

# The CMS Level 1 muon trigger system for the HL-LHC

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Universidad de Oviedo



CMS-TDR-021

## Introduction

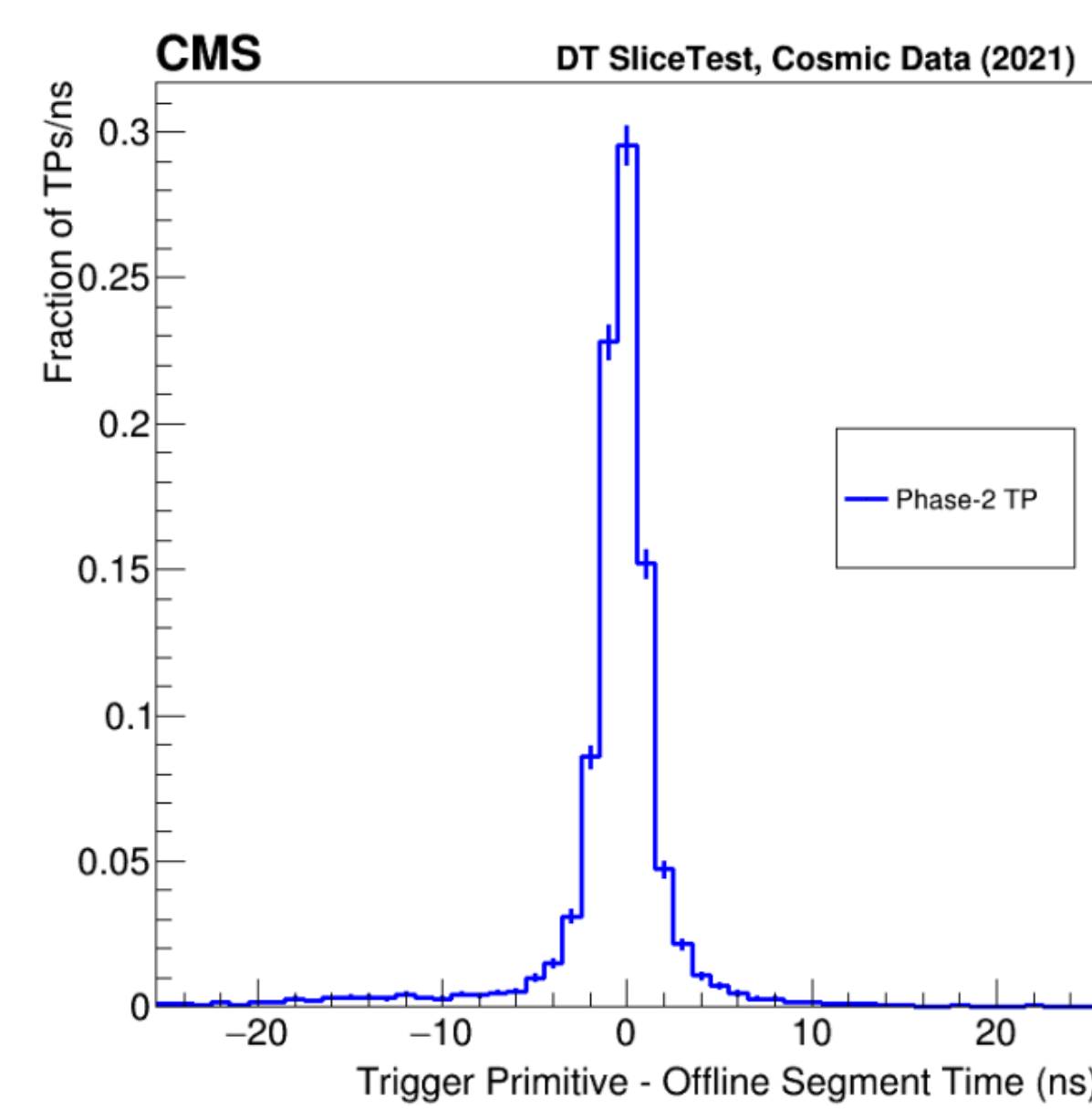
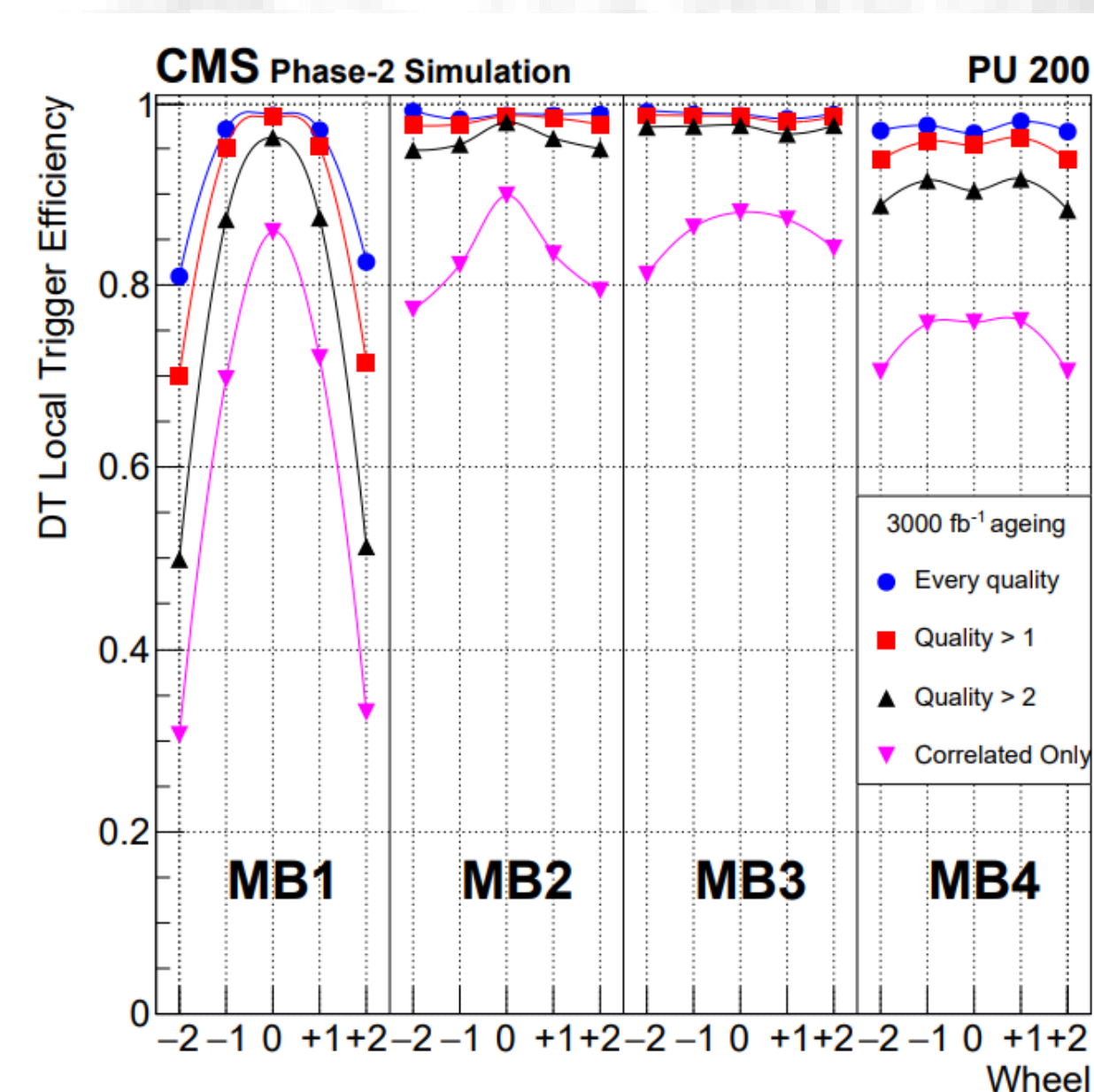
- HL-LHC will open up an unprecedented opportunity for HEP: **high-precision SM measurements** and **extending BSM searches**.
- The **detector readout electronics** and **DAQ** will be **upgraded** to allow an increased L1 trigger rate (750 kHz) and latency of 12.5  $\mu$ s.
- Goal:** maintain or improve trigger thresholds despite the harsher environment and access unexplored regions of the phase-space.

