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The LHCb Upgrade Scintillating Fibre Tracker

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The Scintillating Fibre (SciFi) Tracker is designed to replace the current downstream tracking detectors in the LHCb
Upgrade during 2018 (CERN/LHCC 2014-001; LHCb TDR 15). The operation and the results obtained from the data collected 2011
and 2012 demonstrate that the current detector is robust and functioning very well. However, the limit of $\mathcal{O}(1\ \mathrm{fb}^{-1})$ of data per year cannot be overcome without improving the detector. After 2018, it is planned to run with an increased luminosity of $1-2\times10^{33}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$ to collect up to 50 fb^{-1} of data.
This will be achieved using 25 ns bunch spacing with the average number of proton-proton interactions per bunch crossing
$\nu = 3.8-7.6$. Collecting data at this luminosity will only be possible if the detector is improved by increasing the
readout of the front-end electronics to 40MHz and implementing a more flexible software-based triggering system that will
increase the data rate as well as the efficiency. The increase in interactions per bunch crossing will result in an increased occupancy in the tracking detectors and will exceed the operational occupancy for the Outer Tracker. Here we
present the SciFi Tracker as the replacement for the Outer and Inner Trackers.

The SciFi Tracker is based on 2.5 m long multi-layered ribbons from 10,000 km of 0.250 mm diameter scintillating fibre as
the active medium and signal transport over 12 planes covering 350 m^2. Cooled silicon photomultiplier (SiPM) arrays
with 128 channels and 0.25 mm channel width are used as readout. The front-end electronics are designed to digitize the
signals from the SiPMS with a custom ASIC chip, the PACIFIC, for the approximately 560,000 channels and reconstruct the
track hit position within an on-board FPGA. Several challenges facing this detector will be presented regarding the
precision construction of the large active detector components, the radiation hardness of the scintillating fibres and the
SiPMs, the high density readout electronics, and the necessary cooling systems.

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