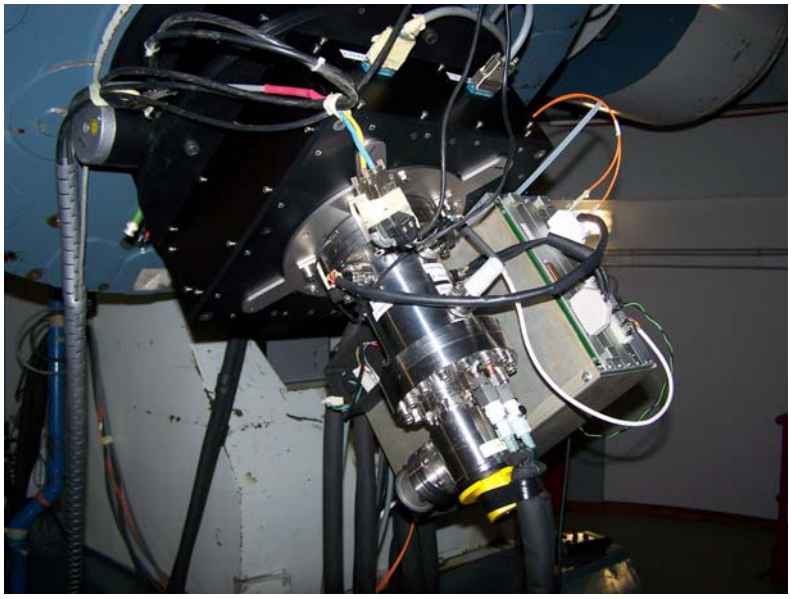
OSSERVATORIO ASTROFISICO DI CATANIA



First Light of the 91 cm CCD camera of the Catania Astrophysical Observatory

Short report on the first light of the instrument

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First Light of the 91 cm CCD camera of the Catania Astrophysical Observatory

The new CCD camera for the 91-cm telescope of the Catania Astrophysical Observatory was tested for the first time between June 28th and July 1st, 2007.

The camera is composed by a focal-reducer optical system built up by Colombo workshop, under design of C. Pernechele, and a CCD camera hosting a Kodak KAF1001E detector of 1024x1024 pixels (pixel-size 24 μm). The Multi Pinned Phase (MPP) CCD operated at -40 °C allows long integration time without significant dark increase.

The focal reducer provides a de-magnification factor of about 2.0 changing the relative aperture of the 91-cm telescope from f/16 to f/8 and the image scale from 14"/mm to 28"/mm. The scale on the CCD is then 0.66"/pixel and the field of view (FoV) covered by the detector is of about 11.2x11.2 arc-minutes.
The FoV is slightly vignetted at the edges by the filter aperture, that determine about 8% light loss at the corners.

The camera is provided with a set of UBVRI filters and three neutral density filters mounted into two filter wheels.

After several tests in the laboratory with the *setup* CCD aimed at understanding the capability of the system to maintain the temperature stable at -40°C and the relevant characteristics - readout noise, linearity, shutter repeatability, positioning accuracy of the filter wheels - we have mounted the camera with the *setup* CCD at the 91-cm telescope to test the overall performances of the system for optical imaging.

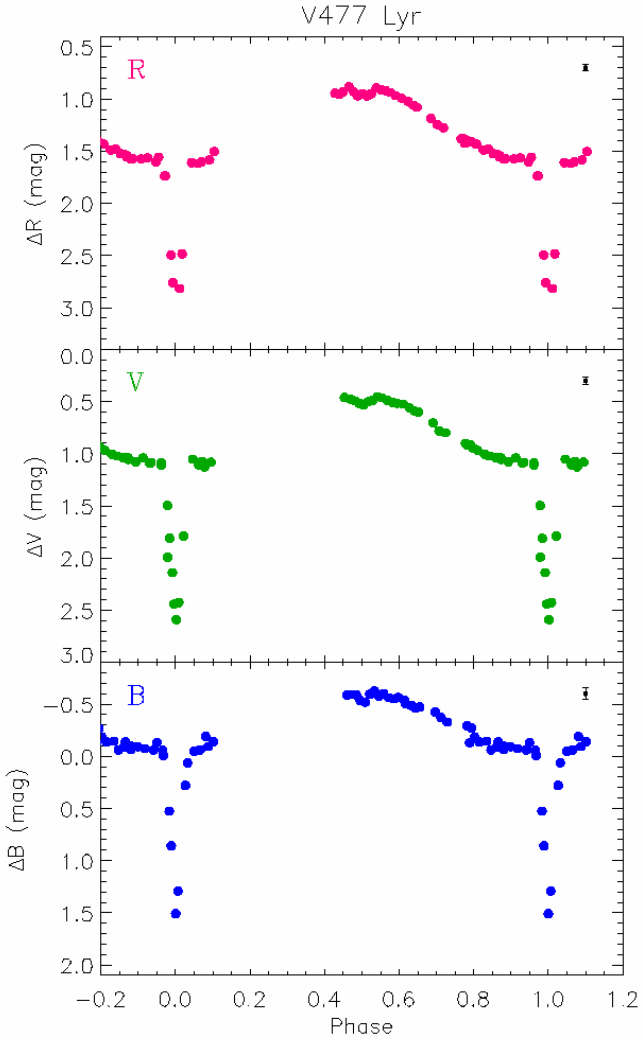
During our test run we had clear skies with a rather good transparency and seeing. However, we observed with the full moon, that gave rise to a high sky background in the images.

