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Silicon Strip Detectors for the ATLAS Tracker Upgrade

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While the Large Hadron Collider (LHC) at CERN is continuing to deliver an ever-increasing luminosity to the experiments, plans for an upgraded machine called High-Luminosity-LHC (HL-LHC) are progressing. The upgrade is foreseen to increase the LHC design luminosity by a factor ten. The ATLAS experiment will need to build a new tracker for HL-LHC operation, which needs to be suited to the harsh HL-LHC conditions in terms of particle rates. In order to cope with the increase in pile-up backgrounds at the higher luminosity, an all silicon detector is being designed. To successfully face the increased radiation dose, a new generation of extremely radiation hard silicon detectors is being designed.

Silicon sensors with sufficient radiation hardness are the subject of an international R&D programme, working on pixel and strip sensors. The efforts presented here concentrate on the innermost strip layers. We have developed a large number of prototype planar detectors produced on p-type wafers in a number of different designs. These prototype detectors were then irradiated to a set of fluences matched to HL-LHC expectations. The irradiated sensors were subsequently tested with prototype HL-LHC readout electronics in order to study the radiation-induced degradation, and determine their performance after serious hadron irradiation of up to a few 10^{15} 1-MeV neutron-equivalent per cm^2.

We will give an overview of the ATLAS tracker upgrade project, in particular focusing on the crucial innermost silicon strip layers. Results from a wide range of irradiated silicon detectors will be presented. We will draw conclusions on what type and design of strip detectors to employ for the upgrades of the tracking layers in the HL-LHC upgrades of LHC experiments.

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