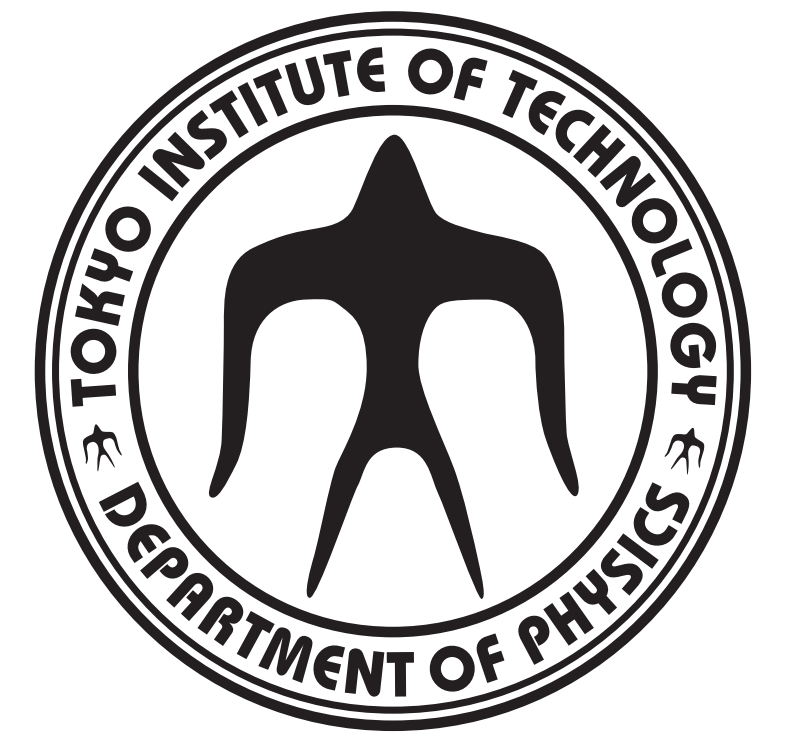


Triggering on leptons and photons on ATLAS

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on behalf of the ATLAS Collaboration



ATLAS Experiment

Motivation

- Search for new physics like SUSY or Extra Dimensions
- Precise measurement of Standard Model including Higgs boson

Detector

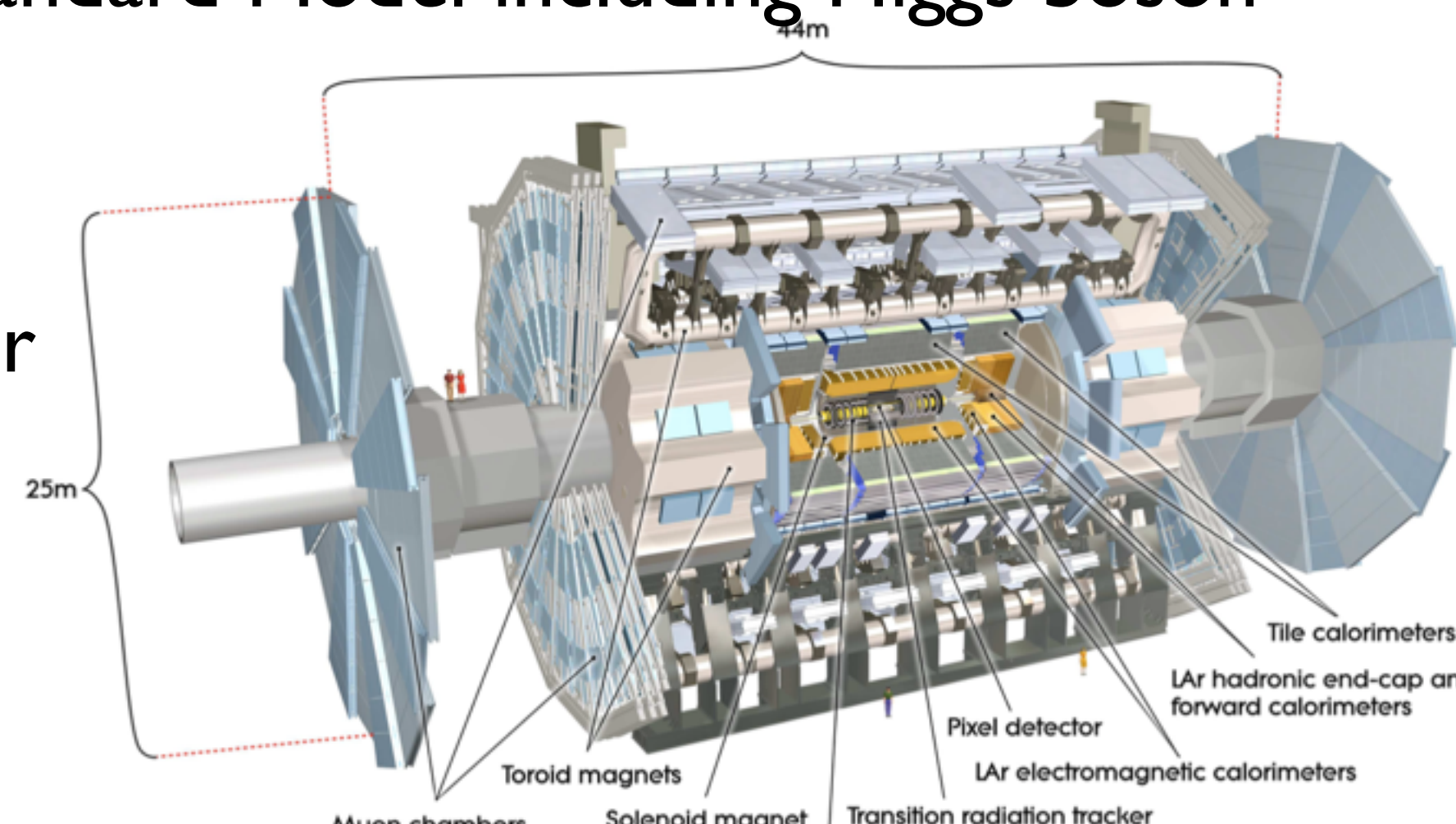
- Inner Tracker
- EM & Hadronic Calorimeter
- Muon Detector