False colour images of the planetary nebulae M57 (Ring) and M27 (Dumb-bell) are shown in Figures 1 and 2, respectively. Each one is obtained by combining three images in R, V, and B filters. The individual images have been pre-reduced, i.e. the dark has been subtracted, the resulting image has been divided by the flat-field and the average sky background has been removed.

Figure 1: Image of the M57 (Ring) planetary nebula obtained by combining three images in R, V, and B filters with exposure times of 80, 100, and 180 sec, respectively.

Some barely visible optical aberration are present near the edges of the image; they are probably due to a small tilting of the detector. The image quality will be improved in the next run, the first with the scientific CCD, also thanks to the fine alignment system on the secondary mirror that was not used during these test observations. The right-handed strips visible on the brighter stars are due to the charge transfer efficiency that is being optimized in laboratory once the scientific CCD will be installed.

Figure 2: Image of the M27 (Dumb-bell) planetary nebula obtained by combining three images in R, V, and B filters with exposure times of 50, 180, and 240 sec, respectively. The top right corner shows light from the full moon.



During the test we measure the open cluster IC 4665 and the sdOB+M eclipsing binary V477 Lyr.
The R, V, and B light curves of V477 Lyr, obtained with 90, 90, 120 seconds integration time, are shown in Figure 3.
The light curve period is 0.471 d; R, V, and B magnitudes at maximum are about 15.3, 15.0, and 14.5, respectively. Magnitudes have been measured with an uncertainty of 0.03, 0.04, and 0.06, respectively.

Figure 3: V 477 Lyr light curves in the three colours R, V B

We cannot give reliable limiting magnitudes because of the presence of the full moon. Based on the described results on V 477 Lyr we estimate that a 18 Vmag star can be measured at S/N=20-30 (sigma 0.05-0.03 mag) in about 15 min.

In Figure 4 we show a fit of the profile of a star in the field of V477 Lyr. This fit allows to estimate the Point Spread Function.

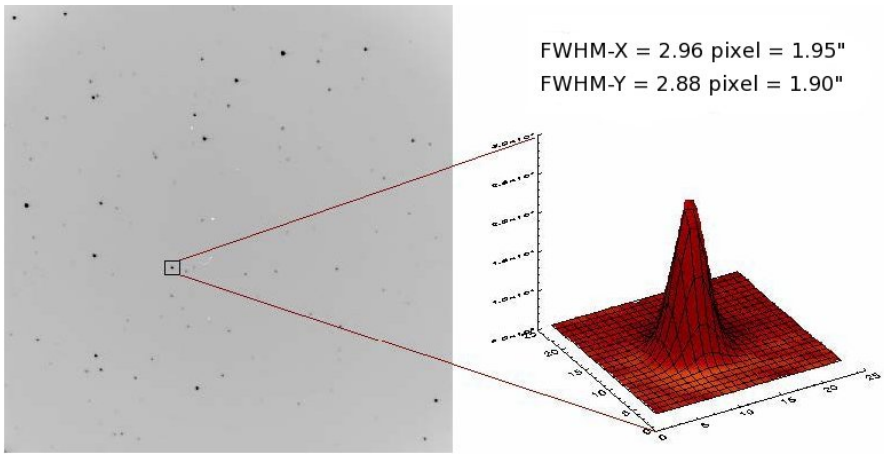


Figure 4: PSF evaluation on a R raw image of the V 477 Lyr field, artifacts of the setup CCD can be seen.

The PSF is almost symmetric; in the case we show the FWHM is 2.96 and

2.88 pixels on x and y axes, corresponding to 1.95 and 1.90 arcsec.

Figure 5: The 91 cm control room. From left: S. Di Mauro with G. Leto (standing up), A. Frasca and G.Occhipinti. Last picture shows G. Bonanno with S. Di Mauro, S. Billotta and M. Belluso (part of the COLD group).

The camera is already fully controlled via a user friendly graphical interface. Some changes/adjustment are needed and will be soon implemented. The camera will be refurnished with the installation of the scientific CCD and will be fine tuned at the Catania Observatory Laboratory for Detectors (COLD).

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