Andor CB2: A Next Generation High Speed CMOS Camera Platform for Wavefront Sensing

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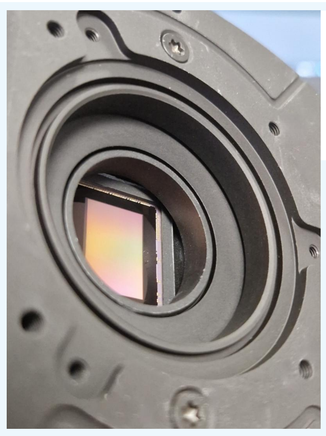
Abstract

We present Andor CB2, a new camera platform improving upon the successful C-BLUE One family of high-speed CMOS cameras developed by First Light Imaging. Like C-BLUE One before it, CB2 is aimed at laser guided wavefront sensing for adaptive optics (AO) systems deployed at large (6-10 m) and extremely large (10+ m) ground-based optical/infrared observatories. CB2 carries forward many strengths from C-BLUE One, including high sensitivity and very low read noise at high frame rates. Likewise, CB2's global shuttering and GigE data interface will continue to support synchronised wavefront sensing across the complex wide-field and multi-conjugate AO systems needed to maximise the performance of extremely large telescopes. The performance and main features of CB2 will be presented and compared to those of C-BLUE One. CB2's integrated liquid cooling (as opposed to C-BLUE One's external cooling plate) supports deeper vibration-free sensor cooling and improved dark current suppression. We will also describe an optional wavefront sensing configuration offered for CB2 which minimises both the distance and amount of optical material between a Shack-Hartmann lenslet array and the active silicon of the sensor. This configuration improves camera sensitivity, reduces ghost images caused by internal reflections, and optimises the wavefront sensor's spot size to the camera's pixel pitch.



CB2's WFS variant offers greater access to the camera's sensor, allowing installation of a Shack-Hartmann lenslet array (or other optics) extremely close to the focal plane. Through special request, CB2 WFS can be provided without a sensor window, shrinking the separation between sensor and optic further. CB2 WFS supports higher sensitivity in wavefront sensing by minimising optical material between the wavefront sensor and the camera's chip, reducing both attenuation of signal and internal reflections.

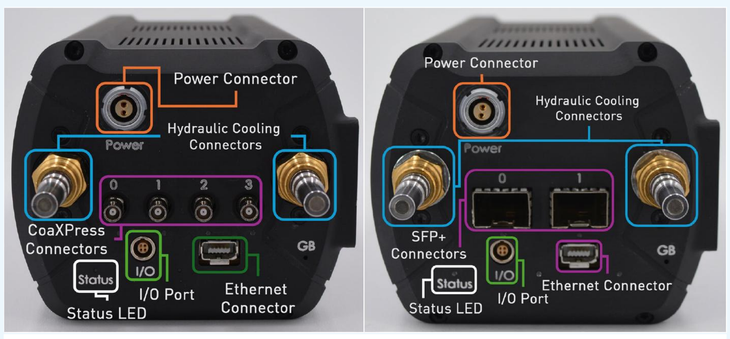


Fig 1 – The two interface configurations of CB2, providing data ports compatible with either CoaXPress 2.0 (left; 12.5 Gb/s per cable) and GigE Vision (right; 10 Gb/s). The connectors for CB2's integrated liquid cooling capability are also visible.

Learn more about CB2 online!

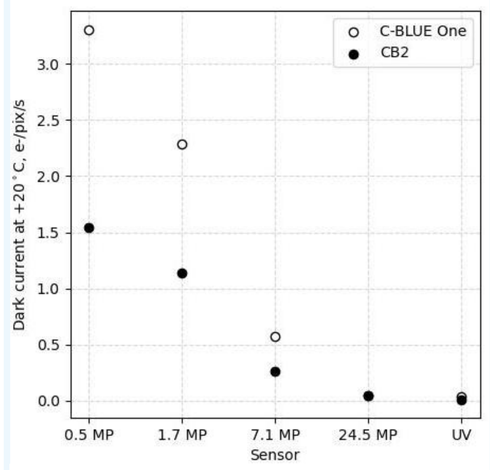


Fig 2 – Improvement of dark current for each sensor from C-Blue One to CB2. C-BLUE One values are approximated by scaling values measured at +10°C by $2^{(\Delta T/8)}$ where ΔT = +10°C. CB2 values are measured at +20°C.

