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SparkPix-ED: a readout ASIC with 1 MHz frame-rate for rare event experiments at LCLS-II

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The LCLS-II accelerator will provide pulses with a repetition rate of up to 1 MHz. To cope with the increase in repetition rate, a new family of detectors named SparkPix is being developed at SLAC.

SparkPix-ED is the first detector based on the Event-Driven information extraction engine, which combines high-frame rates and a triggering capability. Coarse X-ray images are streamed out at 1 MHz in a "Continuous Wave"(CW) mode. These images will be processed by an external computing layer to detect rare events and generate a "trigger" signal when one is found. While the low-resolution images are streamed out, the ASIC records high-resolution images on a pulse-by-pulse basis at 1 MHz repetition rate. The high-resolution images are stored in a local memory implemented as a circular buffer with depth N (in the first prototype, N=4). In this manner, when a rare event is detected, N high-resolution images taken around the event can be read-out. The ASIC can also be operated as stand-alone in high-resolution mode, trading off frame-rate for spatial resolution and noise performance. In this case, the frame-rate scales down to 100 kHz with continuous readout. The first prototype has been designed with a CMOS 130 nm technology. Due to the high level of parallelism required to achieve 1 MHz operation, analog-to-digital converters and control logic has been distributed in the pixel matrix. The first prototype has been received and characterized with a dedicated carrier board, as shown in Figure 1. At the time of writing, the functionality of all blocks has been demonstrated, as shown in Figure 2. Detailed results about the performance will be presented at the conference.

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