

TEACHING ASTRONOMY AT THE UCM OBSERVATORY

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Abstract. There is a long tradition on teaching Astronomy at the UCM University. Since 1972 it is possible to study Astrophysics at the Faculty of Physics of the UCM. The facilities of the UCM Observatory are improving continuously every year. Nowadays two domes (4 m) are available. The *west dome* is mainly used for doing solar observations while the *east dome* is generally used to do night observations. The available instruments allow us to make a small-scaled reproduction of how people work in a large observatory. At the UCM Observatory students of the Astrophysics career do many different kinds of exercises based on the current techniques used by professional astronomers. In addition, during the last years of the career they also have the opportunity of doing a research work under the supervision of a professor.

1 The UCM Observatory

The UCM Observatory (*Observatorio de la Universidad Complutense de Madrid*) (1) is located on the Faculty of Physics of the UCM University (*Universidad Complutense de Madrid*) and the recent reform of the building has allowed to improve its installations (see Fig. 1a). The UCM Observatory is generally used for carrying out the exercises that students have to do in the last years of the Astrophysics career. Besides, since five years they also have the opportunity of doing a research work under the supervision of a professor. In addition, the observatory also organizes eventual scientific communication activities (see contribution by Crespo-Chacón *et al.* in this book).

Nowadays two domes (4 m) are available in the UCM Observatory (Fig. 1a). The *west dome* is mainly used for doing solar observations using the following instruments: Schmidt-Cassegrain telescope (28 cm) with a visible filter to see the solar photosphere (Fig. 1b), refractor telescope (10 cm) with an H α filter to see the solar chromosphere (Fig. 1d), other refractor telescope (6 cm) which is used

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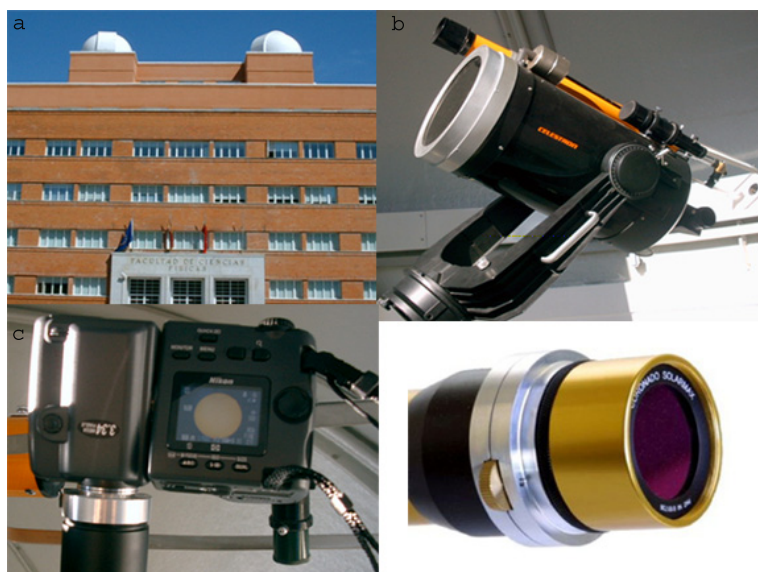


Fig. 1. **a)** The two domes of the UCM Observatory on the top of the Faculty of Physics. **b)** Schmidt-Cassegrain telescope (28 cm) + visible filter. **c)** Digital camera capturing the solar images provided by the telescope. **d)** $H\alpha$ filter.

to observe the Sun by projection, and a digital camera (Fig. 1c). In addition, a solar optic fiber spectrograph (FOCUSS) was designed and constructed and now it is used by students for doing some exercises (Fig. 3 left). At the present time we are working on the design and construction of a celostat that will make higher the possibilities of the UCM Observatory to observe the Sun (see Fig. 3 middle and right). The *east dome* is generally used for doing night observations using instruments that allow us to make a small-scaled reproduction of how people work in a large observatory. These instruments are: Schmidt-Cassegrain telescope (30 cm) with automatic telescope mount (Fig. 4a), CCD (Fig. 4b), photoelectric photometer (Fig. 4c), stellar spectrograph (Figs. 4d and e), etc. In this way, students learn to operate a telescope by hand or remote control, to use a CCD camera and to take scientific and calibration images. They also do exercises based on current techniques used by professional astronomers as, for example, differential and absolute photometry.

