New studies on the rate capability of resistive gaseous detectors

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Dating back to 1990s, the extensive use of resistive elements in gaseous detectors has been a real breakthrough, since it provided them with auto-triggering capabilities, spark protection and long term stability. Though, it implies a limitation on the maximum flux of particles that can be measured without efficiency loss, and this is of major relevance both for the operation of the experiments at the High Luminosity LHC, and for the design of the detection systems at the next generation of accelerators.

In a gaseous detector operated at high rate, the instantaneous voltage applied to the gas volume undergoes rapid variations, which have to be carefully modeled and taken into account to understand the performance of these devices.

The average value of the instantaneous voltage lowers with increasing rate, and its fluctuations as well. This last aspect cannot be described using the Ohm’s law.

Efficiency at low and high rate: here a comparison between experimental and simulated results is shown, demonstrating that these basic effects are well understood.

Multiple-cells model: In a more refined simulation, also charge spreading and surface current onto the resistive plates has to be taken into account. An accurate simulation in this case is still missing.

It is of paramount importance to understand the physics processes at the base of the limitations in rate capability of resistive gaseous detectors, in order to design a next generation of devices where the necessary improvements will be correctly implemented.

In this field, the most refined approach included the thorough description of the local behavior of the voltage applied to the gas volume, and the use of a time dependent weighting field, in order to provide a complete description of the dynamic processes taking place in these devices.

Just part of the studies needed to arrive to a complete understanding and simulation of resistive gaseous devices at high rate has been completed. Also, some of the parameters needed to describe the charge-discharge process, are, at the moment, unknown, and they have to be tuned by hand.

The effort needed will open new and original pathways to follow for the optimization of resistive gaseous detectors at the experiment of the future large accelerators.