Trigger system

- Hardware based L1 trigger
- Software based High Level Trigger (HLT)
- 40 MHz of initial collisions are decreased to 1 kHz

Run 1: $\sqrt{s} = 7-8$ TeV

Run 2: $\sqrt{s} = 13$ TeV

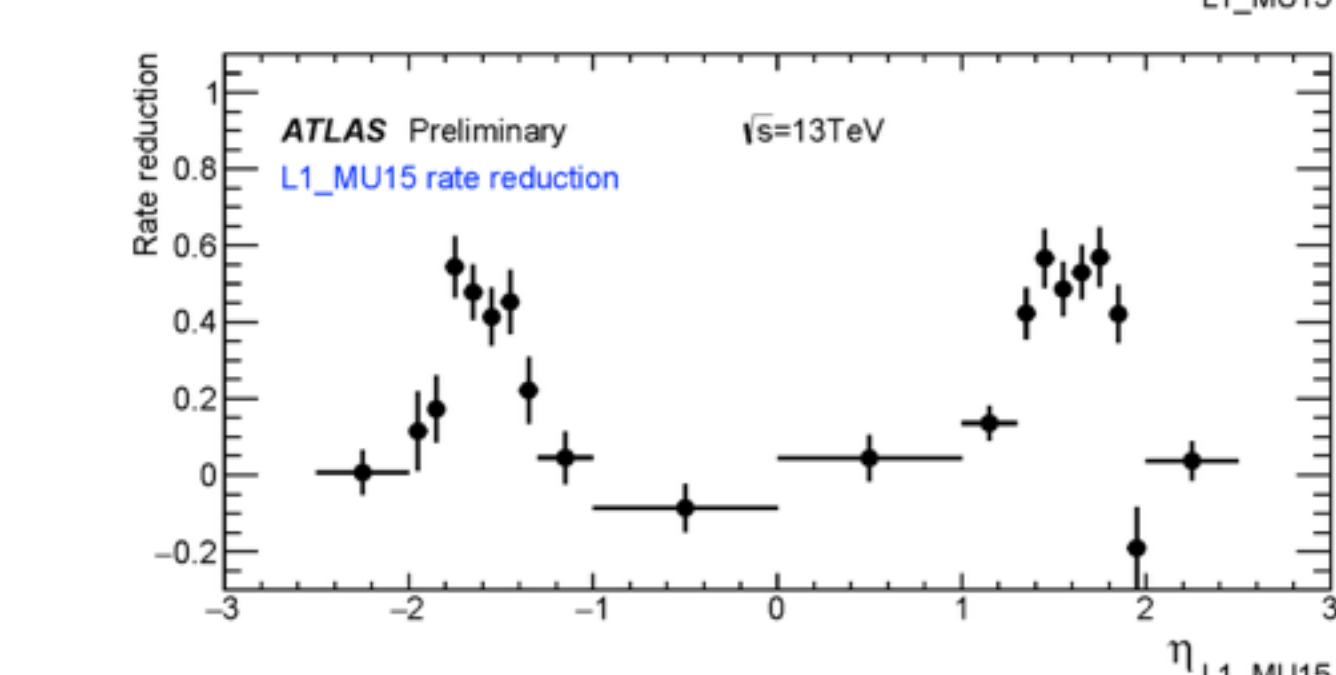
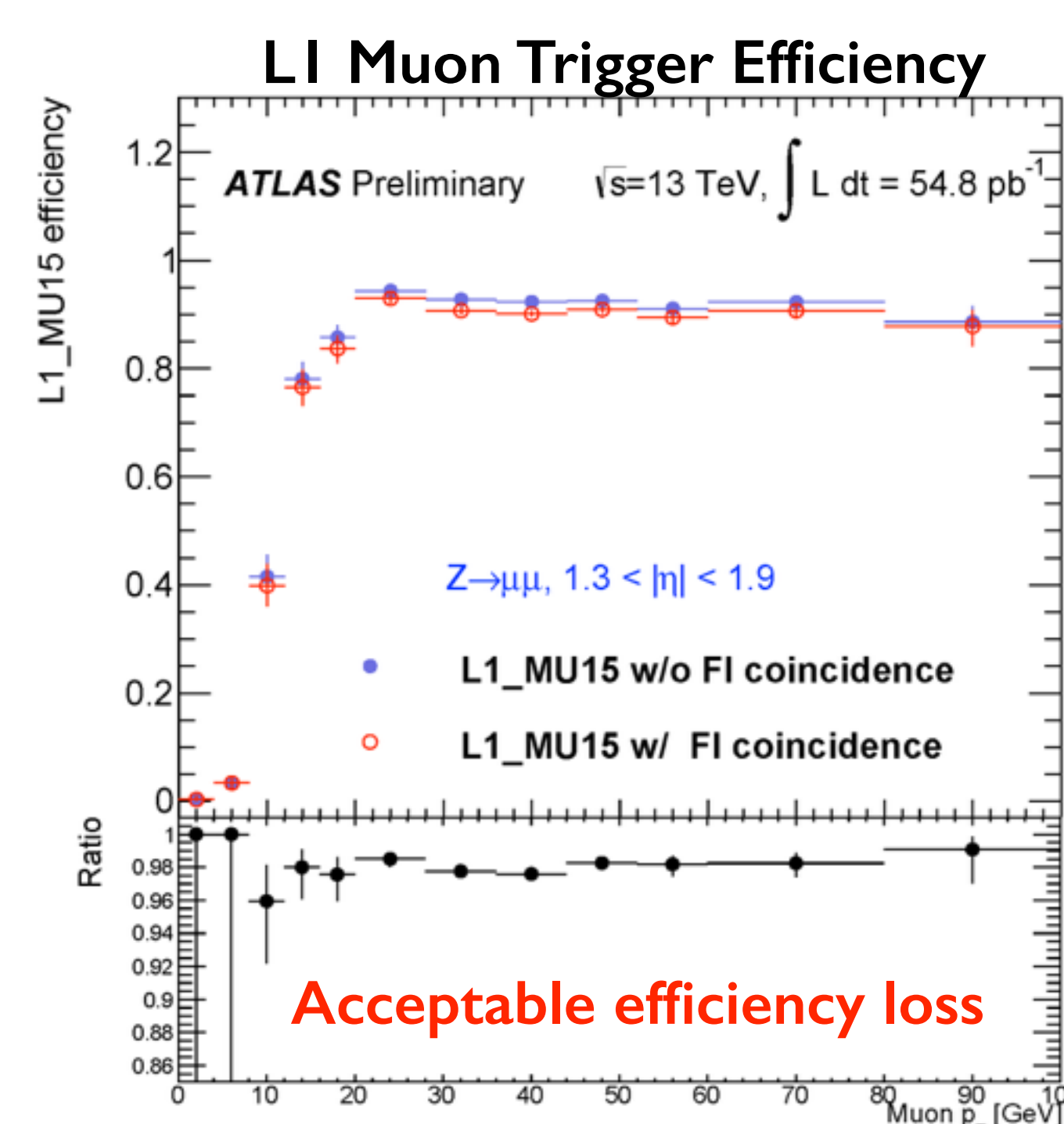
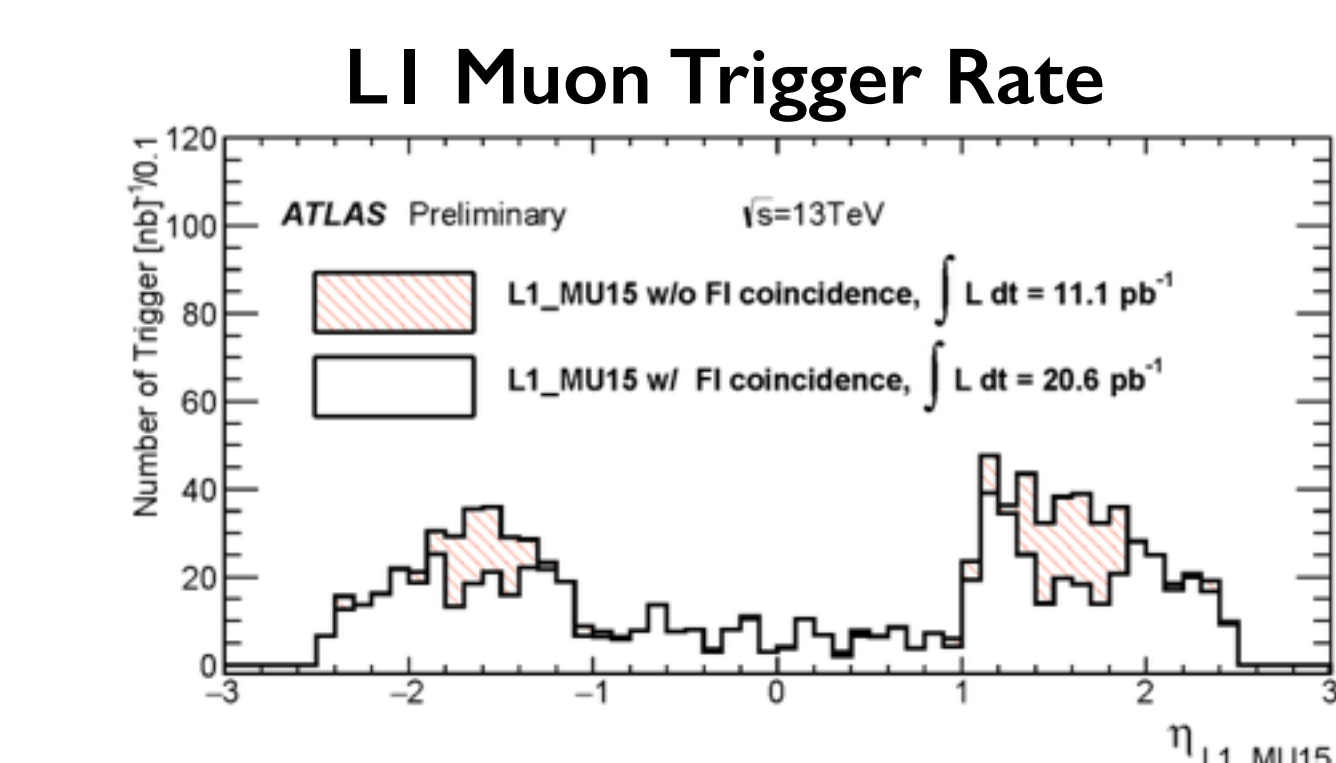
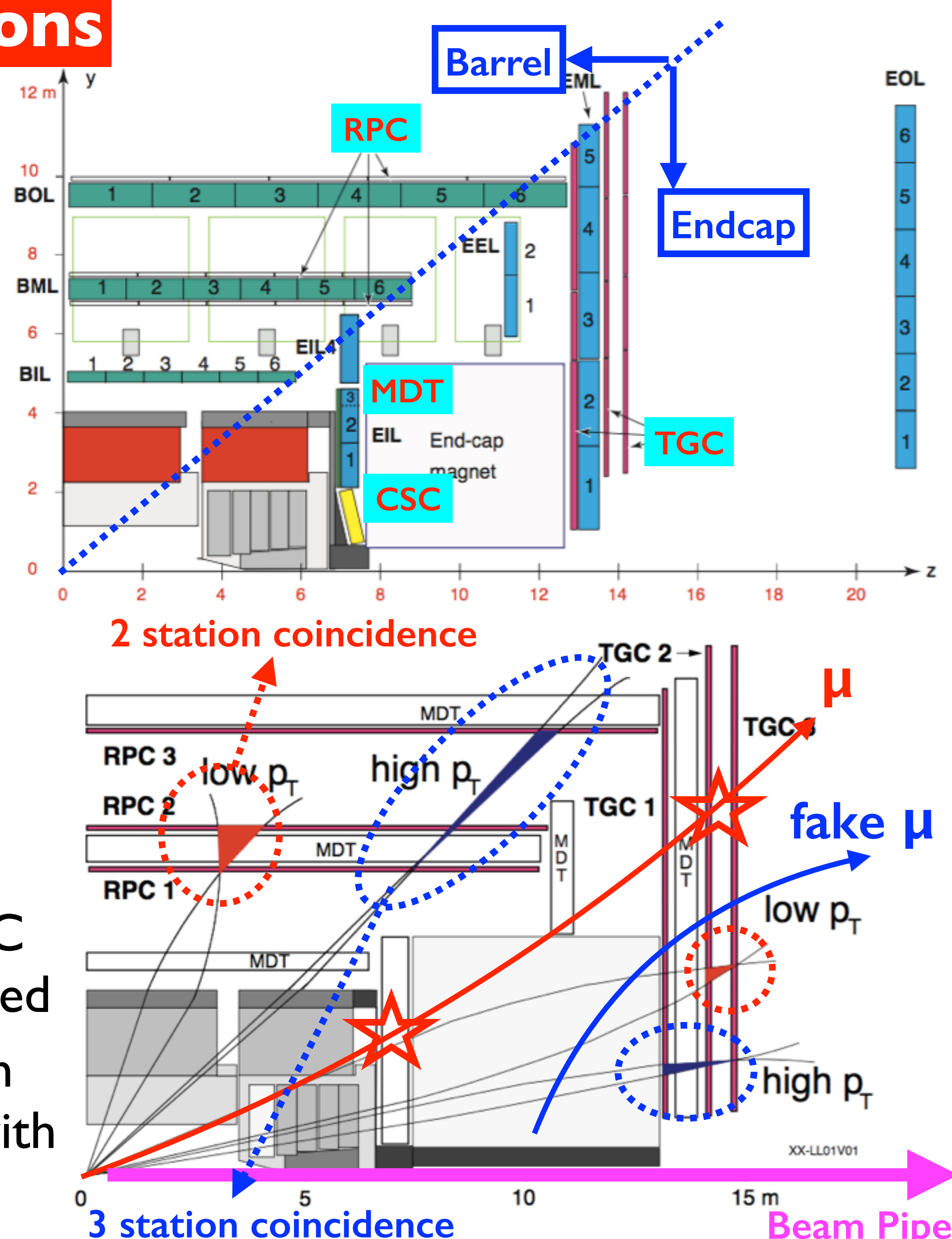


