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Induced signals in particle detectors with resistive elements: modelling novel structures.

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Novel detector structures are proposed regularly, mixing old and new ideas, with resistive detectors widening the landscape of possible configurations. In this talk, a universal way of calculating the signals induced in structures with resistive elements is presented. This is done by applying an extended form of the Ramo-Shockley theorem to several different detector configurations using numerical methods. For these, the time dependence of the signals is not solely given by the movement of the charges in the drift medium but also by the time-dependent reaction of the resistive materials. The weighting potential becomes dynamical for these geometries due to the mediums' finite conductivity and can be computed numerically. COMSOL Multiphysics provides these needed time-dependent solutions, which, coupled with Garfield++ and a general-purpose circuit simulation program (e.g., SPICE) to describe the front-end electronics, allows for the targeting of a universal modelling toolkit for the modelling of the signal induction in particle detectors. This study includes a wide range of MicroPattern Gaseous Detector (MPGD) and silicon-based detectors. Particularly for the PICOSEC Micromegas detector and the AC-coupled Low Gain Avalanche Diode (LGAD), the possibility of modelling the time and position response for different readout patterns could provide key insights for the design of new prototypes and application.

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