The Aosta Valley Astronomical Observatory

Albino Carbognani

The Aosta Valley Astronomical Observatory

Carbognani, A.[1,2]

[1] Laboratoire Cassiopee - Observatoire de la Côte d'Azur, Boulevard de l'Observatoire
B.P. 4229 F-06304 NICE Cedex 4, France
[2] Fondazione Clément Fillietroz-ONLUS - Osservatorio Astronomico della Regione
Autonoma Valle d'Aosta e Planetario di Lignan, Loc. Lignan 39, 11020 Nus (AO), Italy
albino.carbognani@alice.it

Introduction

OAVdA stands for Astronomical Observatory of the Autonomous Region of the Aosta Valley (Italy). The centre is located in the northwestern Italian Alps, near the border with France and Switzerland (Lat: 45° 47′ 22″ N, Long: 7° 28′ 42″ E), at 1675 m above sea level in the Saint-Barthélemy Valley and is managed by the "Fondazione Clément Fillietroz", with funding from local administrations.

OAVdA was opened in 2003 as a centre for the popularization of astronomy but, since 2006, the main activity has been scientific research, as a consequence of an official cooperation agreement established with the Italian National Institute for Astrophysics (INAF). In 2009, a planetarium was built near the observatory with a 10-meter dome and 67 seats, which is currently used for educational astronomy. In the year 2009 about 15,200 people visited OAVdA and the planetarium. The staff in 2010 was made up of 12 people, including a scientific team of 5 physicists and astronomers on ESF (European Social Fund) grants and permanently residing at the observatory.

As far as observing conditions are concerned, the mean seeing allows to have a Full Width at Half Maximum of the Point Spread Function (PSF) of about 1.5-2 arcsec. Lightpollution is low because the surrounding mountains shield the site of the observatory from the lights of nearby Aosta, Turin and Milan, so the sky background is around +21.5 mag.

1. The OAVdA Building

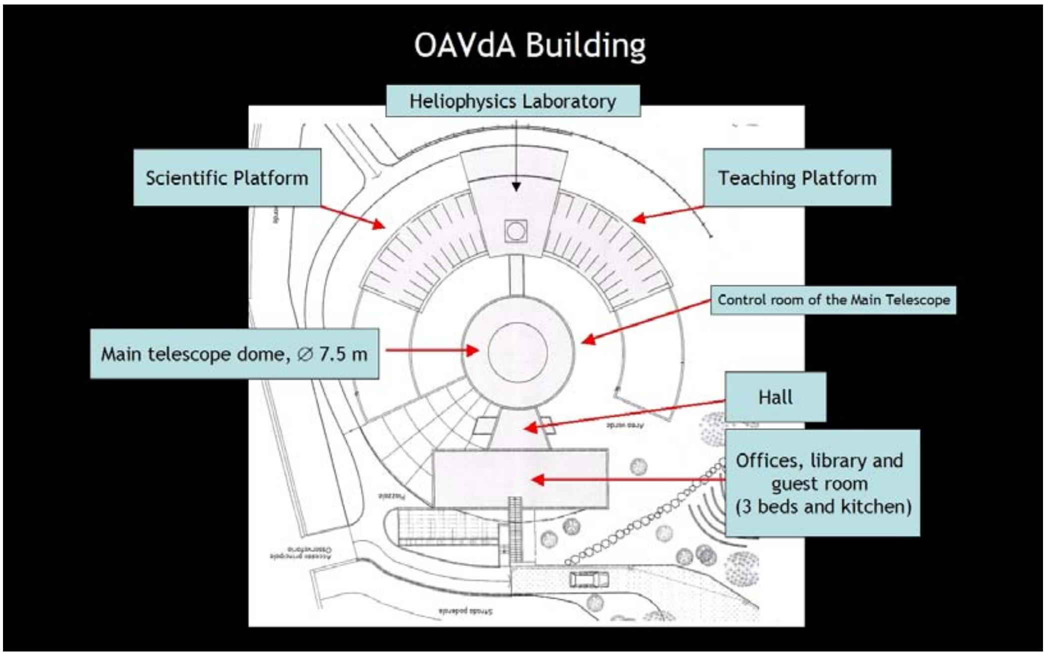

Fig. 1 – The OAVdA building. The arrows indicate the main features of the observatory.

