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The ATLAS RPC Phase II upgrade for High Luminosity LHC era

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RPC detectors play a crucial role in triggering events containing muons in the central region of ATLAS. In view of the HL-LHC program, the existing RPC system, consisting of six independent concentric cylindrical detector layers each providing a full space time localization of hits, is currently facing a significant upgrade. In the next few years, 306 triplets of new generation RPCs will be installed in the innermost region of the ATLAS Muon Barrel Spectrometer, increasing from 6 to 9 the number of tracking layers, doubling the trigger lever arm. This allows a substantial enhancement of the present trigger redundancy, increasing the coverage from 76% to 96% approximately. The new chamber design is based on a very efficient integration of an innovative front-end electronics within the detector Faraday cage, allowing to operate the RPCs with an order of magnitude less of average charge per count, correspondingly increasing rate capability and longevity. Fitting new chambers in the narrow space left in ATLAS inner barrel was a challenge,achieved by optimizing RPC materials and thickness, featuring a 1 mm gas gap (instead of 2 mm), and 1.4 mm resistive electrodes (instead of 1.8 mm). Both sides of RPCs are readout by strip panels oriented to measure the bending coordinate of the muon spectrometer, while the second coordinate is reconstructed from the time difference of signal drift at opposite detector's ends. To achieve such results, a 100 ps precise TDC has been integrated in the front-end electronics ASIC. The expected time resolution of a single 1 mm RPC gas gap is approximately 300 ps, and the possibility of a stand-alone Time of Flight measurement will have a huge impact on ATLAS searches for massive long-lived particles. An overview and the present status of the ATLAS RPC Phase II project will be presented.

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