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Radiation tolerant fiber optic sensors for long-term humidity monitoring in the CMS experiment

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Relative humidity (RH) monitoring has a significant impact in various application fields and many sensing schemes and solutions have been proposed according to the specific applications. Here we concentrate our attention on the use of RH fiber optic sensors (FOS) recently developed for application in the CMS experiment. Any humidity sensor to be introduced in the volume of a Tracking detector should comply with many requirements in terms of radiation resistance (required up to 1 MGy for regions close to the Interaction Point), insensitivity to strong magnetic field, small dimensions and low mass, operation at very low temperatures, reliable readings across long distances and reduced number of wires for operation. In this scenario, FOS-based thermo-hygrometers appear as a good alternative to the conventional instruments. Indeed, the fiber itself, if properly selected, can tolerate a very high level of radiation, optical fiber transmission is insensitive to magnetic field and electromagnetic noise and perfectly suited for read-out over very long distances. After a few years of development, 72 FOS thermo-hygrometers, based on polyimide-coated Fiber Bragg Gratings (FBG) organized in multi-sensors arrays, have been installed in CMS in December 2013 and are currently providing constant monitoring of temperature and RH. However, experience in operation has shown some limitations of the polyimide coated FBG sensors which will be thoroughly discussed An alternative to overcome the FBGs' limitations, might come from an innovative class of RH-FOS, based on high-sensitivity titanium dioxide coated Long Period Grating (LPG). Preliminary results obtained on samples produced in-house are very encouraging. In this contribution we present results from the first application of FBG thermo-hygrometers in CMS and we discuss the status of the R&D on the new generation of LPG sensors.

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