Performance of the ATLAS Muon Trigger in Run 2

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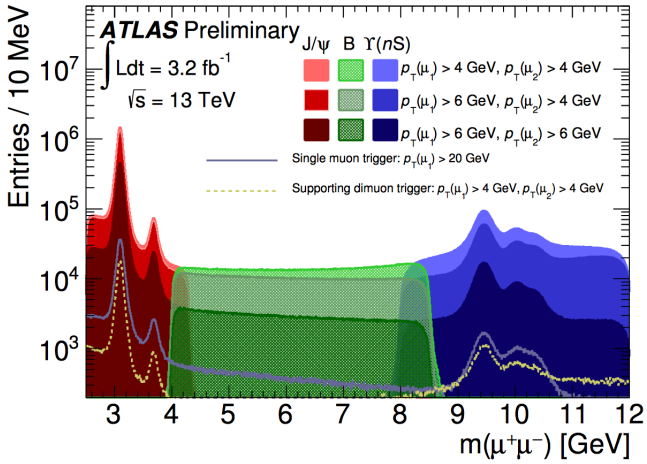
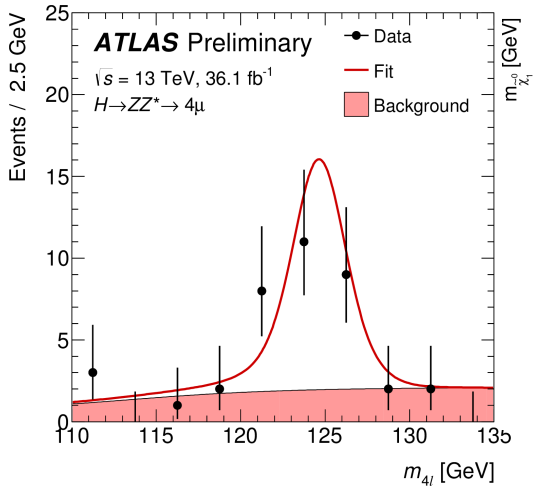
On Behalf of the ATLAS collaboration

26th International Symposium on Nuclear Electronics & Computing

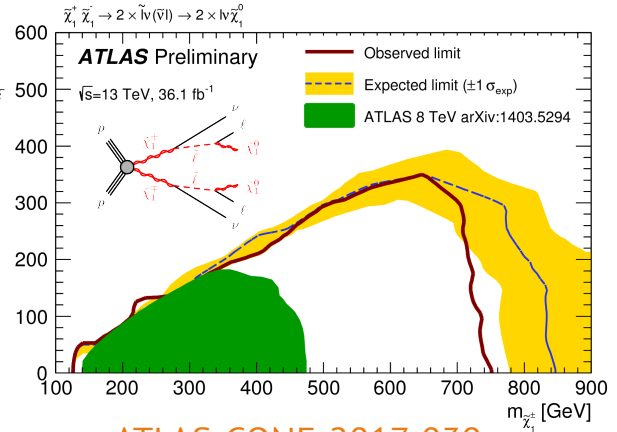
September 28th, 2017

Why triggering on muons?

