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Radiation Tolerance of the Outer Tracker in the Forward Region at the LHC

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The LHCb experiment is designed to study B-decays at the LHC, and as such is constructed as a forward spectrometer. The large particle density in the forward region poses extreme challenges to the subdetectors, in terms of hit occupancies and radiation tolerance.

To accurately and efficiently detect the charged decay particles in the high-density particle environment of the LHC the Outer Tracker (OT) has been constructed. The OT is a gaseous straw tube detector, consisting of 53,760 straw tubes, covering an area of 360 m² of double layers.

At the time of the conference, the performance of the OT during run I of the LHC has been scrutinized. The detector has operated under nominal LHC conditions for a period of over 2 years, corresponding to an integrated luminosity of approximately 3 fb⁻¹. A remarkable radiation resistance of this sensitive gas detector is reported. Unlike most other subdetectors in LHCb, constructed with various technologies, no sign of ageing is observed after having received a total dose corresponding to about 100 mC/cm in the hottest region.

Two independent and complementary methods have been used to measure the radiation resistance of this gas detector in the forward region at the LHC. One method uses a dedicated setup in situ, with which a ⁹⁰Sr source is scanned over the surface of part of the OT detector. The second method utilizes reconstructed tracks during LHC operation, with which the hit efficiency over the full detector surface is determined at increased amplifier threshold.

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