2 Solar Observations

The Sun is generally observed from the *west dome* of the UCM Observatory. Using the facilities and instruments described in Section 1 we can observe the solar photosphere (Fig. 2 left and middle) and the solar chromosphere (Fig. 2 right) as well as to detect several phenomena produced as consequence of magnetic activity on

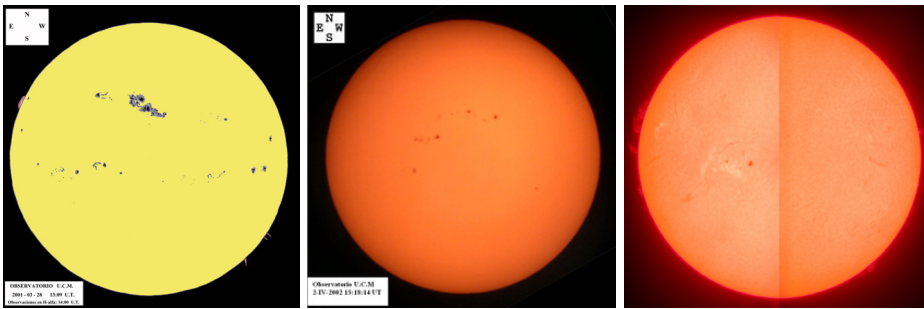


Fig. 2. *Left:* sunspots plotted on the solar disc (28 March 2001). *Middle:* solar photosphere observed by a Schmidt-Cassegrain telescope (28 cm) + visible filter + digital camera (2 April 2002). *Right:* solar chromosphere observed by a refractor telescope (10 cm) + H α filter + digital camera. Note: these three images belong to different supervised research works made by students.

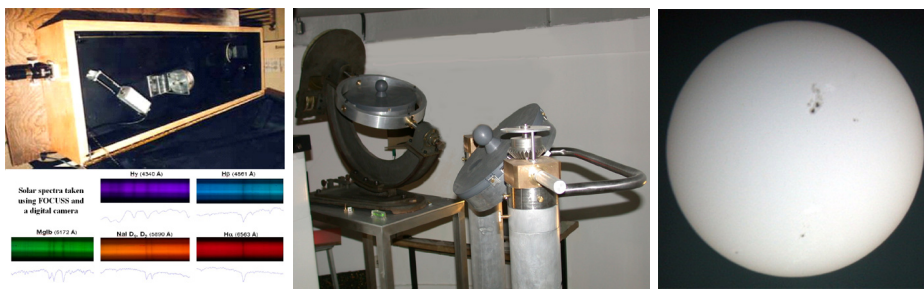


Fig. 3. *Left:* stellar spectrograph of the UCM Observatory (FOCUSS) + details of some regions of the solar spectra taken using FOCUSS. *Middle:* celostat of the UCM Observatory. *Right:* image of the Sun projected by the celostat. Note: both the stellar spectrograph and the celostat were designed and constructed by students of the Astrophysics career and their supervisors.

the Sun such as spots, faculae, filaments, prominences and plages (see Fig. 2). The Sun can be also studied spectroscopically using the solar spectrograph (FOCUSS) (Fig. 3 left) and by projection (Fig. 3 right) using the celostat of the UCM Observatory (Fig. 3 middle). Both the celostat and the solar spectrograph were made by students of the career. Other supervised research works that were done at the UCM Observatory consisted in studying the evolution of the photosphere and sunspots during the last maximum of activity (2000–2001), determining the heliographic coordinates of several sunspots, and studying the evolution of different filaments and prominences.

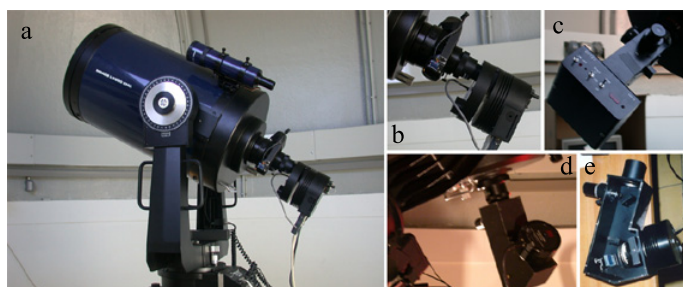


Fig. 4. a) Schmidt-Cassegrain telescope (30 cm) + automatic mount. b) CCD camera. c) Photoelectric photometer. d) Stellar spectrograph. e) Stellar spectrograph's inside.

