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The LAMBDA photon counting pixel detector

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Single-photon-counting pixel detectors are the cutting-edge technology in a range of scattering and imaging experiments at synchrotrons. The Medipix3 readout chip has a number of novel features that are attractive for synchrotron experiments: a high frame rate with zero dead time, high spatial resolution, and a "charge summing"feature that can improve image quality.

Using this readout chip, DESY are developing a large-area Medipix3-based detector array (LAMBDA). A single LAMBDA module consists of 2 by 6 Medipix3 chips on a ceramic carrier board, bonded to either a single large silicon sensor or two smaller high-Z sensors. The readout electronics are placed behind the sensor, allowing tiling of multiple modules. The readout electronics consist of a signal distribution board, which provides services to the detector head such as powering, and a readout board, which uses an FPGA to control the detector head and communicate with a control PC. Currently, the first large silicon modules have been constructed and read out with a prototype readout board, and we are working on the hardware and firmware for a high-speed readout system based on 10-Gigabit Ethernet links.

One limitation of standard silicon hybrid pixel detectors is their poor quantum efficiency at higher photon energies. In collaboration with Canberra France Specialty Detectors, we are developing a germanium hybrid pixel detector for use on higher-energy beamlines. Although germanium needs to be cooled during operation, small-pixel photon counting detectors are much more tolerant of leakage current than large spectroscopic detectors, so cryogenic temperatures are not need. Canberra have produced a set of 256-by-256-pixel planar germanium sensors with 55µm pitch, and these have been bonded to Medipix3 readout chips by Fraunhofer IZM (Berlin). These first germanium hybrid pixel detectors are currently being tested.

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