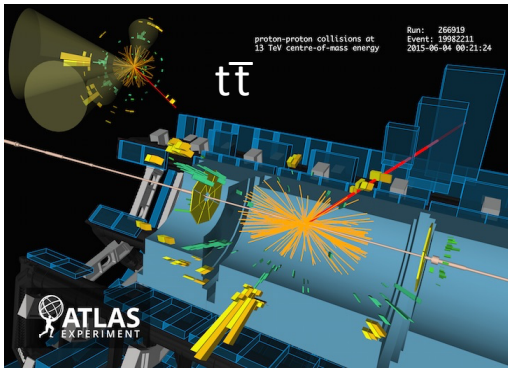


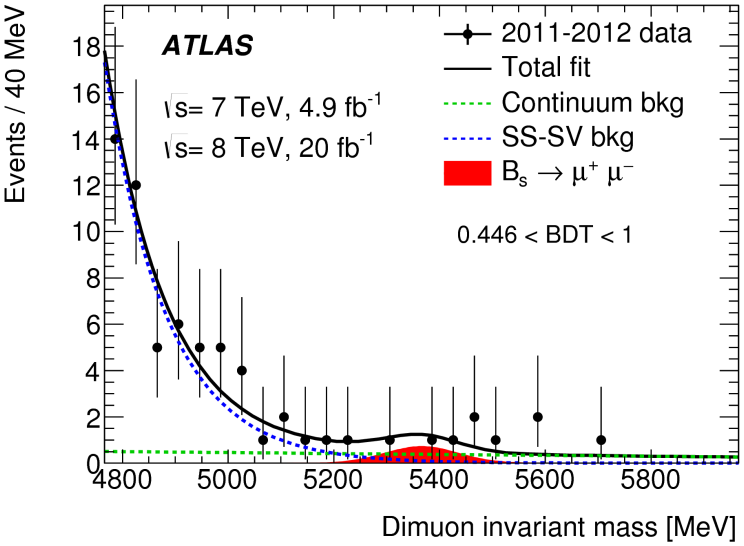


ATLAS-CONF-2017-046

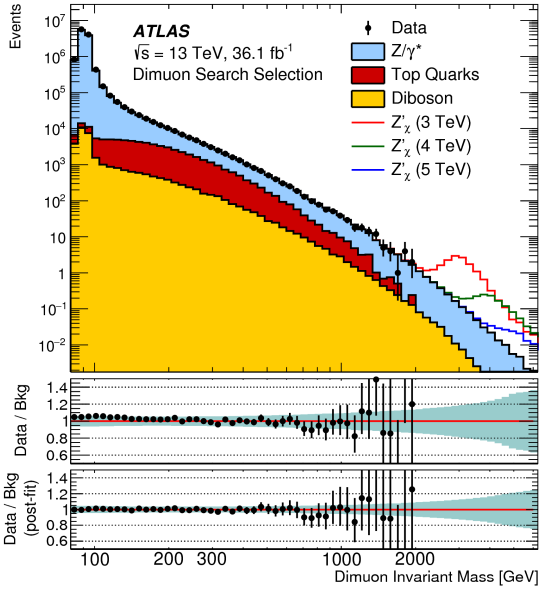


ATLAS-CONF-2017-039



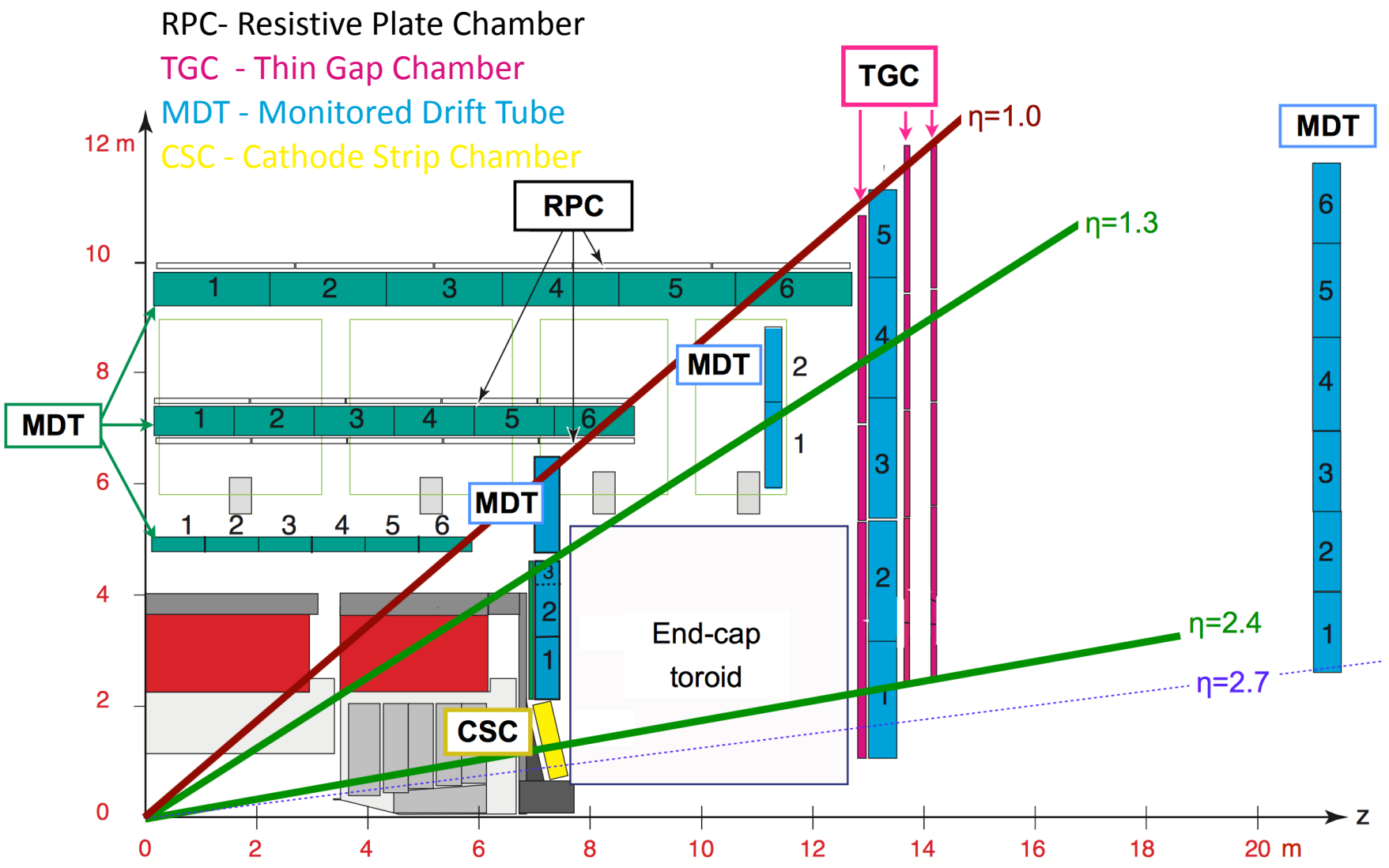


arXiv:1604.04263



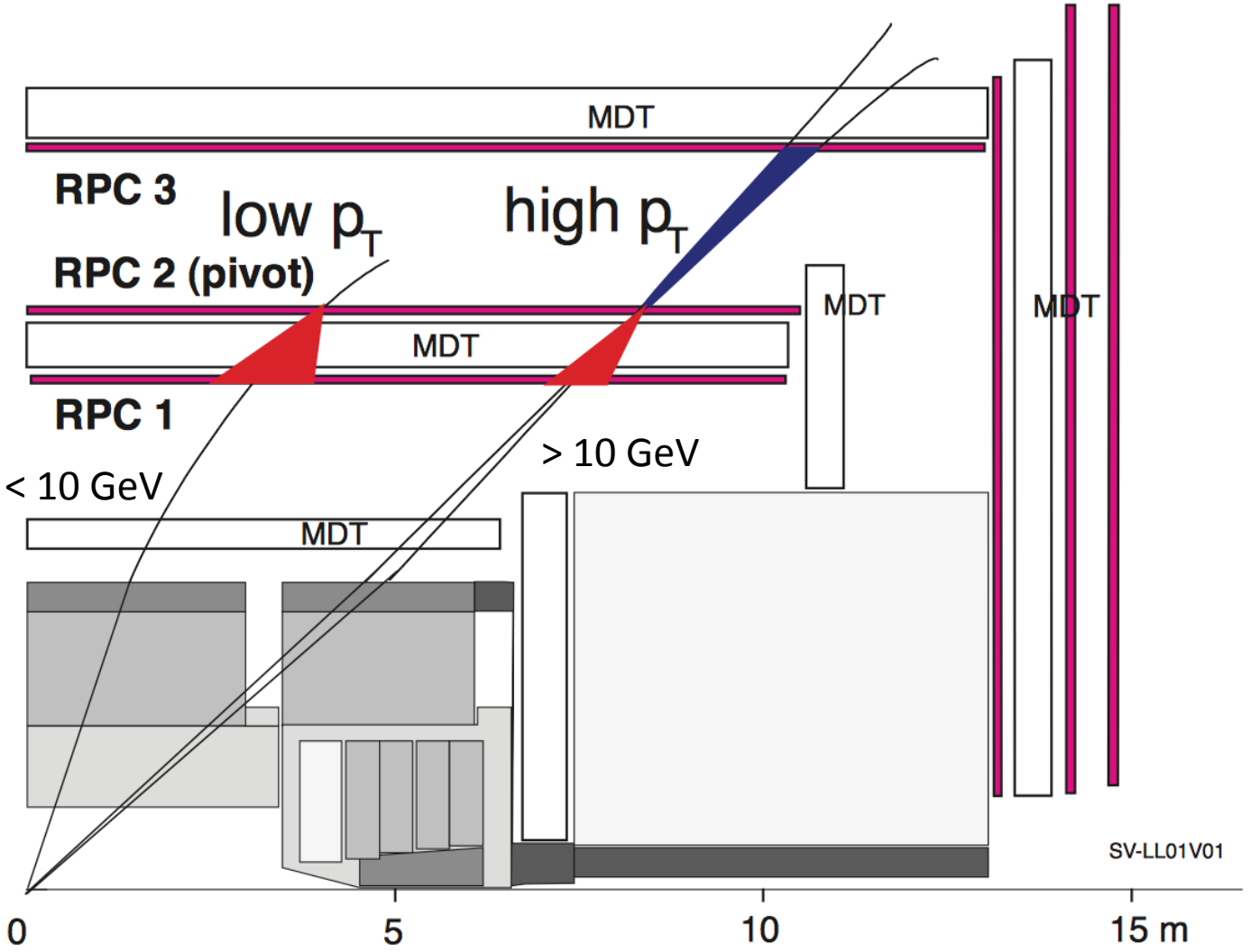
arxiv:1707.02424

Muon trigger detectors



