Available on CMS information server

CMS DP -2018/034

The Compact Muon Solenoid Experiment

CMS Performance Note

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland

26 June 2018

Muon HLT Performance with 2018 Data

CMS Collaboration

Abstract

The performance of the muon triggers is presented for the data collected in 2018, corresponding to an integrated luminosity of 11.8 fb^{-1} at 13 TeV. The data are split with respect to the HLT muon reconstruction update deployed this year.

Muon HLT Performance with 2018 data

CMS Collaboration

Contacts: cms-tsg-steam-conveners@cern.ch

cms-trigger-coordinator@cern.ch

Introduction

- On 15th May 2018, the muon reconstruction at high level trigger (HLT) was updated
  - More seeds for the muon track building are generated to improve the efficiency
  - One more iterative tracking is added to the muon tracking algorithm to improve the efficiency
  - A simple ID on HLT muons is applied to keep high purity with lower rate
- In these slides, the efficiency of muon triggers will be shown with 2018 data
  - Comparison of the efficiencies before and after the HLT muon reconstruction update
  - Two kinds of the triggers will be presented
    - Isolated single muon trigger with $P_T > 24$ GeV
    - Non-isolated single muon trigger with $P_T > 50$ GeV

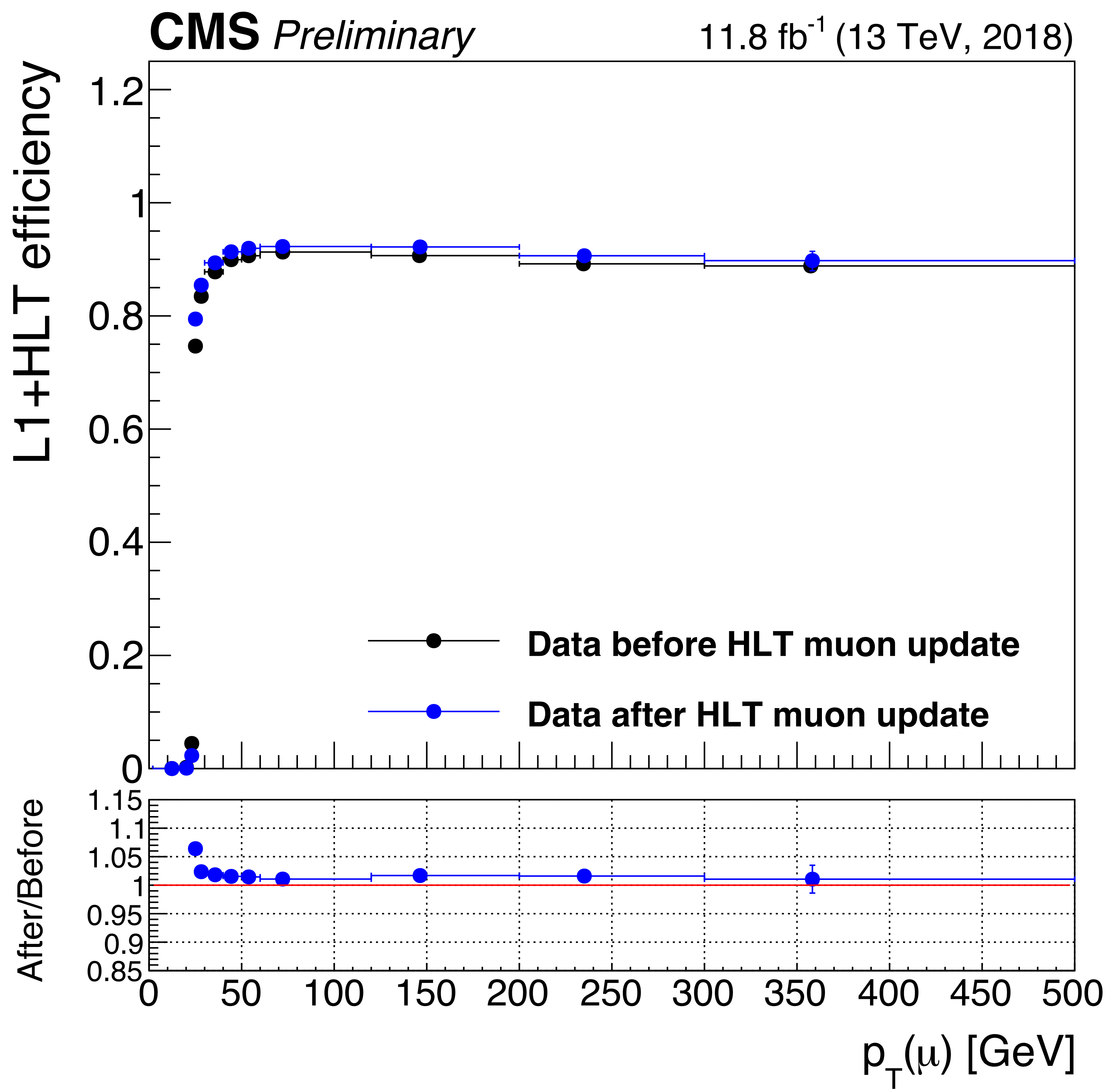
Setup for Trigger Efficiencies

- The trigger efficiencies are measured with the data collected in 2018 corresponding to an integrated luminosity of 11.8 fb^{-1}
  - Before HLT muon update: 7.7 fb^{-1}
  - After HLT muon update: 4.1 fb^{-1}

- Efficiencies are estimated using Tag and Probe (T&P) method using $Z \rightarrow \mu\mu$ events
  - Tag is an offline muon with $P_T > 29$ GeV and $|\eta| < 2.4$ passing a tight identification criteria ensuring the high purity
  - Probe definition is different for each trigger efficiency
    - The definition will be explained in the captions
  - Tag & probe invariant mass should be within [70, 130] GeV mass range
  - The background events are subtracted by the fit on dimuon invariant mass distribution with Double Voigtian (signal) and Exponential (background) functions

