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Unveiling the Operational Principles of MICROMEGAS Gas Detectors at Low Pressure: A Comprehensive Exploration

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In the last years, our research group at the INFN Pisa Laboratory has been deeply involved in the development of a gas detector optimized for operation in a low-pressure regime down to 100 mbar and below. Our objective is the precise detection of atoms within the energy range of 1-100 keV, providing energy measurement and particle tracking with a compact instrument. The MICROMEGAS technology has proven to be inherently well-suited for low-pressure operations, offering tunable avalanche volume to achieve the desired signal amplification.
At the very beginning and by using standard simulation tools, the elaborated model of our detector predicted a very low gain for our selected pressure interval. Through an extensive test campaign using X-ray sources and refined software simulations based on experimental results, we have now acquired a thorough understanding of achievable detector performance as a function of gas pressure.
In this report will provide a detailed summary of a measurements campaign investigating the dependence of the detector gain and energy resolution on the amplification field, gas pressure and drift field. Extensive investigations on gas contaminants and temperature dependency have been also carried on, with the possibility to mitigate their effects on the detector response: each experimental measurement has been deeply analyzed minimizing dependencies on model and simulated data. Thanks to this precise activity aimed at comparing predicted values and experimental results, it was necessary to modify the simulated avalanche model introducing new phenomena never considered in the field of detector development working in low-pressure regime.

Collaboration

Role of Submitter

The presenter will be selected later by the Collaboration

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