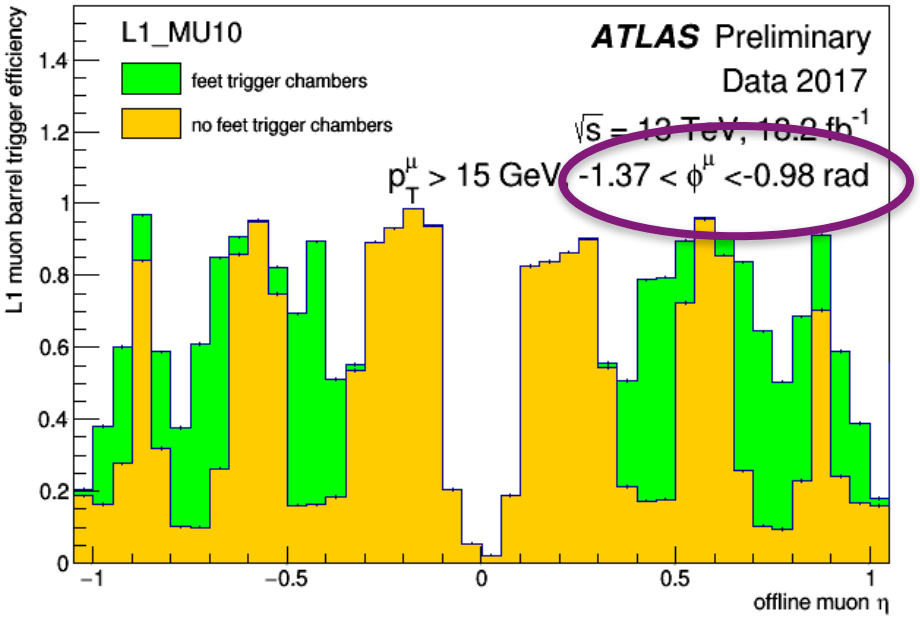
L1 muon barrel trigger

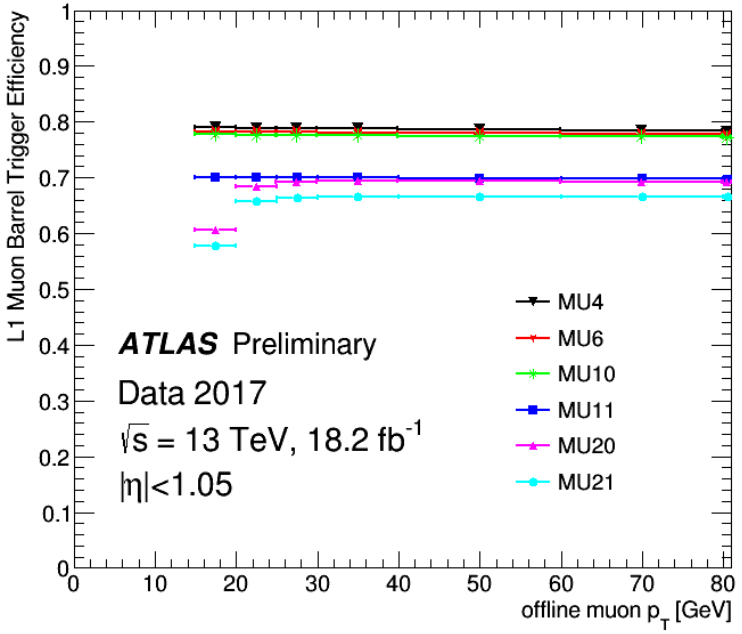
- RPC coincidence requirement depending on p_T



L1 muon barrel trigger upgrade in run-II

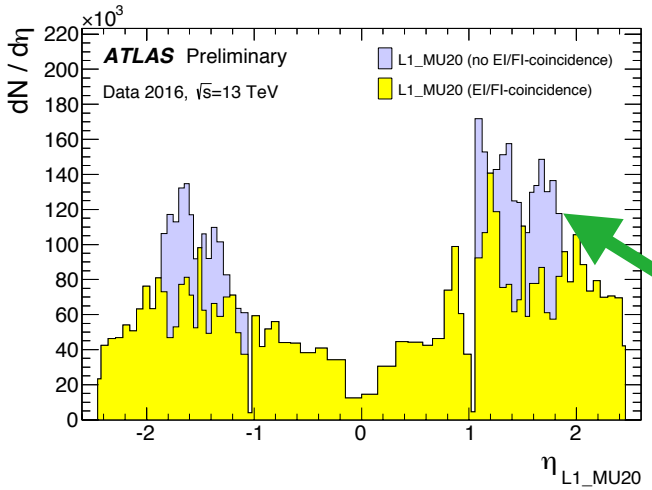
- Additional RPC chambers installed in feet region in 2015
- Increase acceptance in some regions

