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INVITED: Optimization of planar silicon sensors and LGADs for soft X-ray detection

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Soft X-ray applications at synchrotrons and FELs are limited by the performance of the currently available detectors using silicon sensors. The main issues are their low quantum efficiency (QE) due to the photon absorption in the entrance window of the sensor, and their difficulties in achieving single photon resolution, since the small amount of charge generated by the low energy X-rays is often comparable to the electronic noise charge. At present, the hybrid X-ray detectors are the technology widely used for hard X-ray experiments thanks to their high frame rate, fast readout, large dynamic range, large sensitive area, stability and robustness. Further development of the hybrid X-ray detectors with equivalent performance in the soft X-ray energy range would be beneficial for several diffraction, spectro-microscopy and imaging experiments which have to be performed at low energies due to the low interaction of the sample with the radiation or to the presence of characteristic edges interesting for research.

In collaboration with the sensor manufacturer FBK, we are developing and optimizing the LGAD sensor technology as well as the thin entrance window technology targeting soft X-rays. The thin entrance window technology enables the improvement of QE for the soft X-rays and the LGAD technology increases the signal amplitude and signal-to-noise (SNR) ratio and thus it makes single photon resolution possible in this energy regime.

In this talk, the challenges and progress of the development will be introduced. The optimization strategies will be discussed. In addition, first results on the QE and single photon detection of soft X-rays will be reported.

Presenters: ZHANG, J (Paul Scherrer Institut); ZHANG, Jiaguo (Paul Scherrer Institut)

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