Camera Sensor	Sensor Formats Size | Binning | Array @ Pixel Pitch | Read Noise			
Sony IMX426	0.5 MP	1x1	816x656 @ 9.0 µm	2.6 e-
Sony IMX425	1.7 MP	1x1	1608x1136 @ 9.0 µm	2.6 e-
Sony IMX420	7.1 MP	1x1	3216x2232 @ 4.5 µm	1.4 e-
Sony IMX420	7.1 MP	2x2	1608x1116 @ 9.0 µm	1.4 e-
Sony IMX530	24.5 MP	1x1	5328x4608 @ 2.74 µm	1.4 e-
Sony IMX530	24.5 MP	2x2	2664x2304 @ 5.48 µm	1.4 e-
Sony IMX487	UV 8.1 MP	1x1	2848x2848 @ 2.74 µm	1.6 e-
Sony IMX487	UV 8.1 MP	2x2	1424x1424 @ 5.48 µm	1.6 e-

Table 1. – Formats for each of CB2's sensors. 2x2 on-chip binned formats are shown for the IMX420, IMX530, and IMX487 sensors. Diagrams show sensors to scale in colour, and pixels magnified 1000x in grey.

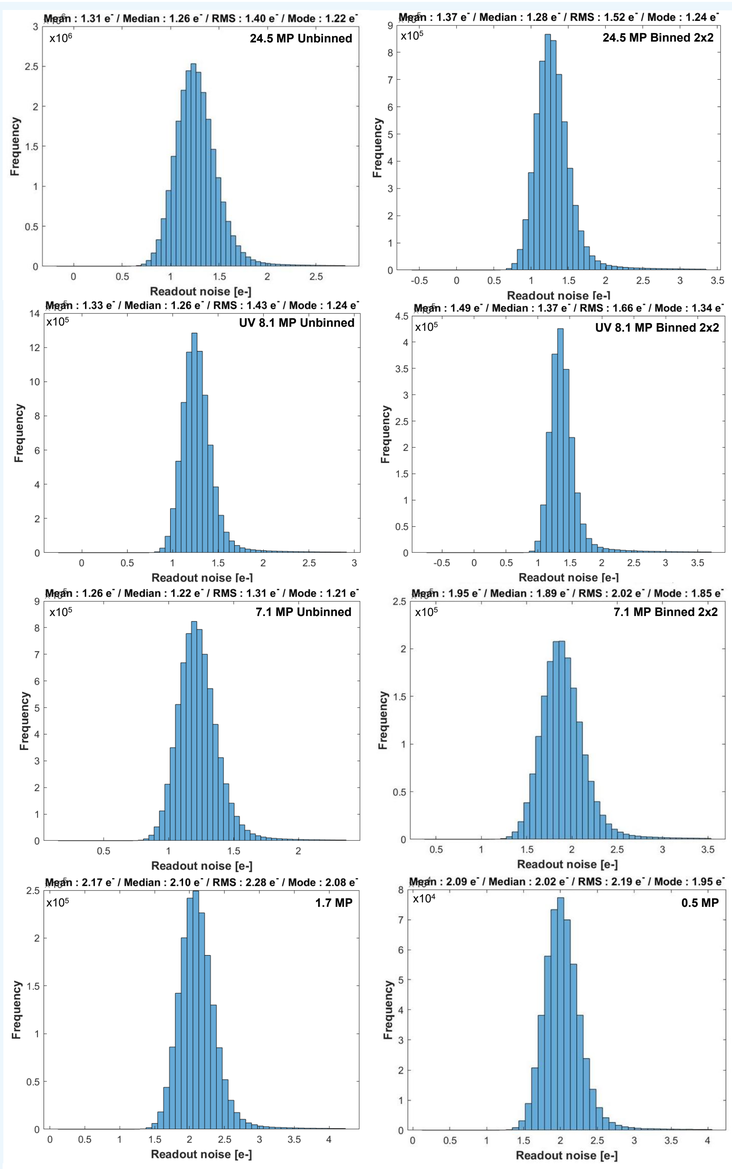


Fig. 3 – Read noise distributions for CB2's sensors. Integration time = 0.05 ms.