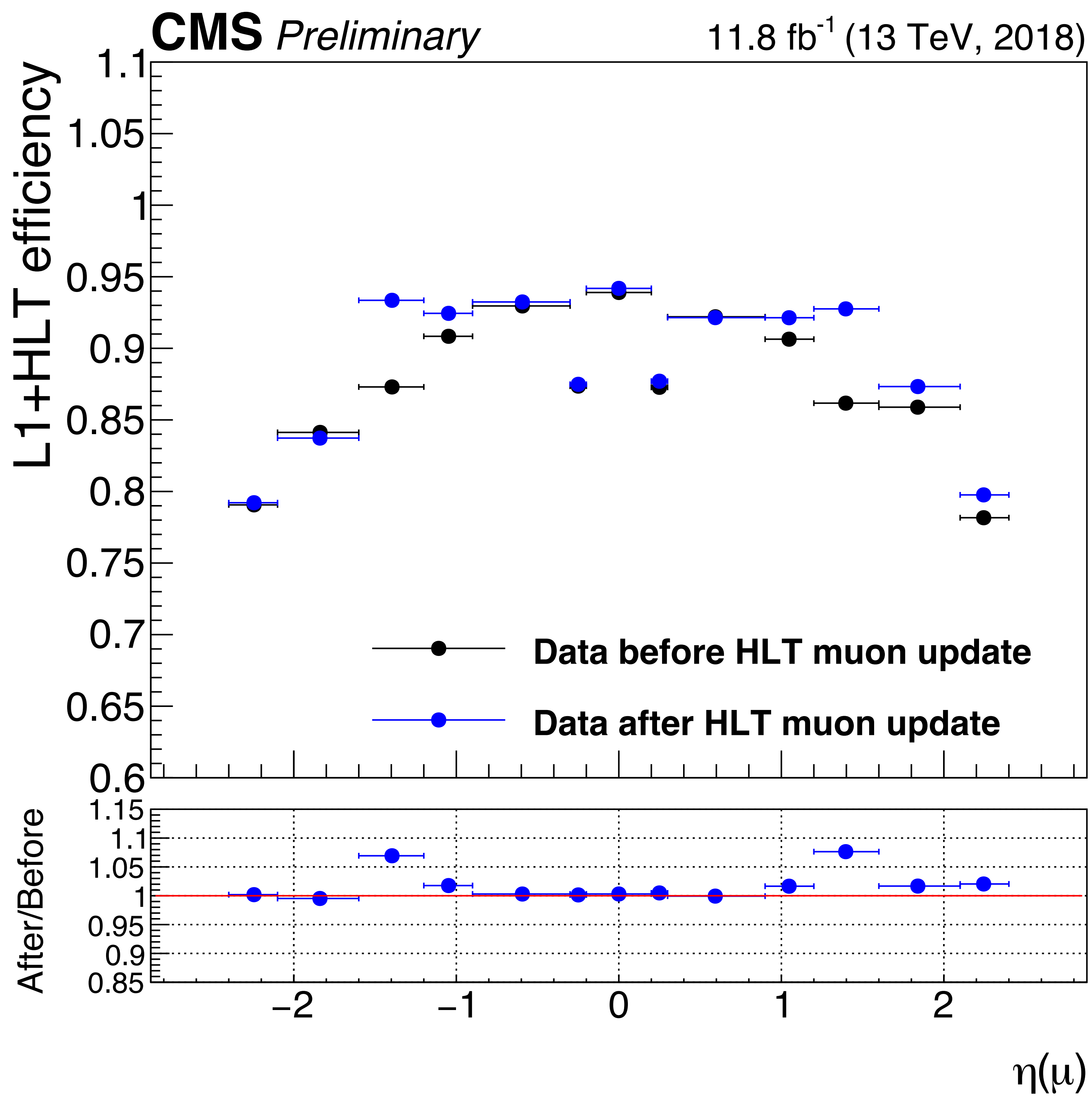
Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon P_T
- The efficiency is estimated with respect to the offline muon passing tight identification and particle-flow based isolation requirements
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



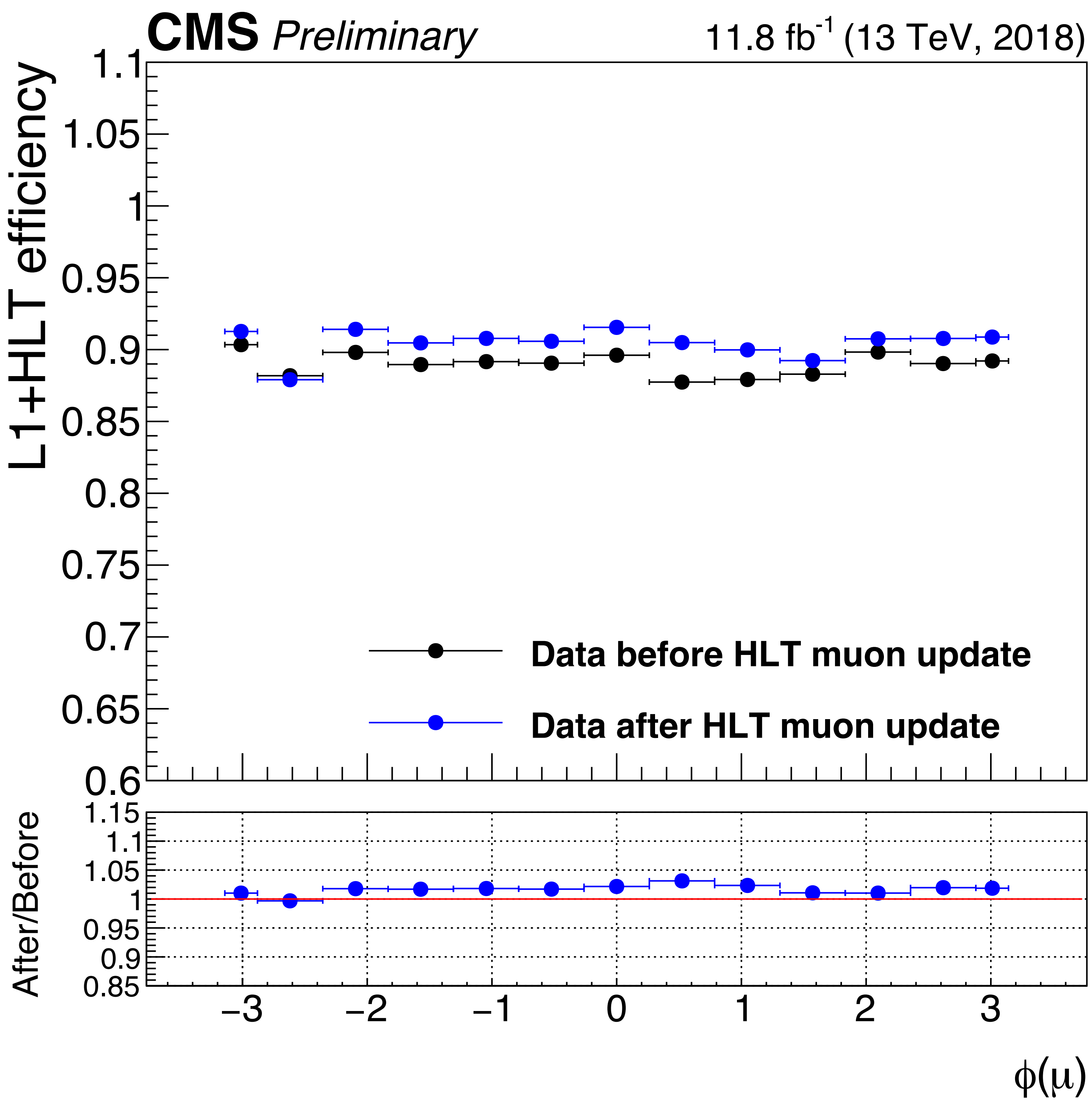
Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon η
- The efficiency is estimated with respect to the offline muon passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- A small asymmetry is observed between the negative and positive endcaps. It is due to disabled muon chambers (CSC)
- The errors are statistical only



