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Hybrid Pixel Detectors
Characterization and Optimization

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Abstract

Hybrid pixel detectors offer an opportunity for improvements in several fields of radiation detection, from X-ray imaging to single particle tracking and personal dosimetry. The performance of the detector depends on several factors such as, radiation interaction in the sensor layer, charge transport and readout electronics. To optimize performance of the current generation of detectors as well as for the development of new detectors, knowledge of all these parts are vital.

This thesis covers several steps of the detection process in detail, and tries to give an overall picture of how they influence detector performance. For the sensor layer Cadmium Telluride and Cadmium Zinc Telluride was studied, looking at defects in the sensor and performance together with hybrid pixel detectors. Although the crystal quality have been improved in the last years, problems with defects affecting charge transport are still present. Hybrid pixel detectors need high quality sensors for optimal performance, but can also be used as a tool to characterize sensors for other applications using the pixellation to produce a detail map of the response.

Since many applications such as clinical CT imaging and quality assurance measurements on X-ray tubes lead to high incident fluxes on the detector, it is important to understand the high count rate performance of the detector system. Under these conditions pulse pileup in the front end can lead to lost counts and a distortion in the measured energy spectrum. The high flux performance was studied using monochromatic radiation and a silicon sensor, in order to provide a clean input signal and focus on the pulse processing in the electronics.

Throughout the work simulations have been a valuable tool to complete measurements and improve the understanding of the detector response. Because of the complexity of simulating a hybrid pixel detector careful design of the simulations is needed to provide sufficient accuracy in the process studied without giving unrealistic long run times.

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Design and Integration of Infrared Absorber Structures into Polymer Membranes based Thermal Detectors

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Abstract

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