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SciFi - A large Scintillating Fibre Tracker for LHCb

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The LHCb detector will be upgraded during the Long Shutdown 2 (LS2) of the LHC in order to cope with higher instantaneous luminosities and to read out the data at 40MHz using a trigger-less read-out system. The current LHCb main tracking system, composed of an inner and outer tracking detector, will not be able to cope with the increased particle multiplicities and will be replaced by a single homogenous detector based on scintillating fibres.

The new Scintillating Fibre (SciFi) Tracker covers a total detector area of 340 m2 and should provide a spatial resolution for charged particles better than 100 μm in the bending direction of the LHCb spectrometer. The detector will be built from individual modules (0.5 m × 4.8 m), each comprising 8 fibre mats with a length of 2.4 m as active detector material. The fibre mats consist of 6 layers of densely packed blue emitting scintillating fibres with a diameter of 250 μm. The scintillation light is recorded with arrays of state-of-the-art multi-channel silicon photomultipliers (SiPMs). A custom ASIC will be used to digitize the SiPM signals. Subsequent digital electronics performs clustering and data-compression before the data is sent via optical links to the DAQ system. To reduce the thermal noise of the SiPM in particular after being exposed to a neutron fluence of up to 10^{12} n_{eq} /cm^2, expected for the lifetime of the detector, the SiPMs arrays are mounted in so called cold-boxes and cooled down by 3D-printed titanium cold-bars to -40^o C.

The production of fibre mats and modules is in full swing: fibre mats are being produced in four production centers and being assembled at two sites. In parallel the readout electronics is finalized and its series production is prepared. The detector installation is foreseen to start end of 2019.

The talk will give an overview of the detector concept and will present the experience from the series production complemented by most recent test-beam and laboratory results.

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