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Development of Sensors for Soft X-ray Hybrid Detectors: Current Status and Future Improvements

Thursday 29 August 2024 17:30 (15 minutes)

Hybrid detectors for hard X-rays developed at the Paul Scherrer Institute (PSI) have demonstrated outstanding performance in terms of fast frame rate, large dynamic range, large area, stability, reliability, and ease of use. To enable these features also for soft X-rays, two main limitations of state-of-the-art detectors have to be addressed: low quantum efficiency and low signal-to-noise ratio. In collaboration with Fondazione Bruno Kessler (Trento, Italy) and PSI, we are trying to address these challenges by optimizing sensor technology. Two required technologies for soft X-ray sensors for hybrid detectors are currently under development: the thin entrance window (TEW) technology and the optimization of the Low Gain Avalanche Diode (LGAD) technology for X-ray detection. The former increases quantum efficiency in the soft X-ray energy regime, and the latter improves the detector's signal-to-noise ratio by increasing the signal amplitude inside the sensor through a charge multiplication process, which enables single photon detection. First measurement results are beyond expectations: the best quantum efficiency achieved so far is greater than 80% down to about 250 eV; the single-photon detection using the developed LGAD sensors has been demonstrated down to 390 eV. The first ptychography experiment using the developed LGAD sensor with the EIGER readout ASIC has been performed by our collaborators at the SIM beamline with 700 eV soft X-rays. It has shown outstanding results: a resolution of a few nanometres on magnetic structures is obtained. Another application that will profit from these developments is RIXS exploiting interpolation, the feasibility of which has also been demonstrated.

The presentation will discuss the status, achievements, and future improvements of soft X-ray LGAD sensors with TEW.

I plan to submit also conference proceedings

Yes

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