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RPC simulations from a current stand-point

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In the past, simulation of RPCs down to charge distributions, efficiency and resolution, has been done by working out the induction characteristics of the avalanches over one of the surrounding electrodes, resulting on a current generator that is sent to a (necessarily bandwidth-limited) charge-sensitive amplifier. This fact inherently hides a difficulty for including the role of the detector capacitance in the process and undermines the ability for a quantitative description of some of the detector characteristics, especially those concerning timing performances, cross-talk and transmission losses, where the signal shape is more important than its charge. Thus, under the 'standard' approach, the detector capacitance matrix (either total or distributed), the electronics frequency response, its gain and threshold are characterized by a single effective parameter, the equivalent charge at threshold Qth, that is left to the experimenter to determine. Despite its simplicity, this great conceptual simplification has allowed to obtain many useful simulation results in the field. Even the combined approach followed in D.Gonzalez-Diaz doi:10.1016/j.nima.2010.09.067 (where information from signal waveforms is used) does not escape fully from the aforementioned approach, although it allows to reasonably describing the most characteristic multi-strip observables like charge sharing and specially cross-talk. By further developing the conceptual work of W. Riegler in NIM A, 491(2002)258, D.Gonzalez-Diaz doi:10.1016/j.nima.2010.09.067 and D. Gonzalez-Diaz et al, NIM A 648(2011)52, we give (and discuss the validity) of a general formulation of the current generation problem in RPCs under the assumption that current induction and current transmission are independent processes, the first taking place ideally on a cross-section of the device. Thus, the multi-conductor transmission line (strip) excitation mechanism is driven by the solutions to a 2-dimensional weighting field problem, that are implemented as ideal current generators at the corresponding cross-section. This is, to date, the most obvious way to factor-out the intrinsically 3D electro-dynamic problem (P. Steinhaeuser, Yu. N. Pestov et al, NIM A 390(1997)86) in a computationally inexpensive way. We will discuss several limits of interest arising from this approach, like the transition from electrically-short (pad) to electrically-long (strip) systems. Our recent experimental results on cross-talk compensation (along the lines of D. Gonzalez-Diaz et al, NIM A 648(2011)52) will be briefly outlined, too.

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