Effect of Variation of Surface Resistivity of Graphite layer in RPC

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The high electric field across the Resistive Plate Chamber (RPC) is generated through the application of high voltage on the resistive layer of graphite. In this work, we have analyzed the effect of variation in the surface resistivity of graphite on the spread of the applied voltage. We have simulated the charge spread and voltage build-up across the resistive plate using the Chani code [1] that we have modified to suit our purpose.

In Chani code, simulation of charge transport is carried out by the solution of the Poisson equation through the surface of interest at each time step and calculation of the currents between small subcells of the surface. Here, "method of moments" is used to solve the corresponding Poisson equation. The initial conditions are given in the form of the charge on the subcells. The potential, as well as the charge, at a later time are calculated by this program for uniform surface conductivity. In order to make the code more realistic, we have introduced a non-uniform conductivity matrix for various subcells and used it to study the effect of resistivity variation. The input resistivity of these subcells has been obtained from the experiment. The voltage build-up follows a capacitive behavior and saturates after some time which we call saturation time. This saturation time depends on the resistivity of the resistive layer. The non-uniform resistivity will lead to non-uniform saturation time at different locations of the RPC which may have an effect on the dead time and charge spreading.

The resistivity of graphite layer has been obtained by measuring the resistance using a square zig. We have used a square probe of size 1 cm^2 attached to Aerotech linear stage having high precision in XYZ and can be controlled by a BASIC program. The resistance is measured by a Pico-ammeter which can supply voltage and measure current with high accuracy. Now, we have obtained a resistivity map of graphite layer by combining Aerotech linear stage and Pico-ammeter. The experimentally measured resistivity map as shown in fig. 2 is given as an input to the simulation which results in the potential distribution as shown in fig. 3.

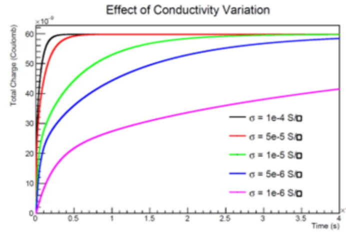

Fig.1 – The saturation time increases with the surface resistivity.

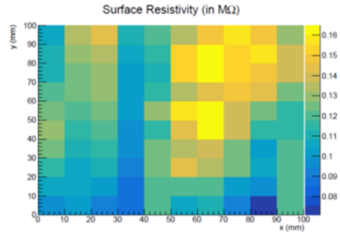

Fig.2 – Surface resistivity measurement of 10 x 10 cm^2 layer of graphite.

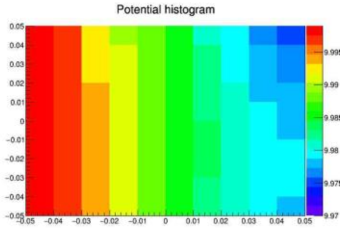

Fig.3 – Simulated Potential distribution after 1.5 μs for non-uniform surface resistivity.

References
[1] arXiv:1207.4585 [physics.comp-ph]
[2] R. Cardarelli, et al., Nucl. Phys. B (Proc. Suppl.) 158 (2006) 25-29