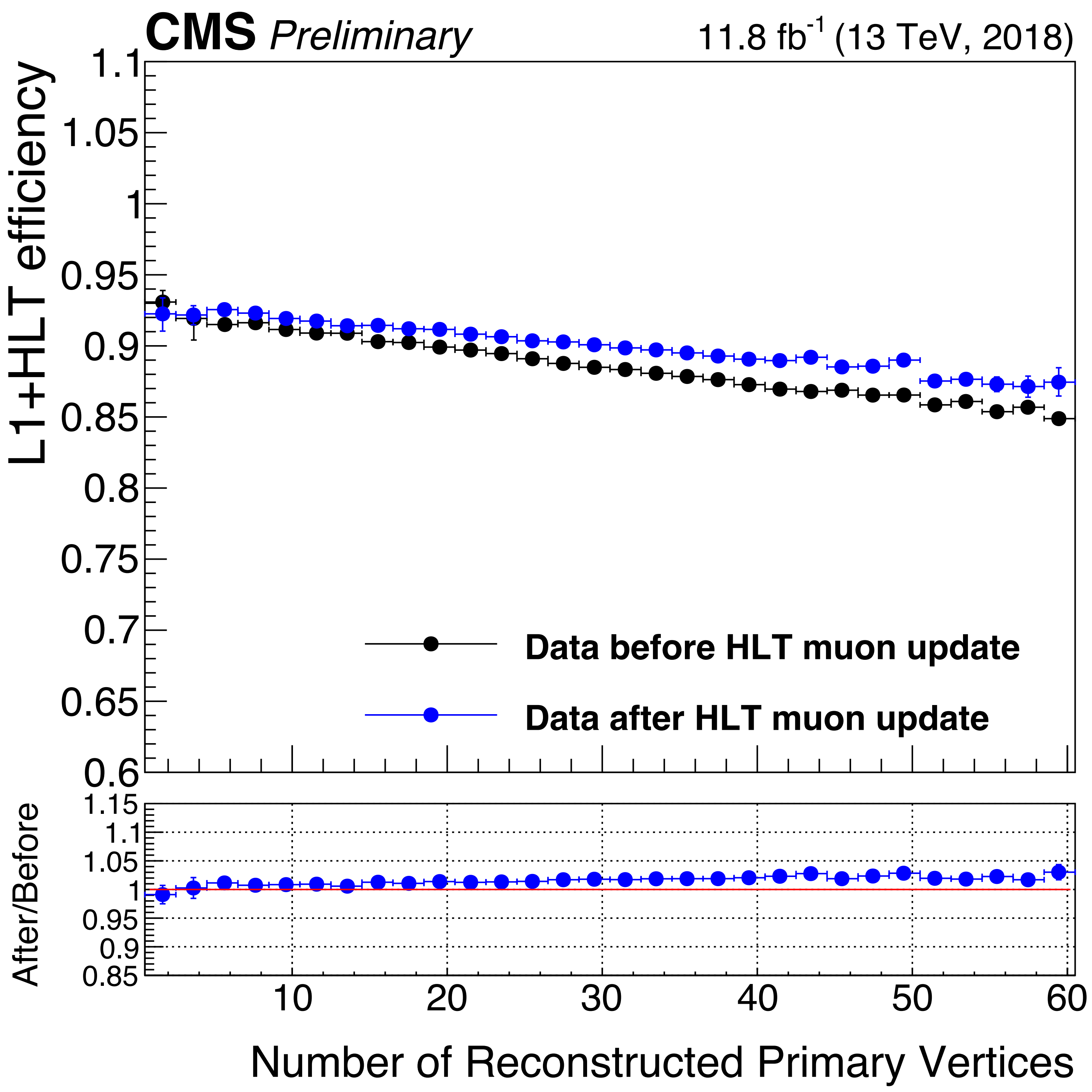
Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon ϕ
- The efficiency is estimated with respect to the offline muon passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



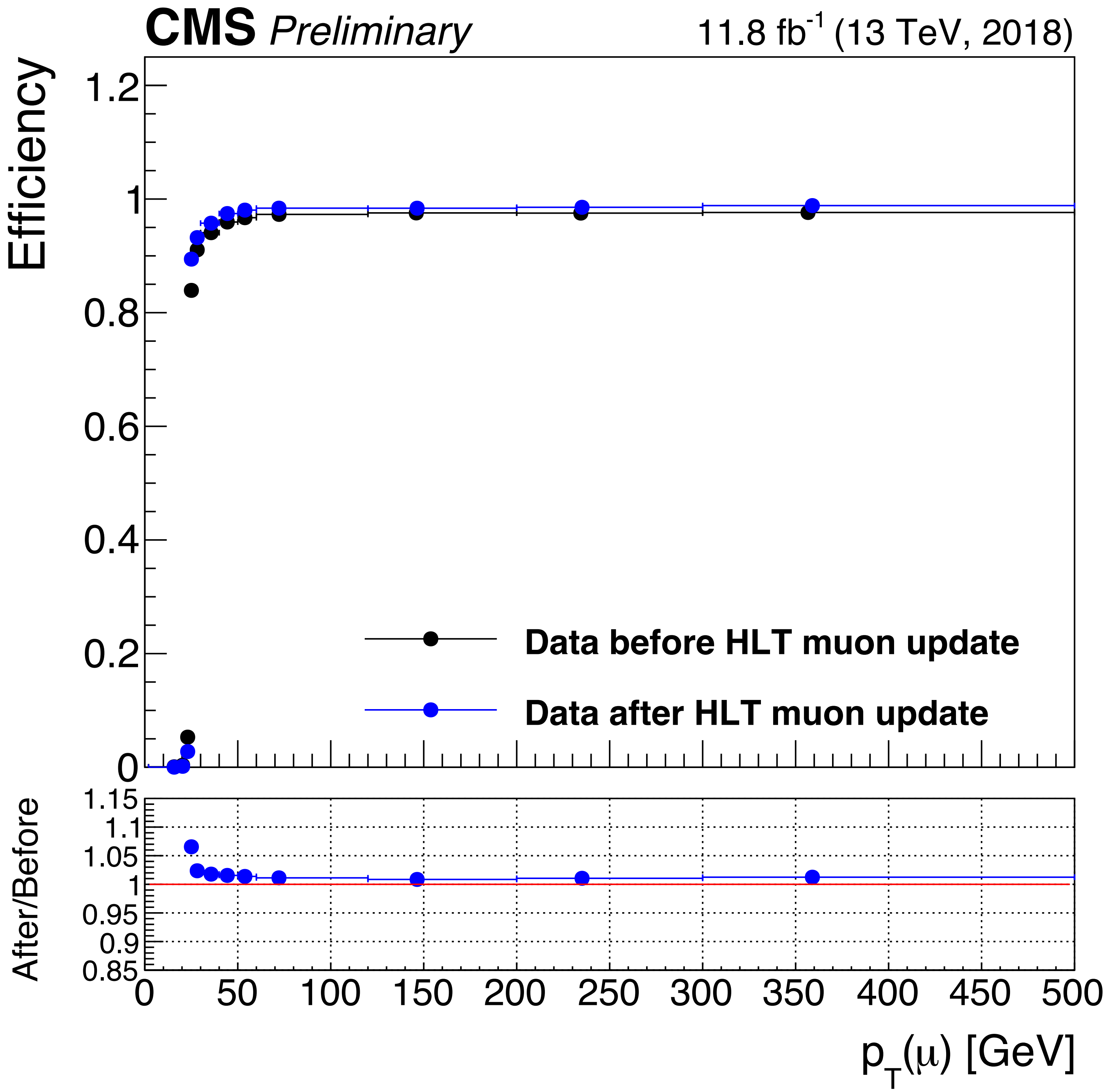
Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of the number of reconstructed vertices
- The efficiency is estimated with respect to the offline muon passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



