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The LAMBDA pixel detector with high-Z sensors

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Single-photon-counting pixel detectors provide high signal-to-noise ratios, fast readout, and sophisticated functionality, making them the technology of choice of many experiments at synchrotrons. LAMBDA (Large Area Medipix3-Based Detector Array) has been developed to improve on existing photon-counting systems. LAMBDA uses the Medipix3 readout chip, and combines the small pixel size (55 μm) and flexibility of this chip with a large tileable module design of 1536 x 512 pixels (12 chips). The high-speed readout system currently runs at 1000 frames per second with no dead time between frames. Additionally, the system can be used in an energy-binning mode to provide additional information in experiments with polychromatic sources. A series of LAMBDA systems have been produced, commissioned and used in experiments at synchrotrons –for example, time-resolved experiments studying soft matter under shear forces.

To allow high-speed experiments with hard X-rays, the LAMBDA system has been combined with different high-Z sensor materials, in collaboration with other institutes and industry. Room-temperature systems using GaAs and CdTe systems have been assembled and tested at beamlines. These show acceptable image quality after flat-field correction. These first systems provide an area of 768 x 512 pixels, and larger systems using multiple tiled sensors are in development. The first Germanium hybrid pixel detectors have been also been produced. These have a layout of 256 x 256 pixels of 55 μm , and work successfully. Due to the high quality of the sensor material, the germanium sensor provides a higher raw image uniformity. Larger germanium sensors are now in production.

To reduce the dead area in large LAMBDA systems, development has also started on a version of LAMBDA where the wire bonds are replaced with through-silicon vias, and the guard ring region is reduced by using an edgeless silicon sensor. The TSV processing will be done by Fraunhofer IZM. A radiation hard edgeless sensor layout is being designed using TCAD simulation.

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