The Wide Field Imager at the 2.2-m MPG/ESO Telescope: First Views with a 67-Million-Facette Eye

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1. Introduction

The basic capabilities of the Wide Field Imager (WFI) were described in a previous *Messenger* article (No. 93, p. 13; see also Table 1) which also includes a brief account of the contributions by the three participating institutes, namely ESO (Garching and La Silla), the Max-Planck-Institut für Astronomie in Heidelberg, and the Osservatorio Astronomico di Capodimonte in Napoli. Table 1 summarises the most important characteristics. A first fairly complete version of the user manual is now offered via the WFI home page on the Web (URL: http://www.ls.eso.org/lasilla/Telescopes/2p2T/E2p2M/WFI/WFI.html). The same page also provides access to some examples of pictures obtained with the instrument. An exposure time calculator is available under the URL: http://www.eso.org/observing/etc/

Following the completion of the 2.2-m Telescope Upgrade Plan (cf. *The Messenger*, No. 93, p. 19 and No. 94, p. 12), the WFI was installed on La Silla as the only instrument offered at the 2.2-m MPG/ESO Telescope. Since January 18, it is used by ESO Visiting Astronomers and MPI-A observers. Every night, the WFI's 67 million pixels produce an amount of data comparable to that generated by all other ESO telescopes on La Silla plus the VLT UT1!

Figure 1: The Wide Field Imager mounted in the Cassegrain focus of the 2.2-m MPG/ESO telescope on La Silla. The authors apologise for the obscuration by foreground objects (from left to right: H. Böhnhardt, J. Alonso, J. Brewer, E. Robledo, N. Haddad, J. Reyes, O. Iwert, A. Böhm, R. Donaldson, K. Meisenheimer, R. Klein, T. Augusteijn, D. Baade). However, although being excellent at taking images, the WFI does not render itself very suitable for being imaged because the instrument housing is deep black.

2. Installation

A team of engineers from Heidelberg and Garching arrived on La Silla on December 8. Nine boxes with a total weight of almost one ton, in which the partly disassembled instrument, a handling cart, tools, spare parts, etc. had been packed after the system integration tests during the second half of November in Garching, were already waiting for them. Because of its sensitivity to mechanical shocks, the dewar head with the fully assembled science mosaic and the tracker CCD was transported as hand luggage by one of the Commissioning Team members. The weight (33 kg) and dimensions (80 cm × 80 cm × 25 cm) of the aluminium container made this travel a small adventure of its own.

Table 1: The Wide Field Imager in a Nutshell

Field of view:	(34 × 33) $arcmin^2$
Pixel scale:	0.24 arcsec/pixel
Detector:	mosaic of eight 2k × 4k CCD's
Filling factor:	96.2%
Read-out time:	27 seconds
Read-out noise:	4.5 ± 0.1 e^-/pixel
(Inverse) gain:	2.0 ± 0.1 e^-/ADU
Dynamical range:	16 bit
Full-well capacity:	> 200.000 e^-
Telescope aperture:	2.2 m
Telescope focus:	Cassegrain (f/8)
Instrument F ratio:	5.9
Useful wavelength range:	atmospheric cut-off through 1 µm
Limiting magnitude (*B* band):	23 mag (5-σ detection in 2 min. at 1″ seeing)
Overall intrinsic image quality:	0.4 arcsec
Overall geometrical distortions:	≤ 0.1%
No. of simult. mountable filters:	50
Slitless spectroscopy:	4.5 (5.7) nm resolution at 400–640 (650–850) nm
Raw data format:	FITS (with extensions), 142 Mbyte/file

