Aging Studies for the Resistive Plate Chambers (RPC's) of the CMS Muon Trigger Detectors

(title assigned)

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The CMS Resistive Plate Chambers (RPC's) of the muon trigger detectors will work in presence of an intense gamma and neutron background. The total accumulated dose and charge for 10 years of LHC operation have been estimated to be about 1 Gy and 0.05 C/cm^2 per gap, respectively. In order to study possible aging effects, dedicated irradiation tests have been performed both with gamma fluxes and neutron fluxes. These tests were performed with the final detector geometry and readout electronic chain at the CERN Gamma Irradiation Facility and Louvain-la-Neuve neutron facility.

Summary of Talk: The RPC's are well known gaseous ionizing detectors. They will be used as dedicated detectors for the CMS muon trigger system at the future Large Hadron Collider (LHC). At the maximum LHC luminosity (10^{34} cm^{-2}s^{-1}) the expected background fluxes in the barrel region of CMS due to low energy photons (up to about 100 MeV) and neutrons (up to 1 GeV) will be about $4 \cdot 10^2$ cm^{-2}s^{-1} and 10^3 cm^{-2}s^{-1}, respectively. Monte Carlo simulations have estimated that the corresponding integrated dose in ten years of LHC operation will be about 1 Gy. Moreover, a total charge of about 0.05 C/cm^2 per gap will be integrated in the active area of the detector. It has been extensively verified that double-gap RPC's, operated in avalanche mode, have a time resolution better than 2 ns, an efficiency above 95% and a rate capability of $\approx$ 1 kHz. However, aging tests are necessary to realistically reproduce the background conditions of the CMS experiment. This talk summarizes the experimental results obtained during the past years on CMS-RPC's irradiated with gamma and neutron fluxes at the CERN Gamma Irradiation Facility and the Louvain-la-Neuve neutron facility, respectively. These tests were performed with the final detector geometry and electronic readout chain. It is well known that a thin layer of linseed oil on the Bakelite surface has the effect of reducing the RPC noise and dark current. Therefore, detectors with and without linseed oil treatment have both been tested, in order to verify a possible different behavior from the aging point of view. To investigate possible aging effects the current, the counting rates, and the efficiency of the chambers have been monitoring during the irradiation. Concerning the gamma irradiation, the results show no significant variation of the RPC efficiency with cosmic muons. No variation of the gamma sensitivity of the detector has been observed. However, an increase of the counting rate and of the current have been measured. For the neutron test, very preliminary results will be available. Finally, the RPC front-end chips have been also tested during the irradiation to measure the S.E.U. (Single Event Upset) rate. No degradation both in their timing characteristics and in drawn current have been observed.