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The upgrade of CMS Resistive Plate Chambers for HL-LHC

The High Luminosity phase of the Large Hadron Collider (HL-LHC) that will follow the 3rd Long Shutdown of the accelerator opens the window to a very rich and ambitious physics program, exploiting an integrated luminosity of 3000 fb^{-1}. During the HL-LHC operation, the instantaneous luminosity will be increased to $5\times10^{34}cm^{-2}s^{-1}$, i.e. five times the machine's original design value, and the ultimate performance of the HL-LHC would enable the collection of 400 to 450 fb^{-1} of integrated luminosity per year. The expected experimental conditions in that period in terms of background rates, event pileup and the probable ageing of the present detectors present a challenge for the entire CMS detection system. In particular, to ensure a highly performing muon system under HL-LHC conditions, different upgrades are required and currently implemented. This includes the upgrade of the Resistive Plate Chambers (RPC), which covers both barrel and endcap regions, contributing to the trigger, reconstruction and identification of muons. To extend the RPC coverage from $|\eta|$=1.9 up to 2.4, an improved version of the already existing RPCs (iRPCs) will be installed in the forward region of the 3rd and 4th endcap disks. Figure 1 shows the region where new RPCs will be placed to extend the coverage (inside the red box) [1]. This will lead to an increase in the efficiency for both muon trigger and offline reconstruction in a region where the background is the highest and the magnetic field is the lowest. New front-end electronics will fully exploit the intrinsic time resolution of iRPCs, improved it by about a factor just two compared to the current system, which will enhance the background hit rejection, and identification as well as the reconstruction of slowly moving Heavy Stable Charged Particles (HSCP). The iRPCs will also offer a better spatial resolution of the order of a few cm along the strip direction (non-bending projection), by measuring the time difference between the signals at both ends of the readout strips. The performance of the proposed iRPCs has been studied with gamma radiation at Gamma Irradiation Facility (GIF++), CERN. A longevity study is ongoing and main detectors parameters (currents, rate, resistivity) are regularly monitored as a function of the integrated charge. Prototype chambers were built and studied for validating the chamber mechanics. The present overall status of the CMS iRPC project, including also results of the ongoing studies at GIF++ will be presented.

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