

Scientific CCD characterisation at Universidad Complutense LICA Laboratory

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Abstract

A CCD test-bench has been built at the Universidad Complutense's LICA laboratory. It is initially intended for commissioning of the MEGARA¹ (Multi-Espectrógrafo en GTC de Alta Resolución para Astronomía) instrument but can be considered as a general purpose scientific CCD test-bench. The test-bench uses an incandescent broad-band light source in combination with a monochromator and two filter wheels to provide programmable narrow-band illumination across the visible band. Light from the monochromator can be directed to an integrating sphere for flat-field measurements or sent via a small aperture directly onto the CCD under test for high accuracy diode-mode quantum efficiency measurements. Point spread function measurements can also be performed by interposing

additional optics between sphere and the CCD under test. The whole system is under LabView control via a clickable GUI. Automated measurement scans of quantum efficiency (QE) can be performed requiring only that the user replace the CCD under test with a calibrated photodiode after each measurement run. A 20cm diameter cryostat with a 10cm window and Brooks Polycold PCC closed-cycle cooler also form part of the test-bench. This cryostat is large enough to accommodate almost all scientific CCD formats has initially been used to house an E2V CCD230 in order to fully prove the test-bench functionality. This device is read-out using an Astronomical Research Camera controller connected to the UKATC's UCAM data acquisition system.

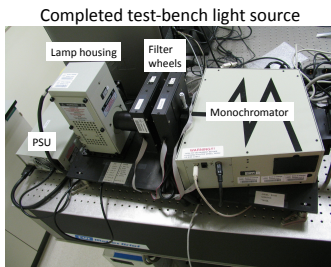
Test-bench operation

Quantum Efficiency measurement mode

The monochromator slit is re-imaged onto a 5mm aperture located 1m downstream. The CCD detector is placed behind this aperture and connected to a picoammeter. The CCD diode-mode current is logged as the monochromator is stepped in wavelength between 360 and 1000nm. The CCD is then removed and a 10mm diameter calibrated photodiode placed behind the aperture. The wavelength scan is then repeated. The CCD QE can be calculated from simple ratioing of the CCD and photodiode currents.

[E2V CCDs can be operated as photodiodes by connecting a picoammeter between the DD and SS pins.]

Hamamatsu S2281-04 photodiode calibrated by NPL



CCD230 test camera.

Built in conjunction with the test-bench.

3-D model of test camera with cryostat removed. Shows details of the thermal link between the cryotiger cooler head and the CCD mounting structure.

Close-up of the detector mount showing G10 supports.

Close-up of the detector mount showing the detector PCB.

Finished camera on pump. The cryocooler gas hoses are also visible.

CCD230 detector 4k x 4k x 15µm pixel. e2v

The wired-up cryostat ready for closure.

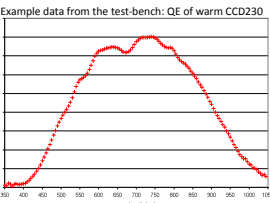
Flat-field measurement mode

A Newport oriel S¹ 70677 integrating sphere was mounted at the exit port of the monochromator. A 4k x 4k x 15µm CCD placed at the end of the optical rail experienced an illumination non-uniformity of $\lt; 0.5\%$. The sphere contained an internal baffle to block straight-through illumination. The sphere also contained a blue-LED for rapid flat-field and linearity measurements.

The test-bench is under full LabView control

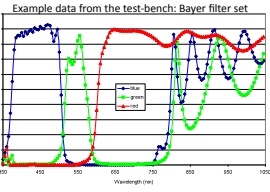
PSF measurement mode

A 25µm pinhole was placed at the output port of the sphere and imaged onto the CCD detector under test via two doublet lenses. One of these lenses was mounted on a manually adjustable X-Y translation stage to aid with focusing and centering the pinhole image. This mode was useful for diagnosing charge transfer and charge-spreading problems in CCD detectors.



Filter measurement mode

In this mode the configuration was similar to the QE measurement mode except that the photodiode was left permanently mounted behind the aperture. An additional filter mount was placed on the optical rail just upstream of the diode. Two wavelength/current-tagging scans were performed the first with the filter and the second without the filter. Simple current ratioing then gave the filter transmission.



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