Triggering on Muons

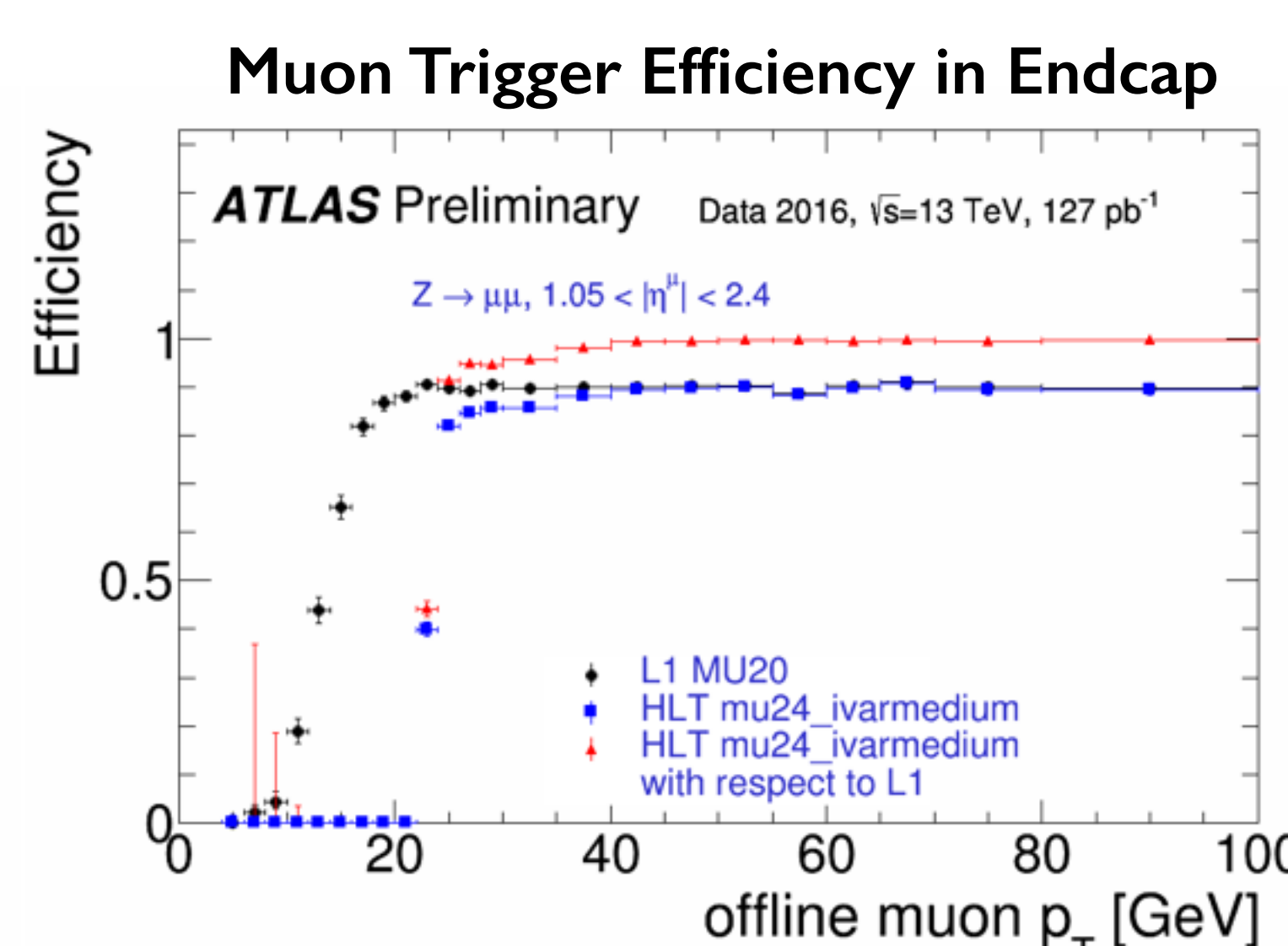
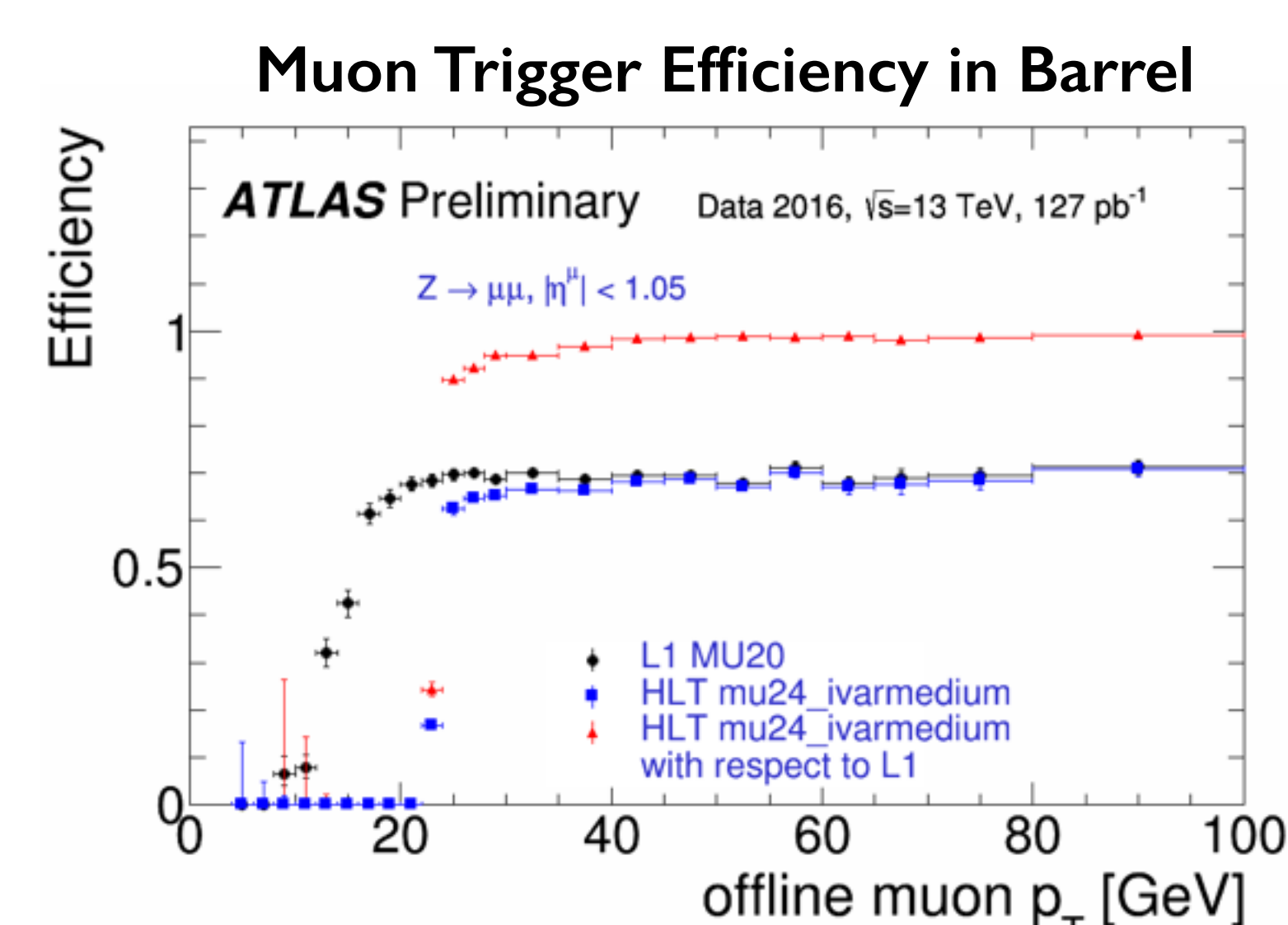
- RPC and TGC have rapid response
- ➔ Used for L1
- MDT and CSC have high resolution
- ➔ Used for HLT