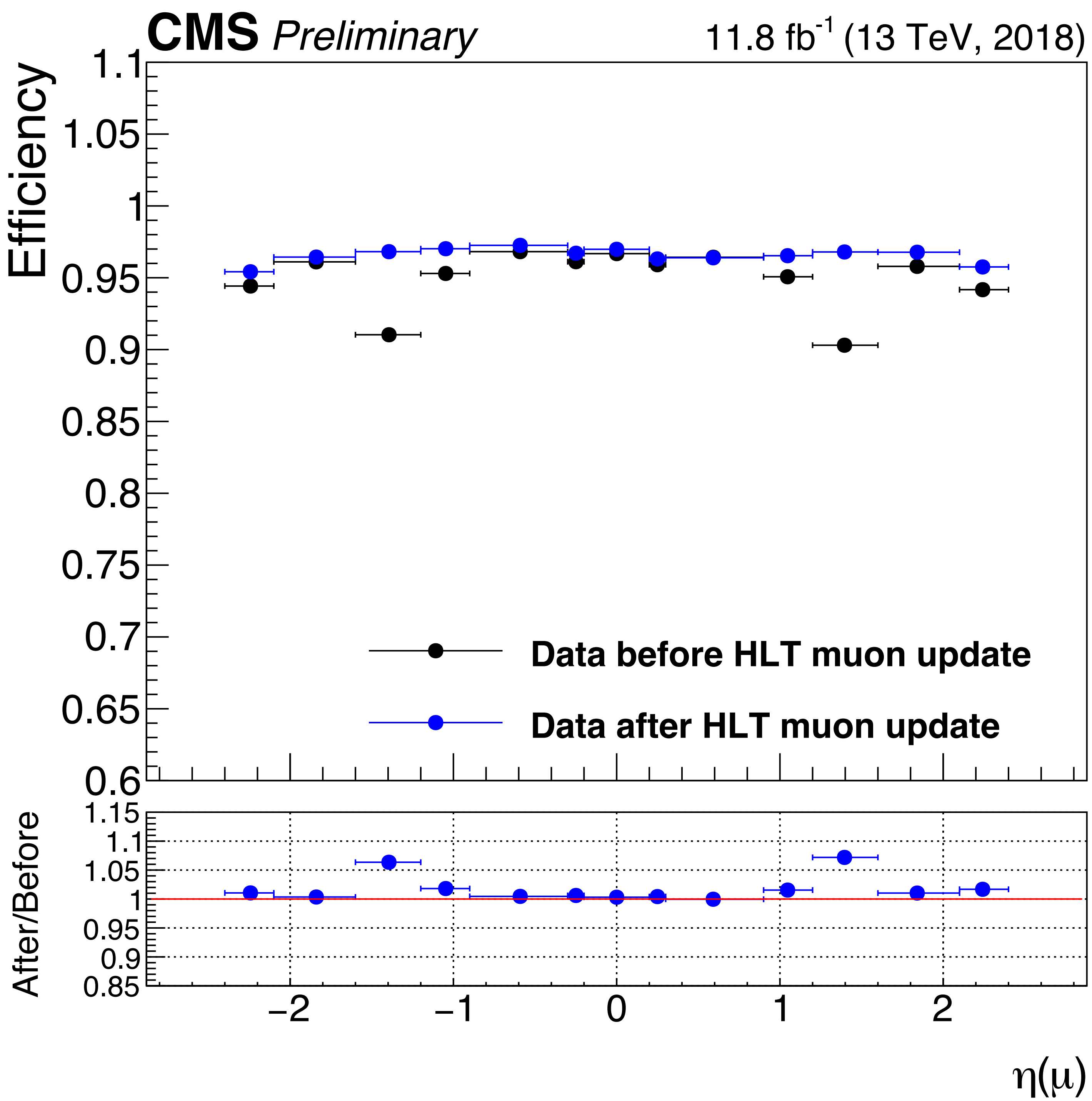
Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon P_T
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing tight identification and particle-flow based isolation requirements
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



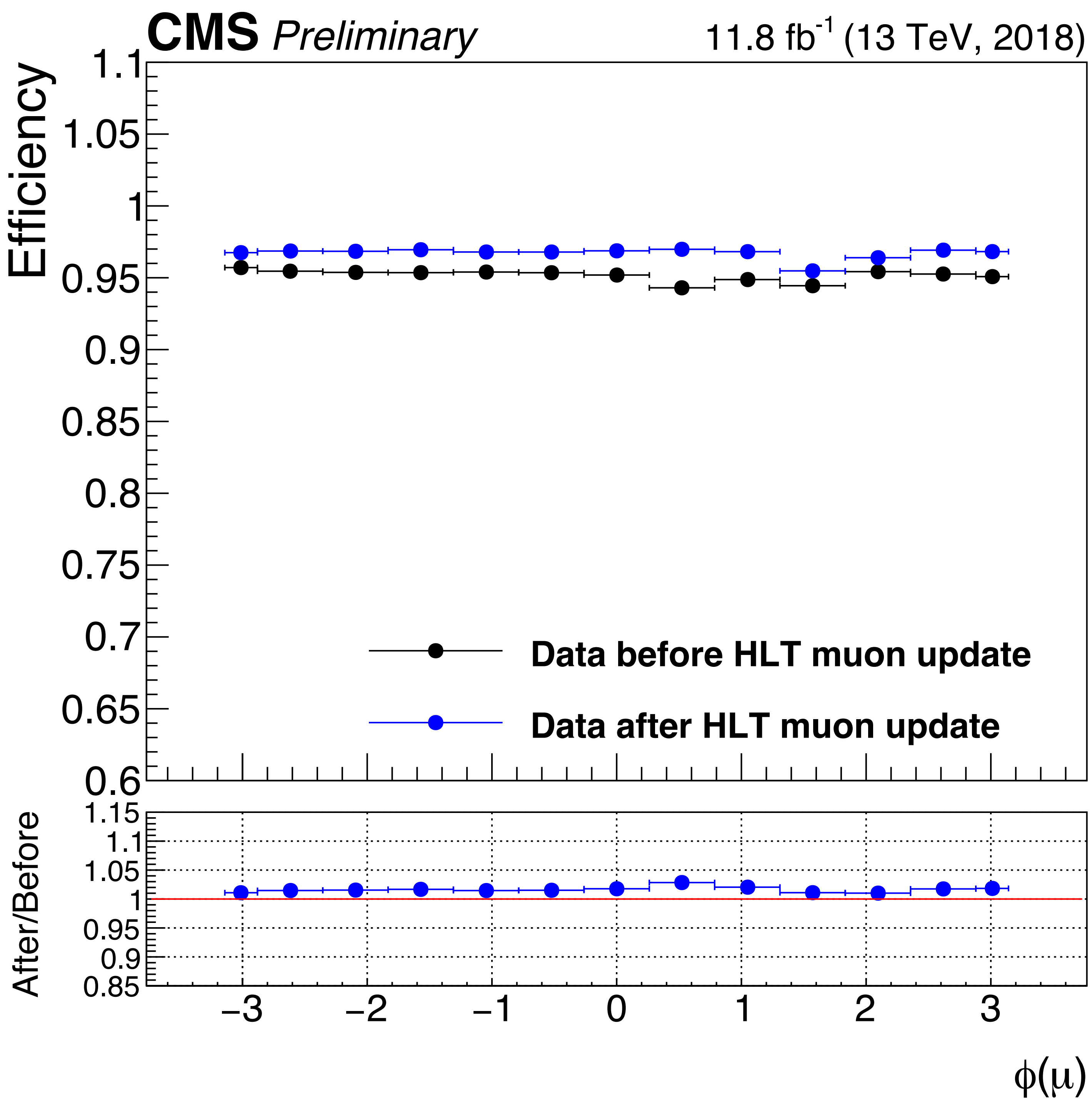
Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon η
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



