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New Eco-gas mixtures for the Extreme Energy Events MRPCs: results and plans

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The Extreme Energy Events Observatory is an extended muon telescope array, covering more than 10 degrees in latitude and longitude. The 53 muon telescopes are equipped with tracking detectors based on MRPCs technology with time resolution better than 200 ps. The current MRPCs are six gas gaps detectors, 300 micron each. The chambers are filled with a mixture of 98% of tetrafluoroethane and 2% of sulfur hexafluoride and are operated in avalanche mode. A new bunch of 24 MRPC chambers have been produced in 2017 for the observatory upgrade: they are again 6 gaps MRPCs with a thinner gap size of 250 micron.

The recent restrictions on greenhouse gases require studies for new gas mixtures in compliance with the law requirements. A set of tests with new mixtures have been carried out at the T10 test beam at CERN, where a hadron beam of intensity 104-106 h/s allows for intermediate rate tests. Both the new EEE MRPCs (6 gaps, 250 micron width) and a new prototype with a double-stack of 10+10 gaps, 220 micron size, have been tested with the standard mixture and with new mixtures of tetrafluoropropene and carbon dioxide or sulfur hexafluoride. Tetrafluoropropene is one of the candidates for the tetrafluoroethane substitution, showing a Global Warming Power 300 time lower.

Several mixture compositions have been tested, measuring efficiency curves, charge distributions, discharge fractions and time resolutions. Results are presented for the whole set of mixtures and operating conditions. A set of tests on a real EEE telescope, with cosmic muons, are being performed at the CERN-01 EEE telescope. The tests are focused on identifying a mixture with good performance at low rates, at the standard operating conditions.

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