## Local Reconstruction

- Trigger primitives are the basic muon object obtained from L1 local reconstruction.
- DT+RPC – Analytical method
- Baseline:** start from individual hits and build straight patterns (segments).

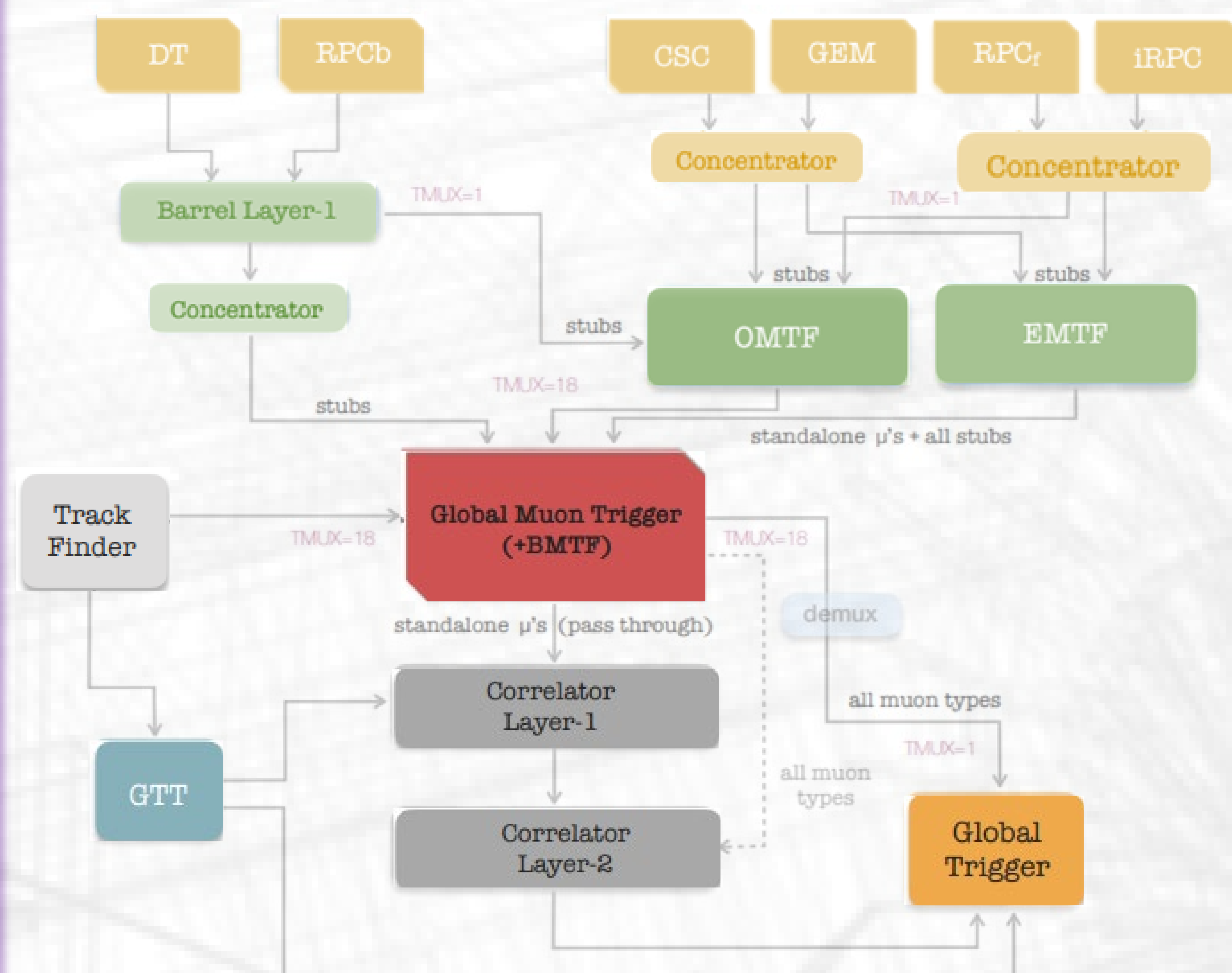


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