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Performance of LGAD sensors for the ATLAS High-Granularity Timing Detector

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We report on the layout and performance of Low-Gain Avalanche Detectors (LGAD) produced for the ATLAS High Granularity Timing Detector (HGTD) foreseen for the HL-LHC upgrade of the ATLAS experiment. The HGTD is a multi-layer silicon-based detector with a total active area of 6.4 m2 covering the pseudo-rapidity region between 2.4 and 4.0 with timing sensors with primary resolution of at least 50 ps/hit, and capable of providing 30-50 ps/track time resolution. This represents the first large scale application of the LGAD technology.

Sensors with an active thickness of 50 μm and 35 μm were produced with common masks and different combinations of doping profile of the gain layer. The power dissipation and breakdown voltage are determined from I-V measurement, doping profile of the gain layer and the bulk from C-V data. The dynamic properties of the LGADs were determined by charge collection measurements using laser and charged particles. Samples of the sensors are irradiated with neutrons, protons and gammas to study the radiation-hardness. The dependence of the gain and of the time resolution on bias voltage and fluences and the early results of the LGADs bump-bonded to the ALTIROC1 chip will also be presented.

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