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Comparative aging studies of GEM chambers in contaminated environment

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GEM-based detectors are widely used in High Energy Physics (HEP) environments due to their inherent resistance to classical aging. Their unique design, which spreads charge amplification across multiple GEM holes and layers, effectively reduces the local plasma energy responsible for polymer formation, a major cause of detector aging. Consequently, GEM detectors are particularly advantageous for high-rate environments.

However, with the ongoing upgrade of the Large Hadron Collider (LHC) and with anticipated future particle accelerators, the radiation environment in which gaseous detectors operate will experience a significant increase in particle rate and contribution from heavy ionizing particles. In this context, it is crucial to reassess aging study strategies and establish appropriate test conditions that realistically replicate long-term operation in the target environment.

This report presents the results of comparative aging tests conducted on small GEM prototypes and wire chambers, all operated in forced contaminated environments and subjected to different irradiation conditions. Specifically, we investigate the aging effects caused by low-energy X-rays and Alpha particles. The performance of the detectors after irradiation, as well as the microscopic effects, were measured.

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