**Introduction:**

The ATLAS experiment utilises a trigger system consisting of a first level hardware trigger and a higher level software trigger in order to reduce the 40 MHz LHC proton-proton collision rate to about 1 kHz rate for recording interesting physics signatures. Muon triggers are central to many important physics measurements at the LHC. The ATLAS experiment uses the Resistive Plate Chambers detector (RPC) for the first level muon trigger system in the barrel region of the detector. A detailed understanding of RPC detector performance is required in order to operate the trigger at high efficiency. This poster presents measurements of RPC detector and trigger performance using proton-proton collision data collected in 2017, when the LHC increased its instantaneous luminosity to more than twice the design luminosity. This poster shows results of measuring the first level barrel muon trigger efficiency and timing, using muons produced in proton-proton collisions at a centre-of-mass energy of 13 TeV.

**The ATLAS RPC Detector and Trigger System:**

The present ATLAS muon trigger in the barrel region (|η|<1.05) is based on three concentric layers of Resistive Plate Chambers (RPCs). RPC1 and RPC2 stations are located in the Medium Layer (BM) of the Muon Spectrometer (MS), while the third station,

RPC3, is in the Outer Layer (BO). There are 16 physical RPC sectors and each sector is segmented in 2 trigger sectors, totally 64 trigger sectors in side A and side C. Each trigger sector is segmented along η in towers (6 in small sectors, 7 in large sectors, 8 in feet sectors)

**muon barrel trigger logic:**

The Level-1 (L1) trigger algorithm is based on hit coincidence of three concentric RPC stations (both in η and Φ projections). 2 different pT-regimes exist:

● the Low-pT trigger requires a coincidence between the innermost two RPC stations. It is used to select muons with pT thresholds between 4 and 10 GeV;

● the High-pT trigger requires an additional confirmation on the third external station and selects muons with pT thresholds between 11 and 20 GeV.

During ATLAS Run 2, only the high-pT triggers are used for single-muon

signatures, while the low-pT triggers are used in coincidence with other trigger

objects to select multi-object signatures, including muon pairs.

**Tigger timing performance**

One of the main requirements of the L1 trigger system is the association of the

triggering muon to the correct collision bunch crossing (BC). Left plot shows the fraction of RPC trigger hits associated correctly to the collision BC for each of the Barrel Muon trigger towers. Right plot shows the fraction for the whole RPC trigger system. The fraction of reconstructed high pT muons associated to the correct BC is 99.6%

**Trigger efficiency vs. offline muon eta:**

Plots show Efficiency of Level 1 MU10 and MU11 trigger in 2017 including (in green) or excluding (yellow) the newly commissioned trigger chambers in the “feet” region of the ATLAS Muon Spectrometer.

The efficiency is plotted as a function of η at the interaction vertex of offline muon candidates in the barrel detector region, for 2 specific sectors (corresponding to -2.16 < φ(mu at the interaction vertex) < -1.77 and -1.37 < φ(mu at the interaction vertex) < -0.98) of the “feet” region of the ATLAS Muon Spectrometer.

The efficiency is computed with respect to offline isolated muon candidates which are reconstructed using standard ATLAS software and are required to pass a “Medium” quality requirement and have a transverse momentum of at least 15 GeV.

*The MU10 trigger requires that a candidate passed the 10 GeV threshold requirement of the Level 1 muon trigger system, using medium trigger chambers. The MU11 trigger requires that a candidate passed the 10 GeV threshold requirement of the Low-pT Level 1 muon trigger system, with a coincidence with a High-pT RPC chamber.*

*The efficiency is measured on an inclusive sample selected using all non-muon Level 1 ATLAS triggers, in 13 TeV data from 2017 with 25 ns LHC bunch spacing. The plot shows the efficiency increase across the pseudo-rapidity range in the ATLAS Barrel Region, introduced by using the new trigger RPC chambers commissioned by the end of 2015 to cover the indicated φ range, corresponding to the detector support structure feet. The efficiency is also made more constant across η, instrumenting the positions where the detector structure support feet are placed.*

**Trigger efficiency vs. offline muon pT:**

Level 1 muon barrel trigger efficiency for reconstructed muons with p T > 15 GeV and |η| < 1.05 as a function of transverse momentum. The efficiency is shown for the six Level-1 thresholds: MU4, MU6, MU10 which require a coincidence of the two inner RPC stations, and MU11, MU20, MU21 with a further coincidence on the outer RPC stations. MU21 threshold is equal to MU20 everywhere but in the “feet” region, where the new feet trigger does not have this threshold. The efficiency is measured using events selected by independent triggers.

Plateau value of the Level 1 muon barrel trigger efficiency as a function of time. Each point corresponds to a different ATLAS run recorded in 2017. Only runs with integrated luminosity greater than 50 pb -1 and a minimum number of reconstructed muons have been used.

**Trigger efficiency vs. offline muon phi:**

Efficiency of Level 1 MU10 and MU11 trigger in 2017 and comparison with 2016 trigger efficiency. The efficiency is plotted as a function of φ at the interaction vertex of offline muon candidates in the barrel detector region.

η-φ map of the ratio between the Level 1 Barrel muon trigger efficiency in 2017 and 2016 for the trigger threshold MU10 and MU11.