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Towards charge sharing analysis for user operation at the European XFEL

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The Heisenberg-RIXS spectrometer (hRIXS) at the Spectroscopy and Coherent Scattering (SCS) instrument of the European XFEL is dedicated to performing resonant inelastic X-ray scattering (RIXS) measurements in the time domain, with time and energy resolution approaching the Heisenberg limit imposed by the uncertainty relations [1, 2]. The spectrometer uses a dispersive element and requires a detector with a position resolution in the order of 5 μm along the spectroscopic dimension capable of detecting photons with an energy below 1 keV. Furthermore a high frame rate capability is necessary, in order to exploit the pulse structure of the European XFEL, which provides pulse trains at 10 Hz in which individual X-ray pulses are delivered at rates of up to 4.5 MHz.
A prototype hybrid detector, developed in a collaboration of the Paul Scherrer Institute (PSI) and Fondazione Bruno Kessler (FBK), features X-ray-sensitive Inverse Low Gain Avalanche Diode (iLGAD) sensors. They are combined with the widely adopted charge-integrating readout application specific integrated circuit (ASIC) JUNGFRAU [3, 4]. The iLGAD sensor is segmented into rectangular pixels with a size of 25×225 μm2 each, offering a high resolution along the dispersion direction. In order to achieve the required spatial resolution, photon hit position finding algorithms which exploit charge sharing events are being investigated, allowing for a position determination with sub-pixel resolution. Currently different approaches for event classification are considered, evaluating their suitability and robustness in an automated data analysis framework, i.e. needing minimal expert intervention, in order to be employed in routine user operation. We will briefly report on the status and appreciate feedback, sharing of experiences and additional ideas regarding this kind of event classification.

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[4] Hinger, Viktoria, et al. “Resolving soft X-ray photons with a high-rate hybrid pixel detector.” Frontiers in Physics 12 (2024): 1352134

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