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Development of large size hybrid Micromegas gaseous detectors for high hadron flux at COMPASS experiment

Future physics programs using high intensity muon and hadron beams of a few hundred GeV on fixed targets are being prepared by the COMPASS experiment at CERN for the years 2015 and beyond. Large size Micromegas gaseous detectors (40x40cm² active area) which are used in COMPASS tracking since 2001 need to be upgraded in order to cope with the foreseen higher beam intensities (up to a few hundred of kHz/mm²), and in order to be active in the beam area where the present detectors are blind. Sparks generation between electrodes by highly ionizing particles is a major issue for Micromegas detectors at high hadron flux; several studies are lead to cope with it, most of them focused on resistive layers deposited above the read-out anodes.

Beside studies done on specific resistive Micromegas detectors using buried resistor technology, our group did a lot of efforts to study, in view to reduce spark rate, hybrid detectors, which are a combination of a non-resistive Micromegas board and a pre-amplifying GEM foil. Performance of both hybrid and resistive detectors where measured in test beams and in the COMPASS environment with both muon and hadron beams. Hybrid detectors showed very promising results in term of spark rate reduction as well as spatial and time resolutions, and efficiencies. Two hybrid detectors were finally installed as active trackers at COMPASS for the 2012 run, becoming the first Micromegas detectors featuring a spark reduction technology used in an actual high flux particle physics experiment. The preparation of the detector production is presently in progress, and all the Micromegas detectors will be replaced by hybrid ones for the next COMPASS run in spring 2015.

After a presentation of the project and its constraints, an overview of the performance of both resistive and hybrid detectors will be given, with an emphasis on the interest of hybrid Micromegas. The comparison between both types of detectors will be discussed, based on detector performance as well as on the capacity for the industry to build such detectors and on their cost. The impact on the tracking efficiency of the detector reconstruction optimization will also be discussed with the particular case of the highly occupied beam area, and the possibilities to optimize the detector design for the final production will be presented.

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