The ATLAS Trigger system

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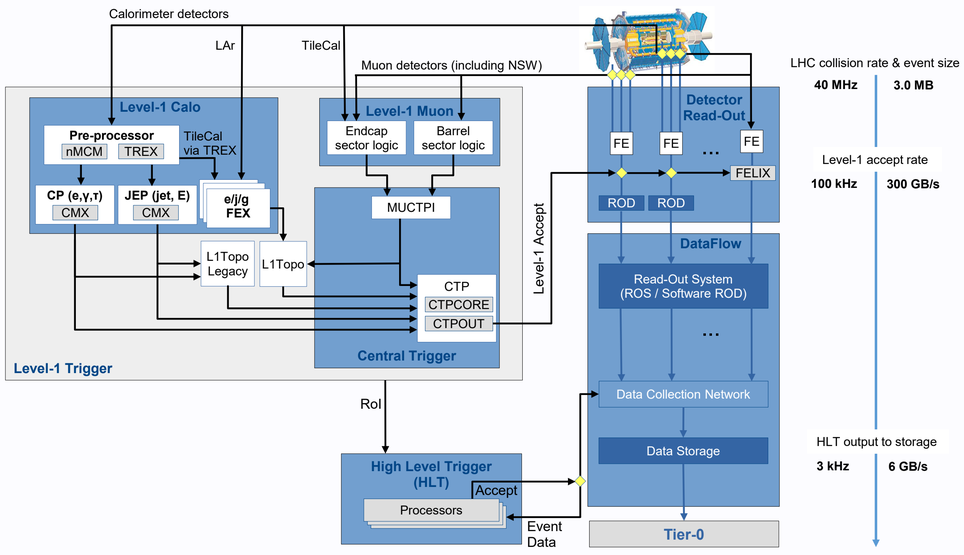
Introduction

During LS2, ATLAS trigger system underwent a **major upgrade**.

- enhance the physics reach of the experiment in Run 3 conditions



The ATLAS L1 trigger upgrades for Run 3

Goal: keep Run-2 thresholds, operate with much higher pile-up.

L1 calorimeter trigger upgrades

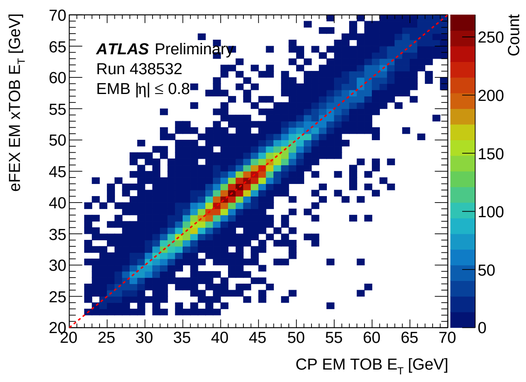
LAr calorimeter upgraded to **increase readout granularity**.

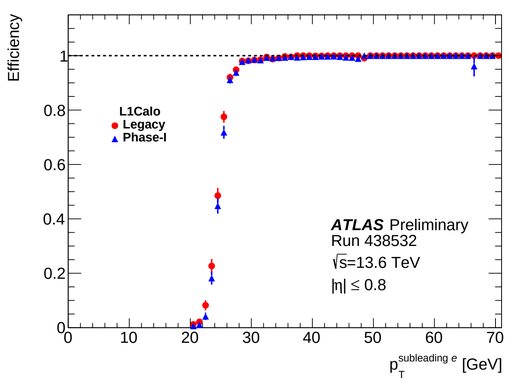
- FPGA-based Feature EXtractors (FEX)

→ e(M)FEX: clustering/shower shape/isolation for e, γ, τ

→ j(et)FEX: jet reconstruction, for jets and hadronic τ

→ g(lobal)FEX: global quantities such as $E_{\mathrm{T}}^{\mathrm{miss}}$





Run 2 system used for 2022 data-taking

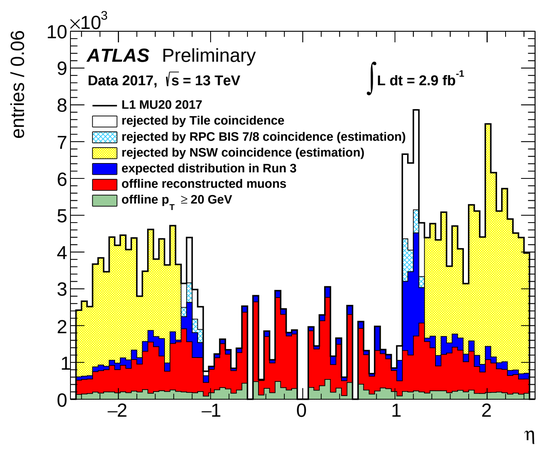
- upgraded systems undergoing **successful commissioning** [1]
- recent results show (even) better performance for Run 3 system

L1 muon trigger upgrades

Goal: extend functionality + take full advantage of new endcap detectors (NSW and BIS78) [2].

Main upgrades:

- additional thresholds and muon information
- full-granularity RoIs



NSW: focusing on sTGC pad trigger readiness for 2023 physics run.

ATLAS HLT upgrades for Run 3

Upgrades to general HLT software

Offline and HLT software migrated to common multi-threaded framework.

