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Defect level identification of ATLAS ITk Strip Sensors using DLTS

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With the upgrade of the LHC to the High-Luminosity LHC (HL-LHC), the Inner Detector will be replaced with the new all-silicon ATLAS Inner Tracker (ITk) to maintain tracking performance in a high-occupancy environment and to cope with the increase in the integrated radiation dose.

Comprising an active area of 165m2, the outer four layers in the barrel and six disks in the endcap region will host strip modules, built with single-sided micro-strip sensors and glued-on hybrids carrying the front-end electronics necessary for readout. Before being shipped out for module building, the ATLAS18 main sensors were tested at different institutes in the collaboration for mechanical and electrical compliance with technical specifications, the quality control (QC), while fabrication parameters were verified on test structures from the same wafers, the quality assurance (QA).

As part of ongoing studies in parallel to ITk Sensor Production QC and QA, diodes fabricated as part of the test structures were measured using Deep-Level Transient Spectroscopy (DLTS). This was done to achieve precise sensor simulations motivated by findings of anomalous leakage current behaviour, as well as to compile a more complete model of radiation damage in ITk Strip Sensors. Utilising DLTS spectra with varying test parameters, trap energy levels and cross-sections associated with defects in the devices were obtained. Furthermore, employing related measurements techniques, such as Thermal Admittance Spectroscopy (TAS), results were supplemented and expanded, or additional points of interest, such as the deep level profile and the capture kinematics of the trap levels, were investigated with double-pulse DLTS (DDLTS).
In this talk, results of the defect characterisation will be given. Spectra for unirradiated and irradiated diode samples from both prototyping and production period will be presented, and their details collected from Arrhenius analyses will be shown.

Submission declaration

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Author: KLEIN, Christoph Thomas (Carleton University (CA))

Co-authors: DUVNJAK, Damir (Carleton University (CA)); JESSIMAN, Callan (Carleton University (CA)); KELLER, John Stakely (Carleton University (CA)); KOFFAS, Thomas (Carleton University (CA)); Mr STAATS, Ezekiel (Carleton University (CA)); VANDUSEN, Robert (Carleton University (CA)); FADEYEV, Vitaliy (University of California,Santa Cruz (US)); ULLAN, Miguel (CNM-Barcelona (ES)); UNNO, Yoshinobu (High Energy Accelerator Research Organization (JP))

Presenter: KLEIN, Christoph Thomas (Carleton University (CA))

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