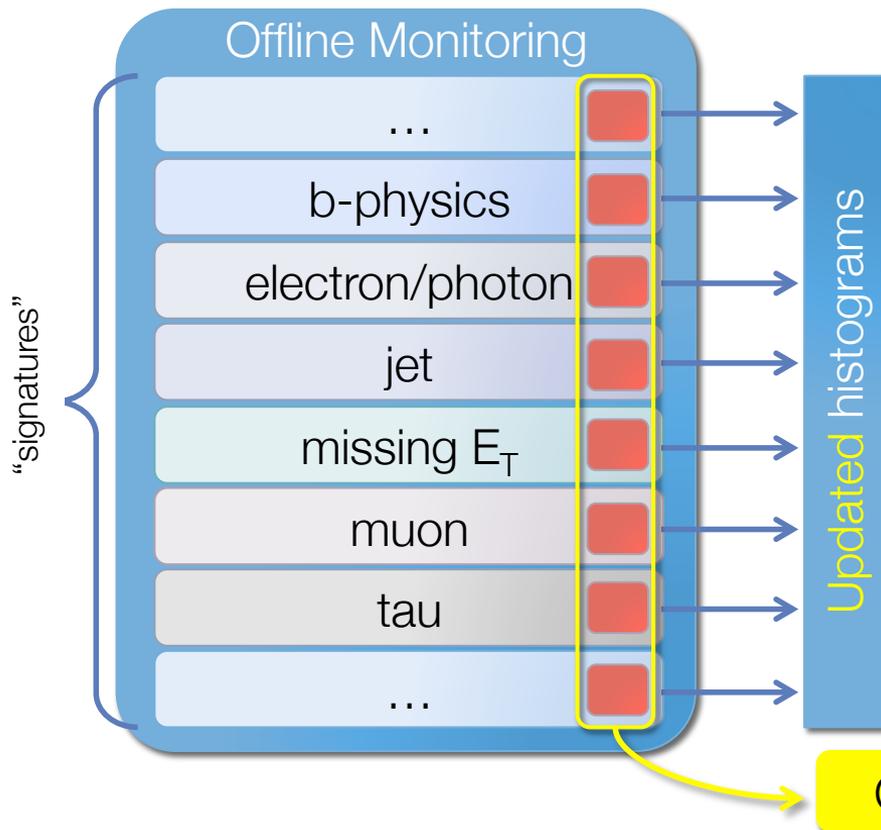


Monitoring configuration patches



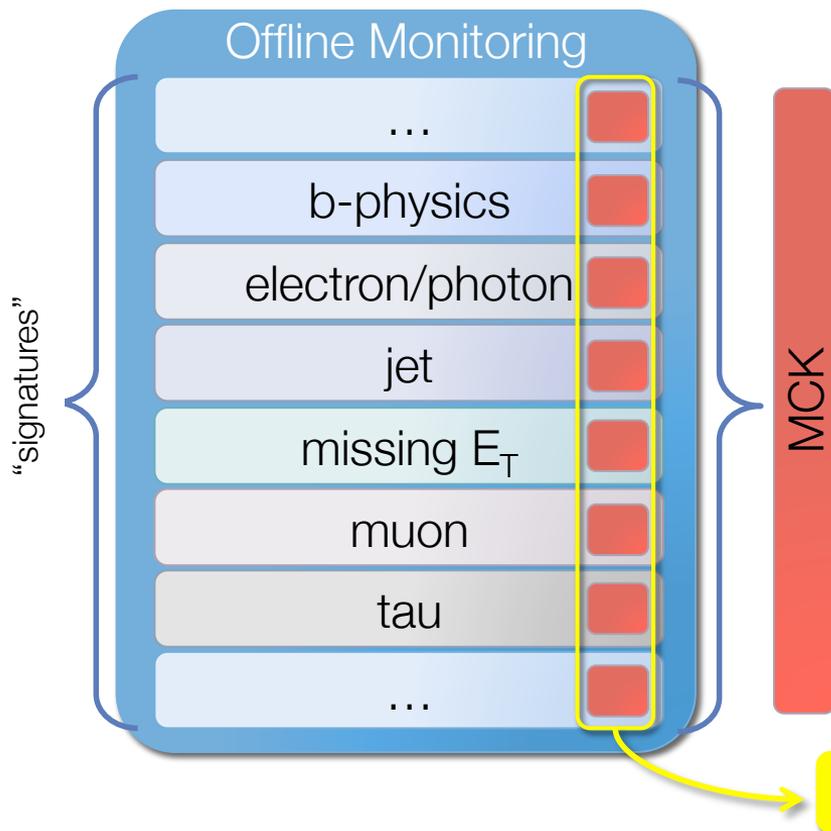
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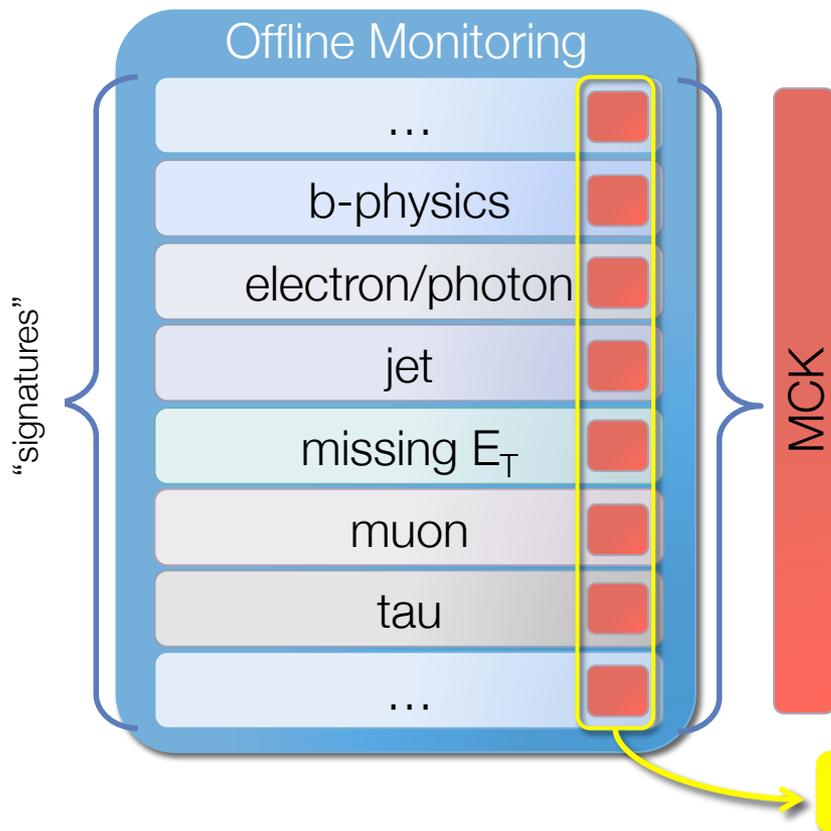
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- A bundle of patches that should be used with a particular offline software release is identified by a Monitoring Configuration Key (MCK)

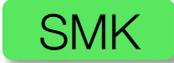
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- **MaM achieves this by allowing temporary patches to be applied to the Python configurations**
- A bundle of patches that should be used with a particular offline software release is identified by a Monitoring Configuration Key (MCK)
- Patches are produced by making local changes to the Offline Trigger Monitoring configuration files
- MaM's Python functions are used to extract and compare these local changes to the default configurations, and store the differences

Relating patches to the Trigger Menu

- MaM's configuration patches (and their MCK identifiers) are stored in the ATLAS Trigger database
- Also stored in the same database is the complete online Trigger configuration, including the Trigger Menu
- A 'Super Master Key' (SMK) identifies a particular online Trigger configuration for a particular data-taking run



