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Development of a Silicon PIN Diode X-Ray Detector

X-ray detectors currently on the market are expensive, costing thousands of dollars each and still limited in data acquisition options. The goal of this project is to create a device that can be used to accurately measure gamma and x-ray flux, calculate radiation dose rates, and be simple and inexpensive to produce. Developing an accurate and reliable system of measuring gamma and x-ray flux will allow for laboratories to conduct irradiation tests with confident calibration.

Many methods used to calculate x-ray flux are incapable of accounting for the high x-ray flux generated by modern x-ray machines. Advances in the technology of silicon PIN diodes in the datacom and telecom industries allows for the development of an inexpensive and compact solid-state ionizing sensor to calculate x-ray flux.

X-ray flux can be determined from the photocurrent produced by silicon PIN diodes when they capture a photon. The photocurrent is estimated for a given energy from the charge deposited, and x-ray flux in turn can be calculated from the current, charge, energy deposited, and properties of silicon.

Two working detector circuits, an AC-coupled version that outputs pulses and a DC-coupled version that outputs a DC voltage level, have already been completed. Cosmic muon, beta particle, and gamma photon events have been observed and characterized. Also, the charge and energy deposited onto the PIN photodiodes have been estimated. Remaining work for this project will be to combine the AC and DC circuits into one system with readout electronics.

Summary

This project is to design, build, and utilize such a detector with silicon PIN diodes to accurately determine gamma and X-ray levels.

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