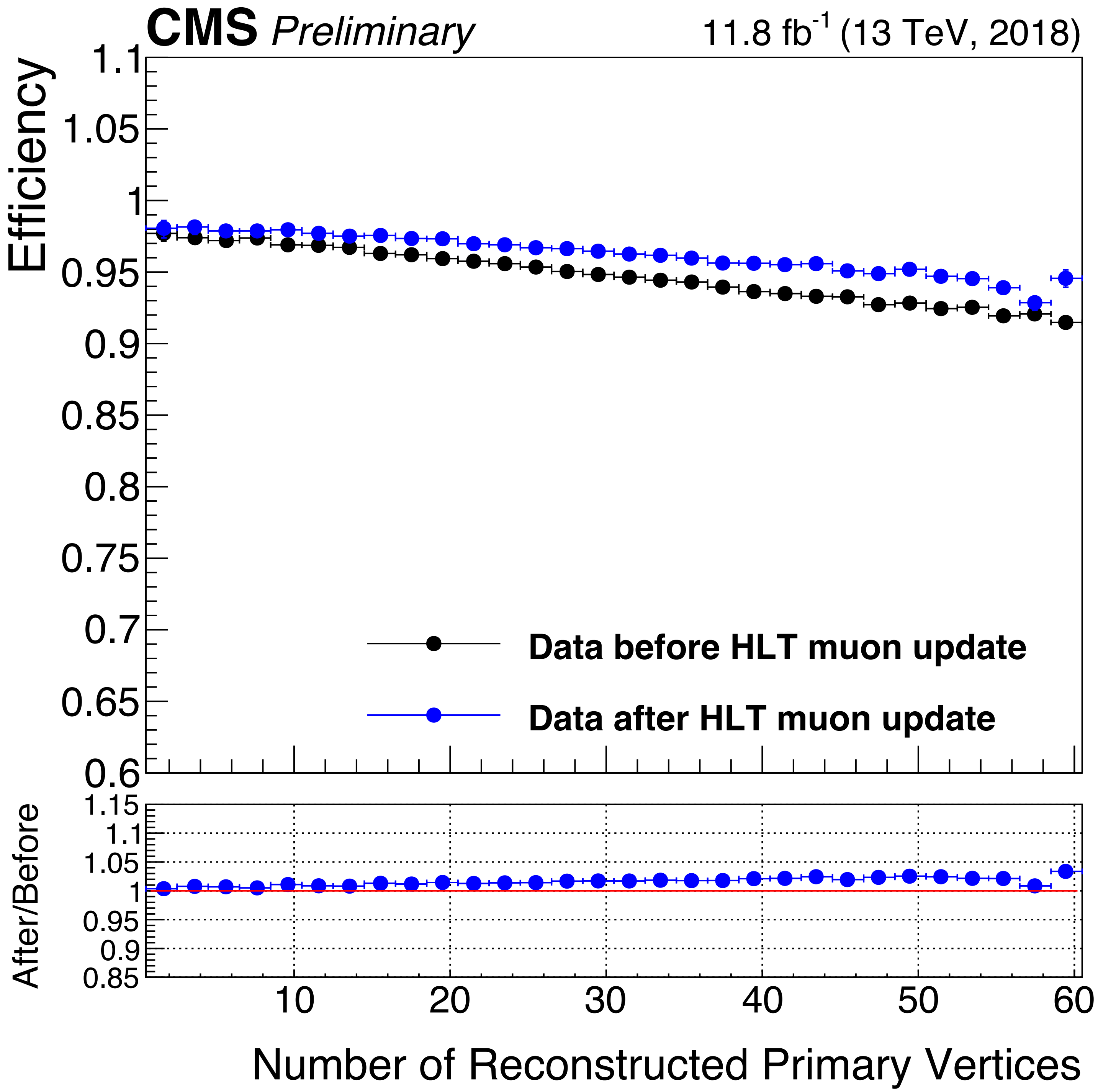
Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of muon ϕ
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



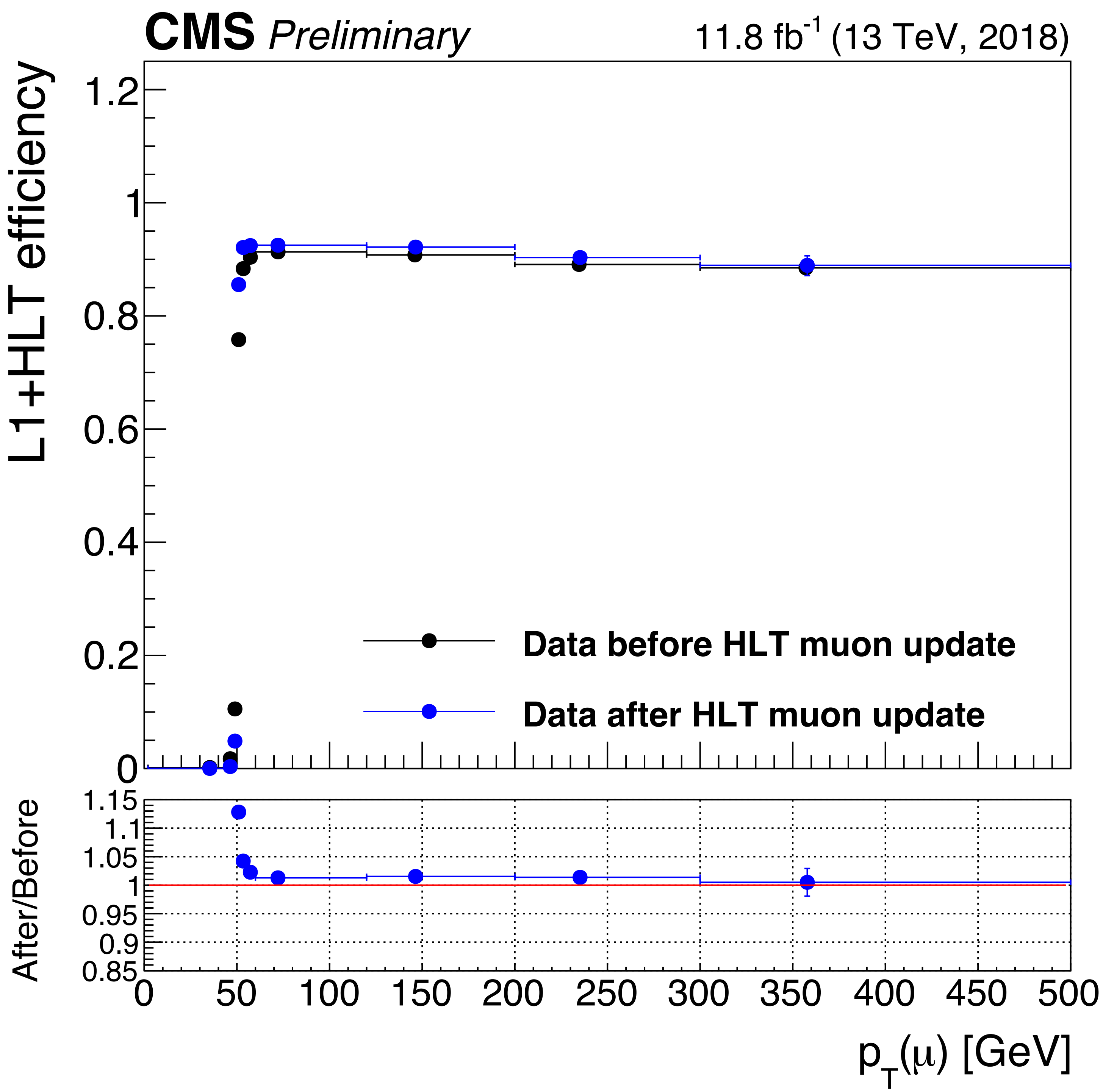
Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring isolated single muon with $P_T > 24$ GeV is shown as a function of the number of reconstructed vertices
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing tight identification and particle-flow based isolation requirements with $P_T > 26$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



