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Radiation Hardness Studies of RPC Based on Diamond-Like Carbon Electrodes for MEG II Experiment

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The MEG II experiment searches for the $\mu \to e\gamma$ decay which is charged lepton flavor violating process. A new type of resistive plate chamber (RPC) using diamond-like carbon (DLC) electrodes is under development for the identification of gamma ray from the radiative muon decay background, in the MEG II experiment. In order to identify the background, low energy positrons on the muon beam line need to be detected, hence the DLC-RPC is planned to be installed in a high-rate (10^8 μ/s) and low-momentum (28 MeV/c) muon beam. There are several strict requirements on the DLC-RPC $-$ the extremely low material budget of 0.1 $\%$ of radiation length, the high detection efficiency for MIP positrons of 90 $\%$, the high-rate capability of up to 4 $\mathrm{MHz/cm^2}$ and the radiation hardness for 30 weeks of operation. The radiation hardness of the DLC-RPC has never been investigated before, although irradiation doses corresponding to a total energy deposit of $\mathcal{O}(100)$ $\mathrm{C/cm^2}$ are assumed. As the DLC-RPC uses the same gas configuration used in conventional RPCs ($\mathrm{C_2H_2F_4}$, isobutane, and $\mathrm{SF_6}$), fluorine deposition due to irradiation is expected, which is an aging phenomenon observed with conventional RPCs. Aging tests were carried out using a single-layer prototype detector with 2 $\mathrm{cm} \times 2$ cm size to investigate these effects. This presentation will describe the aforementioned the DLC-RPC and the results of the aging tests on the DLC-RPC.

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