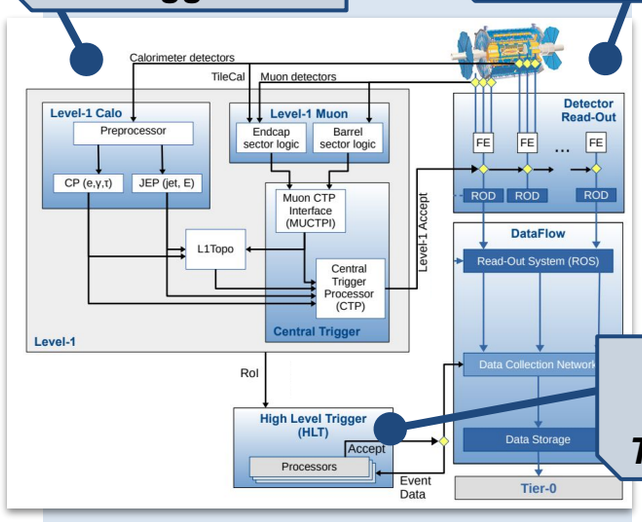
The ATLAS Trigger Menu From Run 2 to Run 3

RUN 3 HARDWARE CHANGES

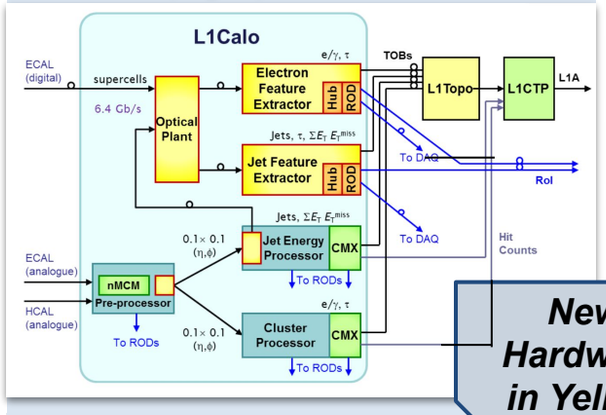
Level 1 (L1) Hardware Trigger

Detector Front-End Buffers

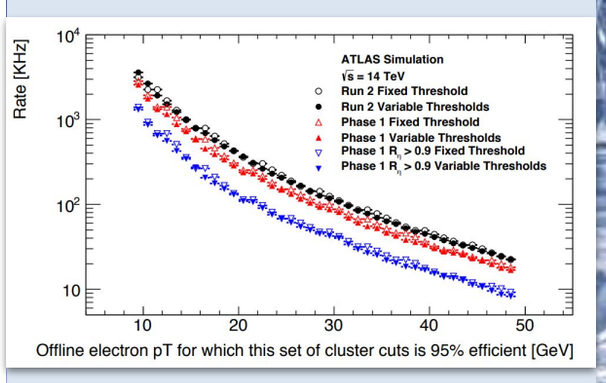


ATLAS L1 and HLT Trigger (left), and Data Acquisition (right) in Run 2.

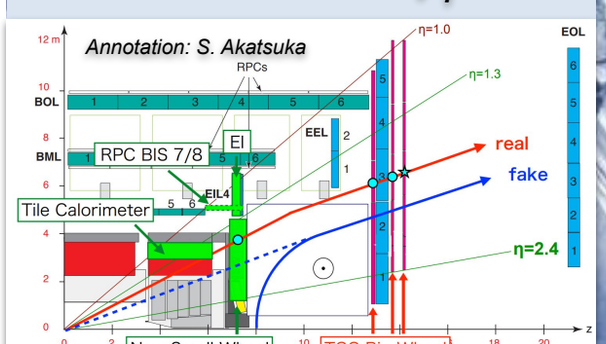
High Level Software Trigger (HLT)