SMK



Online



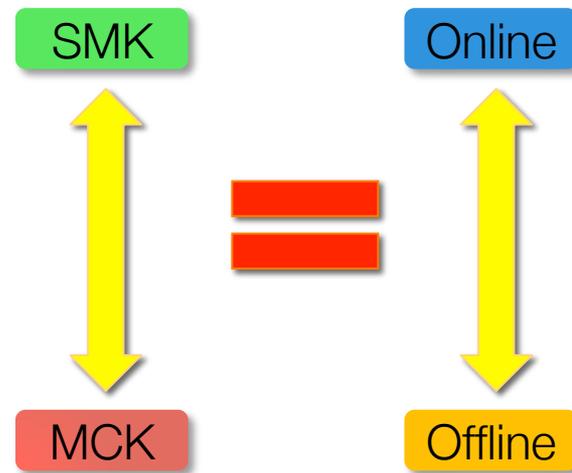
MCK



Offline

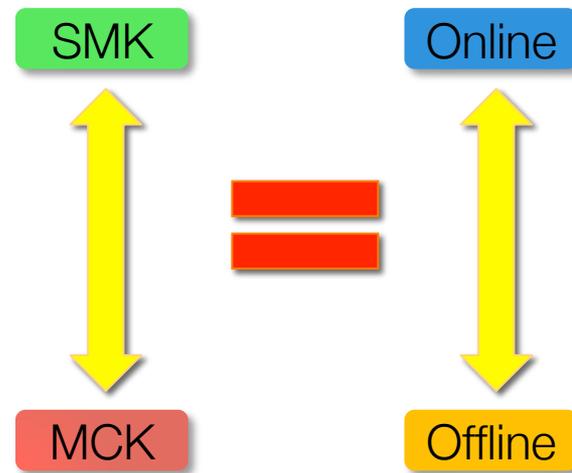
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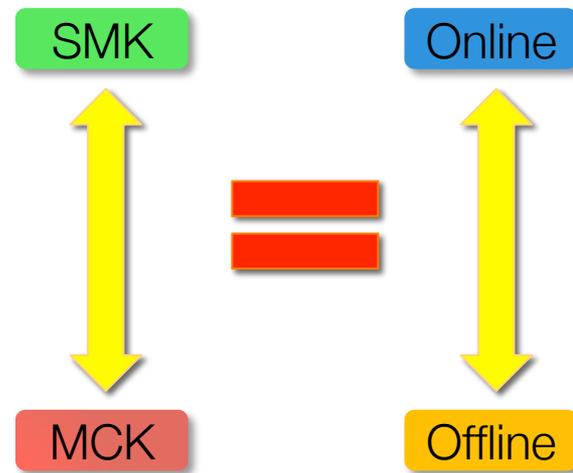
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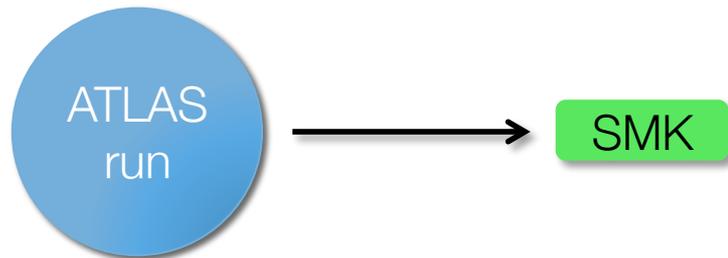


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- **SMK-MCK links can be updated if the offline software release is changed, meaning that offline monitoring configurations can be kept in sync with the online Trigger Menu**
- The use of the database means that offline monitoring configurations can be updated without needing to wait for a new offline software release

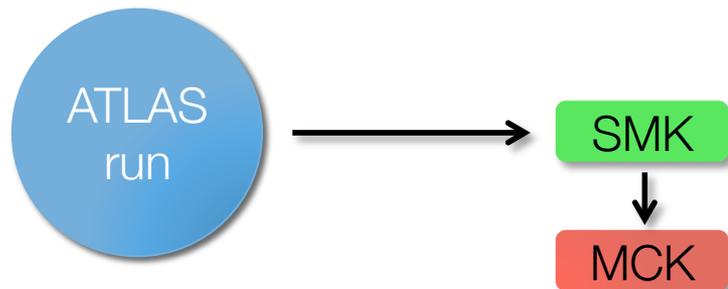


Use of MaM during Monitoring



- At the start of a data-taking run, the 'Super Master Key' (SMK) associated with the run is read from the Trigger database by MaM

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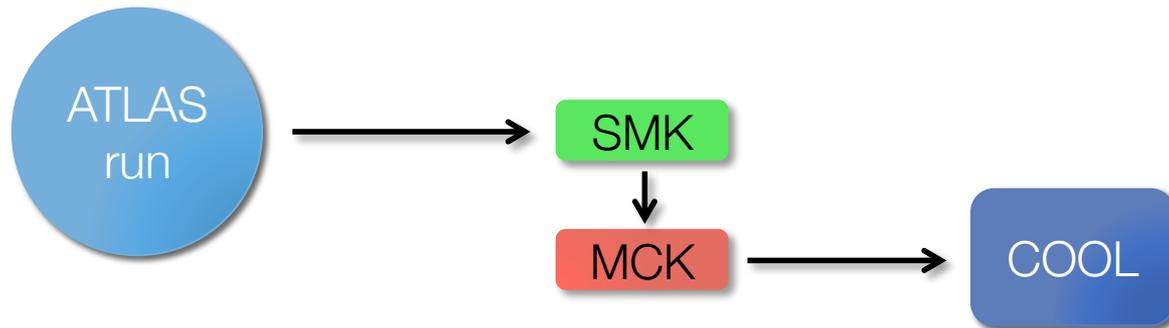


