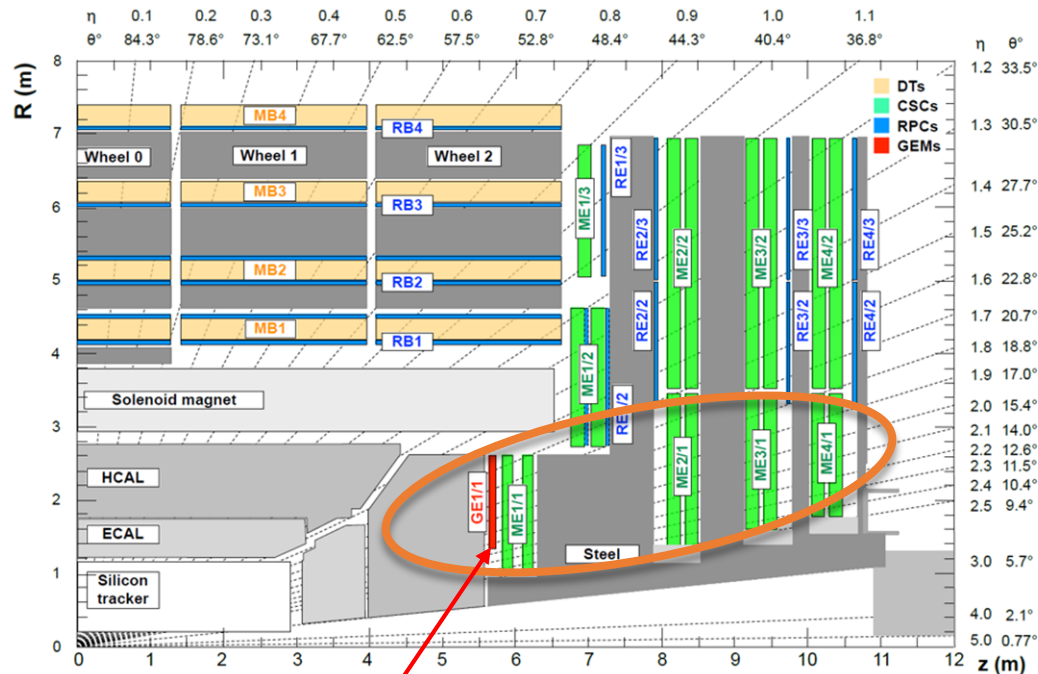


# Impact of the GE1/1 station on the performance of the muon system in CMS



Alice Magnani on behalf of the CMS GEM Collaboration

Department of Physics, University of Pavia, Italy  
Istituto Nazionale di Fisica Nucleare, Pavia, Italy



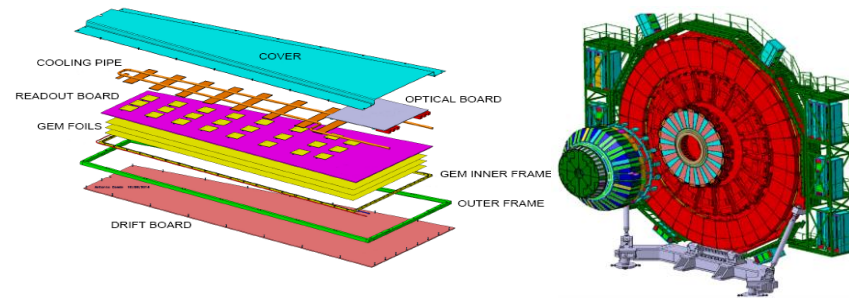
## The high $\eta$ region of the muon spectrometer

- harsh background environment
- lack of detection redundancy
- higher trigger rate
- worse momentum resolution

After the LHC luminosity upgrade in 2018, the trigger rate in this region alone will approach values of 1/10 of the bandwidth of the entire CMS Level1 trigger. To prevent the deterioration of the muon system performance, an additional measurement station, made of triple GEM chambers will be installed.