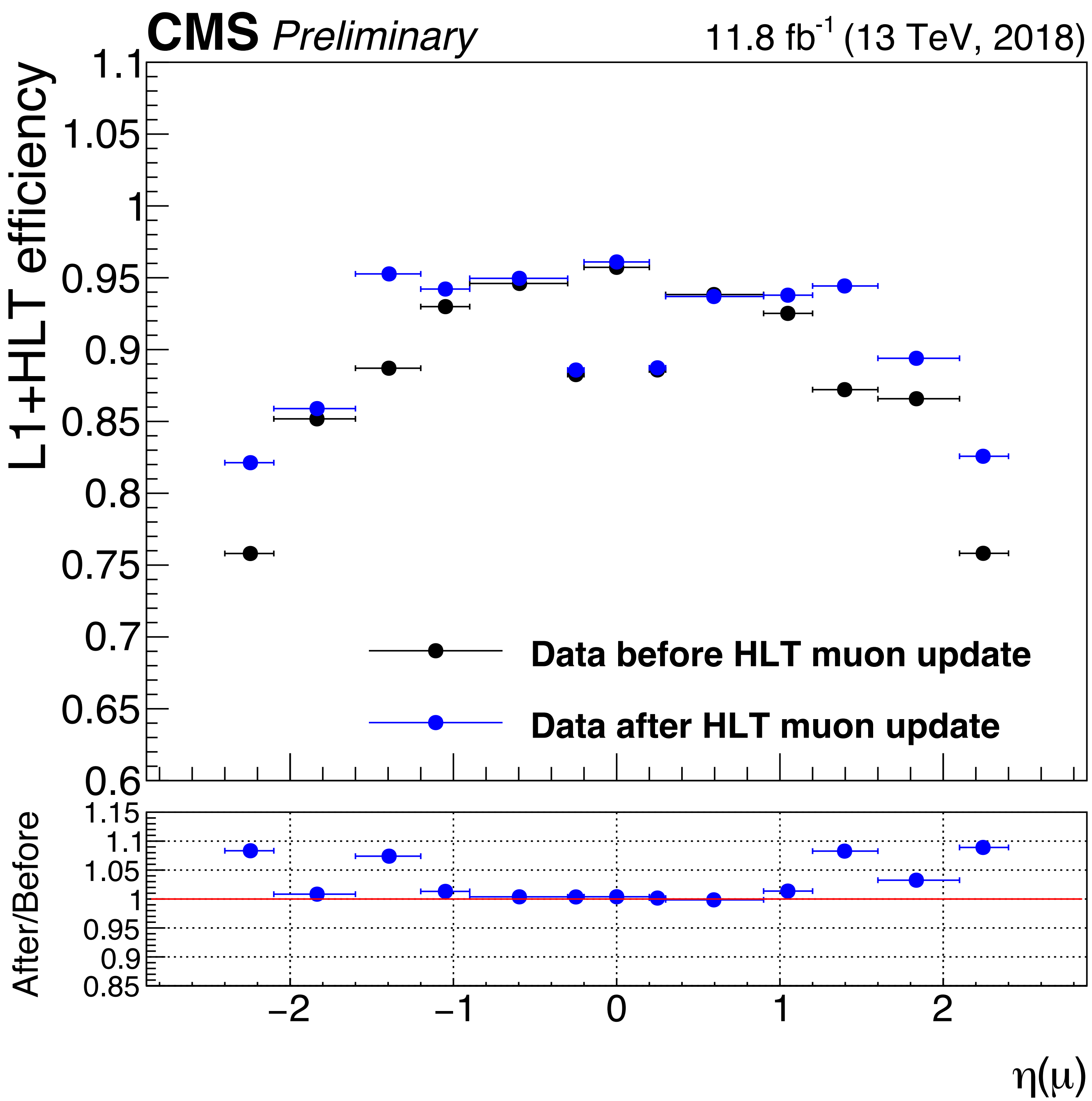
Non-Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon P_T
- The efficiency is estimated with respect to the offline muon passing identification optimized for high-P_T muons and track based isolation requirements
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



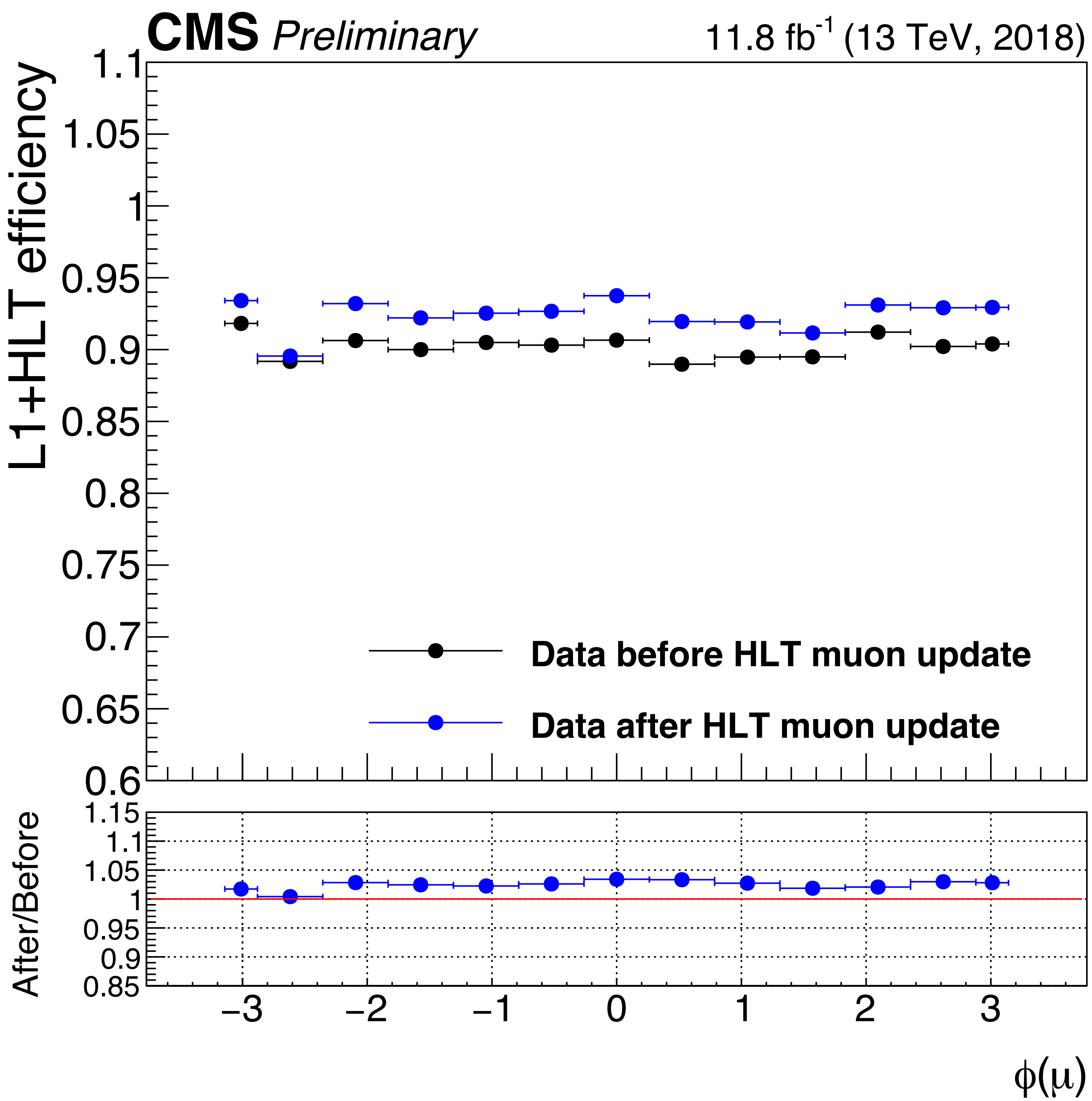
Non-Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon η
- The efficiency is estimated with respect to the offline muon passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- A small asymmetry is observed between the negative and positive endcaps. It is due to disabled muon chambers (CSC)
- The errors are statistical only