L1

- 2 station coincidence for lower p_T threshold
- 3 station coincidence for higher p_T threshold
- Coincidence of Inner TGC and Middle TGC is required
- ➔ Fake muons mainly from beam pipe are reduced with negligible efficiency loss



Trigger rate is reduced by ~60%



- Plateau efficiency of L1 ~70% in Barrel, ~90% in Endcap
- Plateau efficiency of HLT w.r.t. L1 is ~99%

Triggering on Electrons & Photons

- Information from the EM and Hadronic calorimeter, Inner tracker is used for online reconstruction

L1

- Same procedure for electron and photon trigger
- Sliding-window algorithm is used for cluster reconstruction
- η dependent E_T threshold is used
- ➔ Thanks to some new modules precision of ΔE_T and granularity of $\Delta\eta$ was improved

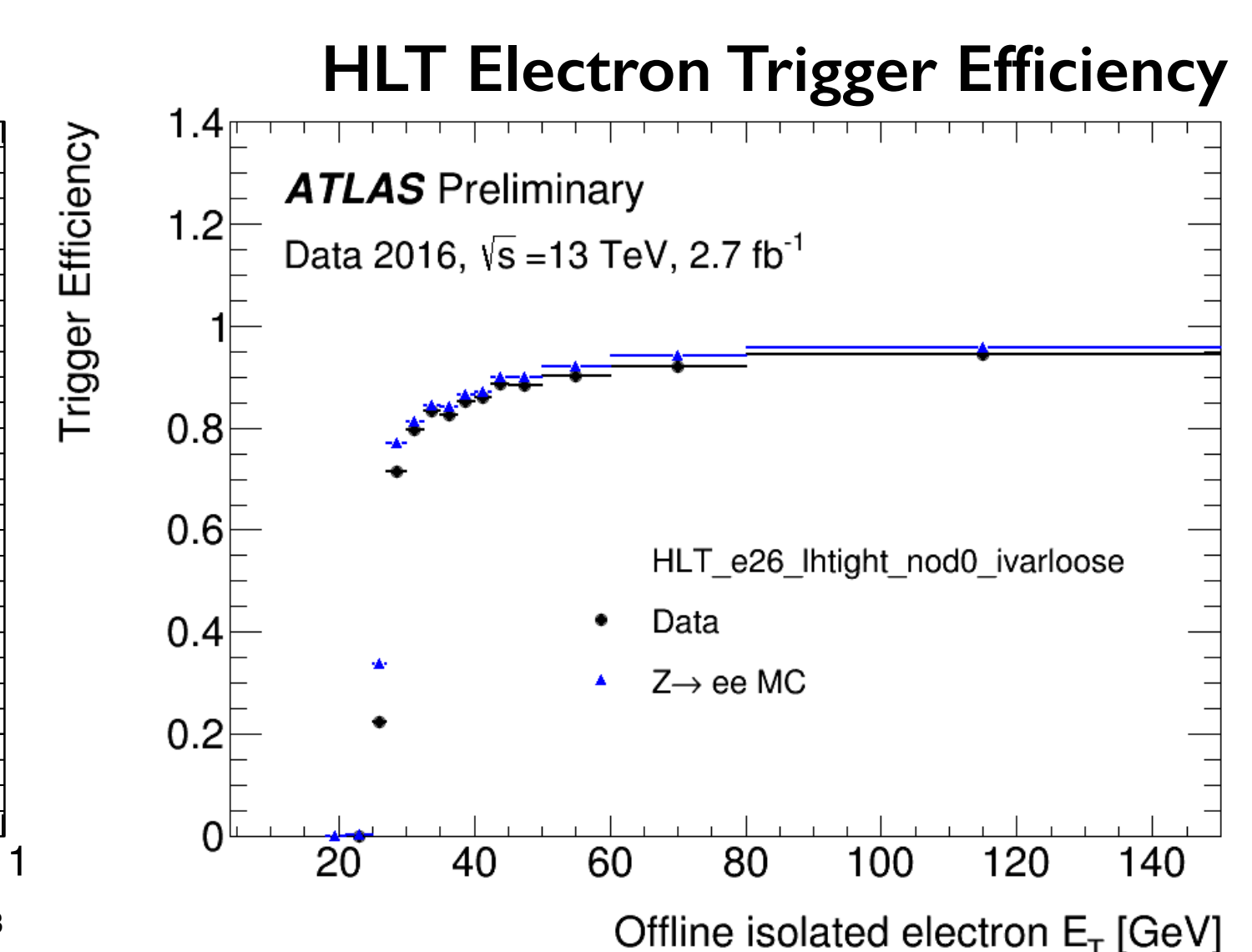
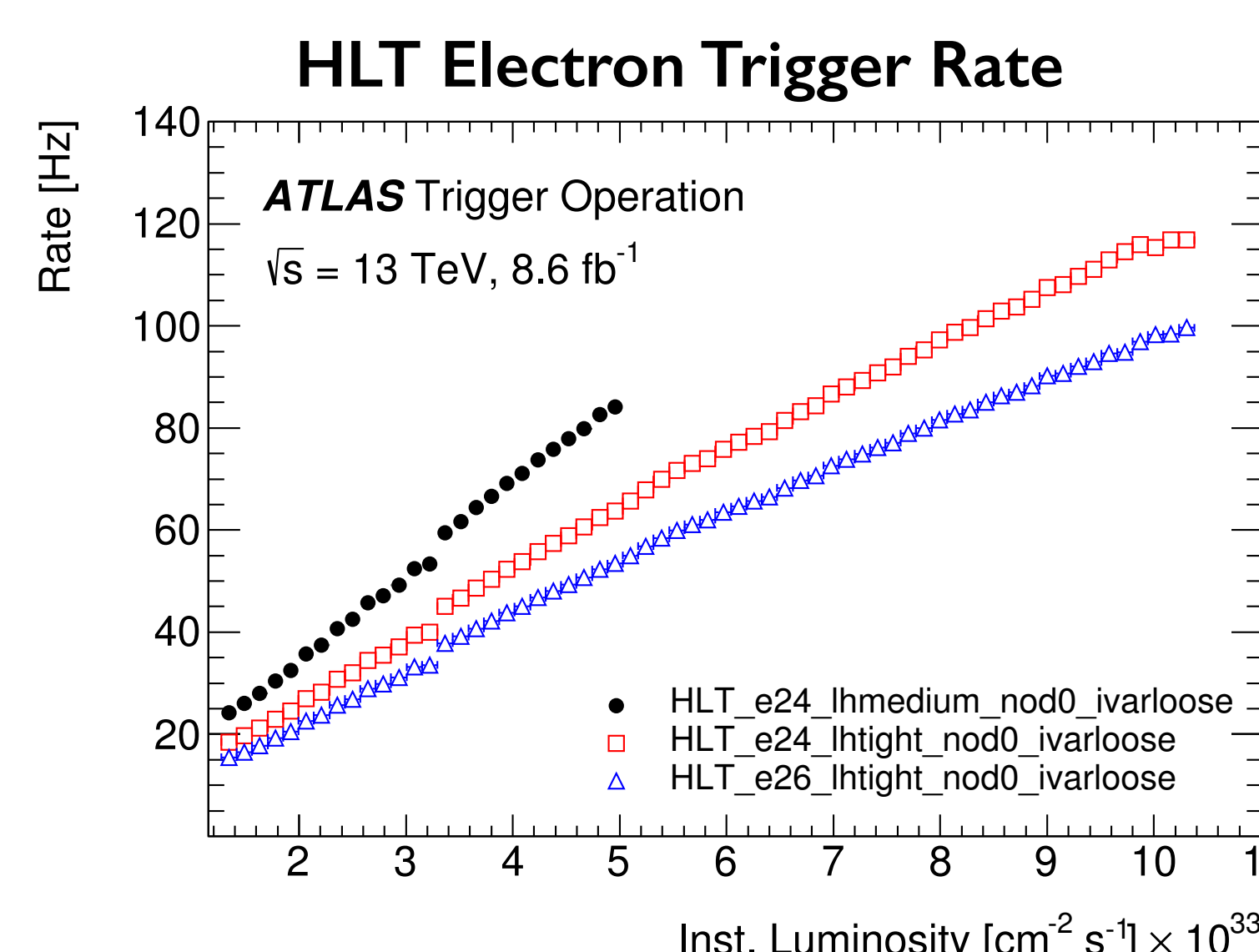
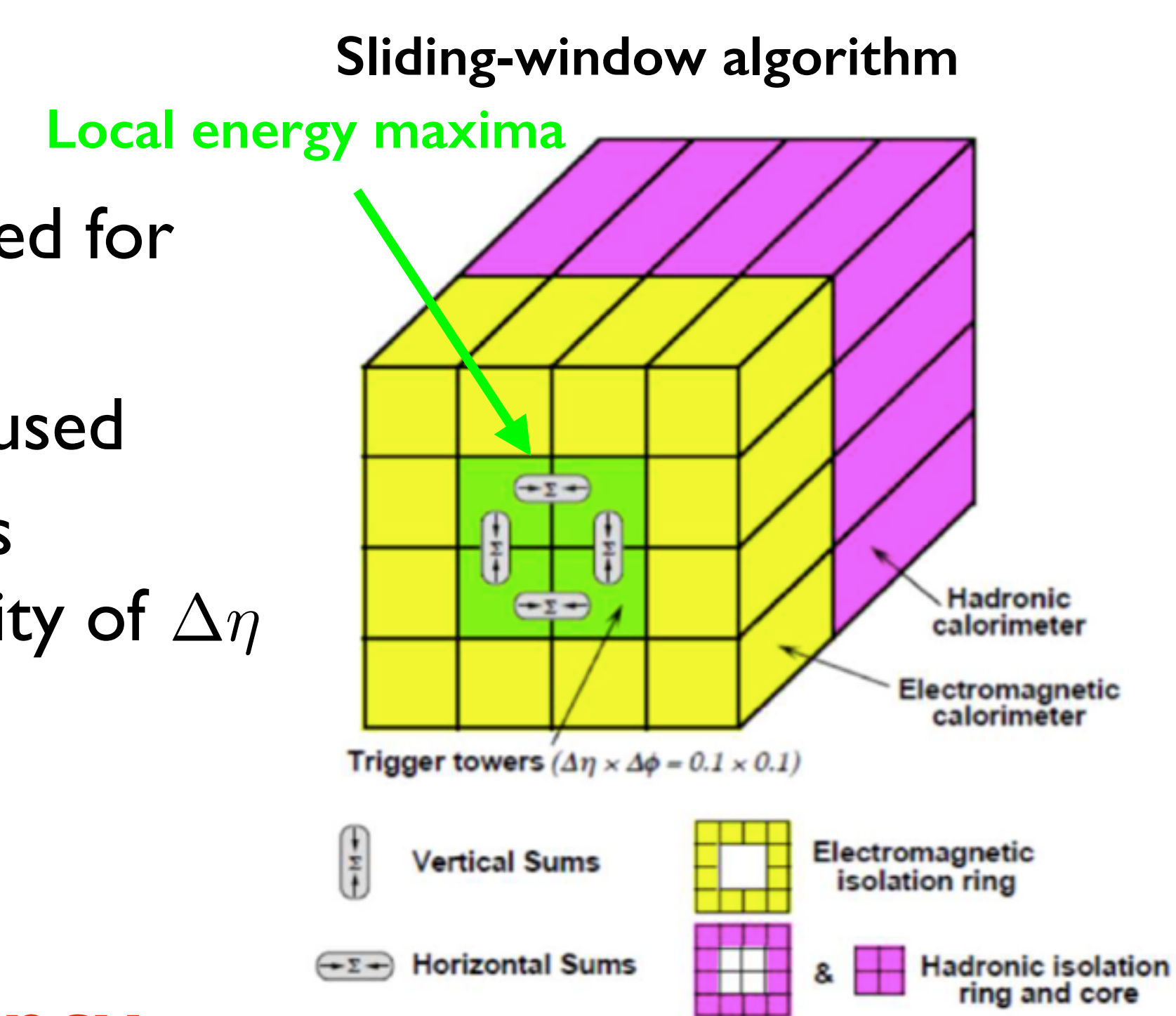
$$\Delta E_T : 1 \text{ GeV} \rightarrow 0.5 \text{ GeV}$$

