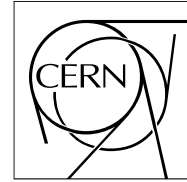


The Compact Muon Solenoid Experiment
CMS Performance Note



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2023 April+July Test Beam results for CO₂ based gas mixtures

CMS Collaboration

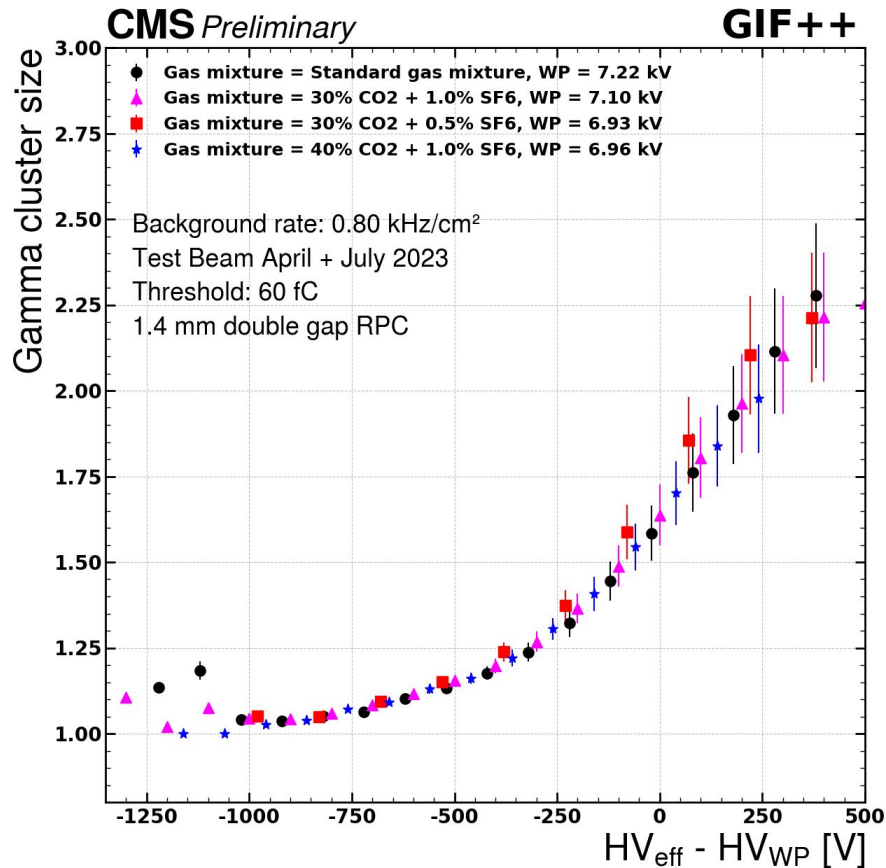
Abstract

Results from the 2023 April+July Teast Beam for CO₂ based gas mixtures.

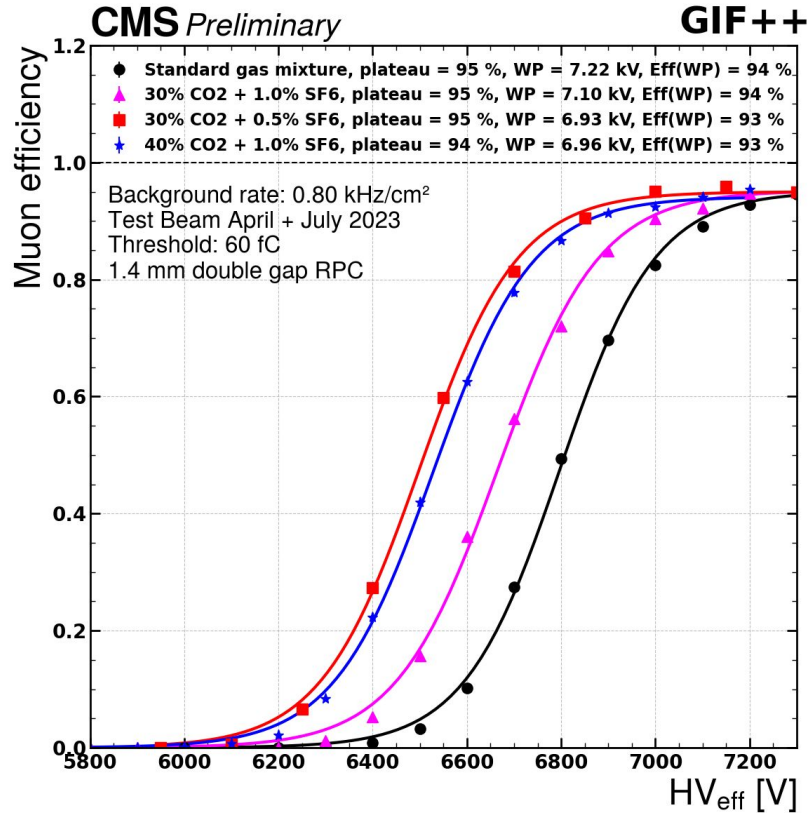
2023 April+July Test Beam results for CO₂ based gas mixtures

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The figure shows the gamma cluster size against the high voltage applied (HV_{eff}), relative to the working point (WP), for the standard gas mixture of CMS RPC, compared to mixtures where 30% and 40% of $C_2H_2F_4$ is replaced with CO_2 , and the concentration of SF_6 is varied between 0.5% and 1.0%. The WP is defined as $HV_{\text{knee}} + 150$ V, where HV_{knee} is the point at which the efficiency curve reaches plateau. The gamma cluster size for low HV values is spread out due to low statistics and intrinsic chamber noise. Measurements are taken under a background gamma radiation of 800 Hz/cm², close to the 600 Hz/cm² radiation expected for the HL-LHC in the iRPC region. Tests are performed using a small iRPC prototype with a 1.4 mm double gap and KODEL electronics. The data were collected at the GIF++ facility during the April and July 2023 test beam with a 13 TBq Cs-137 source.



The figure shows the efficiency versus effective high voltage applied (HV_{eff}), for the standard gas mixture of CMS RPC, compared to mixtures where 30% and 40% of $C_2H_2F_4$ is replaced with CO_2 , and the concentration of SF_6 is varied between 0.5% and 1.0%. The different concentrations of CO_2 and SF_6 shift the working point (WP) as expected. The WP is defined as $HV_{\text{knee}} + 150 \text{ V}$, where HV_{knee} is the voltage at which the sigmoid curve reaches plateau. The dashed line is placed at the 100% efficiency. The standard gas mixture and the one with 30% $CO_2 + 1\% SF_6$ show similar efficiency at WP, around 94 %. The others have a drop of 1% efficiency. Measurements are taken under a background gamma radiation of 800 Hz/cm², close to the 600 Hz/cm² expected for the HL-LHC in the iRPC region. Tests are performed using a small iRPC prototype with a 1.4 mm double gap and KODEL electronics. The data were collected at the GIF++ facility during the April and July 2023 test beam with a 13 TBq Cs-137 source.