3 Night Observations

Night observations are generally done at the *east dome* of the UCM Observatory. Despite the light pollution, the facilities and instruments described in Section 1 allow us to observe many different celestial objects such as the Moon (Fig. 5 left), several planets as Mars, Jupiter (Fig. 5 middle) or Saturn, comets (Fig. 5 right), binary stars and some galaxies. Some supervised research works about different kinds of night observations has also been done. Some of them consisted in estimating the size of several features of the Moon, taking the spectra of several different objects using the stellar spectrograph (which was also constructed by students under supervision), and observing the evolution of the light curve of several objects (see, for example, the ones obtained for the binary star RT And (Fig. 6 left) and the quasar 3C 273 (Fig. 6 right)).

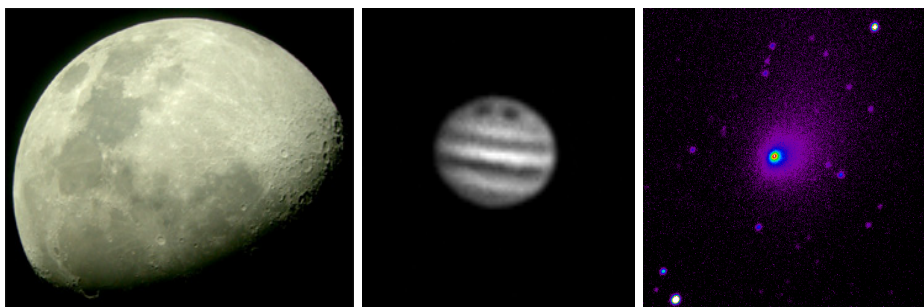


Fig. 5. *Left:* image of the Moon taken by a Schmidt-Cassegrain telescope (28 cm) + digital camera. Pay attention to craters near the dark part. *Middle:* image of Jupiter taken by a Schmidt-Cassegrain telescope (28 cm) + CCD camera. The impacts of the comet Shoemaker-Levi 9 (July 1994) are noticeable. *Right:* image of the comet C/2000 WM1 (LINEAR) taken by a Schmidt-Cassegrain telescope (30 cm) + CCD camera (14 November 2001). Note: the first picture belongs to a supervised research work.

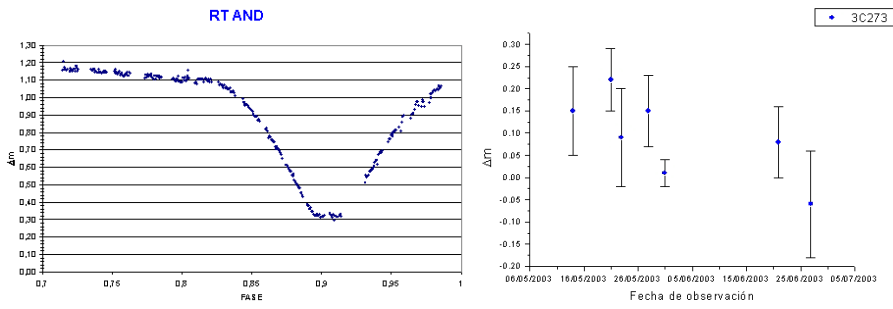


Fig. 6. Differential photometry of the eclipsing binary RT And (left) and the quasar 3C 273 (right). Note: these two plots belong to different supervised research works made by students.

References

- UCM Observatory (Observatorio de la Universidad Complutense de Madrid):
http://www.ucm.es/info/Astrof/obs_ucm/obs_ucm.html
- Solar images archive of the UCM Observatory:
http://www.ucm.es/info/Astrof/obs_ucm/sol/sol_D_ucm_imagenes.html
- FOCUSS, Fiber Optics Complutense University Solar Spectrograph:
<http://www.ucm.es/info/Astrof/users/jaz/FOCUSS/focuss.html>
- Celostat of the UCM Observatory:
<http://www.ucm.es/info/Astrof/users/jaz/CELOSTAT0/index.html>
- Supervised research works at the UCM Observatory:
http://www.ucm.es/info/Astrof/docencia/trab_a_d/trabajos_a_d.html