$$\Delta\eta : 0.4 \rightarrow 0.1$$

➔ Better trigger efficiency

HLT requirements for Electron

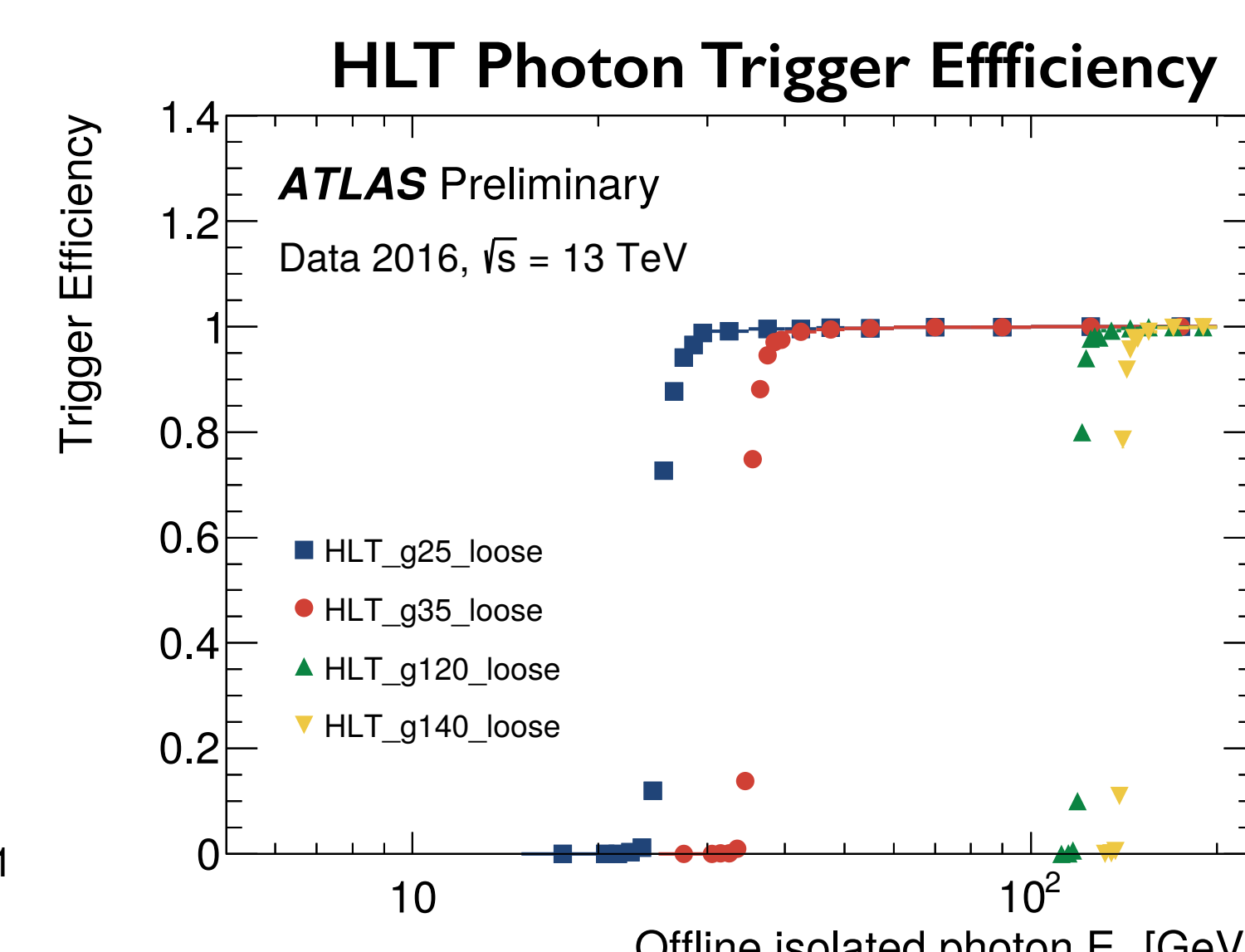
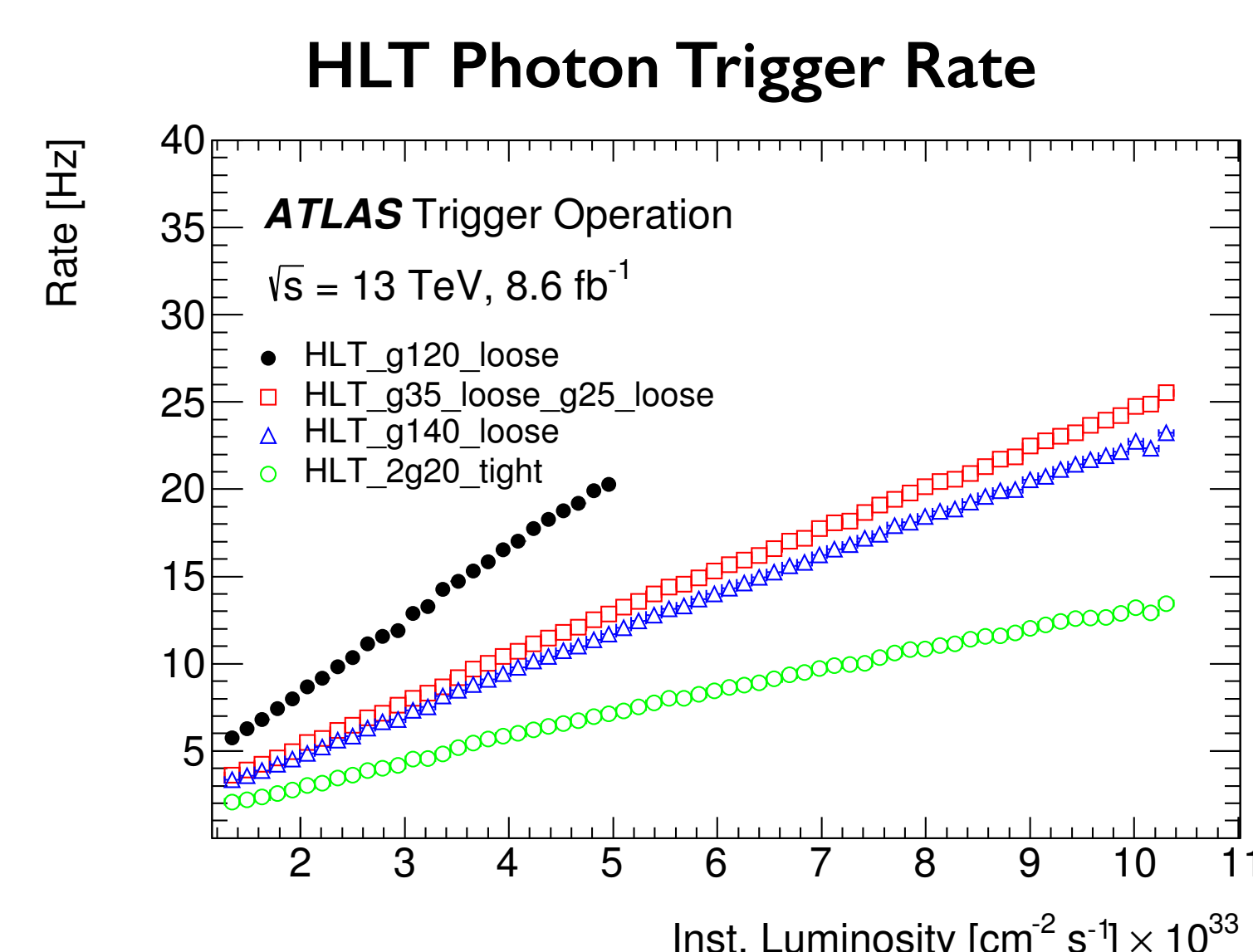
- Requirement for matching between tracks and clusters
- Some fast algorithms are skipped and **likelihood** based identification and **MVA** based calibration are introduced
- ➔ Faster and more precise online reconstruction



- Likelihood based identification results in **20% lower rate** and **6% more efficiency** than cut based one
- 90% efficiency in Barrel region for medium selection
- Excellent Data-MC agreement

HLT requirements for Photon

- No requirement for matching between tracks and clusters
- Simpler algorithm steps and **MVA** based calibration are introduced
- ➔ Faster and more precise online reconstruction



- Sufficiently low trigger rates for single and di-photon triggers
- Very high plateau efficiency of ~99.5%

Conclusion

- ➔ Lepton and Photon triggers on ATLAS have high performance, keeping sufficiently low trigger rates and thresholds