

# MEGARA

## Multi Espectrógrafo en GTC de Alta Resolución para Astronomía

### Instrument characterization facilities at LICA-UCM

### in preparation for MEGARA

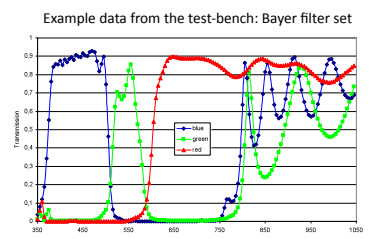
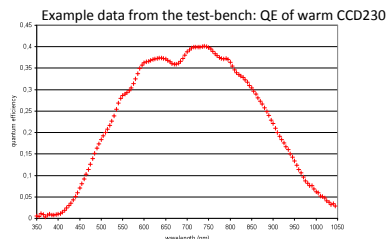
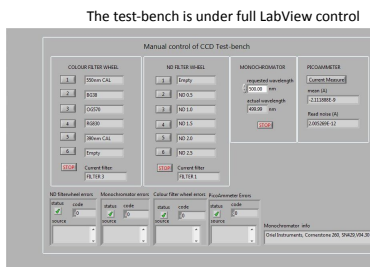
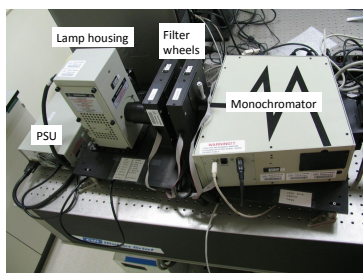
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A CCD test-bench has been built at the UCM LICA laboratory. It is initially intended for the characterization of the MEGARA instrument but can be considered as a general purpose scientific CCD test-bench. The test-bench uses an incandescent broad-band 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.

#### Completed test-bench light source



#### 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 D0 and SS pins.]

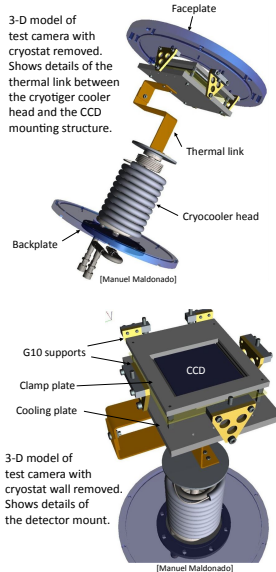
Hamamatsu S2281-04 photodiode calibrated by NPL

#### Available Test-bench facilities related to MEGARA

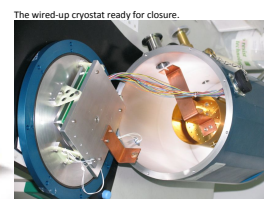
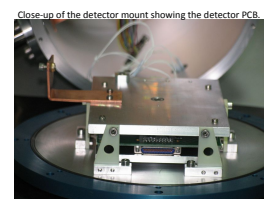
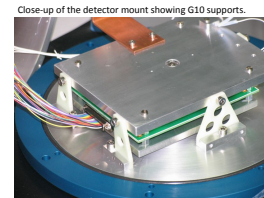
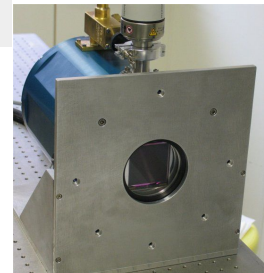
- ❑ Fibers characterization Needed for MEGARA 100 mini-bundles (with and without microlenses)
- ❑ Detector characterization for MEGARA detector and for the data acquisition system.
- ❑ Optical and alignment tools for mounting and characterizing MEGARA VPH gratings.

#### CCD230 test camera.

Built in conjunction with the test-bench.



The finished camera in its IR-Labs cryostat on the test-bench.



#### Flat-field measurement mode

A Newport oriel 8" 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 <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.

#### PSF measurement mode

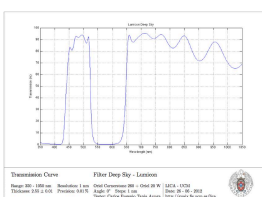
A 25µm pinhole was placed at the output port of the sphere and imaged onto the CCD detector under test via two doublet lenses. One of these lenses was mounted on a manually adjustable X-Y translation stage to aid with focusing and centering the pinhole image.

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-logging scans were performed the first with the filter and the second without the filter. Simple current ratioing then gave the filter transmission.

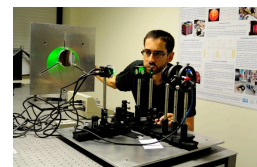
#### Teaching and training activities



UCM physics students are being trained in the techniques of optical tests and detector calibration. Laboratory work for master students is being designed and is planned to begin this academic year.

A result of their training work at UCM is the database of astronomical filters used in amateur astronomy that have been characterized using the optical bench described above.

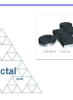
- Finally, some students are developing their own instruments using LICA facilities:
- A Fizeau-Michelson interferometer for optical test of surface mirrors from f/2 with accuracy better than lambda/15
- Portable night sky photometers for light pollution studies.



All the MEGARA posters presented at this meeting available at ...



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Participating companies