The structure of the Observatory is shown in fig. 1. Around the dome of the Main Telescope (used for asteroids and blazar observations) are a Scientific Platform (used for extrasolar planet transit search), a Heliophysics Laboratory (for educational observations of the Sun), a Teaching Platform (meant for educational astronomy, which houses seven 250 mm f/10 Cassegrain reflectors with computerized pointing), offices, a library and a guest room.

2. Scientific Research Areas

The scientific research areas investigated at OAVdA are as follows:

1 – Observation of asteroids (NEOs, MBAs and Trojans), in collaboration with the Minor Planet Centre, INAF-OATo (Turin Astronomical Observatory) and DLR-German Aerospace Centre in Berlin (Mottola et al., 2010). The research work is both theoretical (Carbognani, 2010 and 2011a) and observational (Carbognani et al., 2008; Carbognani, 2008, 2010 and 2011b).

2 – Detection of small-size extrasolar planets in orbit around nearby M dwarfs using the photometric transit method. The research is conducted in cooperation with INAF-OATo and the University of Padova (Damasso et al., 2010).

3 – Monitoring of Active Galactic Nuclei (AGN) as part of the international Whole Earth Blazar Telescope (WEBT) organization in cooperation with INAF-OATo (Villata et al., 2009).

4 – Observation of Solar Corona (K-corona), on an innovative polarimeter designed for space coronagraphic study by INAF-OATo (Abbo et al., 2008).

Below, we will only briefly look at the work on extrasolar planets transit and the asteroid observations, more relevant for GAIA-FUN-SSO. The short list of selected references can give an idea of the earliest results of the scientific research.

2.1 *The Scientific Platform and the Extrasolar Planet Transit*

Since December 2008 OAVdA, in cooperation with INAF-OATo, has been actively involved in the field of extrasolar planets. A detailed feasibility study has been carried out to demonstrate that OAVdA is a well poised observing site to detect small size extrasolar planets around M dwarfs using the photometric transit method (Damasso et al., 2010). Since December 2009 a pilot study has been carried out on a small sample of nearby M dwarfs with accurate parallax measurements, mainly aimed at characterizing the photometric microvariabilty of the target stars. This study is a preliminary step toward a long-term photometric survey to search for transiting exoplanets, which will use an array of five identical f/8 Ritchey-Chretien 400mm telescopes that will be located in the Scientific Platform (fig. 1).

2.2 *Main Telescope and Control Room*

The Main Telescope is a 0.81-m f/7.8 Ritchey-Chretien reflector with a field flattener near the Cassegrain focus. The instrument is equipped with a guide telescope (a refractor with a diameter of 120 mm open to f/9) and a back illuminated 16 bit CCD camera (FLI PL 3041-1-BB, 2048 × 2048 square pixels), with a pixel size of 15 micrometers, field of view of 16.5 × 16.5 arcminutes and image scale of 0.48 arcseconds/pixel. The CCD camera is equipped with a filter wheel and a set of standard Johnson-Cousins B, V, R and I filters.

The Control Room is a separate and warmer area than the dome housing the Main Telescope. The computers controlling the pointing of the telescope and CCD imaging are located in this room. The observations are schedulable via script, so it is possible to automate the pointing of the instrument, the CCD image acquisition, the length of the pose and the filter type.

2.3 *NEAs astrometry with Main Telescope*

In July 2006, OAVdA was allotted the Minor Planet Center code B04. Around the time of the new Moon, NEAs follow-up is made of the new objects reported in the NEOCP page updated by the MPC. The typically observed NEOs have a magnitude between +19 and +20 with a sky motion of about 5 arcsec/minutes (see Fig. 2 and Fig. 3). The limiting magnitude reached on the NEOs is +20.7 with image stacking to compensate for the asteroid movement and a total exposure time of 15-20 minutes. So far, from 2006 to 2010, astrometric positions for 80 NEOs have been recorded. For the year 2010, from the Web page of "residuals statistics for observatory codes" maintained by MPC (MPC, 2010), the residues for B04 are less than an arcsecond in 98.99% of the cases. For the previous years the results are similar.

