New Detectors for New (and Existing) Light Sources

Hugh Phillip
Department of Physics, Cornell University

Pixel array detector (PAD) development at Cornell is advancing x-ray imaging technology and creating scientific opportunities at light sources. Current development projects focus on three detector characteristics: 1) Fast framing so new dynamic studies can easily exploit the pulsed illumination of synchrotron sources. 2) High dynamic range so x-ray images with intense signals can be quantitatively captured while still maintaining good single-photon signal-to-noise ratios. 3) Extended x-ray energy range to directly detect and image x-rays above 20 keV. With regard to these goals: 1) High-speed imaging has been demonstrated using the “Keck-PAD” to acquire images from successive pulses at APS, where bunches are separated by 153 ns, and at CHESS. First experimental Keck-PAD results have been published and more experiments are in the planning phase. 2) High dynamic range imaging has been demonstrated with the “mixed-mode PAD” (MM-PAD), which is capable of recording 1 to 4x10^8 8 keV x-rays/pixel/frame/second while framing continuously at 1 kHz. The MM-PAD is designed for typical storage ring experiments where the x-rays do not arrive all at once. We are presently working to extend this dynamic range to storage ring experiments with fluence rates up to 10^11 ph/pix/s, and to XFEL experiments from 0 to 10^6 ph/pix/pulse. 3) All these PAD projects are being tested with CdTe detector diodes, replacing standard silicon diodes, to extend the useable x-ray energy range. Despite the common material features of CdTe, initial tests indicate that high-quality scientific data can be obtained with these devices. Some details on all of these projects will presented.