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## **Fibre Optic Sensors for environmental measurements: status of the R&D at CERN EP-DT**

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Due to their peculiar properties, Fibre Optic Sensors (FOS) are progressively gaining interest in all applications involving harsh environmental conditions, and/or long networks of sensing points, and/or tight space constraints for cables. All of the above conditions are met in HEP detectors.

However, as of today the use of FOS sensors in industrial or commercial application is basically limited to the measure of strain, temperature and chemical species concentration. Since 2011, the CERN EP-DT group and the Optoelectronic Division of the Department of Engineering at the University of Sannio have started the development of a new class of FOS sensors finalized to Relative Humidity (RH) sensing. The couple formed by a RH sensor combined with a temperature sensor produce a thermo-hygrometer, i.e. a miniaturized instrument capable of providing direct measurements of the local dew point (hence of the absolute humidity).

Following the first operational installation in the CMS experiment of an array of 72 FOS thermo-hygrometers based on the Fibre Bragg Grating (FBG) technology (Dec 2013 & Jan 2015), the combined team of CERN and University of Sannio started developing a second generation of FOS for relative humidity measurement, based on the Long Period Grating (LPG) technology. The technology underlying this second generation of RH-FOS sensors has been presented in the 2017 Forum, together with a discussion of the complementary performances of the FBG- and LPG-based sensors. In March 2019, 12 LPG-based FOS have been installed for the first time in the ATLAS experiment. These sensors have been produced on different types of fibres and with different technologies, and this installation will be used as a test bench for all future applications of this second generation of FOS environmental sensors.

Meanwhile, two new lines of development have been recently launched:

- 1) The study, in collaboration with EPFL, of a third generation of FOS thermos-hygrometer based on the so called “distributed sensing” concept, i.e. the sensors are not concentrated on singular points along the fibre, where the gratings are produced, but the whole fibre is a continuous sensor throughout its length (up to few km);
- 2) The additional use of LPG sensors of the second generation as full-scale dosimeters, for continuous on-line measurement of doses from 0 to several MGy.

The talk will review the status of the R&D on FOS sensors in the CERN EP-DT group, will discuss the first measurements provided from the first operational installation of LPG thermo-hygrometers in ATLAS, and will present the first promising results provided by the two new R&D lines.

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