**A New High-speed, Photon-counting X-Ray Area Detector**

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We describe, for the first time, a powerful new type of imaging detector for X-ray crystallography: the Resistive Microgap Detector (RMD). This detector is based on new micropattern detector technologies which have been developed for high-energy particle physics experiments [1]. The detector exhibits a number of compelling advantages over the conventional, analog detectors typically used in crystallography experiments (viz., CCDs and image plates). The RMD is a pure digital photon-counter and thus exhibits true single-photon sensitivity with essentially zero intrinsic noise and zero frame readout dead time. This allows it to acquire both very long exposures on weakly diffracting samples without data degradation and also extremely fast exposures for time resolved experiments. It also demonstrates a very high counting rate capability of up to $10^6$ X-rays/mm$^2$-sec with a linear dynamic range of over 9 orders of magnitude (over a thousand times higher than CCD or image plate detectors). With an active area of 20 cm and a spatial resolution better than 100 microns the RMD can resolve over 400 diffraction orders. Also, the RMD is extremely robust, does not require cooling and has no internal dead areas.

[1] Bachman S., Bressan A., Ropelski L., Sauli F., *Nuclear Physics A,* 2000, **663**, 1069C-1072C.

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