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Depletion voltage and leakage current simulation of the ATLAS Pixel Detector according to the Hamburg model

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The ATLAS Pixel detector consists of hybrid pixel modules where the sensitive elements are planar n-in-n sensors and has been operating since 2010.
In order to investigate and predict the evolution of the depletion voltage in the different layers, a fully analytical implementation of the Hamburg model was derived. The parameters of the model, describing the dependence of the depletion voltage on fluence, temperature and time were tuned with a fit to the available measurements of the depletion voltage in the last years of operation. While the temperature was monitored with on-module measurements, the 1MeV neutron equivalent fluence needs to be derived from the luminosity profile. The results of FLUKA simulations have been employed to convert the available integrated luminosity data into a neutron equivalent fluence. Since the uncertainties associated to these FLUKA based predictions prevent any precise estimate on the depletion voltage model parameters, a validation based on the comparison of leakage current data and simulation will be shown. Different numerical implementations of the available leakage current model will be compared.

Primary author: BEYER, Julien-Christopher (Max-Planck-Institut fur Physik (DE))

Co-authors: LA ROSA, Alessandro (Max-Planck-Institute for Physics (D)); MACCHIOLO, Anna (Max-Planck--Institut fur Physik (DE)); NISIUS, Richard (Max-Planck-Institut fur Physik (DE)); SAVIC, Natascha (Max-Planck--Institut fur Physik (DE))

Presenter: BEYER, Julien-Christopher (Max-Planck-Institut fur Physik (DE))

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