A New Gaseous Detector of Ionising Particles - the Dielectric Resistive Plate Chamber. Principles of operation.

A. Akindinov [a] V. Golovine [a] A. Martemianov [a] A. Smirnitski [a] K. Volochine [a]

[a] *Institute for Theoretical and Experimental Physics, Moscow, Russia*

Presented by: K. Volochine

Abstract

In terms of priciples of operation, the Dielectric Resistive Plate Chamber (DRPC) combines features of two well-known detectors: the Parallel Plate Chamber (PPC) and the Resistive Plate Chamber (RPC). Particles are detected in a narrow (from 0.1 to several milimeters) gas gap formed with two planar parallel electrodes. One of the electrodes is conductive. The other is made of dielectric which is covered, from the gap side, with semiconductive ceramics (SiC). The resistivity of the layer may be widely varied by choosing SiC resistivity ($10^3 - 10^{12}\Omega\cdot$ cm) and changing the surface thickness. The external side of this dielectric-resistive (DR) electrode is conductive and is used for readout purposes.

A high electric field of 6–8 kV/mm, applied between the electrodes, initiates immediate Townsend avalanche amplification of primary ionization at any point within the sensitive volume, providing a gain of up to $10^6 - 10^7$. Electron avalanches induce a very fast (with the rise time of less than 1 ns) signal on the inner surfaces of the electrodes, and immediate fast signal on the outer surface of the DR electrode. In case of a breakdown, the dielectric layer strongly suppresses spark energy resolution, by charging an elementary plate condensator which then discharges through the resistive surface.

The detector has shown stability of operation in the avalanche mode within a wide range of applied voltages. As semiconductive ceramics SiC has a pure electron mode of conductivity, no charge accumulation on the surface or inside the DR electrode, and no characteristics degradation have been observed.

The relevant applications of DRPC may be large-scale high-granular cheap mosaic detectors for studying high energy nucleus-nucleus collisions.

1. V. Golovine, A. Smirnitski. Patent of Russia #2148283, 13.11.1998.
2. A. Akindinov *et al.* Preprint ITEP 45–98, 1998.
3. A. Akindinov *et al.* Preprint ITEP 20–99, 1999.