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Early Performance of the Scintillating Fibre Tracker for the LHCb Upgrade

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LHCb has undergone a major upgrade during LHC LS2 (2019-2022) to cope with increased instantaneous luminosities and a 40 MHz read-out with a full software-based trigger and real-time analysis to improve on many world-best physics measurements. A light and homogeneous tracking detector based on plastic scintillating fibres has been installed downstream of the LHCb dipole magnet.

The Scintillating Fibre (SciFi) tracker covers an area of 340 m² by using more than 10,000 km of blue emitting scintillating fibre with 250 μm diameter, enabling a spatial resolution of better than 80 μm for charged particles and a hit efficiency better than 99%. Six-layer fibre mats of 2.4 m length are assembled to form individual detector modules (0.5 m x 4.8 m) consisting of eight fibre mats each. Linear arrays of Silicon Photomultipliers cooled to -40 $^{\circ}\text{C}$ are placed at the fibre ends. The readout of 524k channels occurs through custom-designed front-end electronics with fast 10 ns shaping, dual integrators, and a 3-comparator flash ADC to digitise the signals. An FPGA clusters the signals over threshold and outputs a barycentre to the 40 MHz DAQ farm with a total bandwidth of over 20 Tbits/sec.

At the time of the conference, the commissioning will be complete with measurements of the early performance of the detector in 2022 and 2023. The presentation will include the first results of the SciFi detector performance as well as results from SiPM irradiations studies.

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