

Outgassing studies for the CMS GEM detectors

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Like other gaseous technologies, GEM detectors can experience premature aging when operating in high-rate environments. This occurs when gas molecules dissociate and recombine within the plasmas generated during electron amplification, leading to the formation of large and complex polymers. These polymers can be deposited on the amplification structure and significantly impact the performance and stability of the detector. Although gas mixtures can be optimized to reduce or suppress polymerization, the presence of unwanted pollutants in the gas volume can fuel plasma polymerization, thus triggering conventional aging.

The CMS GEM group has conducted extensive research on the long-term behavior of triple-GEM detectors for over 10 years. This research is part of the upgrade of the forward muon system, which involves the incorporation of three new detector stations based on GEM technology. In addition to studying aging in high-radiation environments, the group has performed a series of specific tests to evaluate the outgassing properties of the materials used in detector construction and the impact of potential contaminants on the operation of gaseous detectors.

In this report we present the rationale behind the design of the dedicated outgassing test stand used for CMS GEM detectors. Furthermore, we discuss the operational experience gained from the tests and potential upgrades for future applications. We also present the test conditions and final results for all the materials that were tested.

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