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Simulation and Optimization of Resistive Plate Chamber (RPC) Performance using Garfield++

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Resistive plate chamber (RPC) is a type of gaseous detector which was developed in 1981 by R. Santonico and R. Cardarelli. RPCs are pivotal in cosmic ray research, offering precise timing and efficient muon detection. Their fast response allows accurate measurements of cosmic ray particle time of flight, aiding in energy and origin analysis. RPCs'affordability and robustness make them ideal for large-scale experiments, contributing significantly to our understanding of high-energy cosmic phenomena and the universe's mysteries. It comprises two parallel plates with a negatively-charged cathode and a positively-charged anode. Both electrodes are consisted of plastic material with extremely high resistivity and 2mm thickness and spaced apart by gas volumes with the same thick- ness containing a gas mixture of $C_2H_2F_4$(95.2%), iC_4H_{10}(4.5%) and SF_6(0.3%).
In this research, we employed the Garfield++ simulation tool to identify the most suitable operating conditions for RPC. The study focused on assessing the pressure's impact on RPC parameters, including electron transport characteristics such as the Townsend coefficient, diffusion coefficient, and drift velocity. Utilizing the MAGBOLTZ package, these parameters were calculated and compared with experimental one. Additionally, the HEED package was utilized to investigate energy loss and primary ionization number. The neBEM solver facilitated the calculation of weighting field and electric field, while Ramo's theorem was applied to measure the induced signal

Primary author: ABDELHAMEID, Tahany (Helwan University)

Co-authors: Dr ASSRAN, Yasser (The British University in Egypt); Prof. YASSEN, mohamed (Helwan University); Prof. RIZK, Rizk (Helwan University); Prof. MAHROUS, Ayman (Institute of Basic and Applied Science, Egypt-Japan University of Science and Technology)

Presenter: ABDELHAMEID, Tahany (Helwan University)

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