Contribution ID: **369** Type: **Poster**

High Granularity Small-Pad Resistive Micromegas for Rates above MHz/cm2

Friday, 27 May 2022 09:03 (1 minute)

An R&D project has been recently started to consolidate the technology of resistive Micromegas for operations well beyond the actual operations at HEP experiments, aiming at stable, reliable, and high gain operation up to particle fluxes of the order of 10 MHz/cm2, over large surfaces.

To cope with these challenges, readout copper pads, of a few mm2 size, have been proposed to reduce the occupancy of the readout elements, calling for innovative solutions for the spark protection resistive scheme. It is known that single stage amplification Micro Pattern Gaseous Detectors suffer from sparks when operated under harsh environments. Resistive anodes drastically mitigate the spark intensities but, on the other hand, they reduce the rate capability when high currents flow into the detectors, generating a drop in the amplification voltage. Ad-hoc solutions must be adopted.

Two resistive schemes have been studied. The first one is based on a pad-patterned resistive double layer, superimposed to the readout pads, with an embedded resistor connecting the resistive pads. In this scheme, each pad is independent from the others. The second scheme exploits the recently developed Diamond-Like Carbon (DLC) resistive foils. A double layer of DLC is superimposed to the readout pads, with a grid of interconnecting vias to ground for a fast evacuation of the accumulated charge. In this case the pads are not completely independent since the charge can spread over more pads. For each of these resistive schemes, detectors with different configurations and construction techniques have been built.

All detectors have been thoroughly tested and fully characterized with radioactive sources, X-rays and with test-beam carried out at CERN in 2021. The performance and achievements in terms of gains, rate capabilities, energy, space and time resolutions will be reported, along with a detailed comparison among the different schemes and configurations.

Collaboration

RHUM

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Session Classification: Gas Detectors - Poster session