Aging Measurements with the Gas Electron Multiplier (GEM)

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Continuing previous measurements, we have made long-term, high-rate exposures of production GEM detectors – built for the COMPASS experiment – to radiation to study aging properties. In standard operating conditions, with Ar/CO_2 filling, no change in gain is observed after a total collected charge of 5 mC/mm^2, corresponding to 5 years of normal operation. The observation confirms previous results demonstrating the relative insensitivity of GEM detectors to aging, even when manufactured with common materials.

Summary of Talk: Due to the absence of thin anodes, the GEM multiplier seems a priori much less sensitive to aging than other micro-pattern devices. Indeed, since the gain is determined by the field strength in the central region of the holes, far from electrodes and walls, it is very little affected by possible polymerization deposits. This has been already confirmed experimentally by us and various authors. As a necessary complement of our previous measurements, made with small detectors under somewhat ideal conditions, we have exposed a standard large-area production model of the triple-GEM detectors built for the COMPASS experiment at CERN. In this case, because of practical constraints, the choice of the materials, epoxies and sealants is somewhat less optimal. Nevertheless, a long-term exposure to X-rays, made over a substantial area of a detector (about 100 cm^2) has shown no sign of degradation of gain up to a total collected charge of 5 mC/mm^2. This corresponds to 5 years of operation in the experiment. The chamber is operated in a mixture of Ar/CO_2 70:30. Measurements continue to assess the possible effects of contaminants, the most likely one being water permeating through the windows or the gas tubes.