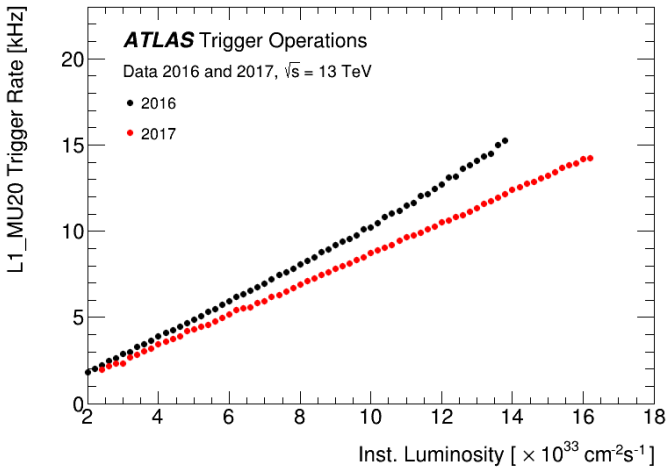


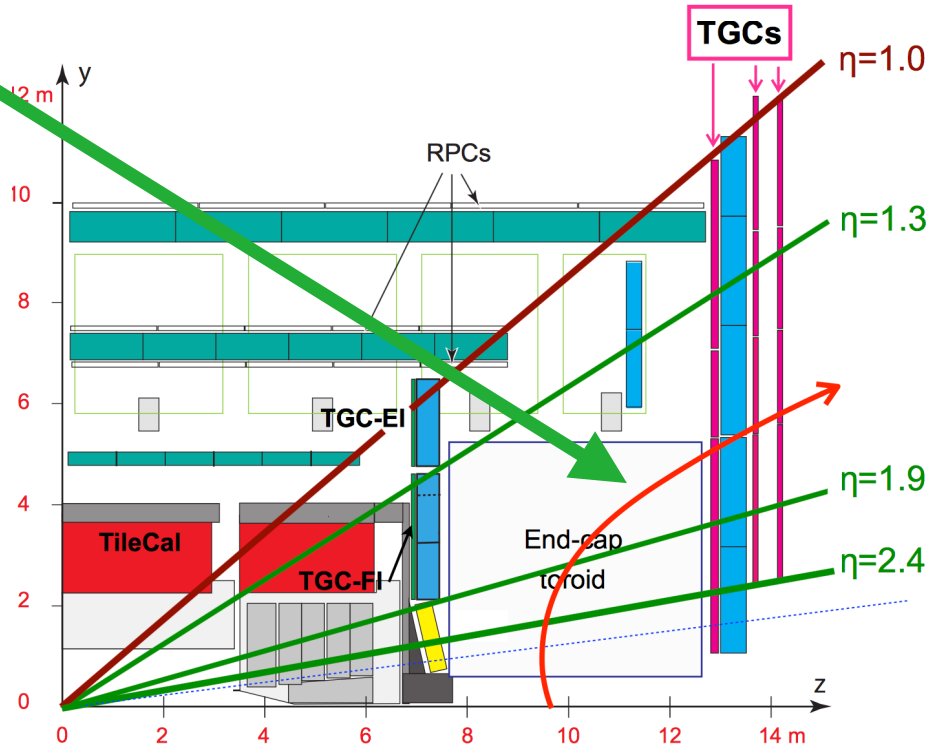


L1 muon end-cap trigger

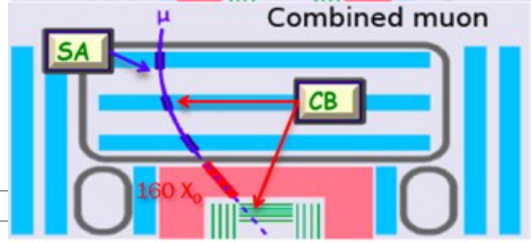
- Coincidence requirement depending on p_T
- Suppress low-p_T out-of-time protons by FI/EI coincidence requirement
- No efficiency loss

