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A Simple Theory for Resistive Plate Chambers

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A simple model for computing the current through the anode strips of a resistive plate chamber (RPC) is developed; a simple approximate but quite accurate formula for this current is found. The model is an infinite plane condensor filled with two layers; one is vacuum and represents the gas gap. The other one neighbouring the anode is a dielectric with a relative dielectric constant between 2 and 4; its weak conductivity is neglected as it has been shown by Schöpf and Schnizer (WCC 1992) that for the high values of the specific resistance of the melamine-phenolic laminate or glass it has no influence on the signals so that the quasi-static approximation can be applied. The potential for a point charge representing the avalanche moving across the gas gap is calculated. From this the current flowing through a strip of the anode is derived. It turns out that the influence of the dielectric on the signal is also small and may be neglected; so a formula derived for an empty condensor and giving the strip current as function of the distance between the anode and the cathode, of the width of the strip and of the distance between the strip and the trajectory of the charge is a good approximation to the real case. A more refined model including a real gap between the anode strips again justifies the simple formula.

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