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Upgrade of the Level-1 muon trigger of the ATLAS detector in the barrel-endcap transition region with RPC chambers

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This report presents a project for the upgrade of the Level-1 muon trigger in the barrel-endcap transition region ($1.0 < |\eta| < 1.3$) of the ATLAS detector with RPC chambers.

The ATLAS Level-1 muon trigger rate is dominated by fake triggers in the Endcap region ($|\eta| > 1$) caused by charged particles originating from secondary interactions downstream of the interaction point. After the LHC phase-1 upgrade, foreseen for 2018, the Level-1 muon trigger rate would saturate the allocated bandwidth unless new measures are adopted to improve the rejection of fake triggers. ATLAS is going to improve the trigger selectivity in the region $|\eta| > 1.3$ with the addition of the New Small Wheel detector as an inner trigger plane.

To obtain a similar trigger selectivity in the barrel-endcap transition region $1.0 < |\eta| < 1.3$, it is proposed to add new RPC chambers at the edge of the inner layer of the barrel muon spectrometer. These chambers will be based on a three layer structure with thinner gas gaps and electrodes with respect to the ATLAS standard and a new low-profile light-weight mechanical structure that will allow the installation in the limited available space. New front-end electronics, integrating fast TDC capabilities will be used.

A preliminary study based on 2012 data demonstrates that the new system could reject more than 90% of the fake triggers while maintaining high trigger efficiency. This will allow to keep a relatively low momentum threshold, while matching the rate requirements of both Phase-1 and Phase-2 LHC runs.

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