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Silicon Photomultipliers in the Scintillating Fibre Tracker at the LHCb experiment

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In order to cope with 5-10 times higher instantaneous luminosities at the LHCb detector, a large Scintillating Fibre Tracker has been developed to replace the tracking detectors downstream of the dipole magnet. This detector is currently being installed and will be commissioned after the Long Shutdown 2 (LS2) of the LHC in 2021.
The detector is based on plastic scintillating fibres read out by multi-channel Silicon Photomultiplier arrays. The technology was chosen to build a large area (300m^2), high granularity (250μm and 500K channels) and fast tracking detector.
The major challenge is to reach a sufficiently high signal to noise ratio in a harsh radiation environment, to obtain high detection efficiency.
The photodetectors will be exposed to fast neutrons at an equivalent fluence of $6{\cdot}10^{11}$n$_{eq}$/cm^2 and ionising radiation dose of 50Gy. To limit the severe increase of the dark count rate, cold operation down to -40\degC is foreseen.
We report on the application of the Silicon Photomultipliers in this context regarding the optimisation of their characteristics, packaging, integration into the system and production quality assurance. Our R&D focus for the future upgrades of LHCb and other Scintillating Fibre Tracker applications is to improve photodetection efficiency using micro-lenses and to reduce noise with cryogenic operation.

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