Contribution ID: **27** Type: **Poster presentation**

Results of the longevity study with the triple-GEM technology for the upgrade of the CMS muon end-caps

Thursday 25 May 2017 14:58 (4 minutes)

In order to maintain the physics performance and the detection efficiency of the CMS muon system in the future HL-LHC environment, the CMS muon group has proposed to instrument the vacant regions of the forward muon end-caps with the Gas Electron Multiplier (GEM) technology, which can operate in high-rate environment with detection performance fully compatible with the CMS requirements.

This ambitious upgrade program, named GEM End-cap station 1 ring 1 (GE1/1), started in 2009 with the development of the first world's largest triple-GEM chambers. Several years of R&D were then necessary to ensure that the detector's operating characteristics and performance would suit the CMS environment. One of the main R&D project consisted of studying the long-term operation of the GE1/1 detectors and the possible degradation of their performance after a long exposure in the CMS environment.

As for all gaseous detectors, the triple-GEM chambers might be subject to aging effects, in particular due to the production of polymers in the plasma surrounding the electron avalanches. This phenomenon, often referred as "Classical aging", is mainly triggered and enhanced by inappropriate operating conditions or by the presence of contaminants in the detector.

The goal of the longevity study was to reproduce the aging of the GE1/1 detectors in a realistic CMS environment. Three aging tests have been conducted at CERN in the Gamma Irradiation Facility (GIF) with different prototypes, operating conditions and gas mixtures. After several months of continuous exposure to a gamma source, the detectors accumulated a total charge equivalent to 10 years of real operation at HL-LHC (with safety factors). No aging effects were observed during the exposure and no traces of degradation or polymerization were found on the GEM structure.

In parallel to the classical aging test, a set of outgassing tests has been performed to ensure that none of the GE1/1's material could release pollutant in the gas mixture and trigger pre-mature aging. Seven critical materials have been tested, whose one was rejected after observing strong outgassing.

The results of the classical aging test and the outgassing study have been approved by the CMS muon group and will be used as a baseline for the future GEM upgrades in CMS.

Author: MERLIN, Jeremie Alexandre (CERN)

Presenter: MERLIN, Jeremie Alexandre (CERN)

Session Classification: Coffee Break and Poster Session - 2