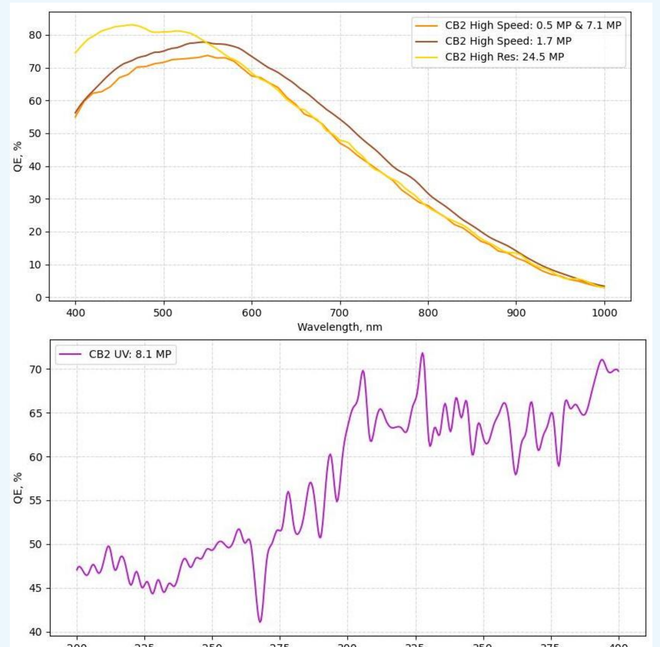


Fig. 4 – QE curves for CB2's sensors.

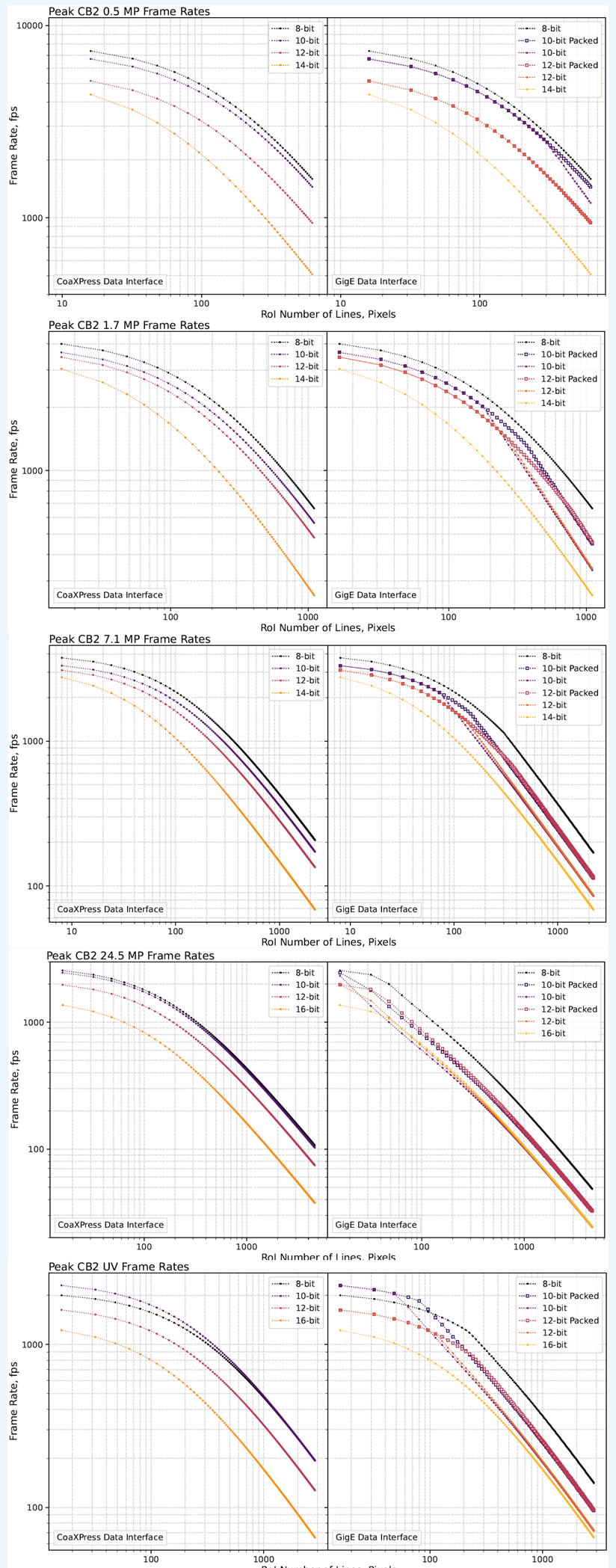


Fig. 5: Peak frame rates for CB2 when operated with different unbinned sensors, regions of interest, bit depths, and data interfaces.

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