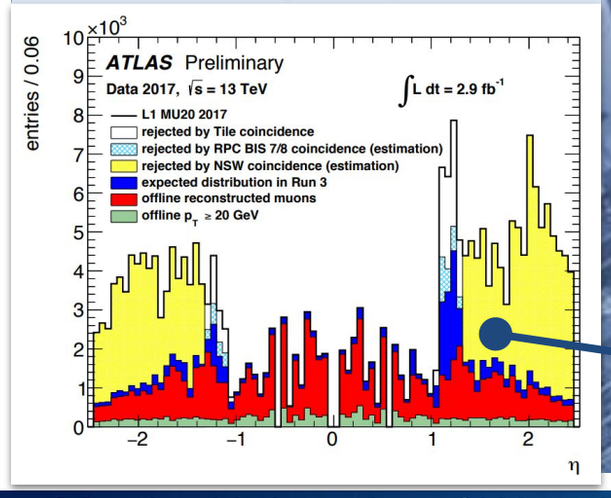
Upgraded L1Calo for Run 3



Reduced L1 rate for given offline electron p_T



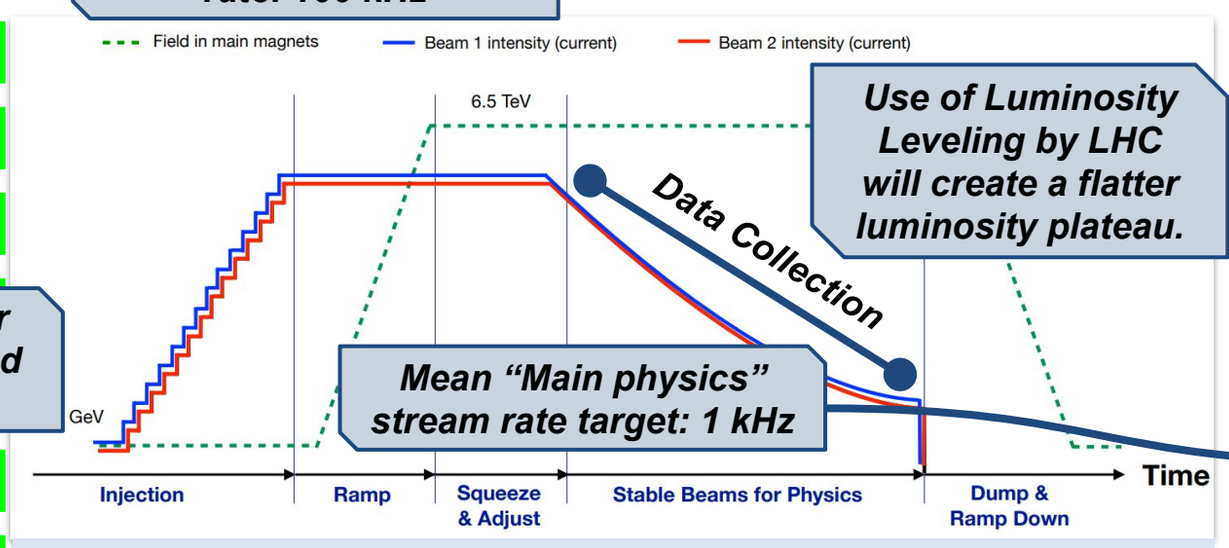
New Small [Muon] Wheel



Improved performance using NSW position and angle information.

Reject a large fraction of the dominant fake and low-p_T μ at $|\eta| > 1$ to reduce the L1 rate.

Maximum L1 Trigger rate: 100 kHz

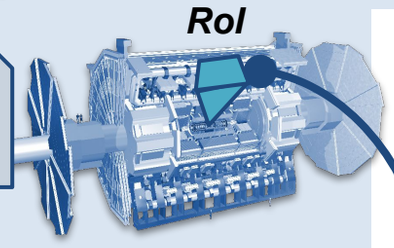


Use of Luminosity Leveling by LHC will create a flatter luminosity plateau.

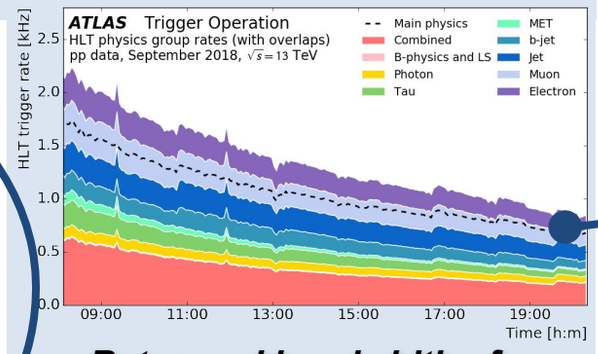
Mean "Main physics" stream rate target: 1 kHz

Prescales are applied to control the rate of individual L1 items and High Level Trigger "chains" in order to maintain constant rates for supporting chains, and to enable additional chains at lower luminosities.