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MCK: Monitoring Configuration Key, identifies bundle of configuration patches

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- The MCK is stored in the ATLAS Conditions Database ('COOL'), where details about each run are stored

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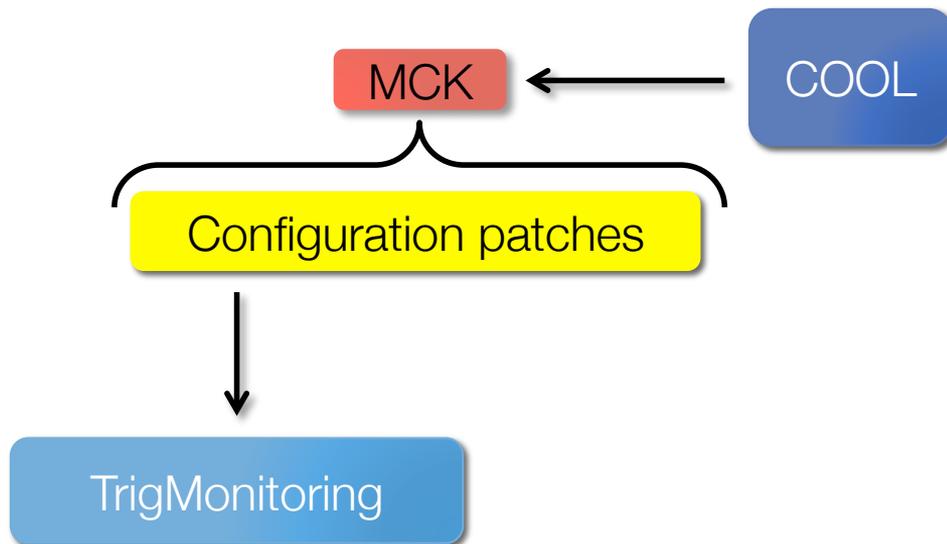
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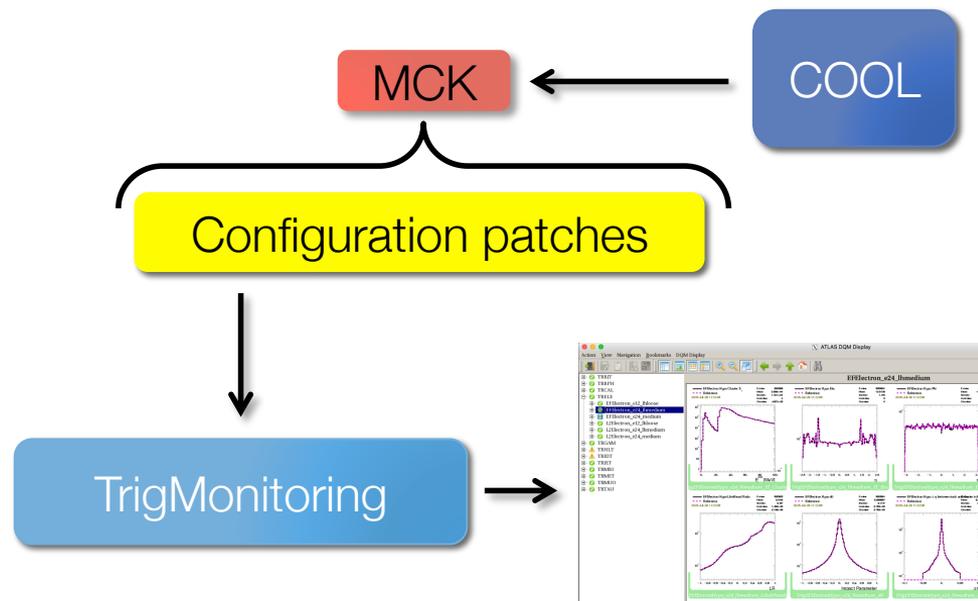


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- Later, when Reconstruction occurs, MaM looks in the ATLAS Conditions Database ('COOL') to find the MCK that should be applied
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- If the releases match, the configuration patches specified by the MCK are applied on top of the default monitoring configurations

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- The offline software release that the MCK is designed for is found and compared to the release being used
- If the releases match, the configuration patches specified by the MCK are applied on top of the default monitoring configurations
- Offline monitoring runs with patched configurations and produces the histograms needed to monitor data quality

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Thanks for listening!