Avalanche Photo-Diode X-Ray Detectors: Introduction and Recent Results

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We will give a practical overview of the use of Avalanche Photo-Diodes (APDs) for x-ray detection[1]. These devices were first used at synchrotron facilities for Nuclear Resonant Scattering measurements [2][3], but have now come into relatively common use. APDs are interesting as fast, time resolved, photon counters with modest energy resolution. Depending on the device, pulse widths can be sub-ns duration, making count rates ~ 10^8/sec possible for a single device, while leading edge discrimination can provide time resolutions ~ 75 ps (FWHM). However, there are many practical issues that should be addressed in using such a device, and in selecting among the various devices available. One important one that we will discuss is the trade-off between device efficiency and time resolution. This is due to saturation of the high field carrier drift velocity (~100 ?m/ns for electrons in silicon) so that thicker, more efficient devices have poorer time resolution. However, this limitation can be overcome by using an array of thin devices at grazing incidence, and we will show results where ~17% efficiency for single photon detection at 25 keV can be obtained with 180 ps time resolution. We will also show recent results from a multi-channel multi-parameter data acquisition system [4] for use in timing experiments with array devices. Finally, we show some recent work in amplifier development.

References

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[1] A.Q.R. Baron, Hyp. Int. **125,** (2000) 29.
[2] S. Kishimoto, NIM A **309,** (1991) 603.
[3] A.Q.R. Baron and S.L. Ruby, NIM A **343,** (1993) 517.
[4] H. Thiess, A.Q.R. Baron, T. Ishikawa, In preparation.