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ADAS: Asiago-DLR Asteroid Survey

C. Barbieri[1], I. Bertini[1], S. Magrin[1], L. Salvadori[1], M. Calvani[1], R. Claudi[2], G. Pignata[2], G. Hahn[3], S. Mottola[3], and M. Hoffmann[4]

[1] Dipartimento di Astronomia, Università di Padova, Padova, Italy
[2] INAF, Osservatorio Astronomico di Padova, Padova, Italy
[3] DLR Institute of Space Sensor Technology and Planetary Exploration, Berlin, Germany
[4] Institute for Geology, Geophysics and Geoinformatics, Freie Universität Berlin, Berlin, Germany

Abstract. The Asiago-DLR Asteroid Survey is the joint program among the Department of Astronomy and Astronomical Observatory of Padova and the DLR Berlin, dedicated to the search of asteroids. The Minor Planet Center has attributed to ADAS the survey code 209. The project is carried out since the end of December 2000 with the S67/92cm telescope at Asiago - Cima Ekar equipped with the SCAM-1 camera of DLR, in Time Delay Integration mode, in a strip from $-5°$ to $+15°$ around the celestial equator. The camera has a front illuminated Loral chip of 2048×2048 pixels of 15 μm each, covering a field of $49' \times 49'$ with a resolution of $1.4''$ pixel^{-1}. This paper presents the main results obtained till March 15, 2002, when the telescope has been closed for a complete overhaul. ADAS will resume presumably at the end of June 2002.

Key words. surveys – minor planets, asteroids

The project to adapt a CCD camera to the S67/92 cm Schmidt telescope at Cima Ekar is a joint collaboration between the Department of Astronomy and the Astronomical Observatory of Padova on one side, and DLR Berlin on the other. The main scientific driver is the discovery and follow up of moving objects (asteroids, NEOs, NEAs, TNOs, KBOs, etc.). Hence the name ADAS: Asiago-DLR Asteroid Survey given to the project[1]. The Minor Planet Center has attributed to ADAS the survey code 209. Other scientific programs will be possible: no filter is at moment provided, but a filter wheel device is available and it will be mounted in the near future. DLR has provided the SCAM-1 camera (which can be operated both in Time-Delay Integration mode and in normal mode), the software for image acquisition and quick look, and for astrometry and automatic detection of moving objects by comparing

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

[1] `http://planet.pd.astro.it/planets/adas`

3 frames (Rackis). Photometry and centroiding of all stars on the frame is accomplished by using Sextractor (Bertin & Arnouts 1996). The thick front-illuminated CCD is a grade A 2048×2048 LORAL chip with a pixel size of 15 μm ($1.437''$ on the sky), and covers an area of $49' \times 49'$ arcmin (0.67 degree^2). In TDI, the effective exposure time for each star is of 196 s at the equator. The camera is equipped with a Vincent 45 precision shutter, the shortest exposure time being 0.1 s; because the diameter of the shutter is of 45 mm, a slight vignetting is introduced. The chip is refrigerated by a two-stage cooling device, where the primary stage is a Peltier cooler and the secondary one consists of a closed-circuit liquid refrigerator. The achieved CCD operational temperature is -63 C. A complete characterization of the chip and its electronics was performed thanks to the kind help of Catania Astrophysical Observatory (Claudi et al. 2002).

The system obtained useful data since Dec. 21, 2000. Till the middle of Feb. 2001, the focal plane was folded to the CCD camera via a (slightly undersized) flat metal mirror kindly provided by Officine Galileo (Firenze); the mirror is a spin-off of the very successful prototype built for the Halley Multicolour Camera on board GIOTTO, now produced in large quantities for several non-astronomical applications. A new flat mirror in glass, with larger dimensions in order to collect all the light beam, and excellent optical quality, was produced by Ottica ZEN (Venezia); it was installed at the telescope on Feb. 21, 2001. Several tools for ADAS have been adapted from available software packages. The astrometric residuals are evaluated by a comparison with the asteroids positions (MPC format) in the asteroid server developed by J. Skvarc through the Web interface[2]. This service uses several programs and information sources developed by different people. The asteroid database is maintained at Lowell Observatory by E. Bowell. Propagation of asteroid positions is done by a program called Orbfit, part of a NEO information tool NEODyS developed by the Orbfit consortium. Identification of the asteroids is made using the MPC tool[3]. The asteroid positions are referred to the USNO SA2.0 and to the GSC 1.1 Astrometric Catalogues.

The first phase of our work, using the metal mirror, lasted from Dec. 20, 2000 through Feb. 20, 2001. Although the optical quality had not reached its optimal value, the limiting magnitude was already sufficiently faint to give hope to have a competitive system. In this first part of the ADAS program, we have essentially operated in guided mode. The second phase started on Feb. 21, 2001, when the new excellent glass mirror was mounted. The optical quality improved and the alignment of the CCD columns with the Hour Angle was optimized, so that the TDI scan mode could be implemented. With the TDI technique and 30 min long scans, we cover a field of 6.15 degree^2 for 3 times in 1.7 hours. The image quality can be maintained good only in the interval of declination $(-5°, +10°)$, on higher declination the curvature of the sky becomes noticeable, but several data were nevertheless obtained at Hour Angles not too far from the meridian. The observing time was divided essentially among 2 different programs: (1) a survey of asteroids around the meridian, in particular around Saturn's Lagrangian points and near the opposition (total number of detected asteroids = 4419); (2) a survey of asteroids at small solar elongations (total number of detected asteroids = 444).

References

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[2] `http://astro.ago.uni-lj.si/asteroids/residuals.html`

[3] MPChecker `http://cfaps8.harvard.edu/~cgi/CheckSN?s=m`