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Services for the LHCb SciFi detector at the LHC at CERN

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The Scintillating Fibre (SciFi) Tracker is the replacement of the Outer Tracker (based on gas straw tubes) and Inner Tracker (Silicon microstrips) by a single detector technology and has been installed in LS2. The detector consists of 3 tracking stations with 4 independent planes each (X-U-V-X, stereo angle $\pm 5^\circ$) and extends over 6 m in width and 5 m in height and has a total active surface of 340 m².

The sensitive detector consists of 2.5 m long blue emitting scintillating plastic fibers of 250 μm diameter and are arranged in a staggered close-packed geometry to 6-layer fiber mats. One end of the fiber is fitted with a mirror and the scintillation light exiting at the other end is detected by linear arrays of SiPM detectors (128 channels of 0.25 x 1.6 mm² size).

The SiPMs need to be cooled down to -40 °C to reduce the single-pixel noise introduced by non-ionising radiation.

Due to space constraints, the cooling lines are isolated with vacuum. To maintain the vacuum, 2 redundant pumping stations based on turbomolecular pumps are located close to the detector and protected against magnetic field by a 2-layer iron shielded case.

Each of the 12 detector segments, named C-frames due to the mechanical shape, has two Pirani vacuum gauges to monitor the pressure. The presence of ionising radiation requires detaching the readout electronics from those Pirani gauges.

To avoid condensation and frost formation inside the coldbox housing the SiPM arrays, the atmosphere inside the box must be free from humidity down to a dew point of approximately -50°C. A complete sealing of the cold boxes is practically impossible, because the boxes need to ensure direct optical contact of the SiPMs to the scintillating fibers and the passage of the SiPM signals via kapton flex cables to the front-end electronics. The low dew point is therefore achieved by flushing a dry gas through the box. A small overpressure compensates for potential leaks and the partial pressure of water vapour, which could let humid air diffuse into the box.

Flowcell devices are installed on the outgoing line of each coldbox in order to monitor continuously the gas flow. To ensure a reliable measurement a fully redundant flow measurement has been designed based on two flow meters per outgoing line. In total 576 flowmeters signals are read through a Data Acquisition system based on a PLC and back-end multiplexing.

Based on experience from testing of the first assembled C-frames a Condensation Prevention System, CPS, was added to prevent condensation on certain external surfaces. This consists of ~800 temperature sensors with multiplexed readout made in radiation tolerant front-end electronics with back-end PLC readout and a system of heating wires mounted around the SiPM coldbox and connecting bellows. An electrical current through the heating wires ensures the temperature is well above the dew point and thereby avoids condensation on the outside of the SiPM coldbox and the connecting bellows. Based on the temperature reading, the power through the heating wires is automatically adjusted.

The full LHCb SciFi detector and all services have been assembled and installed at point 8 of the LHC. The full services system is operational and first performance result will be presented.

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