- more efficient use of available memory, keeping high throughput
- allows using analysis-level reconstruction software at the HLT

→ HLT algorithms adapted when necessary to fit decision latency

ATLAS HLT upgrades for Run 3 - contd.

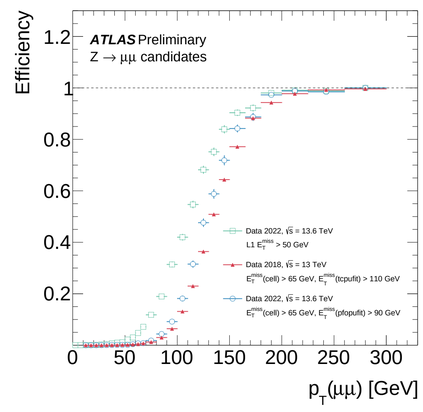
Tracking at the HLT

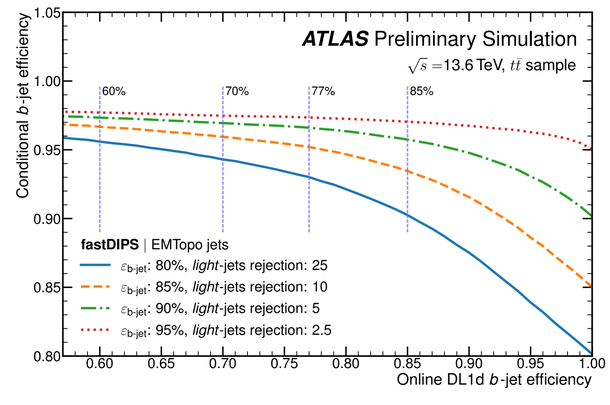
Running FS tracking for hadronic signatures.

- **improved performance** via Particle Flow/pfopufit [3]
- CPU cost too high to run on all events at the HLT - **pre-selections**

→ calorimeter-only jets/$E_{\mathrm{T}}^{\mathrm{miss}}$

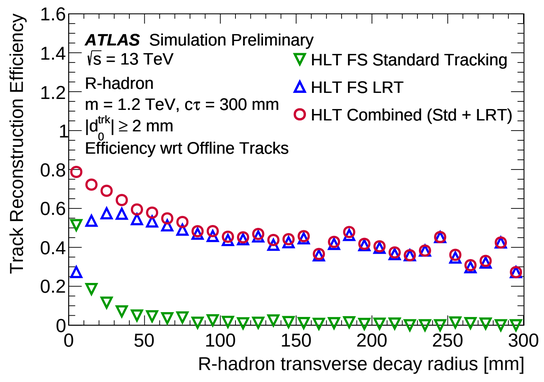
→ fast b-tagging - **small reduction in efficiency** [4]

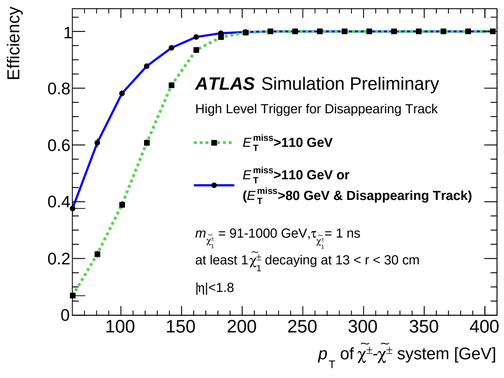




Large-Radius tracking (LRT) implemented [5]

- reconstructs tracks at large transverse impact parameter (d_0)
- used in new triggers for **long-lived particle searches**





Unconventional trigger strategies

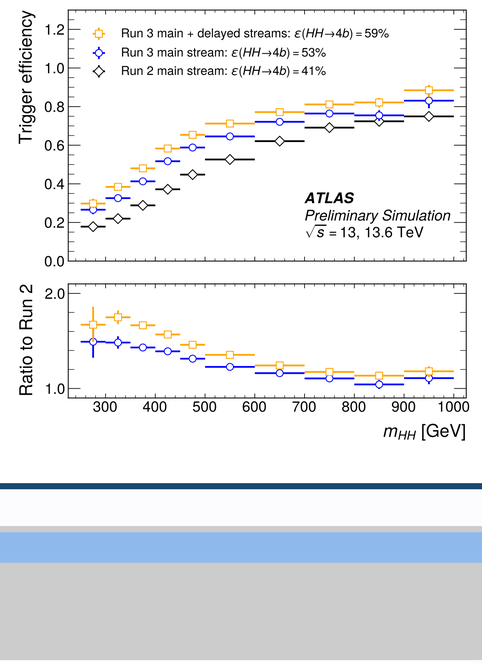
Extended delayed and trigger-level analysis (TLA) streams.

Delayed: saves full events to be processed later

- lower thresholds → **increased acceptance** [4]

TLA: only record objects used by the trigger

- extend physics reach to smaller masses/coupling strengths



References

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2. https://twiki.cern.ch/twiki/bin/view/AtlasPublic/L1MuonTriggerPublicResults
3. https://twiki.cern.ch/twiki/bin/view/AtlasPublic/MissingEtTriggerPublicResults
4. https://twiki.cern.ch/twiki/bin/view/AtlasPublic/BJetTriggerPublicResults
5. https://twiki.cern.ch/twiki/bin/view/AtlasPublic/HLTTrackingPublicResults

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