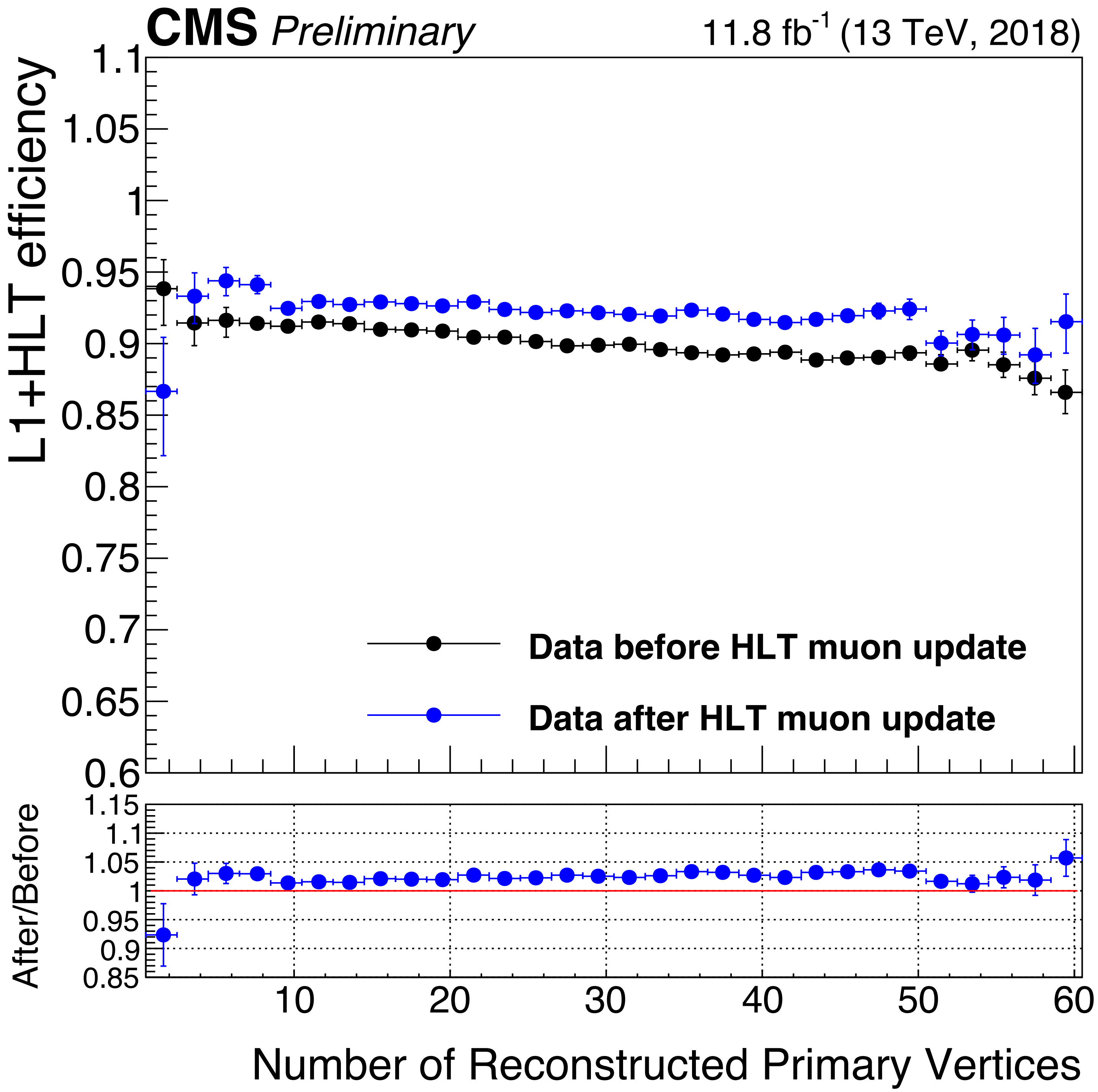
Non-Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon ϕ
- The efficiency is estimated with respect to the offline muon passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



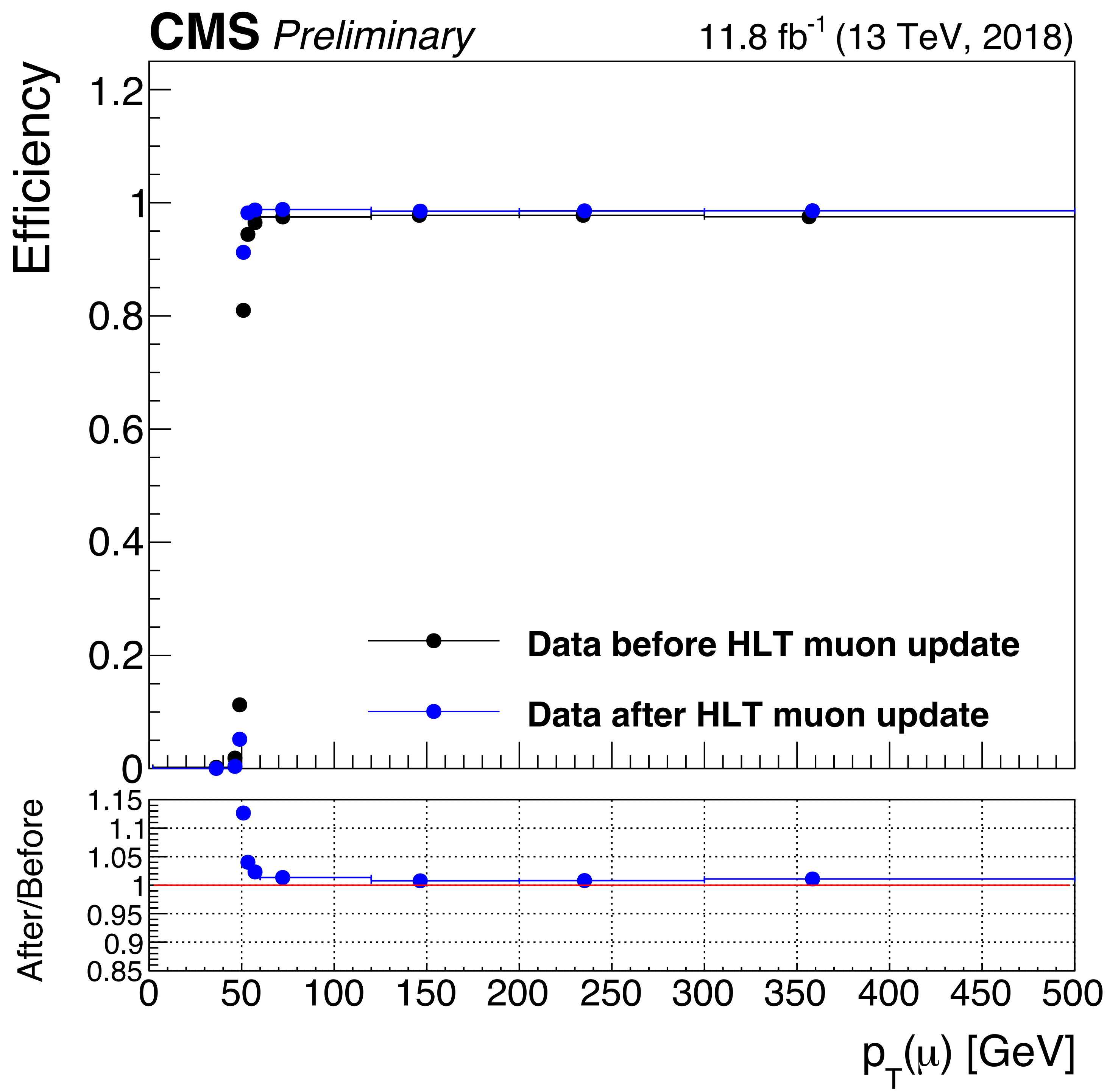
Non-Isolated Single μ Trigger Efficiency

- The efficiency of combined L1 and high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of the number of reconstructed vertices
- The efficiency is estimated with respect to the offline muon passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