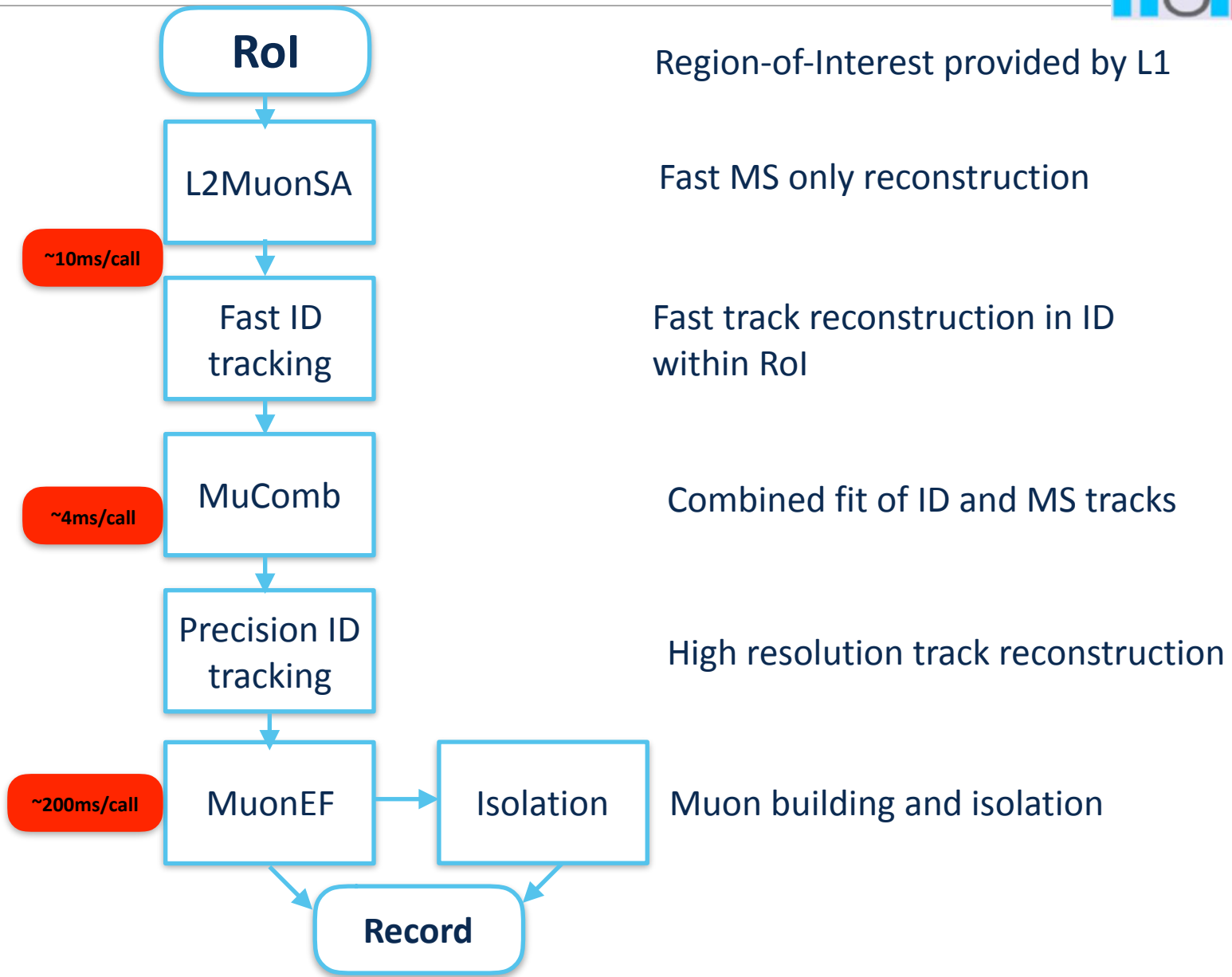






Muon trigger @ HLT - default sequence





Region-of-Interest provided by L1

Fast MS only reconstruction

Fast track reconstruction in ID within RoI

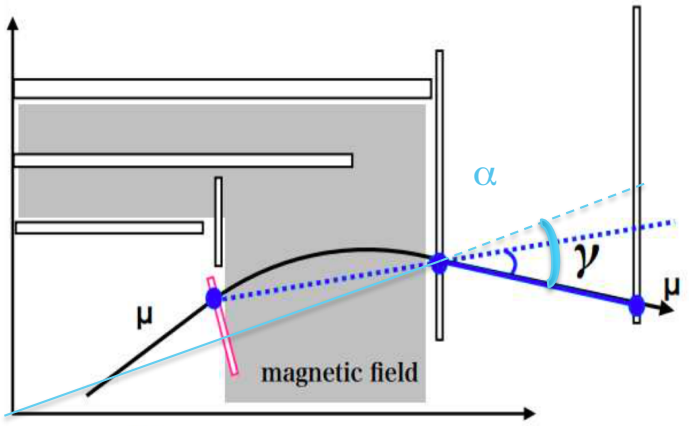
Combined fit of ID and MS tracks

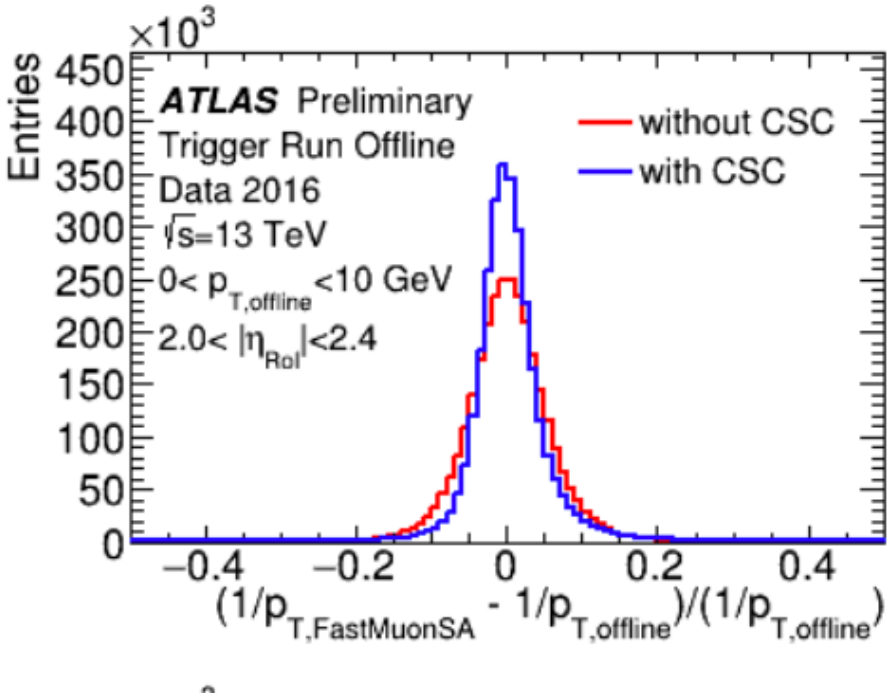
High resolution track reconstruction

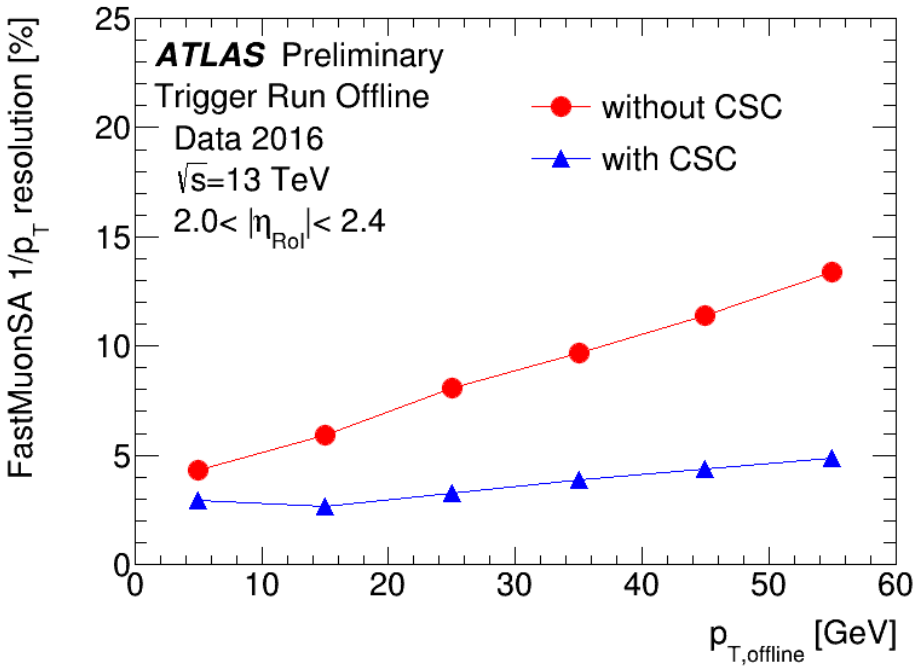
Muon building and isolation

Fast HLT p_T determination

- Exploit CSC measurement to improve p_T resolution

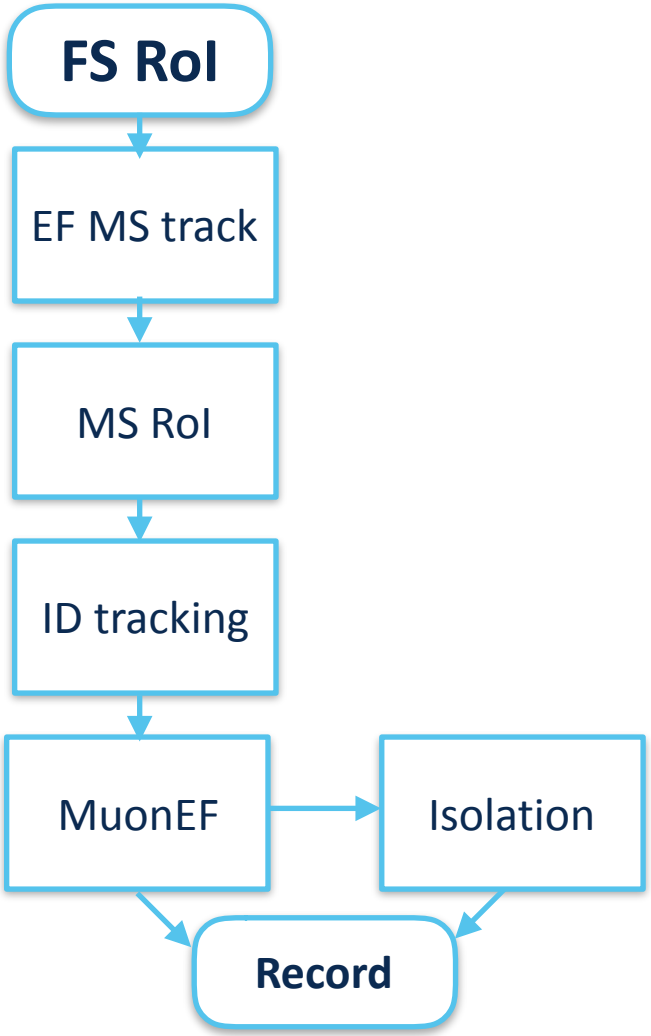






Muon trigger @ HLT - full-scan sequence

