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Scintillating Fibre and Radiation Damage Studies for the LHCb Upgrade

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The Scintillating Fibre (SciFi) Tracker for the LHCb Upgrade (CERN/LHCC 2014-001; LHCb TDR 15) is based on 2.5 m long multi-layered ribbons of 0.250 mm diameter Kuraray SCSF-78MJ scintillating fibre as the active medium and signal transport over covering 350 m² with silicon photomultiplier (SiPM) arrays for photo-readout. Over 10,000 km of fibre will be turned into precision detector elements. The performance of the detector depends crucially on the geometrical and optical fibre parameters and, in particular, on their possible degradation due to ionizing radiation. The dearth of results for this fibre type in the total ionizing dose range of the upgrade, 60 Gy up to 35 kGy, along with conflicting conclusions regarding annealing and dose rate behaviour in literature, required a set of irradiation campaigns to estimate the behaviour of the full detector over its lifetime, especially as it is non-linear with dose. We will present results from the irradiation experiments performed by the LHCb SciFi collaboration over the last two years which show a behaviour due to radiation damage consistent with published models for polystyrene-based fibres, and are able to reproduce these results in various test facilities and beams. Other measurements of the fibre properties will be shown as well.

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