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Numerical study of electric field due to space charge in Resistive Plate Chamber

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Resistive plate chamber (RPC) is one of the state-of-the-art particle detection technology for the HEP experiments. The basic operating mechanism of an RPC involves ionization of gas due to the passage of charged particles, electron transport , avalanche, and subsequent electromagnetic induction on readout strips due to the movement of the electrons and ions. Especially during streamer mode of operation, the electric field applied to the RPC can get significantly modified due to the presence of large number of electrons and ions.
In this study, we have worked on dominant issues related to the estimation of electric field due to the space charge arising out of the presence of electrons, ions within an RPC. For this purpose we have considered two approaches: representation of the space charge cloud as (a) a collection of point charges, and (b) as a collection of line charges. Due to the parallel plate geometry of RPC, the number of reflections or images of these charged entities is infinite. For representation (a), the convergence of the electric field at any point due to image charges has been studied by evaluating the electric field only for several possible number of image charges. For (b), we have calculated the electric field with standard electric field formula for line charge distribution, and their images. The same has also been estimated with the help of the neBEM[1] field solver. The results from these different methods have been compared with results available in the literature[2,3,4].
Reference:
1. http://nebem.web.cern.ch/nebem/
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3. C. Lippmann, W. Riegler, Nuclear Instruments and Methods in Physics Research A, 517 (2004) 54–76.
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