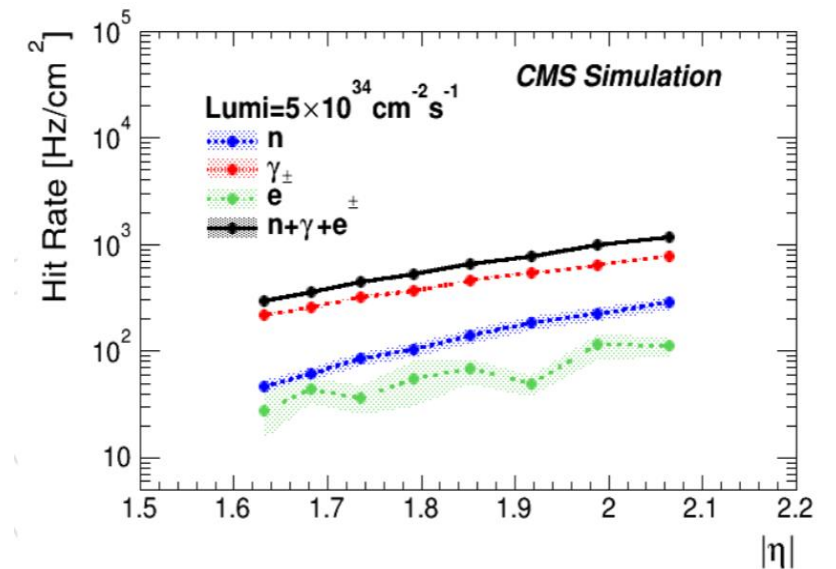
To be implemented during in 2018

# The GE1/1 station

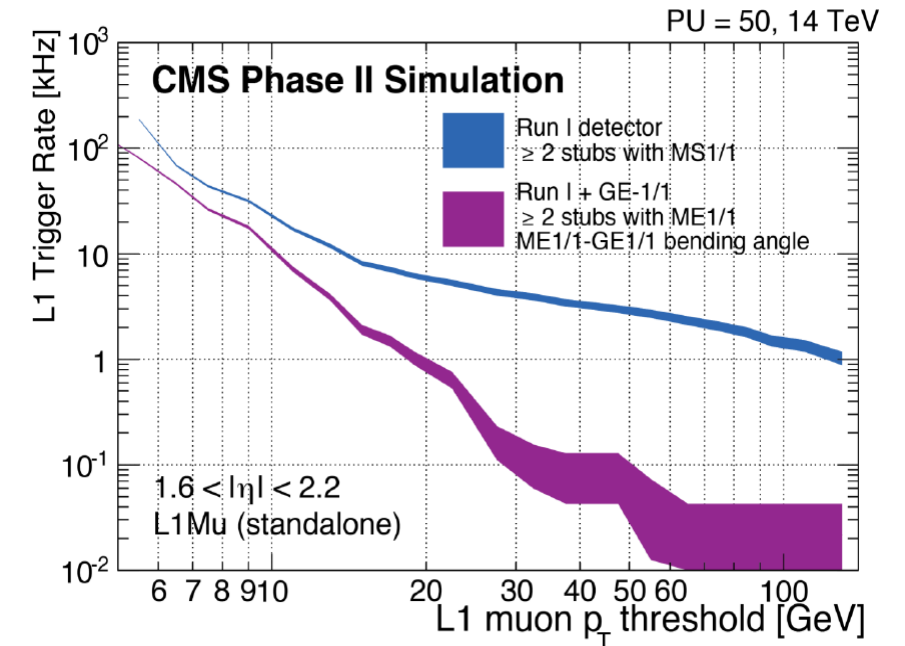
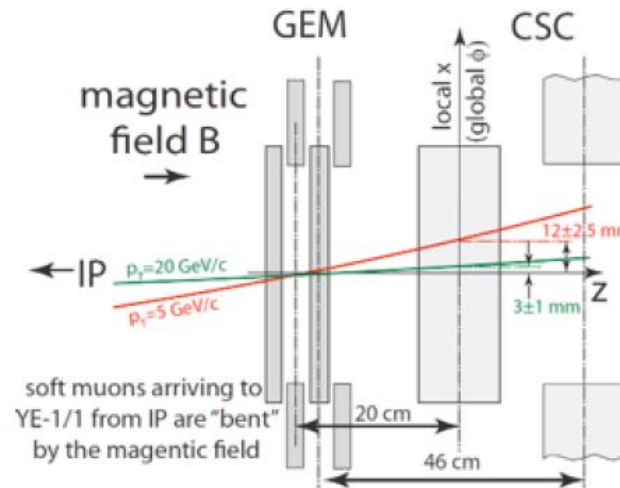


The sensitivity of the triple GEM chambers to the different component of the cavern background and the background hit rate have been studied with Geant4 and Fluka simulations.

