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Defect characterization studies on highly irradiated Low Gain Avalanche Detectors

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The operation of Low Gain Avalanche Detectors (LGADs) in the harsh radiation environment of the CERN-LHC is limited by the disappearance of the gain at particle fluences higher than 2E+15 cm-2 due to the so-called Acceptor Removal Effect (ARE). Thereby radiation induced defects inside the highly doped LGAD multiplication layer are created, like the boron-interstitial oxygen-interstitial (BiOi), that deactivate the active boron dopant and reduce the capability for charge multiplication. However, based on fundamental defect models, BiOi formation alone does not explain the observed ARE in the highly B-doped LGAD layer. Here we present defects characterization studies on LGADs using Deep-Level-Transient-Spectroscopy (DLTS) as well as Thermally Stimulated Current technique (TSC). Besides an overview about defects that were created, we will also discuss limitations of the characterization techniques applied to LGADs caused by e.g. charge multiplication effects, device geometries as well as internal defect induced electric fields.

Primary authors: HIMMERLICH, Anja (CERN); LIAO, Chuan (Hamburg University (DE)); FRETWURST, Eckhart (Hamburg University (DE)); PINTILIE, Ioana (NIMP Bucharest-Magurele, Romania); SCHWANDT, Joern (Hamburg University (DE)); MAKARENKO, Leonid (Belarusian state University); MOLL, Michael (CERN); CASTELLO-MOR, Nuria (Universidad de Cantabria, CSIC, Instituto de Fisica de Cantabria IFCA, (ES)); SUBERT, Vendula (Hamburg University (DE)); GURIMSKAYA, Yana (Universite de Geneve (CH)); CURRAS RIVERA, Esteban (CERN)

Presenter: HIMMERLICH, Anja (CERN)

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