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Large-Area CdTe Detector for X-ray Imaging and Overcoming Crystal Imperfections in CdTe Sensors

Hybrid semiconductor detectors with CdTe sensor chips find wide applications in medical and industrial X-ray radiography. These detectors enable direct radiation detection through their ability to effectively convert ionizing radiation into electrical signals. The design provides excellent detection sensitivity and eliminates analog noise. However, CdTe sensor chips are known to have crystal imperfections, which can affect detection stability and the quality of the recorded images. These effects are time-dependent and can be effectively addressed through hardware solutions, such as pulsed bias voltage modulation, and software solutions. In this contribution, we will show that using image correction approaches lead to an improvement in the polarization stability of the CdTe sensor and thus to a multiple enhancement in the homogeneity of the image and it represents a significant step forward in improving image quality and resolution.
The use of image correction methods we will demonstrate on the WidePIX MPX3 5x5 detector, utilizing MediPIX chips developed by the Medipix collaboration at CERN. It is an innovative solution for imaging larger objects because it features a CdTe sensor area of 7x7 cm and a resolution of 1280 x 1280 pixels. Due to MediPIX3 technology it is allowing the acquisition of X-ray images with high contrast and wide dynamic range. This means that even low-contrast structures, such as soft tissues or plastics, are easily detectable. Also it includes energy discrimination, the system enables spectral X-ray imaging, allowing the creation of multichannel "color" X-ray images where different materials are identified and displayed in different colors. The combination of image correction methods and a large sensor area opens up broad possibilities for the further development of radiographic imaging technologies.

Workshop topics

Detector systems

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