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Monitoring radiation damage in the ATLAS Pixel Detector

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The record breaking instantaneous luminosities of $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ recently surpassed at the Large Hadron Collider generate a rapidly increasing particle fluence in the ATLAS Pixel Detector. As the radiation dose accumulates, the first effects of radiation damage are now observable in the silicon sensors. A regular monitoring program has been conducted and reveals an increase in the silicon leakage current, which is found to be correlated with the rising radiation dose recorded by independent sensors within the inner detector volume. Such measurements are useful to validate the digitization model that has been developed to simulate radiation damage effects, including charge trapping, electric field modification and realistic signal induction on the electrodes. In the longer-term crystal defect formation in the silicon bulk is expected to alter the effective doping concentration, producing type-inversion and ultimately an increase of the voltage required to fully deplete the sensor.

for the collaboration

ATLAS

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