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Design, simulation and characterization of innovative Low-Gain Avalanche Diodes for High Radiation Environments

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LGAD sensors have proven to be an excellent solution for 4D-tracking in HEP experiments thanks to the presence of internal gain that provides good time resolution also at high fluences (up to ~2·10¹⁵ n_{eq}/cm²). However, approaching 10¹⁶ n_{eq}/cm², the internal gain is completely lost due to the acceptor removal effect, leading to a deterioration of the time performances. In order to have a predictive insight into LGAD electrical behavior and charge collection properties, state-of-the-art Synopsys Sentaurus TCAD tools have been adopted and equipped with a well-validated radiation damage numerical model, called the "University of Perugia model". The model can reproduce experimental data with high accuracy, and the model has been applied to optimise one innovative paradigm for the design of LGAD sensors for 4D tracking: compensated LGAD. This innovative design of silicon sensors able to withstand very high fluences while keeping excellent timing performances will be presented and discussed. This technological solution has been implemented in the most recent R&D batch produced at FBK. Preliminary results on the sensors'characterization will be presented and discussed.

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