First Results of an Aging Test of a Full–Scale MWPC Prototype for the LHCb Muon System

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A four-gap MWPC designed for the LHCb muon is undergoing an aging test at the CERN Gamma Irradiation Facility. The first results of this study are reported. The results are based on the analysis of the chamber behavior after accumulating a linear charge density of about 0.25 C/cm, corresponding to approximately 5 years of operation in LHCb under the worst conditions expected for this chamber type (about 37 kHz/cm^2 counting rate). The chamber showed some increase in dark current during the irradiation, although less than what would affect the proper operation of the chamber.

Summary of Talk: Multiwire proportional chambers (MWPC's) with anode wire and cathode pad readout are being developed as a substantial part of the LHCb muon detector. The maximally expected counting rate for these chambers is about 37 kHz/cm^2, which includes a safety factor of 5 on the best estimate of the particle flux. The accumulated charge density for 10 years of LHCb operation under these conditions would be 0.5 C/cm on the anode wires and 1.7 C/cm^2 on the cathode pads. To collect similar charge densities, the chamber has been exposed to the very intense ^{137}Cs source (675 GBq in February 2001) in the Gamma Irradiation Facility (GIF) at CERN. The photon counting rate produced by the source is about 30 kHz at the chamber. The test is scheduled to last for 1 year and began in February 2001. The MWPC under irradiation is a full-scale four-gap chamber with a gas volume of 3 liters and a total irradiated area of 1500 cm^2. A three component gas mixture Ar/CF$_4$/CO$_2$ 40:10:50 is used. The gas pipes are made from stainless steel (supply) and copper (exhaust). The gas flow rate is one chamber volume per hour, which is the normal flow rate used in high-irradiation conditions. One of the four gaps of the chamber is only under high voltage during measurements and is used as reference gap to measure the relative gas gain variations. All of the cathode surfaces are gold plated in order to minimize the effects of cathode aging. Gold-plated cathodes will be used for the chambers situated in the locations of highest irradiation. Aging effects on the cathodes are checked by regular measurements of the resistances between the cathode-pads and ground. The anode status is checked by current monitors with a current resolution of about 1 nA. The current is monitored both during irradiation and without irradiation. The currents in the gaps are in the range of 150 – 250 μA under irradiation. The pressure, temperature and humidity around the chamber are monitored as well. An Americium source was used to measure the source-induced current over the full area of the chamber before the irradiation. The performance has also been studied with a 3 GeV pion beam. Analysis of the data obtained after a radiation dose corresponding to about 5 years of LHCb operation did not show any deterioration which could prohibit the use of these chambers in LHCb. To achieve a charge equivalent to 10 years of LHCb operation the test will continue until the beginning of 2002.