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Study on Surface Asperities in Bakelite-RPC

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Experimental evidences indicate that the surface treatment of the electrodes with silicone in Bakelite-RPC improves the detector peformance in a significant way [S. Biswas et al., NIM A602 (2009) 749, NIM A604 (2009) 310]. Studies on the morphological features of the Bakelite grades used for building the detectors reveal the presence of surface asperities in these materials. Thus, a detailed investigation becomes necessary to understand the role of non-planarity of the Bakelite surface in affecting the detector performance. It is conceivable that depending on their shape and height, these asperities which are predominantly three dimensional, can distort the local electric field configuration which is otherwise uniform in the parallel plate-like configuration of RPC and thus even lead to local discharges inside the active volume.

A numerical simulation has been carried out to probe effects of surface asperities on the field configuration of the detector and eventually its performance. The data obtained from the measurments of surface profiles of Bakelite sheets of different grades using profilometer and AFM have been used to model the asperities in a Bakelite-RPC. The field configuration in the active volume of the device has been computed using neBEM-GARFIELD package [http://garfield.web.cern.ch, http://nebem.web.cern.ch]. The calculation for a typical Bakelite-RPC with a rectangular ridge of height about 4 micron on one of the Bakelite sheets has shown a change of around 10% in the field values. A few preliminary results for very simple models were reported in RPC2010 [S. Biswas et al.]. However, it is obvious that much more detailed modeling of the device is required in order to investigate the actual effect of surface irregularities on the detector performance. In this work, several models with volumes of different shapes and sizes have been used to represent the measured asperities more realistically. In addition, modelling has been carried out to simulate the effect of surface treatment with a layer of silicone on the electrostatic configuration. Trends observed in the computation seem to agree well with the experimental observations.

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