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Lateral-effect photodiodes as high spatial resolution x-ray beam position monitors

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Lateral-effect photodiodes can be used as high spatial resolution x-ray beam position monitors (BPM). These solid-state devices are inexpensive, electronically passive, simple-to-use photocurrent sensors with excellent mechanical stability and hermetically-sealed packages.

The geometry of the diode guarantees a large linear range. X-rays create photocurrent along the 1 mm wide by 5-15 mm long strip. Analogous to the operation of a sliding resistive divider, the induced photocurrent is split so that the current measured at each end is proportional to the distance from that end. The diode is oriented to measure the vertical x-ray beam position, and a pair of diodes can be used to measure the horizontal beam position.

The diodes are housed in water-cooled copper blocks to keep the thermally-induced noise to a minimum. Also, the copper acts as a x-ray beam filter, allowing only the higher energy photons to strike the diode. Since high energy photons are more concentrated near the synchrotron plane, the spatial resolution of the diode detector is increased.

Our plan is to mount lateral-effect diodes inside the monochromator boxes on each CHESSE beamline. In conjunction with the front-end photoelectron, both the position and angle of a beam can be determined.