

OBSERVATIONS WITH THE REAL INSTITUTO Y OBSERVATORIO DE LA ARMADA CCD TRANSIT CIRCLE IN ARGENTINA

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ABSTRACT

The Real Instituto y Observatorio de la Armada (ROA) meridian circle was moved to the Estación de Altura Carlos Ulrico Cesco in the República Argentina in 1996. Until november 1999 the observations were carry out with a moving slit micrometer. In spring 2001 the result of these observations has been published, forming the first Hispano-Argentinian Meridian Catalogue (HAMC). In december 1999 was installed a SpectraSource CCD camera of 1552x1024 pixels of 9μ . The CCD camera observe in drift scan mode. A survey of the south hemisphere is being observed from $+3^\circ$ to -60° of declination.

In this contribution its presented a description of the telescope and the automatic control system, the results of observations carried out with the slit micrometer, and the observational and preliminary reduction techniques with the CCD camera, the present state of the south hemisphere survey and the future possibilities.

1. INTRODUCTION

The transit circle of the Real Instituto y Observatorio de la Armada (Spain) ROA was built in 1948 by Grubb Parsons. It has an aperture of 18 cm and a focal length of 266 cm. In the early 90's it was fully automated and provided with a moving slit photoelectric micrometer to observe the stars and a automatic system based in six CCD CCTV cameras to read the circle.

In 1996 June was moved to Argentina to the Carlos U. Cesco Observatory (CUC) in the east slopes of the Andes at to 69° W of longitude, 31° S of latitude and 2330 m of altitude. The Observatorio Astronómico Félix Aguilar (OFA) of the Universidad Nacional de San Juan owns the CUC. Both institutions the ROA and the CU share the management of the instrument.

Since 1997 October to 1999 september was observing regularly a program of stars, planets, satellites and minor planets. The results of these observations were published in the Hispano-

Argentinean Meridian catalogue 2001.

In 1999 December the photoelectric micrometer the CMAF was removed and was installed in it a CCD camera of 1552x1024 pixels of 9μ observing in drift scan mode. Since then the telescope is observing a program to produce a survey of stars from $+3^\circ$ to -60° degrees in declination and between 7.5 and 16.0 of visual magnitude. In parallel with the observations for the survey are carried out observations of Pluto, Neptune and Triton when they transit by the CUC meridian during night-time. Also some special observational programs are developed in collaboration with other South American institutions.

2. PHOTOELECTRIC OBSERVATIONS

During the period 1997 October to 1999 September the CMAF observed with its photoelectric micrometer a program of stars, and Solar System objects. With these observations were computed the positions for the Hispano-Argentinean Meridian Catalogue 2001 (HAMC). This catalogue was published in 2001 in CD-ROM format. It is composed with the positions (RA and declination J2000), proper motions and magnitudes of 6192 stars with declinations between $+40^\circ$ and -90° and brighter than 15.5V, and 923 positions and magnitudes of 92 objects of the Solar System. The catalogue also contains 886 mean observed positions of the FK5 stars used to transfer the instrumental system to the ICRF.

The mean error of a catalogue position in the zenith is $0''.08$ in right ascension and declination. The mean error in proper motions is typically in the range of $0''.004$ per year.

3. CCD OBSERVATIONS

The CCD camera is positioned in the transit telescope in order to get that the longer side of the photo sensitive area of the CCD chip is parallel to the local meridian. Having in account the size of the CCD approximately 14x9 mm and the focal length of the objective, when observing in drift scan mode a strip of sky of $18'$ in declination and with a length of until 2.7 hours in right ascension is observed. The length in right ascension is limited for software storage reasons.

At the end of 1999 after the installation in the CMAF of the CCD camera began a regular program of observations of stars south of $+3^\circ$ degrees. Occasionally observations of Pluto, Neptune, Triton and some short special observational programs are carried out.

3.1. Regular observations

The regular program consists in observing the band of the sky from $+3^\circ$ to -60° in declination in order to publish a survey containing right ascension, declination and magnitude of the stars in the band brighter than 16 V. The observations are carried out automatically even the selection of the strips to be observed every night. In the morning all the strips of the previous night are pre-reduced automatically to refer them to the ICRF using Tycho2 stars as references. The identification of the strips and the result of the pre-reduction are stored in a log file. After that a program searches the log file and finds the strips not observed or badly observed (big errors or limit magnitude below 14.5 V) and selects the strips to be observed having in account some priorities chosen conventionally.

