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Development of the USTC LGAD sensors for the ATLAS HGTD upgrade

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The Low Gain Avalanche Detector (LGAD) technology is proposed for the ATLAS High Granularity Timing Detector (HGTD) towards the High-Luminosity Large Hadron Collider (HL-LHC). The USTC-IME v2.0 and v2.1 LGAD sensors are designed by the University of Science and Technology of China (USTC) and fabricated by the Institute of Microelectronics of the Chinese Academy of Science (IME, CAS). Various designs with different peripheral structures and gain layer implantation are realized in the production. The IV/CV electrical characterization, charge collection and timing resolution measurements are carried out with Sr-90 beta source and test-beam are performed on the single-pad test structures and large arrays, both before and after the neutron irradiation at JSI. The results show that the USTC-IME-v2.1 sensors, of which the carbon implantation is well optimized, can provide collected charge of more than 4 fC and time resolution better than 70 ps at appropriate bias voltage even with the radiation fluence up to $2.5 \times 10^{15} \text{ cm}^{-2}$ 1 MeV neutron equivalent, which satisfies the requirements of the HGTD.

Authors: ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

Presenter: ZHENG, Xiangxuan (University of Science and Technology of China (CN))

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