**The hit rate is expected to be ~1kHz, far lower than the rate capability (100 MHz/cm<sup>2</sup>)**

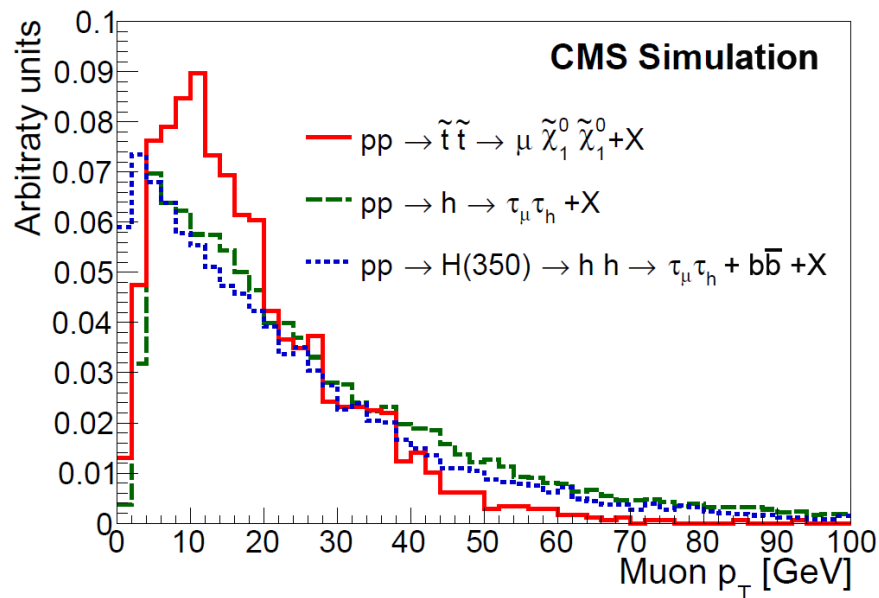


The muon lever-arm between the GEMs the adjacent CSCs will allow to determine the muon  $p_T$  by measuring the bending angle due to the magnetic field in the first muon station alone. This  $p_T$  measurement, helps in reducing the rate of soft muons that pass the trigger threshold due to  $p_T$  mismeasurements. **This will allow to maintain reasonable trigger rates without increasing the  $p_T$  threshold**

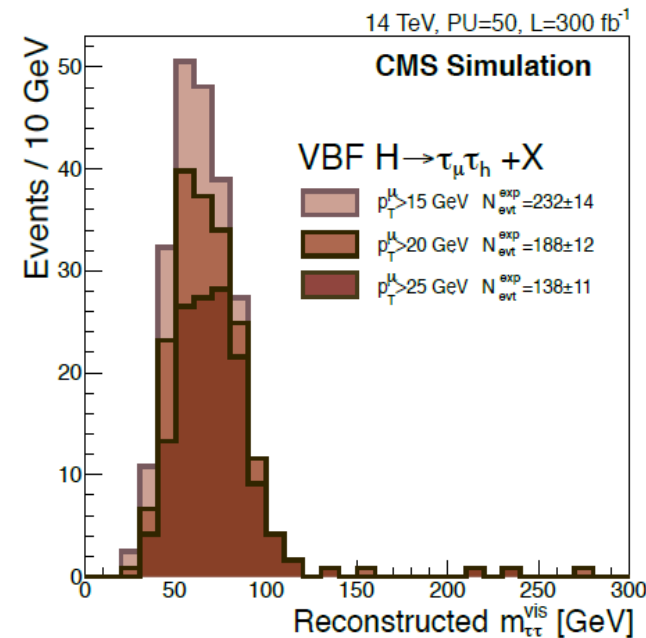


# Benefits to Physics

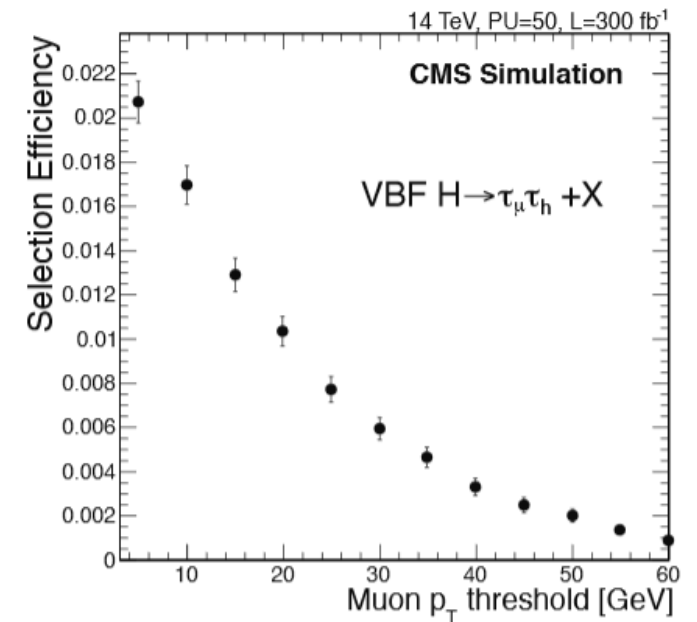
Many physics analyses include soft muons in their signatures. The importance of keeping low  $p_T$  thresholds has been investigated in various benchmark analyses. Studies on the *Vector Boson Fusion*  $H \rightarrow \tau_h \tau_\mu + X$  channel show the yield of events passing the selections increases of 68% moving the threshold from 25 GeV to 15 GeV.



