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The Wide Angle Camera of the ROSETTA Mission

C. Barbieri[1], S. Fornasier[1], S. Verani[1], I. Bertini[1], M. Lazzarin[1], F. Rampazzi[1], G. Cremonese[2], R. Ragazzoni[2], F. Marzari[3], F. Angrilli[4], G. A. Bianchini[4], S. Debei[4], M. Dececco[4], G. Guizzo[4], G. Parzianello[4], P. Ramous[4], B. Saggin[4], M. Zaccariotto[4], V. Da Deppo[5], G. Naletto[5], G. Nicolosi[5], M. G. Pelizzo[5], G. Tondello[5], P. Brunello[6], and F. Peron[6]

[1] Dipartimento di Astronomia, Università di Padova, Padova, Italy
[2] INAF, Osservatorio Astronomico di Padova, Padova, Italy
[3] Dipartimento di Fisica, Università di Padova, Padova, Italy
[4] Dipartimento di Ingegneria Elettronica e Informatica, Università di Padova, Padova, Italy
[5] Facoltà di Architettura, Università di Venezia, Venezia, Italy

Abstract. This paper aims to give a brief description of the Wide Angle Camera (WAC), built by the Centro Servizi e Attività Spaziali (CISAS) of the University of Padova for the ESA ROSETTA Mission to comet 46P/Wirtanen and asteroids 4979 Otawara and 140 Siwa. The WAC is part of the OSIRIS imaging system, which comprises also a Narrow Angle Camera (NAC) built by the Laboratoire d'Astrophysique Spatiale (LAS) of Marseille. CISAS had also the responsibility to build the shutter and the front cover mechanism for the NAC. The flight model of the WAC was delivered in December 2001, and has been already integrated on ROSETTA.

Key words. instrumentation: miscellaneous – space vehicles: instrumentation

1. Introduction

The study of minor bodies is of fundamental importance for the comprehension of our Solar System, because they are the bodies most representatives of its primordial material; ROSETTA is the cornerstone of European Space Agency (ESA) devoted to the study of the minor bodies of the Solar System that will be launched on January 2003. The primary target is comet 46P/Wirtanen, a short period comet of Jupiter family which will be reached by the spacecraft on 2012, at about 4 AU from the Sun.

The spacecraft will orbit the nucleus till the perihelion in 2013, acquiring 9 months of unique data. Secondary scientific targets

Send offprint requests to: C. Barbieri
Correspondence to: Dipartimento di Astronomia, Università di Padova, Vicolo dell'Osservatorio 2, I-35122 Padova, Italy

are two asteroids, 4979 Otawara and 140 Siwa, that will be encountered respectively on July 2006 and July 2008.

ROSETTA has a complex instrumentation devoted both to remote sensing and in situ investigation. The authors were involved in the design and manufacturing of the Wide Angle Camera (WAC) of the OSIRIS imaging system.

2. The Wide Angle Camera

The WAC camera will be principally devoted to the study of the very faint gas and dust cometary features. The principal characteristics of the camera are a large field of view of $12^\circ \times 12^\circ$ with a resolution of 100 μrad px^{-1} and a contrast ratio of 10^{-4}, in order to detect coma gaseous and dusty features close to the nucleus of the comet. To achieve this target the WAC has an innovative optical design (Ragazzoni et al. 1995; Naletto et al. 1996, 2002; Da Deppo et al. 2001), all reflective, unobstructed and unvignetted, employing two aspherical mirrors in an off axis configuration. First mirror, M1, is an off-axis section of an oblate ellipsoid decentered with respect the optical axis of 43 mm and of square shape (53×53 mm). It collects the light from the object at an angle of 20° with respect to the mirror common axis and sends it to the secondary mirror, M2, that is the real entrance pupil. M2 is a concave spherical mirror of circular shape ($r = 30$ mm) decentered of 5 mm with respect to the mirror common axis, which focused the light on the detector placed 51 mm behind M1. The detector is a CCD array with a number of pixel of 2048×2048 and a pixel size of 13.5 μm. Furthermore two filter wheels each carrying 7 square filters plus a hole were adopted. The optical system is design in order to maintain unchanged its performances from infinity down to almost 500 m. The very peculiar optical system and the primary scientific aim to study very faint gas and dust cometary features in the vicinity of the nucleus imposed the design and construction of an innovative baffling system (Brunello et al. 2000), in order to reach the stray-light suppression requirements both for source inside (contrast ratio better than 10^{-4}) and outside the field of view (stray-light attenuation better than 4×10^{-9} at 45° off-axis) of the camera.

The shutter and front door of the camera were completely designed and realise at CISAS, that provides these mechanism also for the NAC camera, the camera at high resolution of the OSIRIS system. The shutter is a very complex mechanism that allows an uniform exposure of the image and exposure times as short as 10 ms. The Front Door Mechanism is designed to achieve the double function to protect the optical devices inside the WAC and the NAC, and to perform an in-flight calibration of the telescopes.

Strong attention was put in the choice of materials and coatings of the camera, in order to satisfy the mechanical, thermal and optical constrains (Debei et al. 2001). Many simulations and measurements were performed to analyse the optical properties of the camera and of the materials, the baffling efficiency, the mechanical, thermal and vibrational properties of the whole system.

The camera satisfied all the requirements and was delivered to ESA on December 2001.

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