- Read-out of full detector → slow



Full scan RoI

MS track finding in whole detector

RoI building around MS tracks

ID track reconstruction

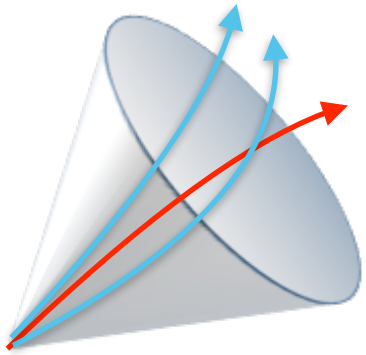
Muon building and isolation

Muon triggers

- Various combinations of muon triggers
  - Single-μ, multi-μ
  - Muon + lepton (e, τ)
  - Muon + γ
  - Muon + b-physics selection, e.g. di-μ invariant mass
  - Late muon triggers

Isolation

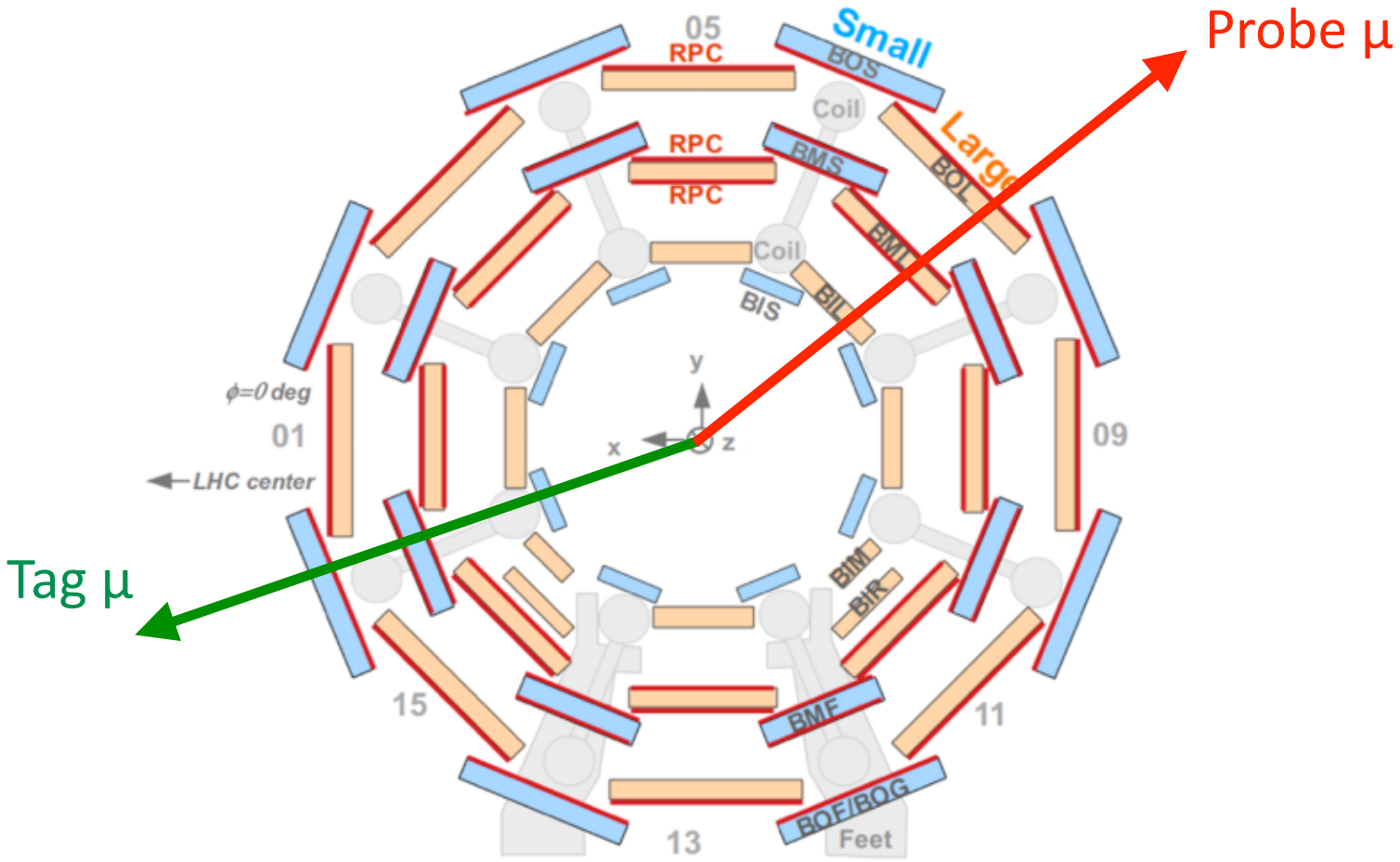
- calculated in p_T dependent isolation cone
- Fractional cut on track p_T sum within cone



