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RIXS Detector Using JUNGFRAU with Rectangular Pixels

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The development of hybrid pixel detectors combining the JUNGFRAU charge-integrating ASIC with inverse Low-Gain Avalanche Diode (iLGAD) sensors continues to advance toward high-performance soft X-ray Resonant Inelastic X-ray Scattering (RIXS) experiments. The project aims to achieve both high frame rates (2 kHz continuous and up to 250 kHz in burst mode with the most recent ASIC version JUNGFRAU 1.2) and super-resolution on the micrometer scale in one dimension by employing rectangular pixels that enable charge-sharing-based position interpolation.

In this contribution, we present a comprehensive overview of the development status of an iLGAD-based JUNGFRAU detector for low-energy RIXS. We summarize results from laboratory characterizations that investigate the detector's performance, including sensor leakage, noise, and spatial resolution. Various prototype configurations, featuring single- and multi-chip assemblies with several different rectangular pixel geometries, have been evaluated in pilot beamline experiments at the Swiss Light Source, SwissFEL, and European XFEL.

We will discuss key findings regarding operation stability, response uniformity, and achieved spatial resolution, and outline the next steps in the presentation. A major focus will be the forthcoming iLGAD sensor R&D batch, currently in fabrication and expected by mid-2026, which is designed to deliver significantly improved quantum efficiency, critical for RIXS experiments due to the required small X-ray incidence angle, and enhanced signal-to-noise ratio at low photon energies. These new iLGAD sensors are expected to further extend the detector's sensitivity and applicability for demanding soft X-ray RIXS experiments.

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