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# Long Term Validation of the Optimal Filters Configuration for the Resistive Plate Chambers Gas System at the Large Hadron Collider Experiments

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Resistive Plate Chambers (RPCs) are widely employed as muon trigger systems at the Large Hadron Collider (LHC) experiments. Their large detector volume and the use of a relatively expensive gas mixture make a closed-loop gas circulation unavoidable. The return gas of RPCs operated in conditions similar to the experimental background foreseen at LHC contains large amount of impurities potentially dangerous for long-term operation. Several gas-cleaning agents, characterized during the past years, are currently in use. Results of new these tests have revealed an optimized configuration that is now under long-term validation at the Gamma Irradiation Facility (GIF) set-up. A very important feature of the new configuration is the increase of the cycle duration for each purifier that results in better system stability and, if needed, it would permit to increase the gas flow in the detectors during the high luminosity running periods at LHC.
During the test of the new filters configuration, the detector performances are monitored in terms of current stability and Bakelite resistivity. A new model has been developed to correct directly the detector current for the effect of the environmental conditions: temperature, pressure, environmental and gas relative humidity. It is now under evaluation the possibility to apply the same correction to a larger set of data, such as a full LHC-RPC detector system.
The Bakelite resistivity can be affected by the water content in the mixture, but also by the deposition of impurities on the internal electrodes surface. This parameter is regularly monitored in special runs where the normal RPC mixture is substituted with Argon only. Results about the stability of RPC gaps produced with new Bakelite (from Puricelli company) are also reported.
The filtering optimization studies are complemented with a finite element simulation of the gas flow distribution in the RPCs, aiming at its eventual optimization in terms of gas flow distribution and rate. Simulation results on the standard configuration for the RPC gas distribution has shown regions in which the gas velocity is 100 times lower than in others. With a gas flow of 1 volume exchange every 4 hours (considered the lower limit for a safe operation without radiation) these regions represent one third of the detector surface. A new RPC prototype with a flexible distribution of gas inlets and outlets has been built in order to experimentally quantify the impact of those critical regions on the detector performance and also to verify if a new, more effective solution can be found. An efficient removal of the used gas mixture inside the RPC volume would permit to reduce the overall gas flow rate.

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