RoI

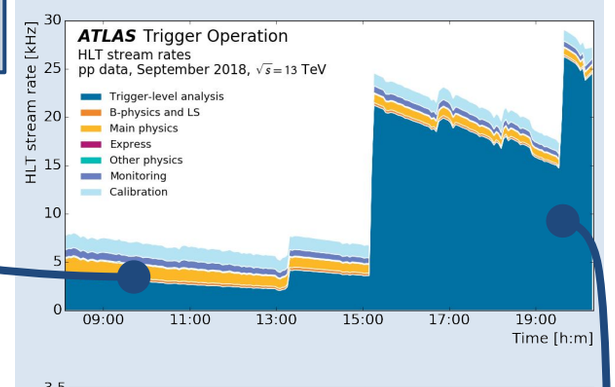


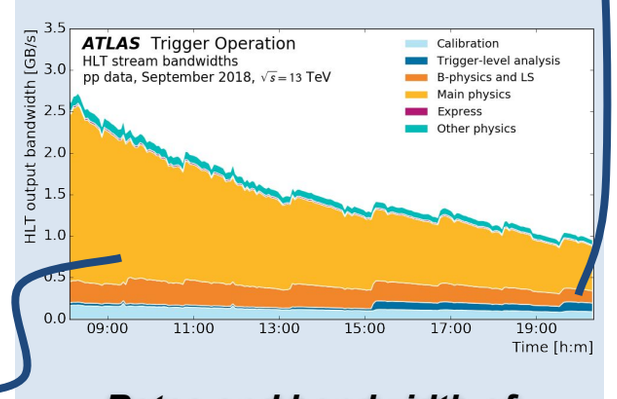
HLT reconstruction predominantly occurs within L1-identified Regions of Interest (RoI)



Rates and bandwidth of different trigger Streams during data collection in one run

RUN 2 DATA TAKING CONDITIONS





Rates and bandwidth of different trigger Streams during Run 2 data collection, illustrating large Trigger Level Analysis rate late in the fill.

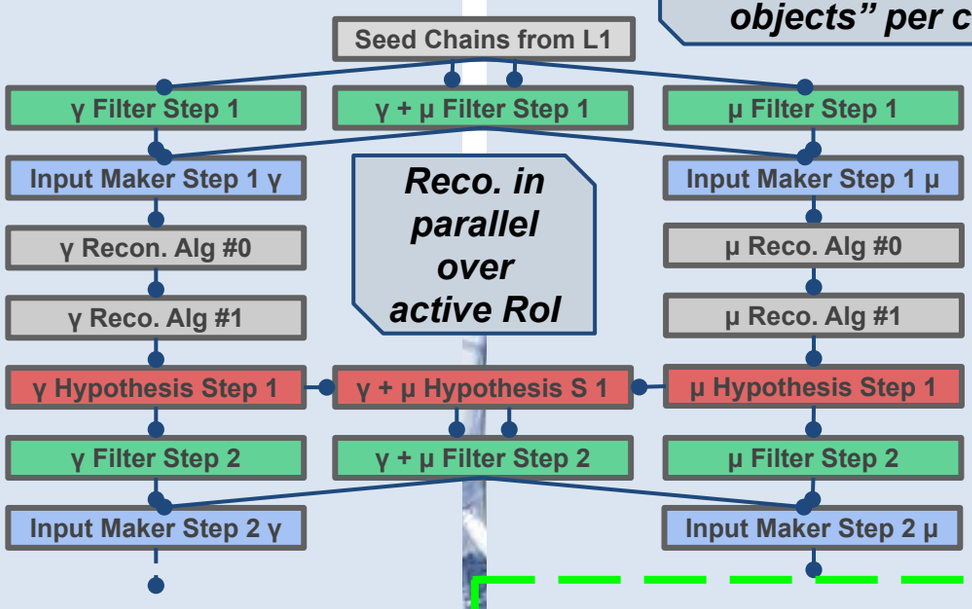
RUN 3 HIGH LEVEL TRIGGER

Run 3 will use a newly implemented multi-threaded (MT) HLT built on the Gaudi-MT framework. MT processing with concurrent algorithms and concurrent events will be used both in the trigger and for offline reconstruction. The primary benefits are lower memory requirement per CPU core and a close integration with offline.