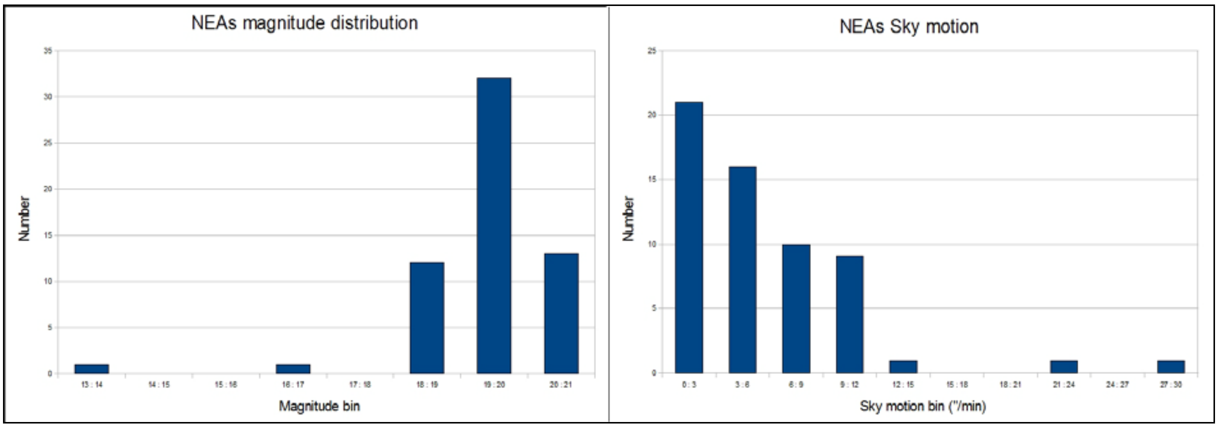

Fig. 2 – Results achieved by the NEAs follow-up. Left: NEAs magnitude distribution. Right: NEAs sky motion distribution

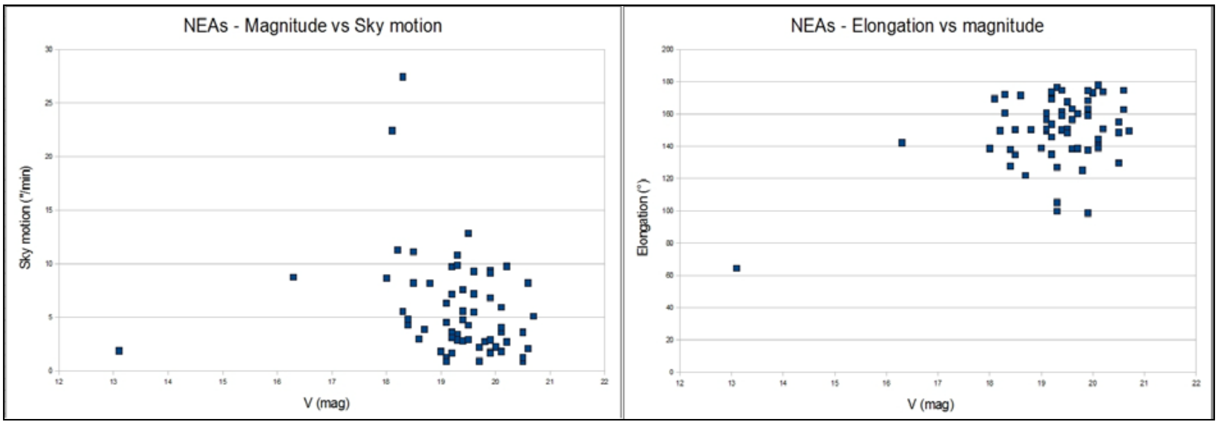

Fig. 3 – Magnitude vs sky motion (left) and elongation form Sun vs magnitude (right) for NEAs follow-up.

