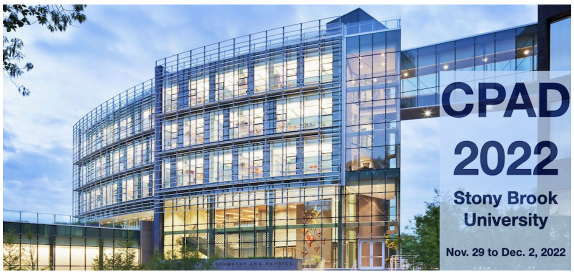

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TCAD simulation studies for the development of LGADs and AC-LGADs

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Low Gain Avalanche Detectors (LGADs) are very thin silicon detectors with modest internal gain. LGADs are characterized by an extremely good time resolution (down to 17ps), a fast rise time (~500ps for 50 μm thickness) and a very high repetition rate (~1ns full charge collection). In a broad array of fields, including particle physics (4-D tracking) and photon science (X-ray imaging), LGADs are a promising new sensor options. For example, LGADs are used for upgrade projects at the HL-LHC in the High Granularity Timing Detectors (HGTD) in ATLAS and the Endcap Timing Layer (ETL) in CMS. LGADs are also proposed as candidate for the Active Stopping Target (ATAR) in the PIONEER experiment. The variant design of LGADs, the so-called AC-coupled LGADs (AC-LGADs), are also a promising detector technology for the Electron-Ion collider (EIC) and for PIONEER.

In this talk, we will focus on the TCAD simulation studies for the development of LGADs and AC-LGADs. For large energy deposition from particle injection, where the generated e/h pairs density is large, the gain of LGADs is significantly reduced. Such gain suppression effect has been observed experimentally with Laser and alpha particles (with energy of ~5 MeV) injection. In order to reduce the gain suppression effect, we use TCAD simulation to characterize the cause of gain suppression and provide guidance for improving the LGAD design. We will also present lab measurements with alpha and Laser injection to cross check with the simulation results.

In addition, the performance and signal formation of AC-LGADs are related to the electrode geometry and charge sharing within the resistive n+ layer. We will present TCAD simulation for AC-LGADs with various strip length, inter-strip capacitance, and n+ layer resistivity.

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