No of muons	L1 threshold [GeV]	HLT threshold [GeV]	Isolation	L1 rate [kHz]	HLT rate [kHz]
1	20	26	Yes	13	133
1	20	50	No	20	48
2	10,10	14, 14	No	1.5	21
2	20	22, 8 (FS)	No	13	30

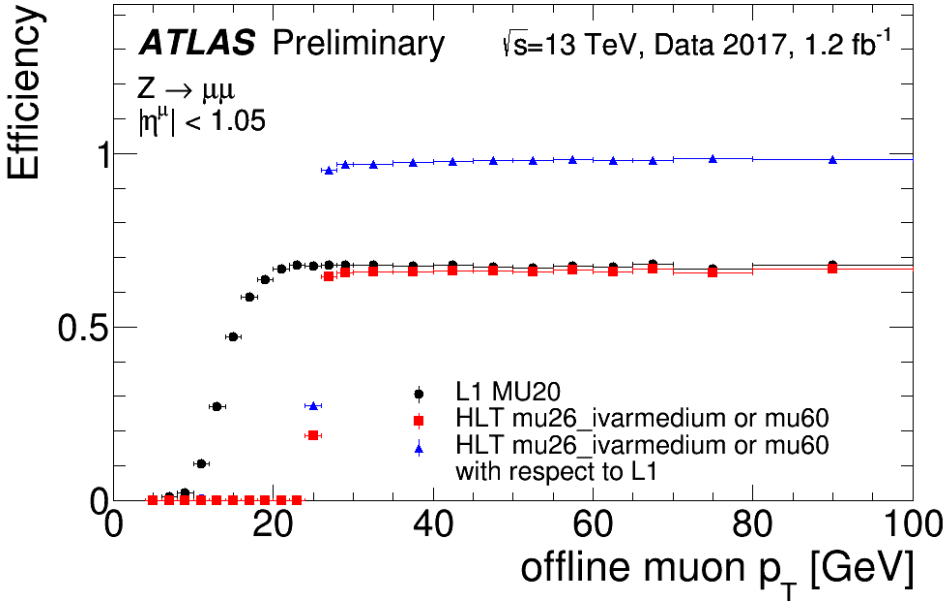
Efficiency measurement (I)

- Exploit di-muon events ($Z \rightarrow \mu\mu$ and $J/\psi \rightarrow \mu\mu$) in Tag-and-Probe efficiency measurement

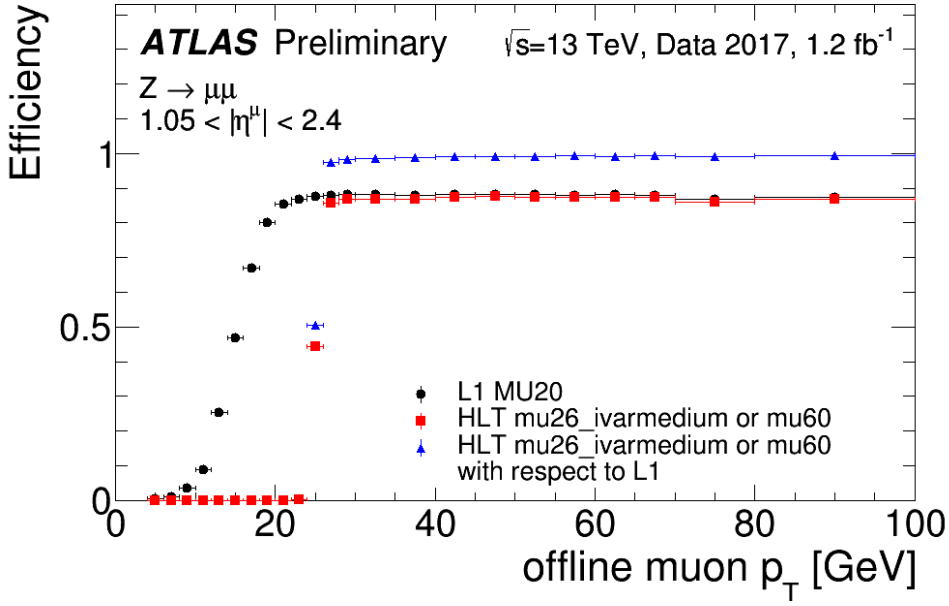


Efficiency measurement (II)

- Measure efficiency in Z→$\mu\mu$ w.r.t several kinematic quantities (p_T, η, ϕ, μ)
- Sharp turn-on for HLT
- L1 efficiency limited by hit efficiency and acceptance
- ~100% efficiency @ HLT w.r.t L1 decision