Muon energy spectrum for different benchmark analyses

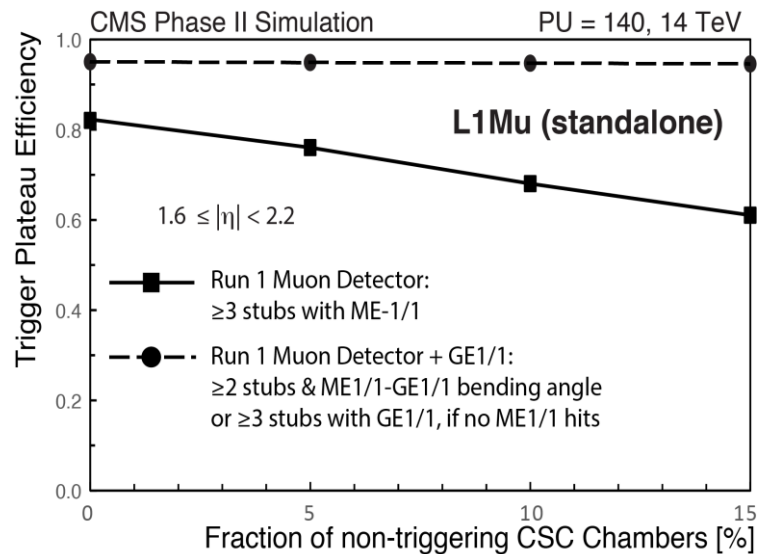


VBF  $H \rightarrow \tau_h \tau_\mu + X$  : Reconstructed H mass and selection efficiency for different  $p_T$  thresholds

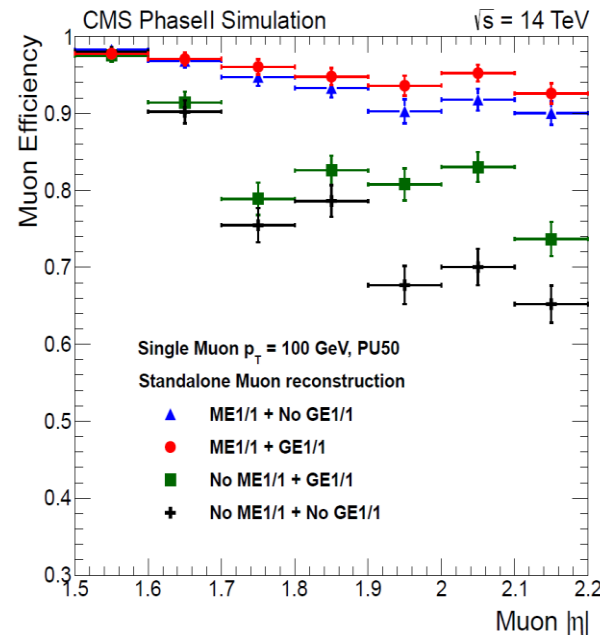


# Detection Redundancy and Reconstruction Performance

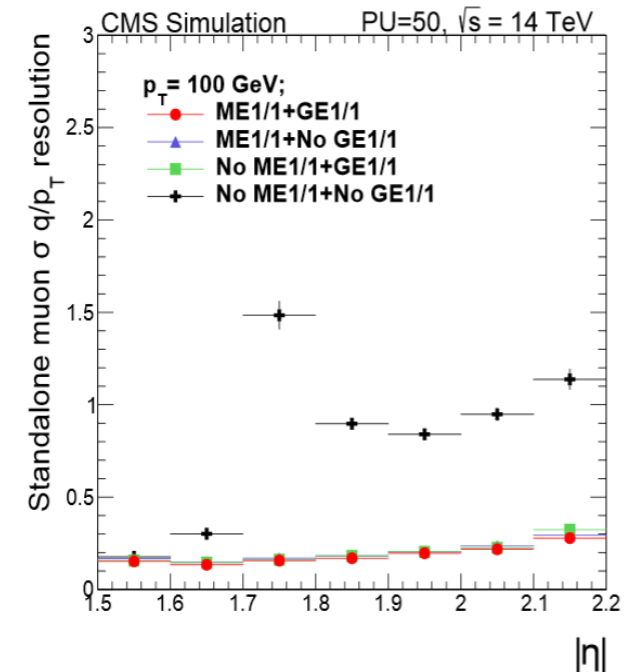
In the High Luminosity LHC era, starting in 2025, the CSCs installed in the forward region will have been operating for 14 years in an extreme radiation environment. Dedicated simulation studies indicate that GE1/1 would guarantee a stable trigger efficiency and improve the muon reconstruction performance, especially in case of ageing problems in the CSCs.



Trigger efficiency



Reconstruction efficiency



Momentum resolution