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A proposal to upgrade the ATLAS RPC system upgrade for the High Luminosity LHC

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The architecture of the present trigger system in the ATLAS muon barrel was designed according to a reference luminosity of 10^34 cm^-2 s^-1 with a safety factor of 5, with respect to the simulated background rates, now confirmed by LHC Run 1 data. HL-LHC will provide a luminosity 5 times higher and an order of magnitude higher background. As a result, the performance demand increases, while the detector being susceptible to aging effects. Moreover, the present muon trigger acceptance in the barrel is just above 70%, due to the presence of the barrel toroid structures. This scenario induced the ATLAS muon Collaboration to propose an appropriate upgrade plan, involving both detector and trigger-readout electronics, to guarantee the performance required by the physics program for the 20 years scheduled. This consists in installing a layer of new generation RPCs in the inner barrel, 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 (BIS), has been already approved by ATLAS and will be installed in 2018, to reinforce the trigger in the region between barrel and endcap. To match the performance requirements, the new RPCs will have a different structure, materials and a high performance front-end electronics, in SiGe technology. We will illustrate the performance of the new detectors and trigger system, as well as the impact on the ATLAS physics performance.

Collaboration

ATLAS Muon Collaboration

Summary

The architecture of the present trigger system in the ATLAS muon barrel was designed according to a reference luminosity of 10^34 cm^-2 s^-1 with a safety factor of 5, with respect to the simulated background rates, and confirmed by LHC Run 1 data. In the HL-LHC conditions, we expect a luminosity of 5x10^34 cm^-2 s^-1 and a rate about an order of magnitude higher than the one experienced in Run 1. As a result, the demand on the trigger performance for fake rejection, muon momentum selectivity and coverage is increased, while being susceptible to ageing effects. Moreover, the present muon trigger geometric acceptance in the barrel is just above 70%, due to the barrel toroid structures and supports. This scenario suggests an appropriate upgrade plan, involving both detector and trigger-readout electronics. We present a proposal of the muon Collaboration for an upgrade of the ATLAS RPC trigger system, under evaluation by ATLAS, conceived to guarantee the performance required by the physics program for the 20 years future operation scheduled. The upgrade consists mainly in installing an additional layer of new generation RPCs in the inner barrel. This will increase the redundancy, the selectivity, and provide almost full acceptance. While we propose this upgrade for the HL-LHC, the first 10% of the system, corresponding to the edges of the inner barrel even sectors (BIS) has been already approved by ATLAS and will be installed in 2018, to reinforce the trigger in the transition region, not covered by the New Small Wheel. We are designing a new generation of RPC detectors to match the performance requirements. The new RPCs will have a different gap geometry, readout system,

mechanical structure, gas mixture and a very high performance front end electronics, in SiGe technology, especially designed for fast detectors. We will illustrate the performance of the new detectors, and the new trigger system, as well as the impact on the ATLAS physics performance.

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