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#10-227 Enhancing Imaging Stability in Hybrid Semiconductor Detectors with CdTe sensors with Pulsed Bias Voltage Switching

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Hybrid semiconductor detectors using Timepix-family and Medipix-family chips, developed by the Medipix collaboration at CERN, offer direct radiation detection by converting radiation particles into electrical signals within the semiconductor sensor. This design provides excellent detection sensitivity and eliminates analog noise. The sensor chip is divided into 256x256 individual pixels, each with a 55 µm pitch, which gives the detectors high spatial resolution. The sensitivity of a sensor for imaging applications depends on its ability to absorb photon radiation across a wide energy spectrum, from X-rays in the keV range to highly penetrating gamma rays. For such a range, heavier materials like CdTe are advantageous due to their superior absorption capabilities, making them suitable for applications such as non-destructive material testing and dense material imaging. Despite unprecedented development in the quality of CdTe with pixelated electrodes, there are still challenges in practical use. A significant issue arises from crystal defects within the CdTe sensor, which lead to the buildup of spatial charge in the sensor. This spatial charge disrupts the internal electric field, degrading the spatial and spectral quality of the images produced. These defects often appear as vein-like artifacts in images, worsening over time. To improve image stability over time, pulsed bias voltage switching can be used. Ideally, this method resets the accumulated spatial charge to a "fixed state"before each image capture, ensuring any remaining artifacts are consistent across images taken in extended period of time. This temporal consistency makes it possible to remove now fixed image artifacts with standard flat-field correction. We investigate various pulsed bias voltage switching schemes and their effectiveness in achieving a stable "fixed state"of spatial charge. The temporal stability of this state is also tested. The optimized pulsed bias switching scheme is found to most effectively reduce spatial charge buildup and enhance the imaging stability of sensor detection performance over time.

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