Fast CCD-based systems for detection of x-rays and electrons

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We are developing a variety of detectors for detection of x-rays and electrons with full frame readout of a few msec with 16 bit dynamic range. These are based on a column parallel format CCD in which the columns of the CCD are associated with individual readout channels. The designs are based on existing technology developed at LBNL for thick, back illuminated deeply depleted CCDs [1] and on an integrated CMOS readout system [2], both of which are to be used in the SNAP space telescope [3]. In this paper we discuss the design of this column parallel CCD format, performance specification and potential applications in x-ray science using synchrotrons and free electron lasers (FELs). In synchrotron radiation research, these range from use in time-resolved small angle x-ray scattering to study conformational changes of biomolecules in solution to use for rapid 3d tomographic imaging of materials. In application to X-FELs such as the LCLS at Stanford, the frame to frame time is small enough that data can be recorded for each shot at 120 Hz. We will describe a system suitable for recording diffraction patterns from single molecules using X-FEL pulses.

1. Bebek, C.J., et al. *Development of fully depleted back-illuminated charge-coupled devices*. in *Optical and Infrared Detectors for Astronomy*. 2004. Glasgow, Scotland, United Kingdom: SPIE.
2. Walder, J.P., et al., *A low power, wide dynamic range multigain signal processor for the SNAP CCD.* IEEE Transactions on Nuclear Science, 2004. **51**(5): p. 1936-41.
3. Aldering, G., et al. *Overview of the SuperNova/Acceleration Probe (SNAP)*. in *Future Research Direction and Visions for Astronomy*. 2002. Waikoloa, HI, USA: SPIE.