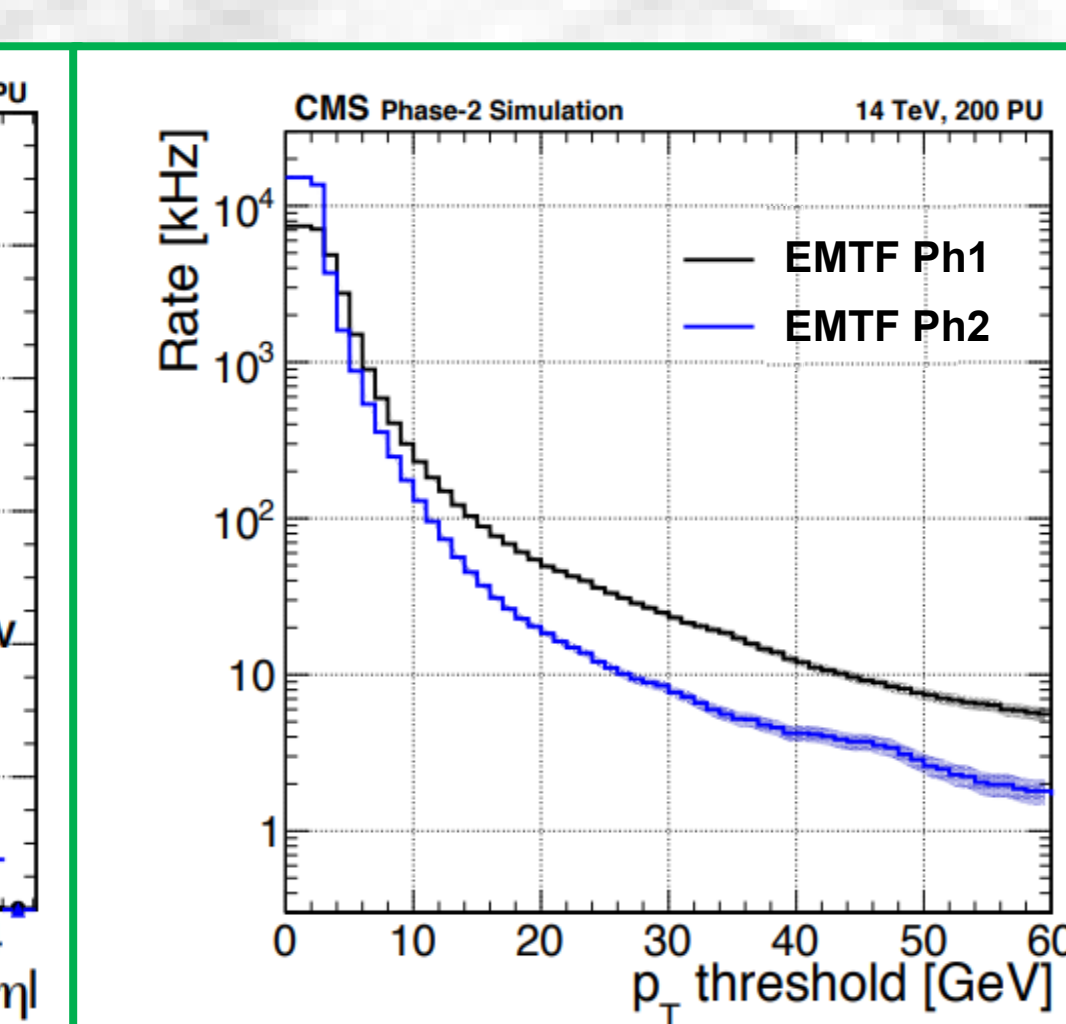
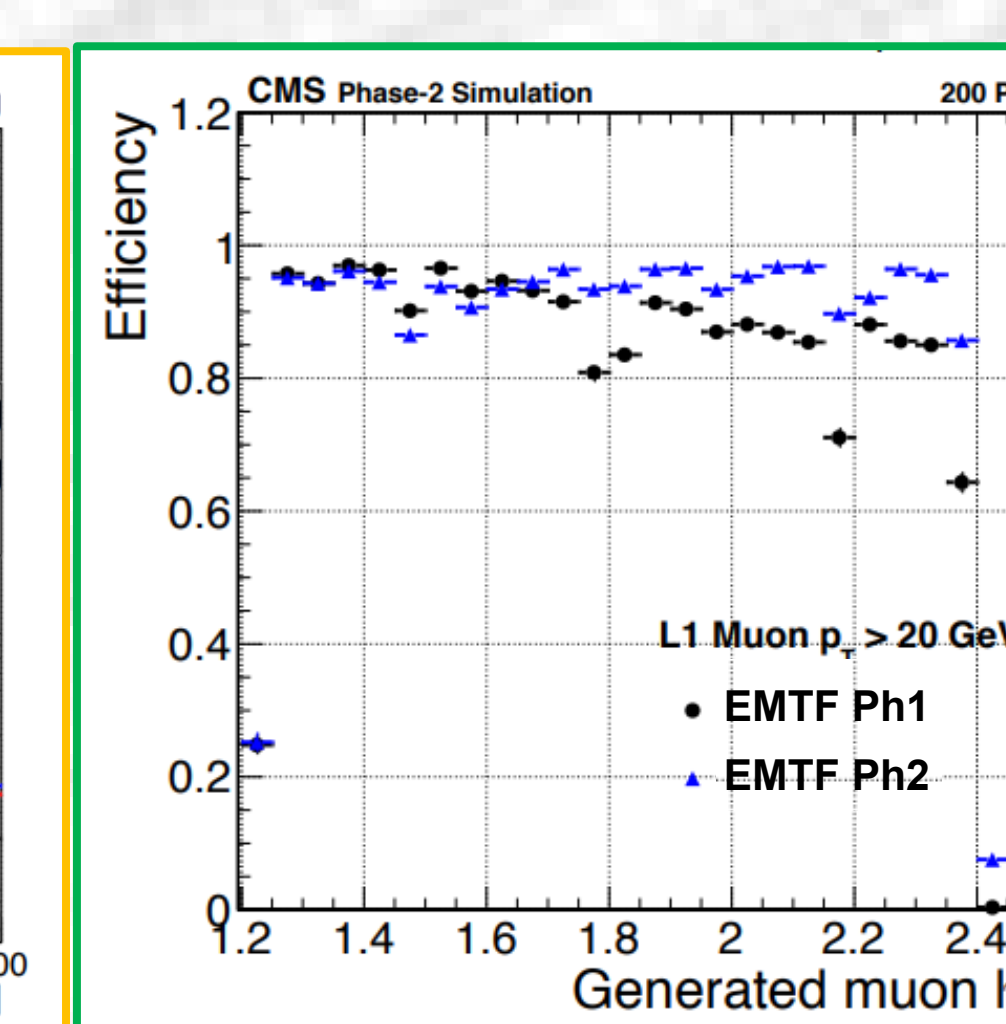
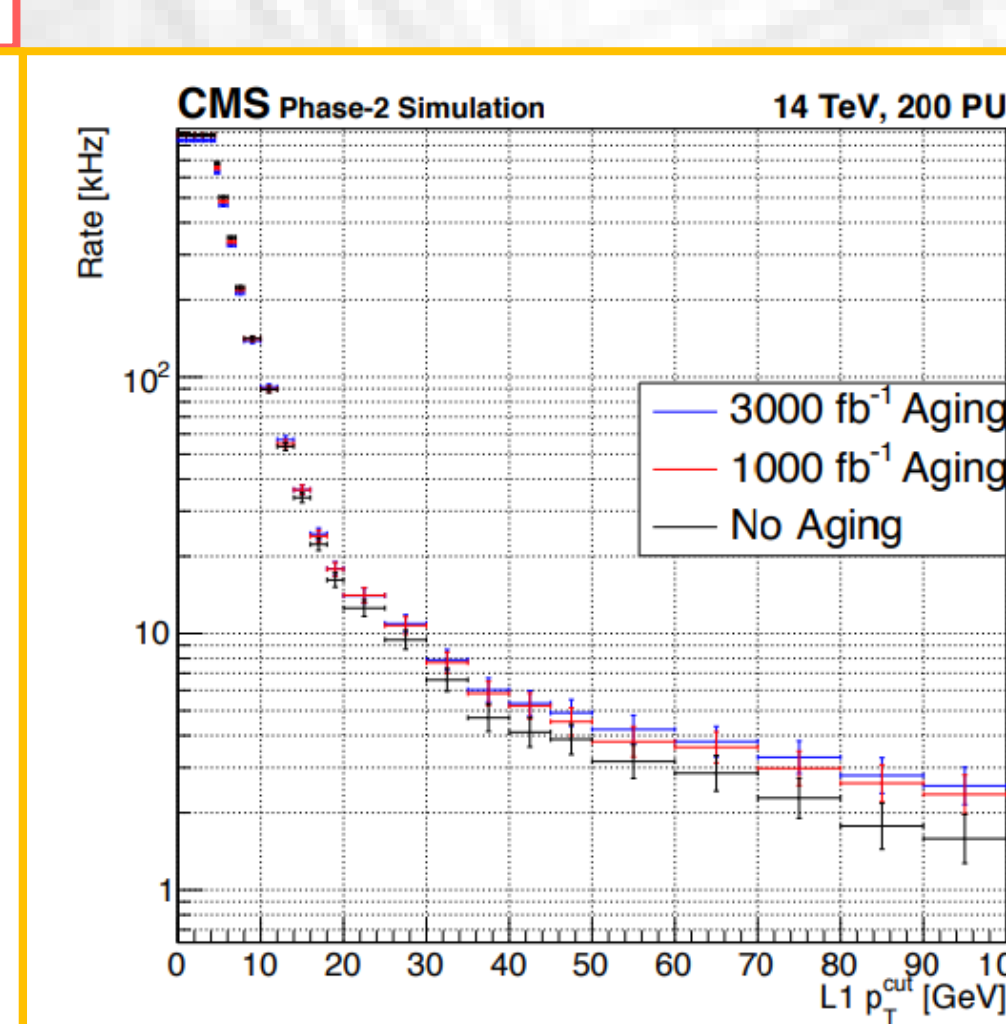
