High-Speed CCDs for optical and NIR astronomy

Fully depleted silicon pnCCDs, developed for the XMM-NEWTON and DUO missions, exhibit high quantum efficiencies from the near infrared to the vacuum UV region. The multiparallel readout allows for frame rates higher than 1 kHz for a device having a format of 264 * 264 pixel and a pixel size of 50μm. An electronic noise contribution of less than 3 electrons (rms) was achieved. The high speed, low noise and high quantum efficiency make these devices especially suited for the use as wavefront sensors in adaptive optics systems.

Back-illuminated pn-CCDs have been developed at the semiconductor laboratory of the Max-Planck-Institut für extraterrestrische Physik over the past years as X-ray sensitive imaging detectors.

Many outstanding characteristics of these X-ray devices, as their high intrinsic quantum efficiency of more than 90% within the entire energy range between 300eV and 10keV and their exceptionally low readout noise of less than 3 electrons (rms), make them ideal detectors in the optical region as well. Measurements of the internal quantum efficiency from the vacuum UV (VUV) to near infrared (NIR) region have revealed nearly 100% within the entire range.

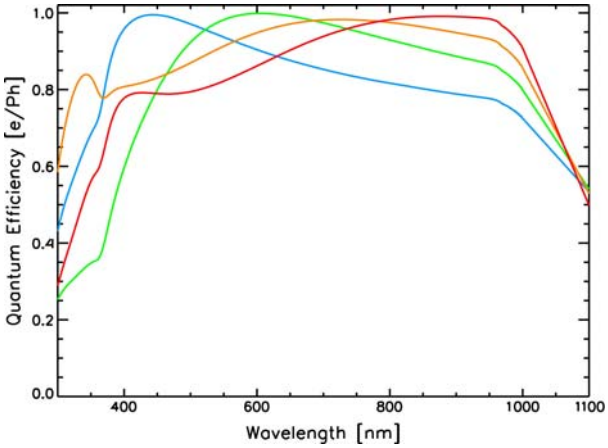

Fig. 1: Quantum efficiency for different anti-reflective coatings.

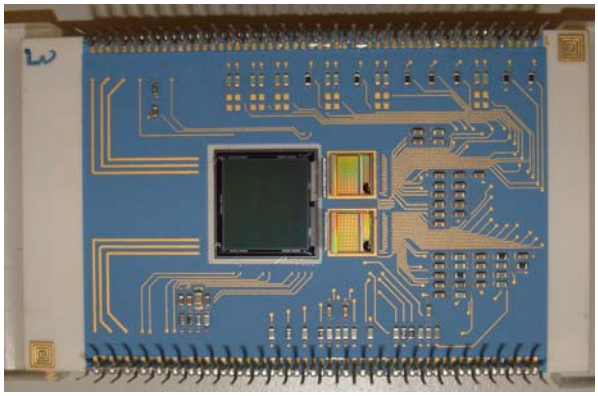

Fig. 2: 50μm pixel size CCD with two CAMEX readout chips.

Parallel to developments in order to improve the detector performance are developments in readout and data acquisition electronics. Operating a 264*264 CCD at 1000 frames per second generates a constant data flow of 140 MByte/s. Electronic subcomponents with integrated data correction and data reduction routines are also currently under development.

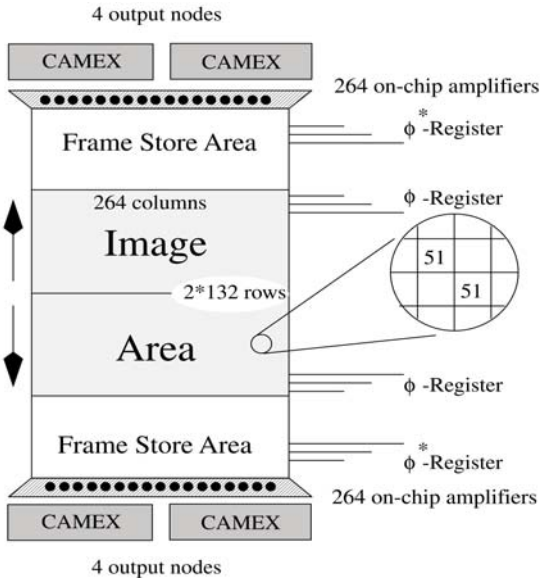

Fig. 3: Design of a future double-sided readout CCD.

References:
• R. Hartmann, K.-H. Stefan and L. Strüder, Nucl. Instr. And Meth. A439 (2000) 216-220
• N. Meidinger et al., Nucl. Instr. And Meth. A512 (2003) 341-349

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