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Micromegas as low background x-ray detectors for axion experiments

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Axion helioscopes aim at the detection of solar axions through their conversion into x-rays in laboratory magnetic fields. The use of low background and low energy threshold x-ray detectors is an essential component contributing to the sensitivity of these searches. Micromegas readouts operated in a Time Projection Chamber have demonstrated they can accomplish these goals. The possibility of reconstructing the event's track in three dimensions make them very competitive regarding discrimination capabilities. Additionally, microbulk type of Micromegas are intrinsically radiopure, imposing no significant limitations in background levels. In this work we present the low background techniques applied to Micromegas detectors in the context of the CAST experiment that has yielded to very remarkable background reductions over the years. The most recent Micromegas setups in CAST have achieved background levels 100 times lower than those obtained by the first generation of CAST d! etectors in 2002. We will also review the promising current developments in underground and surface facilities towards further improvements. Particularly, the best level currently achieved in a test setup operating in the Canfranc Underground Laboratory (LSC) is around 10^-7 keV^{¯1}cm^{-2}s^{-1}, more than 10 times lower than best CAST results. These tests and detailed Monte Carlo simulations are leading to a deep understanding of the background origins, and the extracted strategies to mitigate it will be implemented in CAST for the next data taking campaigns. All this encourages the use of Micromegas readouts for IAXO, a new generation axion helioscope, that aims to improve CAST's sensitivity by more than one order of magnitude.

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