Reconstruction paths only unlock if there are active chains

Lightweight steering tracks active "physics objects" per chain

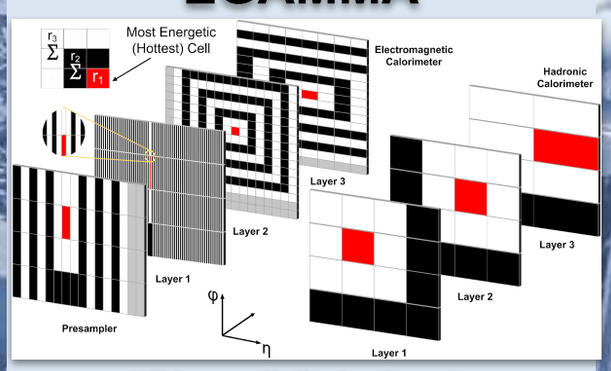
New Hardware in Yellow



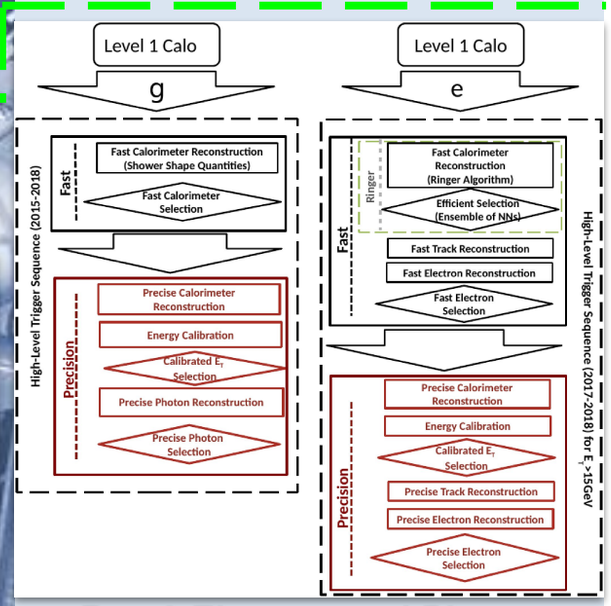
Reco. in parallel over active RoI

Frequent Hypothesis Testing allows for early rejection of both individual physics objects and entire events

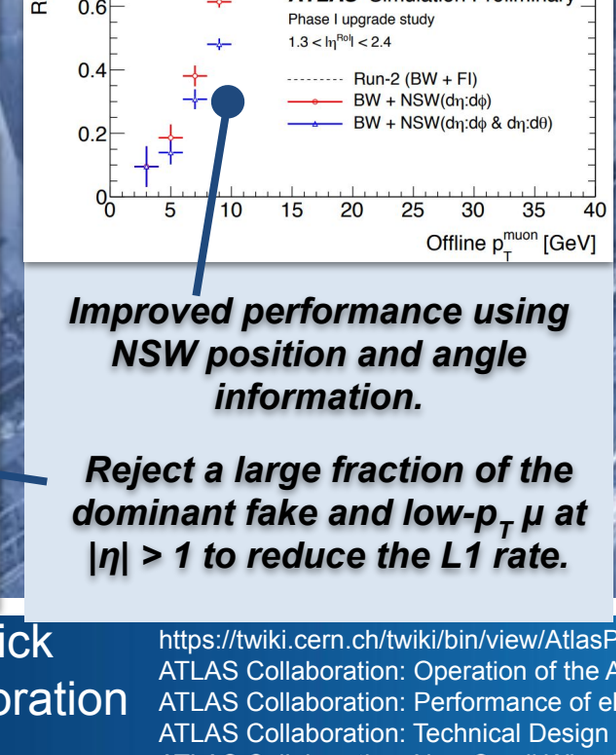
EXAMPLE: HLT EGAMMA



"Ringer" Calorimeter Reconstruction



Run 2 Electron and Photon Reconstruction Flow



Run 3 enhancements to Electron & Photon reconstruction:

- ***Higher granularity eFEX at L1, sharper turn-on curves.***
- ***In Run 2, used Trigger-specific e/γ HLT reconstruction algorithms. For Run 3, trigger uses the offline reconstruction.***
- ***In Run 2, used Sliding Window to build electromagnetic clusters. For Run 3, seed using SuperClusters.***
- ***Neural Network "Ringer" algorithm for fast reconstruction of all electron chains in Run 3, not just for p_T > 15 GeV.***
- ***New for Run 3, use of gaussian sum filter refitting of tracks for Bremsstrahlung recovery.***

Plus other slice improvements, e.g. particle-flow jet reconstruction.

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On behalf of the ATLAS collaboration
ICHEP 2020

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/TriggerOperationPublicResults
ATLAS Collaboration: Operation of the ATLAS trigger system in Run 2, arXiv:2007.12539 [physics.ins-det]
ATLAS Collaboration: Performance of electron and photon triggers in ATLAS during LHC Run 2, Eur. Phys. J. C 80 (2020) 47
ATLAS Collaboration: Technical Design Report for the Phase-I Upgrade of the ATLAS TDAQ System, CERN-LHCC-2013-018
ATLAS Collaboration: New Small Wheel Technical Design Report, CERN-LHCC-2013-006

ATLAS EXPERIMENT