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The micro-Resistive WELL

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In this work we present the micro-Resistive WELL (micro-RWELL): a compact spark-protected single amplification stage MPGD. The micro-RWELL is realized by merging a suitable etched GEM foil with the readout PCB plane coated with a resistive deposition. The copper on the bottom side of the foil has been patterned in order to create small metallic dots in correspondence of each WELL structure. The resistive coating is performed by screen printing technique. The WELL matrix geometry is realized on a 50 micron thick polyimide foil, with conical channels 70 micron (50 micron) top (bottom) diameter and 140 micron pitch (of course different geometries can be considered in order to optimize the detector performance, especially in terms of gain amplitude). A cathode electrode, defining the gas conversion/drift gap, completes the detector.
The micro-RWELL has features in common either with GEMs or MMs
- from GEM it takes the peculiarity of a "well defined amplifying gap", thus ensuring very high gain uniformity.
- from MMs it takes the resistive readout scheme that allows a strong suppression of the amplitude of the discharges.
Even though the amplifying element of the micro-RWELL is practically the same of the GEM, its signal formation mechanism is completely different. The signal in a GEM detector is mainly due to the electron motion, while in a micro-RWELL besides the very fast collection of the whole electron charge produced into the amplification channel also the ionic component contributes to the formation of the signal. In this sense the signal of a resistive-WELL is more similar to the one of a MMs. The assembly aspect of the micro-RWELL technology is a strong point in favor of this architecture. It does not require gluing or stretching of foils or meshes: a critical and time-consuming construction step of both GEM and MM technologies. With respect to the GEM and MM the proposed technology is extremely compact, does not require very stiff (and large) support structures, allowing large area covering based on PCB splicing with a very reduced dead space (< 1mm). The detector gain, about 10^4 has been measured with X-rays in current mode. The use of thicker kapton for the realization of the amplifying component of the detector should allow to achieve gas gain larger than those obtained with the 50 micron thick amplification gap. The detector rate capability, from 100 kHz/cm2 to 600 kHz/cm2 (measured with X-rays, for a surface resistivity of about 100 MOhm/square) can be tuned with a suitable segmentation of the resistive layer. The typical discharge amplitude for the micro-RWELL is of the order of few tens of nA. Results from a test at the H4-SPS beam line with a micro-RWELL prototype, equipped with a 400micron strip pitch, show a space resolution of 60 micron with a detection efficiency of the order of 98% (with 4 mm gas gap). The performance of the detector operated in magnetic field with different incident angles is under study.

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