In order to remove atmospheric fluctuations the strips are overlapped $8'$ with the two adjacent strips in declination. Using the stars in the common zones of several consecutive strips over and below the strip in question it is possible to compute a calibration function (D. Evans, 2002) to remove the fluctuations. The expected precision of a star position in the survey would be below 50 mas in both coordinates.

The magnitudes produced with the CMASF are not in a photoelectric standard system as there is not any filter in front of the CCD camera window. They are referred approximately to the V band using the Tycho2 reference stars magnitudes.

In general no proper motions will be computed, but at present a joint project with Dr. C. Abad from the CIDA (Venezuela) is in progress to remeasure the *Carte du Ciel* plates of San Fernando zone (-3° to -9° degrees). The positions of the stars in those plates and those of the survey will be used to produce proper motions.

Figure 1 is a plot of the status of the survey observations on last september.

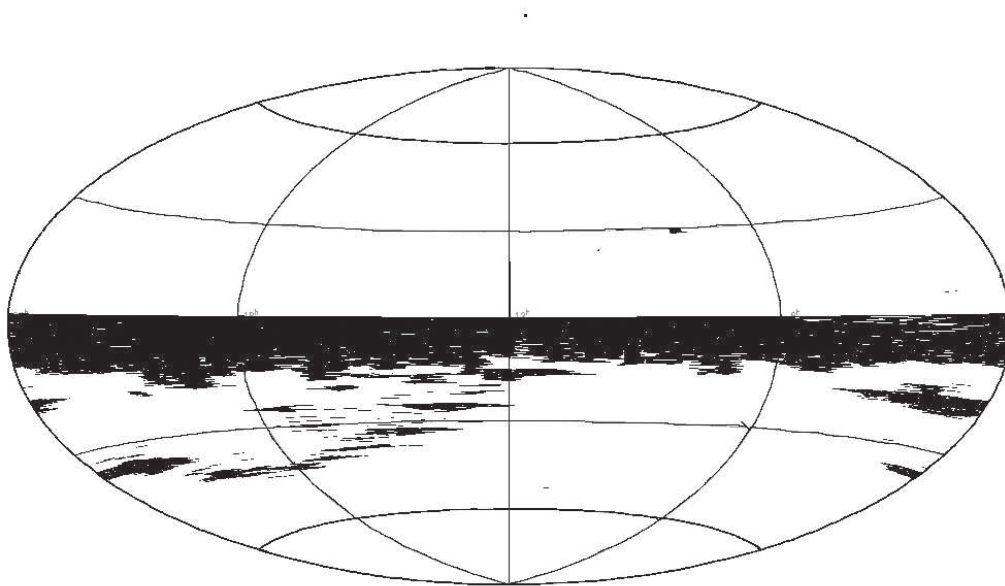


Figure 1: Status of the survey observations on september 2002

3. 2 Planet observations

In parallel with the survey observations a program to observe Neptune, its satellite Triton and Pluto started in 2001. The three objects are observed every five days when they transit through the CUC meridian during night-time. Neptune and Triton are observed in the same strip.

To observe enough Tycho2 reference stars to reduce the planet observation a strip of 10 minutes centred in the planet are observed. In this way a minimum of 10-11 reference stars are identified in every strip.

To correct for the atmospheric fluctuations, the slow right ascension motion of the planet is taken in account. The observed strips of Neptune and Pluto are divided in set of three, four or five of them depending of the time interval in which they are been observed. All the stars surrounding the planet common to all the strips of a particular set are considered. For these stars are computed average of its coordinates and the differences between these averages and

the coordinates in every strip of the set. Using these differences, corrections to the R.A. and declination are computed to remove the fluctuations from the planet coordinates.

3.3 Other occasional programs

Sometime official institutions request to the Management Committee of the CMASF to observe with this instrument some zones of the south hemisphere to use them in joint research with the CMASF team.

In 2001 one of these special program was carry out to research in collaboration with Dr. Teixeira from Valinhos Observatory (Brazil). The matter of the research was to find for stars with big proper motions in areas of X-ray sources to try to search for young stars.

