

Synchrotron light source focused X-ray detection with LGADs, AC-LGADs, TI-LGADs and integrated chip readout

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The response of Low Gain Avalanche Diodes (LGADs), a type of thin silicon detector with internal gain, to X-rays of energies between 6-16 keV was characterized at the SLAC light source (SSRL). The utilized beam-line at SSRL was 7-2, with a nominal beam size of 30 μm , repetition rate of 500 MHz, and with an energy dispersion $\Delta E/E$ of 10–4. Multi-channel LGADs, AC-LGADs, and TI-LGADs of different thicknesses and gain layer configurations from Hamamatsu Photonics (HPK) and Fondazione Bruno Kessler (FBK) were tested. The sensors were read out with a discrete component board or the FAST readout chip and digitized with a fast oscilloscope, CAEN fast digitizer, or the HD-SOC digitizer chip. Standard PiN devices were characterized as well. The devices' energy response, energy resolution and time resolution as a function of X-ray energy and position were measured. The charge collection and multiplication mechanism were simulated using TCAD Sentaurus, and the results were compared with the collected data.

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