OmegaCAM: Wide-field imaging with fine spatial resolution

1 Introduction

On Paranal Observatory in Chile, ESO’s 2.6-m VLT Survey Telescope (VST) will start operations in 2005. It is of modified Ritchey-Chrétien design specifically designed for wide-field imaging, and has been optimized for excellent image quality in natural seeing. Thus, it will have active primary and secondary mirrors, a retractable atmospheric dispersion corrector, a constant focal plane scale of 0.21 arcsec per 1pix pixel over a 1.4 degree diameter field, and a theoretical PSF with 80% of its energy in a 2 x 2 pix area over the whole field. OmegaCAM is the wide-field optical camera designed and constructed for this telescope by a consortium consisting of the Leiden Observatory, the Kavli Institute for Astronomy in the Netherlands, the University of Oxford, the University of Edinburgh, the University of Warwick, and the University of Cambridge. The OmegaCAM: Wide-field imaging with fine spatial resolution

2 Overview of the instrument

2.1 Detector system

The heart of OmegaCAM is the CCD mosaic (Fig. 1), being built on Paranal Observatory in Chile, ESO’s 2.6-m VLT Survey Telescope. On the VST focal plane, and covers an area of 1x1 degree at 0.21 arcsec/pixel. Around this science array lie four auxiliary CCDs, the same format. Two of these are used for on-axis guiding (on opposite sides of the field: the field is so large that also field rotation will be auto-guided), and the other two for off-axis guiding. For this purpose the latter CCDs are deliberately mounted out of focus (one 2mm in front, one 2mm behind the focal plane), and the resulting defocused images can be analyzed on-line and used to infer aberration coefficients such as defocus, coma, or astigmatism every minute. The whole detector system is mounted behind a large, curved dewar window (the first optical element in the VST design) and is cooled using a 40-l Nitrogen cryostat. Readout of the full mosaic takes 45s, and is accomplished by two FIERA controllers (a third FIERA takes care of the four guiding and image analysis CCDs).

The OmegaCAM instrument control electronics follows the well established ESO standards. To facilitate the user interface, coor-

2.2 Hardware

In front of the dewar window is the mechanical part of OmegaCAM: closest to the CCD window sits the filter exchange mechanism, and above that the shutter. The housing provides the mechanical link between the telescope flange and the detector/cryostat system.

2.3 Optics

The VST telescope will work in two configurations, which can be switched remotely. In the standard configuration, foreseen for work at small zenith distances, a two-lens field corrector is used. The second configuration replaces this corrector with one including an Atmospheric Dispersion Corrector (ADC), consisting of one lens and two counter-rotating prism pairs. The operating wavelength ranges are 320–1014nm and 365–1014nm for the two-lens cor-

2.4 Control Software

All instrument functions (filter exchange, shutter, detector readout, as well as monitoring the instrument state) are controlled in software. The programming environment is defined and provided by ESO through the releases of the VLT Common Software which has to be used as the basis for design and development. The part-

3 Calibration and Data Reduction Software

The amount of data produced by OmegaCAM will be truly huge. We estimate that there will be over 15 Terabyte of raw data per year. This raw data volume contains roughly 5 Terabyte of calibra-

4 Current status

Extensive hardware (filter exchange and monitoring mechanism, exposure shutter, safety measures) and control (main, moni-

Figure 4: The i’/l’ filter in the light path (main 5x1 size of view 266x268 mm). On the right and left side of the science filter bar the auxiliary i’/l’ filters for guiding and image analysis are visible. The total thickness of the i’/l’ filters including frames is 6.4g. Note that the shutter was not mounted when the picture was taken.

Figure 5: Theoretical throughput curves from SAGEM for the SDSS filter set, and measured quantum efficiency of one of the OmegaCAM CCDs.

Figure 3: The 1.6 m diameter housing structure with Integrated shutter (structure going from left to right at the bottom of the picture). Magazines for filters (upper and lower part). The filter loading platform is attached to the housing. Each magazine can be fitted with 4 filters which are large and heavy: when fully loaded with 12 filters, the instrument will contain 40 kg of filter glass alone! During the filter exchange process about 715g are moved (mass of 3 filters and the carriage).