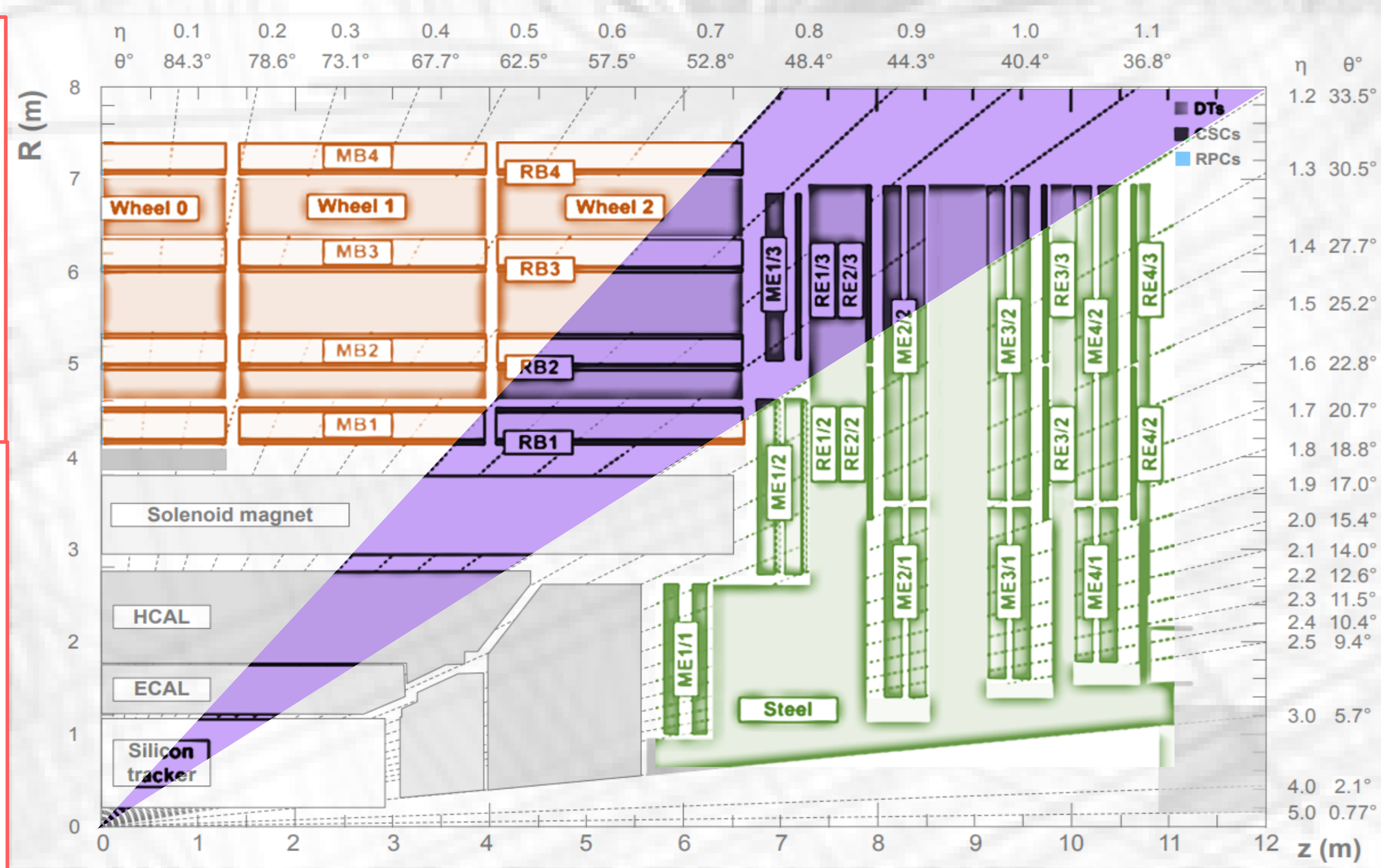
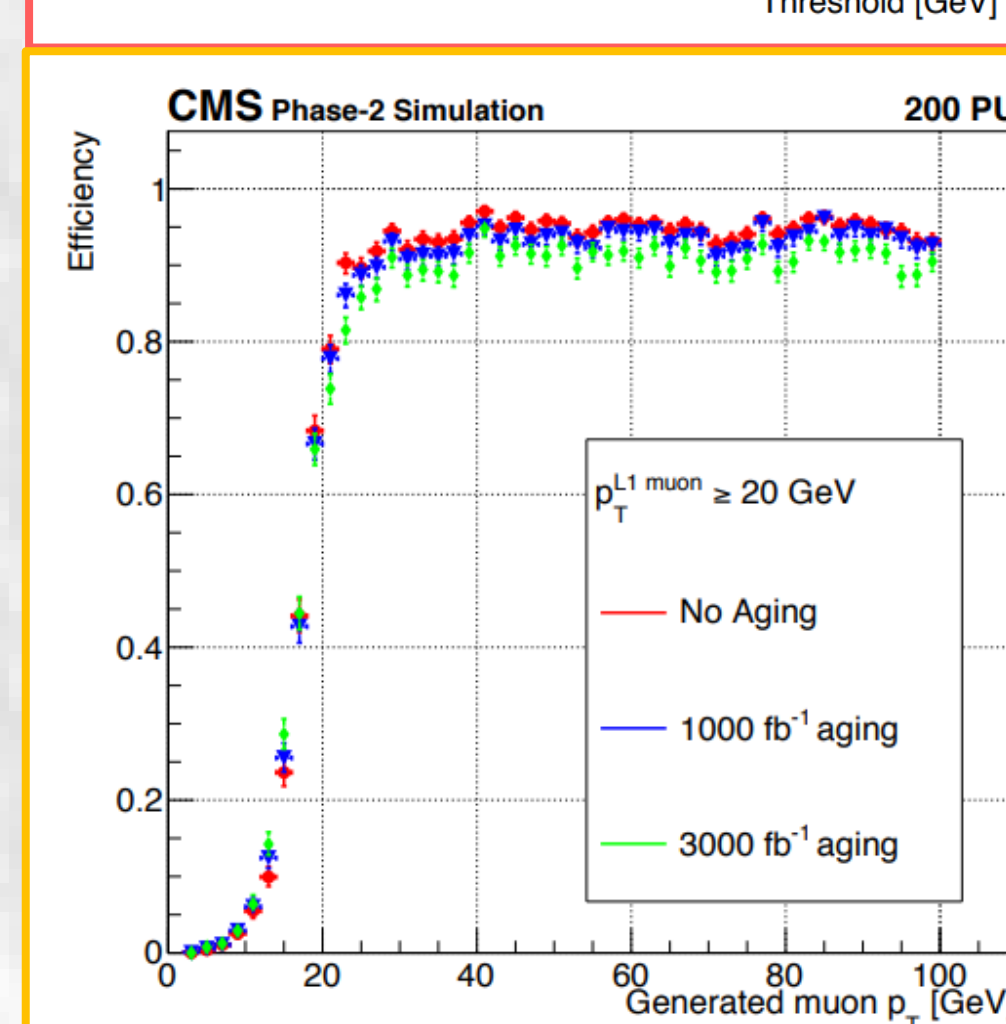
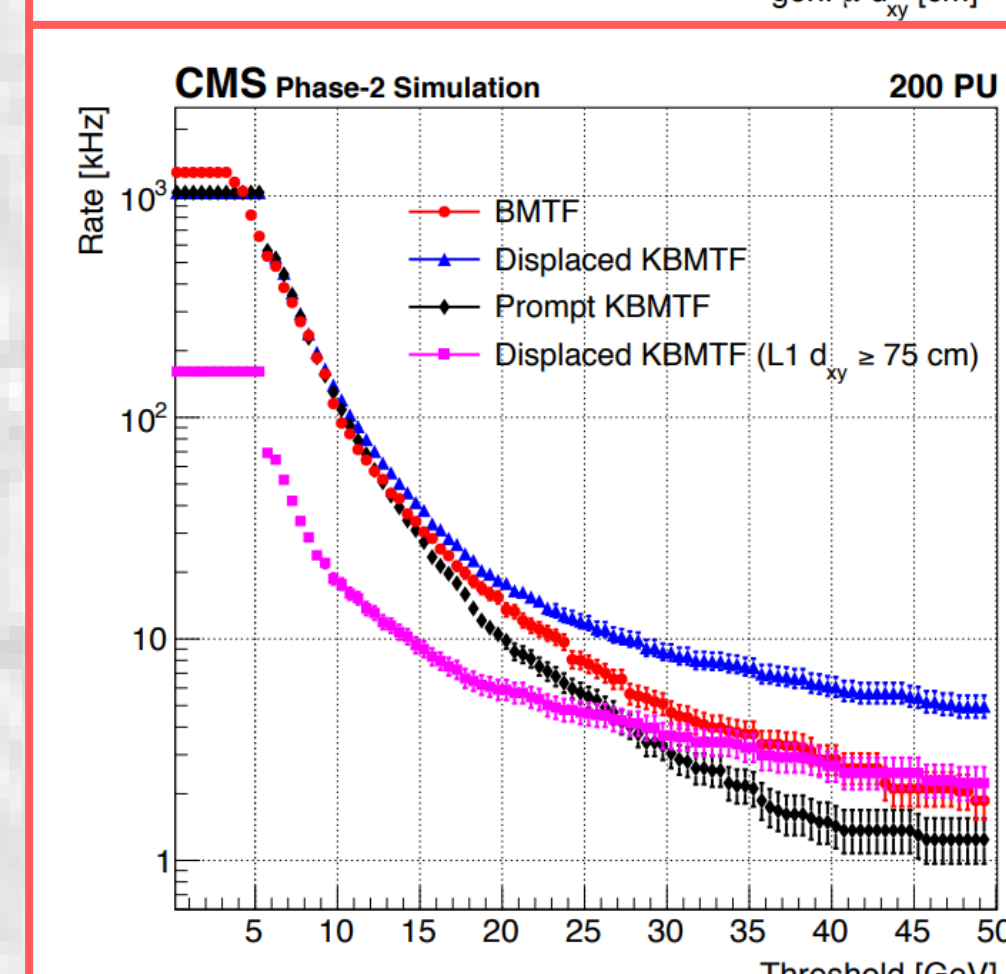
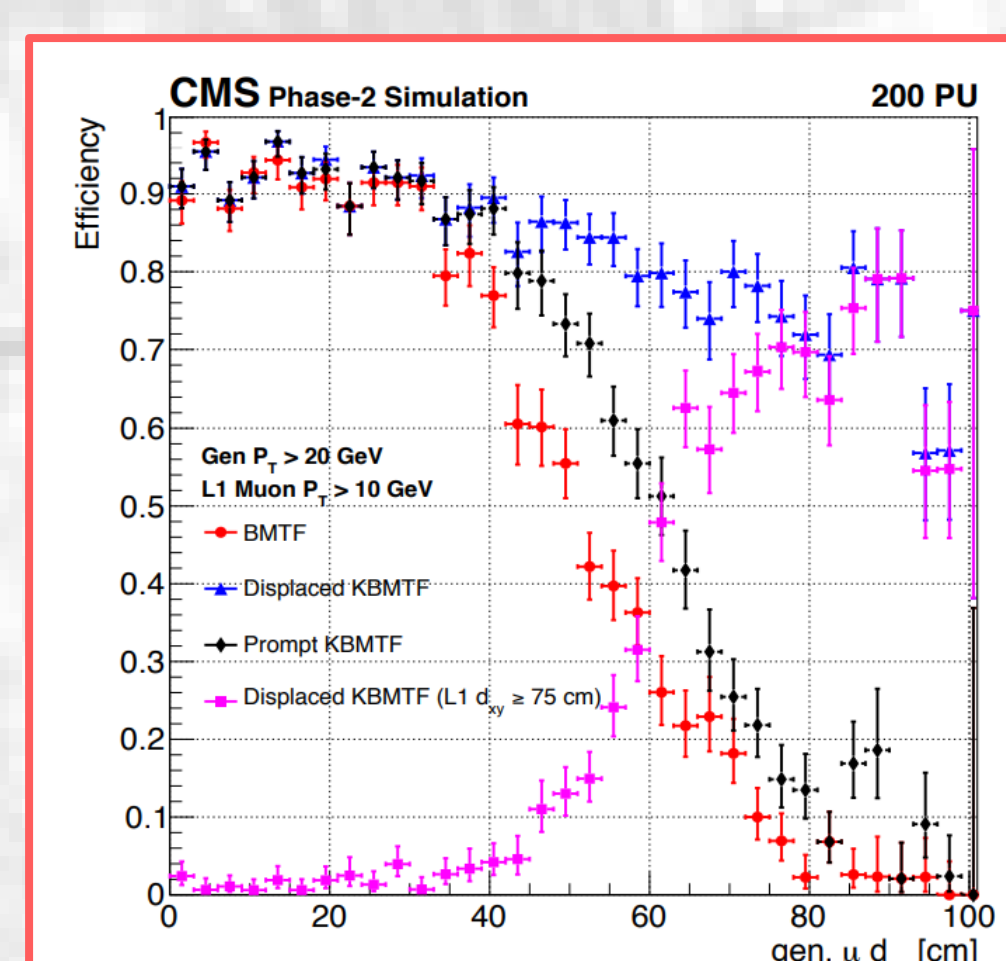
- New filter** for Phase2! CMS will instrument dedicated FPGAs for simultaneous readout of the whole DT+RPC system for Phase2 at L1

