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# INVITED: X-ray Detectors for LCLS-II with real-time information extraction: the SparkPix family

*Tuesday, 27 June 2023 10:50 (30 minutes)*

We will present an overview the development of a series of detectors in the SparkPix family, designed to match the increased repetition rate of LCLS-II. Each detector is customized to meet the specific requirements of different experiments, and dedicated information extraction engines are integrated into each SparkPix ASIC to enable frame rates up to 1 MHz. The article discusses the overall approach behind the SparkPix family and presents updates on the ongoing progress of four different detectors: SparkPix-ED, SparkPix-T, SparkPix-S and SparkPix-RT.

SparkPix-ED [1] is designed for X-ray scattering experiments and captures rare events by recording high-resolution images at closely spaced times and streaming low-resolution images to an EDGE computing system for trigger generation.

SparkPix-S is a novel ASIC for X-ray Photon Correlation Spectroscopy (XPCS) and Speckle Visibility Spectroscopy (XSVS) experiments. It offers fine spatial resolution and can operate at 1 MHz, with on-line information extraction implemented through a sparsified readout. A detailed description of the electronics will be presented in a dedicated presentation by Filippo Mele.

SparkPix-T is a front-end ASIC with spatial and time resolution capabilities, specifically designed for massive multi-particle coincidence experiments at the TMO instrument at LCLS-II. It has  $100\ \mu\text{m} \times 100\ \mu\text{m}$  pixels arranged in a  $176 \times 192$  matrix, capable of measuring charged particle time-of-arrival (TOA) with 100 ps resolution and 6.5  $\mu\text{s}$  range. Signal energy is indirectly assessed through 8-bit time-over-threshold (TOT) measurements.

Lastly, SLAC and Argonne National Laboratory (ANL) are collaborating to develop SparkPix-RT, an ASIC designed for continuous real-time (RT) readout with a high bandwidth detector rate. This ASIC implements a novel digital compression algorithm in the periphery of the ASIC to extract information in real-time [2].

[1] L. Rota et al., "SparkPix-ED: a readout ASIC with 1 MHz frame-rate for rare event experiments at LCLS-II", IWORID 2021

[2] M. Hammer, S. Stempfer, A. Miceli (ANL) - <https://arxiv.org/abs/2208.00069>

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