Advancements in High-Resolution Detector Development for High Energy Instrumentation for Space Telescopes

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At DTU Space the 3D CdZnTe (CZT) drift strip detector technology [1 to 5] has been developed together with the associated Drift Strip Method (DSM) for pulse shape analysis. The detector technology displays excellent position resolution (<0.5mm), and energy resolution (<1% at its best) at 661.6 keV achieved through pulse shape signal processing with the Drift Strip Method. The signal formation on each electrode readout employs bi-polar Charge Sensitive Pre-amplifiers. The output is sampled using high-speed digitizers, providing the full pulse shapes generated by each interaction in the detector.

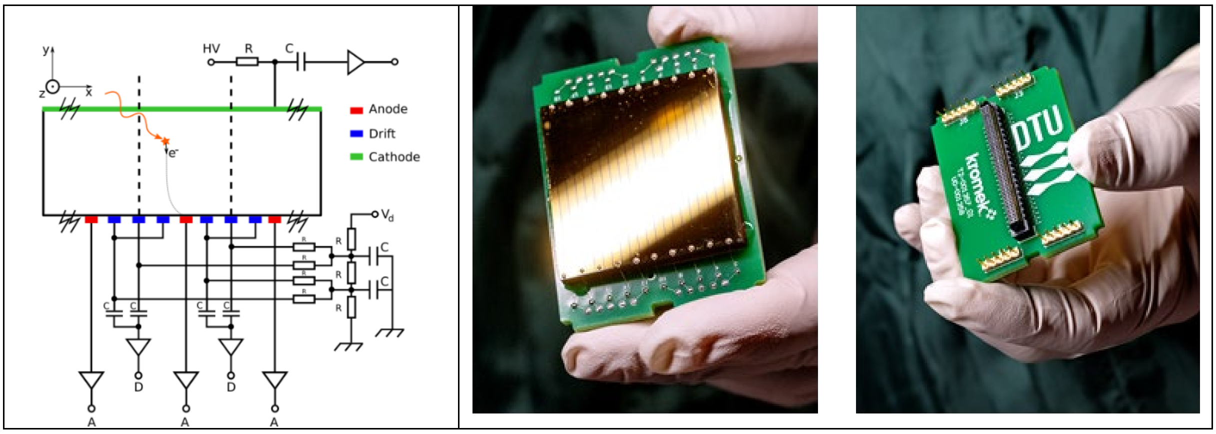

Figure 1: (Left) Principle of Drift Strip Method. (Right) The large area 3D CZT drift strip detector (40mm x 40mm x 5m) attached on a PCB.

Supported by ESA, EU, and national funding, DTU Space has developed novel detector technologies and algorithms [6] that enhance high-resolution spectral-imaging semiconductor detectors. These include AI-powered readout systems and signal processing using artificial neural networks for near-real-time output, applicable in both high-energy astronomy and fields like medical imaging and security.

The 3D CZT drift strip detector technology effectively addresses the challenges of observing MeV (X- and gamma-ray) radiation in telescopes [7 and 8] . This detector offers excellent spectral resolution and spatial resolution, efficiently handling multiple interactions, making it ideal for MeV astronomy and emerging Low-Dose Molecular Breast Imaging (LD-MBI) systems.
This talk will provide a concise overview of these cutting-edge radiation detection technologies, highlighting their significant advancements and applications.

References

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