## The Phase 2 L1 muon trigger architecture

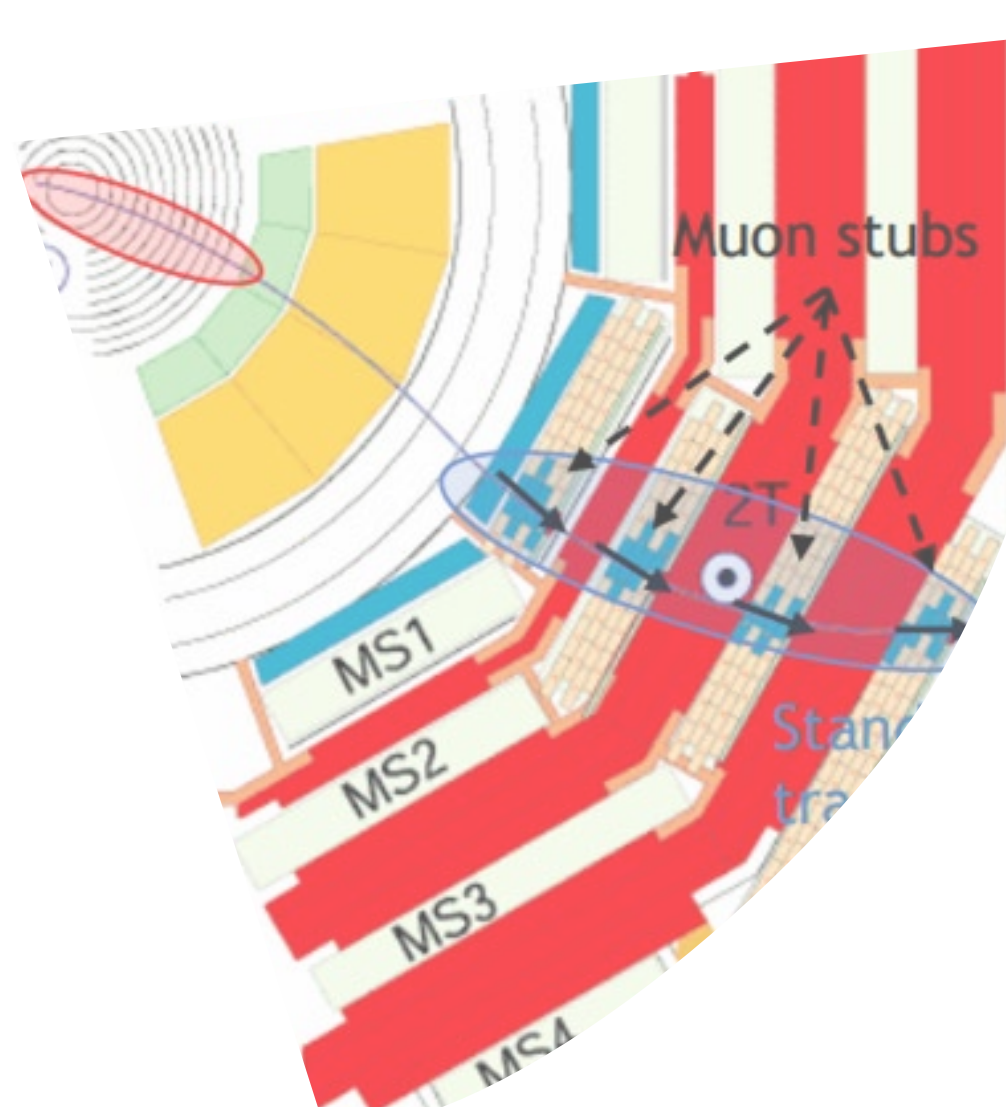


## Muon track finders

- Trigger primitives are used as input for pattern recognition algorithms that aim to correlate muon information across different parts of the detectors
- Barrel MTF**
  - Algorithm: Kalman Filter.
  - combining segments based on phi, bending angle and curvature.
- Overlap MTF**
  - Algorithm: Naïve Bayes Classifier.
  - Log likelihood ( $p_T$ ) = Log likelihood ( $\phi$ ).
  - NEW:** Working in a NN approach that could benefit search for displaced patterns.
  - Implementation in firmware is undergoing.
- Endcap MTF**
  - Algorithm: Neural Network-based track building algorithm (EMTF++).
  - new track patterns to make use of detector upgrades.
  - $p_T$  assignment based on Neural Networks.



## Global Muon Trigger



- One of the great features of the Phase 2 L1T is that tracker tracks will be available at L1.
- A muon correlator is therefore designed to match tracker tracks with muon stubs within microseconds!
- Improvements in precision...
  - ... But also new (displaced) signatures can be explored thanks to the MTF inputs

