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The ATLAS RPC system upgrade for the High Luminosity LHC and beyond

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The architecture of the present RPC trigger system in the ATLAS muon barrel was designed according to a reference luminosity of 1034 cm-2 s-1 with a safety factor of 5, with respect to the simulated background rates corresponding to about 300 fb-1 integrated luminosity. HL-LHC will reach a 7.5 times higher luminosity, and correspondingly higher rate, an expected integrated luminosity of 5000 fb-1 and a total duration extended until at least 2040 largely increasing of detector performance and longevity demand. Moreover, the present muon trigger acceptance in the barrel is just above 70%, due to the presence of the barrel toroid support structures.

The ATLAS muon Collaboration approved a major RPC upgrade plan, involving both detector and trigger-readout electronics, to guarantee the performance required by the physics program for the 20 years scheduled. This plan pivots on installing a layer of 272 new generation RPCs in the inner barrel (BI), to increase the redundancy, the selectivity, and provide almost full acceptance. The first 10% of the system, corresponding to the edges of the inner barrel even sectors (BIS78) will be installed in 2019 and can be considered as a pilot of the phase-2 project. To match the performance requirements, the new RPCs will have a different structure, materials and a high performance front-end electronics, in SiGe technology. The new BI chambers and readout electronics, will substantially increase the redundancy and flexibility of the trigger algorithm, increasing its selectivity and efficiency and at the same time lowering the performance demand on the legacy RPCs, extending thus their longevity to match the HL-LHC target.

We will illustrate the performance of the new detectors and trigger system, as well as the impact on the ATLAS physics performance.

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