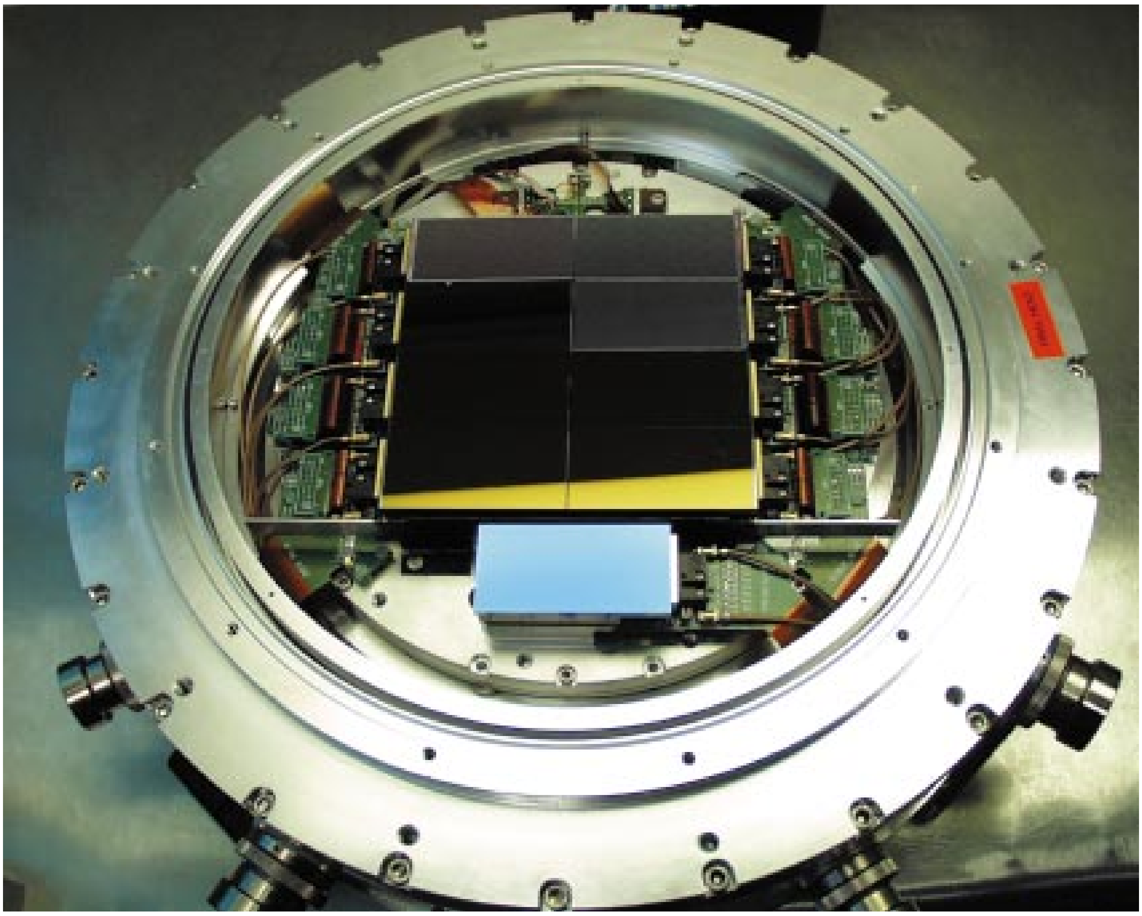

Figure 2: A close-up view of the WFI detector head.

After 4 busy days and with a lot of support from La Silla staff, everything was reassembled. The dewar had been pumped to a pressure of 10^{-6} mbar, the instrument was mounted to the telescope, telescope and instrument were balanced, all software had been installed, and for the first time also the communication with the instrument (DAISY+) and telescope control software had been established. All subsystems had been carefully checked, and no degradation with respect to the tests in Garching had been detected. Nevertheless, the suspense among the about 15 people present in the control room was very noticeable when only 30 minutes before December 13 the Start Exposure button was pressed for the first time. The telescope had been left pointing to an arbitrary field close to the zenith. But the image that appeared within little over half a minute on the Real Time Display (RTD) was greeted with much joy and enthusiasm.

The relief was not compromised by the discovery that the autoguiding of the telescope had failed. It was due to the predictable error in a sign, which was corrected in 5 minutes. That thereafter the autoguider system worked flawlessly was an impressive and instant proof of concept, because for the first time the tracker CCD, FIERA (ESO's CCD controller), the FIERA software, DAISY+, the shutter control electronics and software, and the telescope control hard- and software had all been chained together for a complicated real-time operation.

Days and nights of many engineering tests followed. A number of imperfections were discovered and eliminated one by one. All problems were sufficiently tractable that the 3 bottles of sparkling cooling liquid, which one of the software (!) engineers had put into one of the boxes only minutes before they were closed and shipped to Chile, were not needed. Miraculously, their contents turned out to be perfectly fit for human consumption and, therefore, reached their final destiny during a small farewell and Merry-Christmas party for the engineers, who started to return to Europe a few days before Christmas.

3. Commissioning and Science Verification

Now the astronomical testing and characterisation of the instrument could begin. The temptation to point the telescope at a number of aesthetically attractive large objects such as HII regions, nearby galaxies, globular and open star clusters, galaxy clusters, planetary nebulae, and the Moon was difficult to resist. And it was very impressive to see one image after the other show up on the RTD almost in poster quality even without any processing (a 3-colour composite image of the edge-on spiral galaxy NGC 4945 is shown on pp. 20–21; the corresponding caption is on p. 19). The equivalent of nearly four dark nights was used for *B*-filter observations to cover patch *C* of the EIS project (*The Messenger* No. 91, p. 49 and No. 92, p. 40) fully and three quarters of patch *D* for a total of 10.5 square degrees.

The application of the instrument for real scientific projects enabled the detection of a small number of further insufficiencies before the arrival of the first guest observers. Most of these problems could be solved, but some still persist. However, the important baseline conclusion is that the ESO and MPG communities now have access to a state-of-the-art wide-angle camera with excellent optical quality over the entire field of view and a very good mosaic of thinned, back-side illuminated CCD's with fast and low-noise readout electronics. In every respect, the WFI is rivalled only by very few similar instruments at other observatories. It would require too much space to mention all the salient points here. But they are described in depth in the user manual, and interested readers should kindly refer to it. Moreover, all ESO Commissioning and Science Verification data will be made accessible via the ESO Science Archive. Their availability will be announced on the ESO WWW pages.

A sore point for the Science Verification efforts and subsequent guest observers has been, and partly still is, that especially the standard broad-band filters were delivered very late and/or with major defects. Up-to-date status information is posted on the WFI home page mentioned above. We are very grateful to Dr. G. Luppino and the Institute for Astronomy of the University of Hawaii for the loan of a V filter formerly used with the UH8k camera. This camera was in January 1999 replaced with the even larger CFH12k instrument in the prime focus of the CFHT, and we take this opportunity to congratulate our colleagues on the successful commissioning of this impressive new Gigabyte-generating machine (cf. URL: `http://ftp.cfht.hawaii.edu/News/CFH12K-011399/cfh12k_neus.html`). Finally, we cordially thank the many colleagues in Garching, Heidelberg and La Silla, who have contributed to the project and very effectively supported the commissioning run.

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