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Gain suppression studies at the CENPA tandem accelerator

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Using the CENPA Tandem accelerator at the University of Washington, we studied the response of low gain avalanche detectors (LGADs) to MeV-range deposits from a proton beam. LGADs are thin silicon detectors with moderate internal signal amplification. This type of devices is prone to a gain suppression mechanism, which is the topic of this study, especially for large energy depositions. Several devices with different thicknesses and gain layer configurations were tested as a function of bias voltage, angle and proton energy. Multichannel LGADs such as AC-LGADs and TI-LGADs were studied as well. This work is in the context of the PIONEER experiment, which is a next-generation experiment proposed at the Paul Scherrer Institute to perform high precision measurements of rare pion decays. At the center of the experiment, a high-granularity active target (ATAR) will stop the pion and characterize its decay. The ATAR is being designed to provide detailed 5D tracking information using LGAD sensors, allowing the separation of the energy deposits of the pion decay products in both position and time. Since a range of deposited charge from Minimum Ionizing Particle (MIP, few 10s of KeV) from positrons to several MeV from the stopping pions/muons is expected, the detection and separation of close-by hits in such a wide dynamic range will be the main challenge.

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