Contribution ID: **54** Type: **Poster**

Performance studies of resistive MicroMegas detectors for the upgrade of the ATLAS Muon Spectrometer

Tuesday, October 13, 2015 3:55 PM (1 minute)

Resistive Micromegas (Micro MEsh Gaseous Structure) detectors have proven along the years to be a reliable high rate capable detector technology characterised by an excellent spatial resolution. The ATLAS collaboration at LHC has chosen the resistive Micromegas technology, along with the small-strip Thin Gap Chambers (sTGC), for the high luminosity upgrade of the inner muon station in the high-rapidity region, the so called New Small Wheel (NSW) upgrade project. The NSW requires fully efficient Micromegas chambers with spatial resolution better than 100 μm independent of the track incidence angle and the magnetic field (B < 0.3T), with a rate capability up to ~10 kHz/cm2. Moreover, together with the precise tracking capability the Micromegas chambers should be able to provide a trigger signal, complementary to the sTGC, thus a decent timing resolution is required.
Several tests have been performed on small (10x10 cm2) resistive Micromegas chambers using medium (10 GeV/c, PS) and high (150 GeV/c, SPS) momentum hadron beams at CERN. Results on the efficiency, position and timing resolution measured during these tests will be presented demonstrating the excellent characteristics of the detectors that fulfil the NSW requirements. Exploiting the ability of the Micromegas detectors to work as TPC chambers a novel method, called the μTPC, has been developed for the case of inclined tracks, allowing for a precise segment reconstruction using a single detection plane. A detailed description of the method along with thorough studies towards the refinement the method's performance will be presented. Moreover, during 2014 the first Micromegas quadruplet following the NSW design scheme, comprising four detection planes, two of them with stereo strips to allow for the reconstruction of a second coordinate, has been realised (MMSW). Test-beam results of this medium size (1x0.5 m2) prototype will also be presented and compared to theoretical expectations.

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Session Classification: Poster session & coffee break

Track Classification: MPGD Detector Physics