X-ray Imaging Detector Systems for DLSRs

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We are proposing an upgrade of SPring-8 storage ring to SPring-8-II [1] as one of the diffraction limited storage rings (DLSRs). One of the advancements with the anticipated increased brilliance is the investigation in the shorter time domain without degradation of the data quality. Such applications demand highly linear response to instantaneously intense X-rays. Other advancement will be the improved data statistics within the same acquisition time. In this case, the detector accuracy, especially the uniformity of the pixel response across the X-ray imaging area is to be required. First, we discuss these characteristics of the existing X-ray imaging detectors and ones developed by our team, MPCCD [2] and SOPHIAS [3] for the X-ray free-electron laser facility, SACLA [4]. Then, we describe our performance target of a novel CITIUS (Charge Integration Type Imaging Unit with high-Speed extended-dynamic-range) detector under development. This detector meets the anticipated demands by taking full advantage of the state-of-art CMOS imaging sensor technology. In this talk, we describe the basic operation principle, and the foreseen performance such as continuous 17 kframes/s operation, native 30 Mphotons/s/pixel [5], extended linear response without pile-up up to 600 Mphotons/s/pixel, and associated data process flow under developments. A demonstrator deployments of the CITIUS detectors will be conducted in the fiscal year of 2020.

References

[1] "SPring-8-II Conceptual Design Report" (Nov. 2014) http://rsc.riken.jp/eng/pdf/SPring-8-II.pdf.

[2] Kameshima et.al., Rev Sci Instrum. 2014 Mar;85(3):033110.

[3] T. Hatsui, et.al., Proc. Int. Image Sensor Workshop 3.05, (2013).

[4] T. Ishikawa et.al., Nature Photonics Vol. 6, pages 540–544 (2012).

[5] For 12 keV X-ray photons