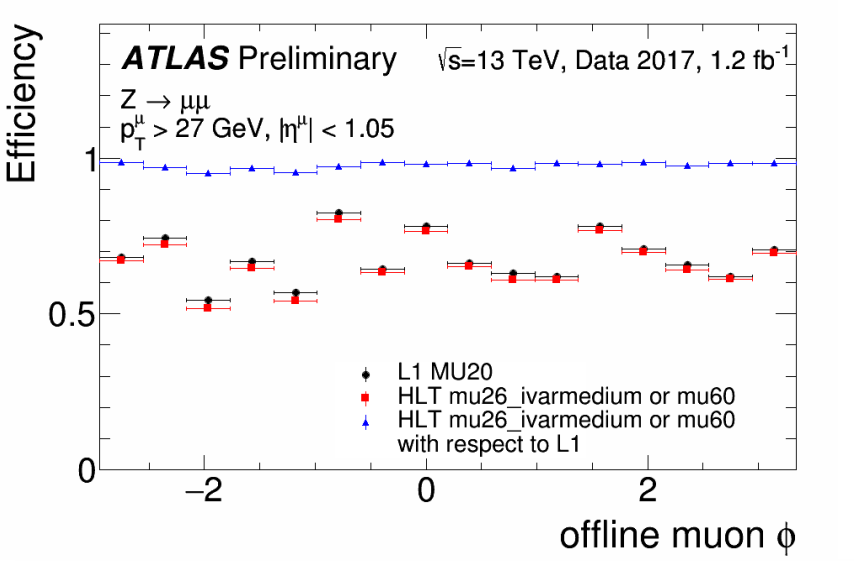
Barrel

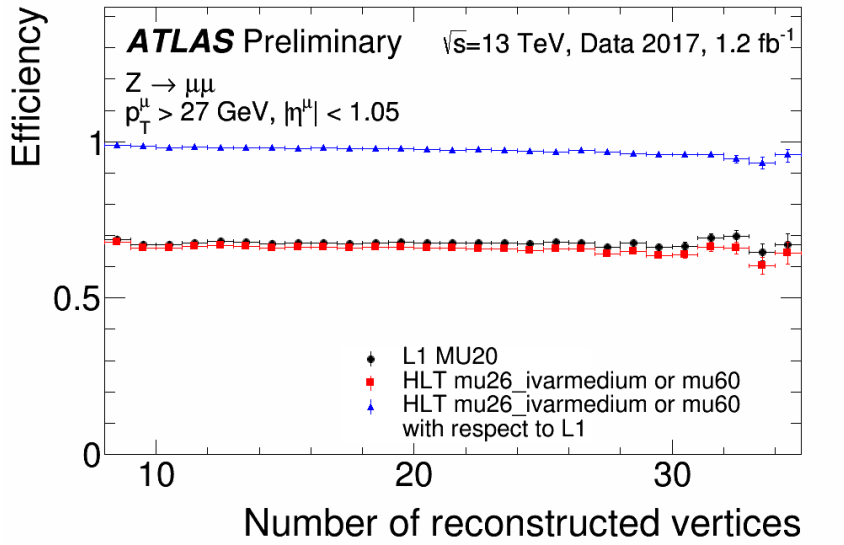


End-cap

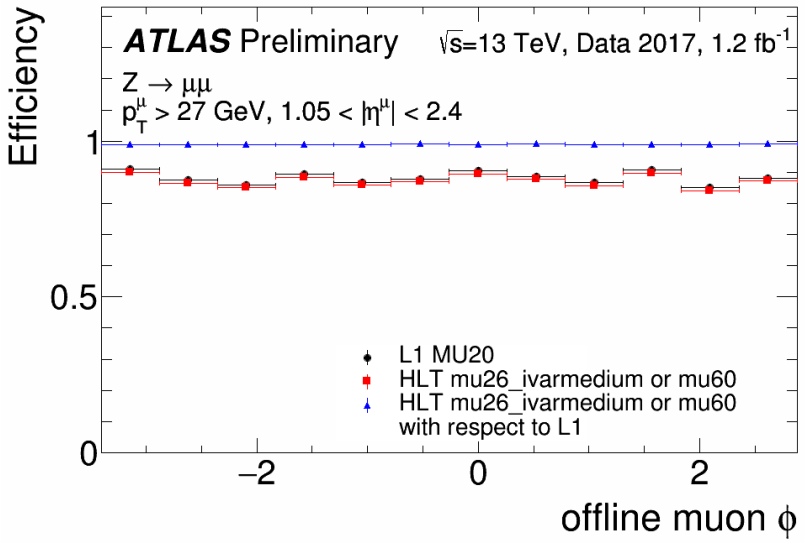
Efficiency measurement (III)

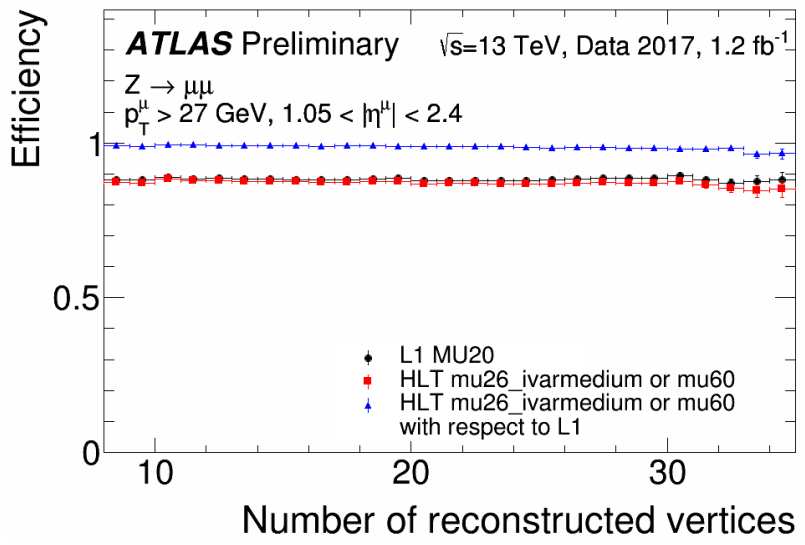
Barrel





End-cap





Summary

- Muon trigger important to fulfil ATLAS' physics program
- Successful operations during run-II
- Several upgrades/improvements to cope with run-II challenges
  - New RPC feet chambers
  - FI/EI coincidence for end-cap L1 trigger
  - Algorithmic improvements to reduce CPU cost
- Excellent performance of muon triggers