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Performance of a real-size Mosaic MRPC developed for CMS upgrade

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The Compact Muon Solenoid (CMS) is one of the two general purpose detectors built at the Large Hadron Collider (LHC).In view of the High Luminosity LHC phase, the CMS detector requires upgrades to preserve the efficiency, resolution, and background rejection of the detector. To overcome the limited particle rate capabilities of the present RPC, a new electrode material, the low resistive silicate glasses with a bulk resistivity about 1010 Ωcm produced in China has been considered. By the use of improved multi-gap RPCs, the excellent timing precision below 100 ps can be used for pileup mitigation, and to provide an excellent signature and mass measurement for hypothetical heavy stable charged particles (HSCP).The initial prototype has been designed by jointing two pieces of glass together and the beam test at Helmholtz-ZentrumDresden-Rossendorf (HZDR) shows that it can reach 95% efficiency and 60 ps time resolution in the active area. Based on previous experience and attempt, a real-size Mosaic Multi-gap Resistive Plate Chamber (MRPC) has been developed. This chamber, also made of the low resistive glasses, has a 5-gap and 6 pieces of glass mosaic design. It has been tested with 30 MeV electron beam at HZDR. The working gas is a mixture of 90% C2H2F4, 5% iso-C4H10 and 5% SF6. At rate of 10 kHz/cm2, its efficiency reaches 95% at ±7000 V, with time resolution around 55 ps. Position scan is also carried out and shows that there is about 5% efficiency loss at vertical mosaic interface.Cosmic ray test at CERN 904 shows that its efficiency can reach above 95%. This prototype was also tested with CMS dry gas(95.2% C2H2F4, 4.5% i-C4H10, 0.3% SF6) at the CERN Gamma Irradiation Facility (GIF++) where an high energy muon beam (150 GeV) combined with a 14 TBq 137Cs gamma source and a set of moveable shields. Efficiency results calculated by a simple tracking method show that it can keep the performance at the rate from 0 to 10 kHz/cm2.

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