The second special program was developed in spring 2002. It was requested by Dress. Orellana from La Plata observatory (Argentina) collaborating also Dr. Teixeira. A zone of 1.5 x 1.5 degrees surrounding NGC2516 was observed to compute proper motions taking as first epoch positions those measured in an old plate observed in La Plata on 1914. Figure 2 is a plot draws with the positions computed from the CMASF observations. In it is possible to appreciate the cluster near the center.

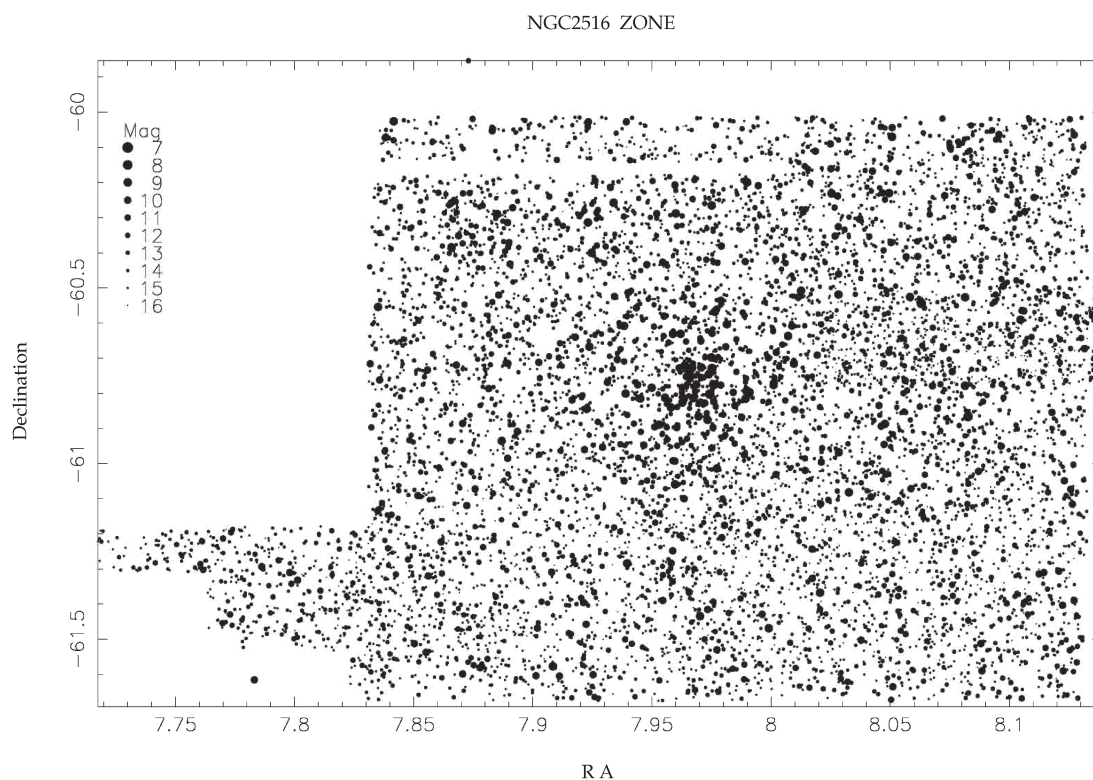


Figure 2: CMASF observations surrounding NGC2516

4 CONCLUSIONS

The CCD observations with the CMASF are expected to be published at least 10 years before the first results of GAIA or SIM will be published. So they will permit to extend the

Hipparcos frame to magnitude 16 in the south hemisphere and the survey positions compared with those from the UCAC will be possible to investigate for systematic errors in both surveys, supplying very good positions to be used for the astronomical community.

Also the comparison of those positions with new measures of existing *Carte du Ciel* plates will produce proper motions with a high degree of precision for faint stars.

Precise positions of Solar System objects are expected to be useful to study the Solar System dynamics.

Short and inexpensive observational programs combined with new measures of old photographic plates will serve to research for young stars or to identify clusters components.

So even if the launch of GAIA and SIM will be produced in the expected respective years and both two will reach their predict orbits, the observations with small and medium astrometric instrument will be very important to the astronomical research in the inter-period.

5. REFERENCES

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