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Mapping the in-plane electric field inside irradiated diodes

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A significant aspect of the Phase-II Upgrade of the ATLAS detector is the replacement of the current Inner Detector with the ATLAS Inner Tracker (ITk). The ATLAS ITk is an all-silicon detector consisting of a pixel tracker and a strip tracker.
Sensors for the ITk strip tracker have been developed to withstand the high radiation environment in the ATLAS detector after the High Luminosity Upgrade of the Large Hadron Collider at CERN, which will significantly increase the rate of particle collisions and resulting particle tracks.
During their operation in the ATLAS detector, sensors for the ITk strip tracker are expected to accumulate fluences up to 1.5 ·10ˆ15 neq/cmˆ2 (including a safety factor of 1.5), which will significantly affect their performance.
One characteristic of interest for highly irradiated sensors is the shape and homogeneity of the electric field inside its active area.
For the results presented here, diodes with edge structures similar to full size ATLAS sensors were irradiated up to fluences comparable to those in the ATLAS ITk strip tracker and their electric fields mapped using a micro-focused X-ray beam (beam diameter 2 × 3 µm).
This contribution shows the extension and shape of the electric field inside highly irradiated diodes over a range of applied bias voltages. Additionally, measurements of the outline of the depleted sensor areas allow a comparison of the measured leakage current for different fluences with expectations for the corresponding active areas.

Submission declaration

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