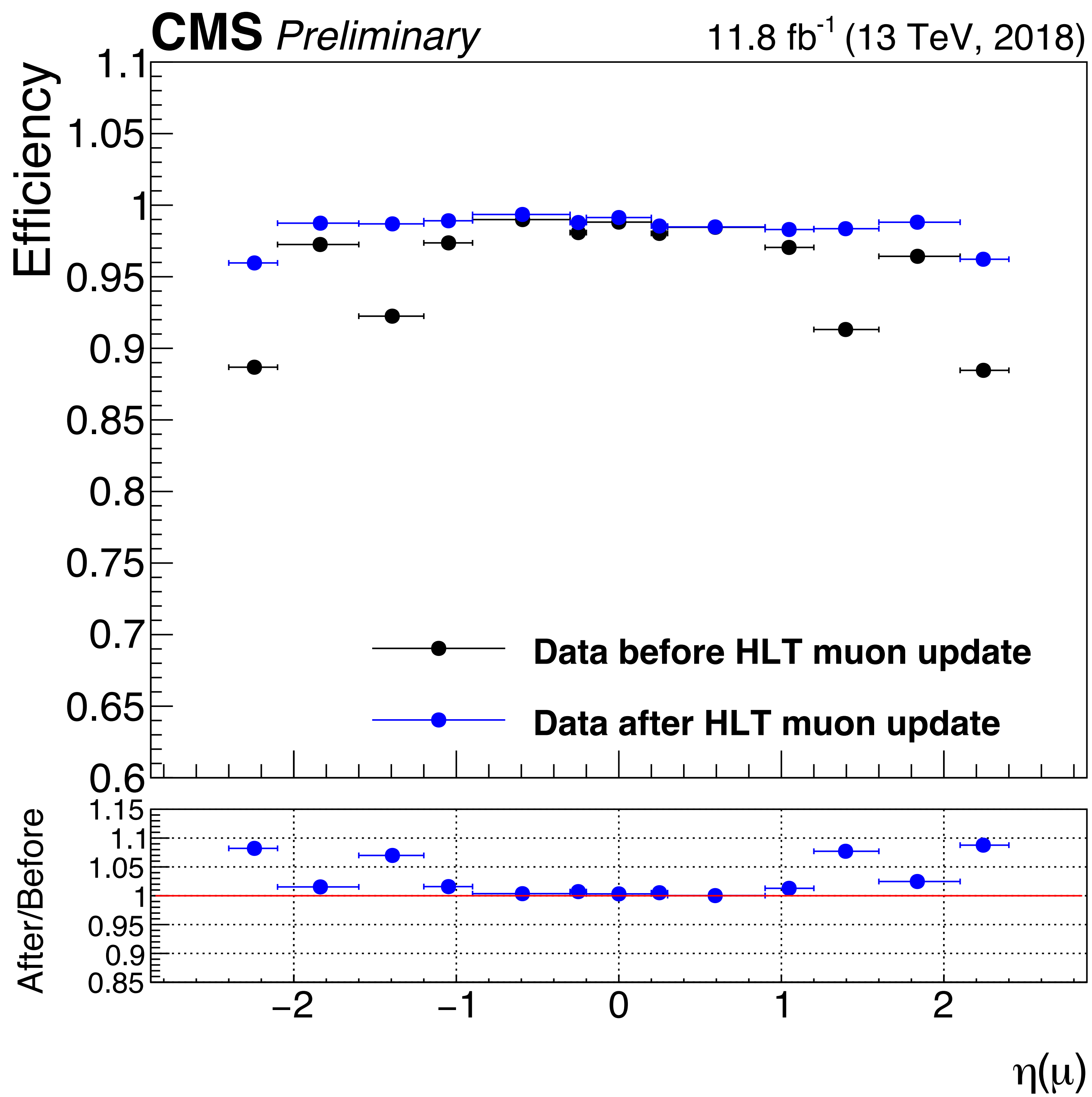
Non-Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon P_T
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing identification optimized for high-P_T muons and track based isolation requirements
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



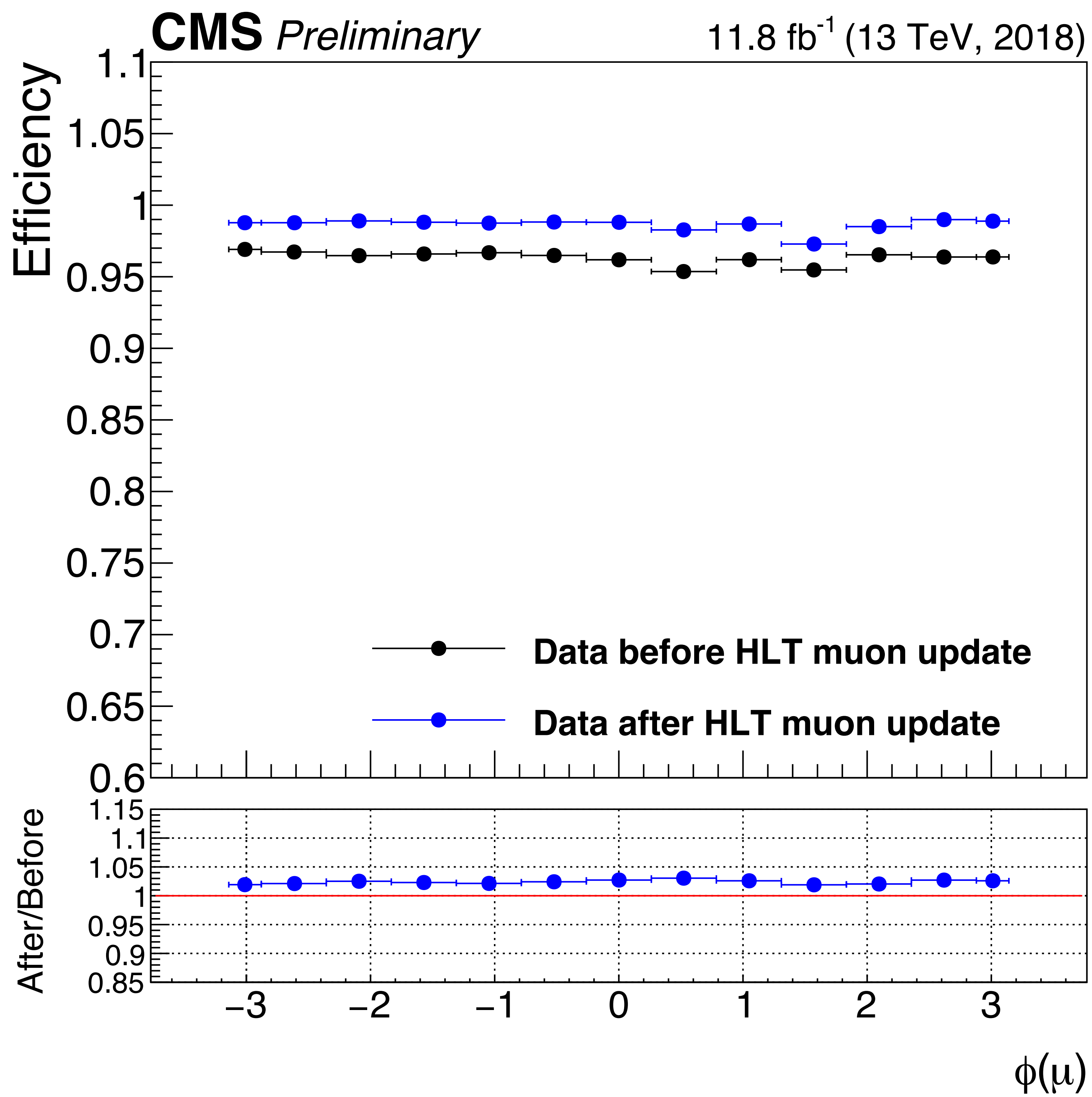
Non-Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon **η**
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



Non-Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of muon ϕ
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only



Non-Isolated Single μ Trigger Efficiency

- The efficiency of high-level trigger requiring single muon with $P_T > 50$ GeV is shown as a function of the number of reconstructed vertices
- The efficiency is estimated with respect to the offline muon matched to L1 trigger object with $\Delta R < 0.3$ as well as passing identification optimized for high-P_T muons and track based isolation requirements with $P_T > 52$ GeV
- The data are split with respect to the HLT muon reconstruction update deployed in 15/05/2018
- The errors are statistical only