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Electron Multiplying CCDs for future Soft X-ray Spectrometers

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EM-CCDs are commonly used for the detection of optical light, but seldom for X-ray detection partially due to the high energy and large charge packets that are generated at these energies. Through the analysis of high energy X-ray events it has been possible to show that the noise generated by the stochastic nature of the gain multiplication process in EM-CCDs can be minimised by operating at modest levels of gain (<10x). This paper will aim to take this work further by attempting to verify this reduction in the noise generated at low levels of gain for 'soft'X-rays (200 –2,000 eV).
Due to their low energy, the photon interaction of a 'soft'X-ray will occur close to the devices back surface; therefore, the charge packet will have a large thickness of silicon to travel through before it is collected in the buried channel. This will lead to charge splitting between pixels in the EM-CCD making complete charge collection difficult, thus degrading the devices energy resolution.
Using the e2v CCD220 it is possible to fully deplete the silicon, causing the charge packet to be collected in the buried channel faster than in a standard device. This should reduce the amount of charge splitting seen, leading to a better energy resolution. With this improved charge collection it should then be possible to verify the effect of gain in the multiplication register on the noise generated by the amplification process allowing predictions to be made about EM-CCDs performance at 'soft'energies with the view to use them on future space missions such as IXO (OP-XGS) and WHIM-EX.
In this paper we discuss the practical limitations when using EM-CCDs for X-ray spectrometers, together with modelling of the excess noise introduced by the avalanche gain and measurements confirming the predictions taken at the BESSY synchrotron.

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