2.4 *Asteroids photometry with Main Telescope*

Photometric observations of Trojans, NEAs and MBAs have been made since July 2007 to determine the asteroids rotation period from lightcurve. Work on the rotation period of

Trojans has been done in collaboration with DLR (Berlin) and INAF-OATo (Mottola et al., 2010). From 2007 to the present (2010), a lightcurve for 32 NEAs and MBAs has been obtained. (Carbognani et al., 2008; Carbognani, 2008, 2010 and 2011b).

Conclusion

OAVdA is a small regional observatory in the Italian Alps, with a Main Telescope that might be suitable to join to the GAIA follow-up network (see Table 1). Reaction time from alert is about 15-30 minutes with direct telescope access and the percentage of available time for the project is estimated around 30-40% of observing time.

Table 1 – Summary of the data relevant to GAIA-FUN-SSO

Main Telescope: 0.81 m diameter, f/7.8, RC reflector.	Field of view: 16.5 × 16.5 arcminutes
Minor Planet Center Code: B04	Image scale: 0.48 arcsecond/pixel (binning 1 × 1)
Pointing accuracy: 1 arcminute	Peak quantum efficiency: 96%@750 nm
Tracking: 5 minutes exposure without autoguider	Limit Magnitude on NEOs: +20.7 with 15-20 minutes exposure
Average seeing condition: 1.5-2 arcsecond Sky background: around +21.5 mag	Available nights: about 200/365

References

Abbo L., Zangrilli L., Antonucci E., Fineschi S., Kohl J., Giordano S., Massone, G., Capobianco G., Calcidese P., Porcu F.: 2008, Investigation of the solar wind outflows and joint observations during the total solar eclipse of March 29, 2006, scientific poster, 37th COSPAR Scientific Assembly, Montréal, Canada, 13-20 luglio 2008. Symposium D, session 24, paper number D24-0038-08.

Carbognani A., Pravec P., Krugly Y. N., Pray D.P., Gajdos S., Gaftonyuk N. M., and Slyusarev I.: 2008, Lightcurve Photometry and Search for Cometary Activity of NEA 2007 PU11, Minor Planet Bulletin, 35, 61-62.

Carbognani A.: 2008, Lightcurve Photometry of NEAs 4450 Pan, (170891) 2004 TY16 2002 RC118, and 2007 VD12, Minor Planet Bulletin, 35, 109-110.

Carbognani A.: 2010, Statistical analysis of C and S Main Belt Asteroids, Icarus, 205, 497-504.

Carbognani A.: 2011a, A possible YORP effect on C and S Main Belt Asteroids, Icarus, 211, 519-527.

Carbognani A.: 2011b, Lightcurve and Periods of Eighteen NEAs and MBAs, Minor Planet Bulletin, 38, 57-63.

Damasso M., Giacobbe P., Calcidese P., Sozzetti A., Lattanzi M., Bernagozzi A., Bertolini E., Smart R.: 2010, Photometric Transit Search for Planets around Cool Stars from the Western Italian Alps: A Site Characterization Study, Publications of the Astronomical Society of the Pacific, 122, 1077-1091.

Mottola S., Di Martino M., Erikson A., Gonano M., Carbognani A., Carsenty U., Hahn G., Schober H-J., Lahulla F., Delbò M., Lagerkvist C. I.: 2010, Rotational Properties of Jupiter Trojans. I: Lightcurves of 80 Objects. Submitted to Astrophysical Journal.

MPC: 2010, Residuals Statistics for Observatory Codes, 2010 Aug. 29, *http://www.minorplanetcenter.org/iau/special/residuals.txt*

Villata M., Raiteri C. M., Gurwell M.A., Larionov V. M., et al. (including Calcidese P.): 2009, The GASP-WEBT monitoring of 3C 454.3 during the 2008 optical-to-radio and gamma-ray outburst, Astronomy and Astrophysics, 504, L9-L12.