

# Amateur contributions to planetary science with one meter professional telescope at Pic du Midi

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## Abstract

Since its creation, many professional observations of the solar system have been performed from the one meter telescope at professional astronomy observatory at Pic-du-Midi de Bigorre (2877m, France). Since a few years, a few experienced amateur astronomers can use it autonomously to make useful observations and following of solar system bodies, leading to a useful collaboration with professional astronomers on the study of giant planets, which retributes them for their involvement in planetary science.

## 1. Introduction

The 106 cm Cassegrain telescope (T1M) installed in 1963 at Pic-du-Midi, has provided regularly high resolution observations thanks to one of the best seeing from Earth. At the beginning it participated to the lunar cartography for Apollo mission but rapidly moved to researches on all solar system objects. For example the Saturn's 12<sup>th</sup> satellite Hellene was discovered by P. Laques, R. Despiau and J. Lecacheux in 1980. Amateurs have always helped professional astronomer like C. Boyer who discovered the 4 four days atmospheric rotation with its own telescope, later confirmed by H. Camichel at Pic du Midi. Nowadays it is used by professional astronomers in different fields: giant planets monitoring, astrometry of NEOs and transneptunian bodies, asteroid photometry and exceptional events observations (comets, Jupiter impacts, ...). Under F. Colas initiative it is still accessible to a few advanced amateur astronomers for participation to key programs, especially regarding the survey of Jupiter, Saturn, Uranus and Neptune atmospheres.

## 2. Instrumentation

### 2.1 Camera

In the early 2000s the apparition of small fast digital camera permitted to restart the observation of planets using lucky imaging techniques. Imaging being done at Nasmyth focal point giving 17.5 meters of focal

length, these cameras are perfectly suited for planets with a small apparent diameter, like Uranus, Neptune or Mars, but Saturn and its' rings or Jupiter need medium sized sensor, which run at average speed (~30 frames/seconds).

Starting in 2013, an "ANDOR NEO" sCMOS is used as well as a slow scan CCD camera for long exposure times. To maximise the efficiency of observations, it is possible to switch between the two cameras in function of the seeing or of the observability of objects.

### 2.2 Telescope

Compared to the amateur usual equipment, the optics are of course of the best quality (J.Texereau), and the site one of the best in the world for its seeing. Additionally the 106cm primary mirror diameter gives:

- higher resolution that what can be achieved with the usual 20 to 40cm instruments used by amateurs
- more light easing imaging in ultra violet or 889nm methane absorption band wavelengths, allowing a monitoring of the giant planets high atmosphere.

## 3. Results

During the successive amateur missions aimed on observing the giant planets, many observations have been performed, shared with all professional (IOPW) and amateur (SAF, BAA, ALPO) organizations.

### 3.1 Jupiter

High resolution methane absorption band images, have been regularly obtained, like the one seen in figure 1. These images, associated with visible or infra-red images, allow to identify the features in the atmosphere which are above the cloud level, appearing bright in this wavelength.

Launched recently, a systematic monitoring of Jupiter contribute to the DeTeCt project aiming at constraining the impact rate at Jupiter by analysing a posteriori with a software all Jupiter acquisition

videos looking for a temporary bright flash ([http://www.astrosurf.com/planetessaf/doc/project\\_detail.shtml](http://www.astrosurf.com/planetessaf/doc/project_detail.shtml)), or attempting to identify abnormal features bright in methane absorption band or dark in other wavelengths which could reveal the trace of a major impact in Jupiter atmosphere.

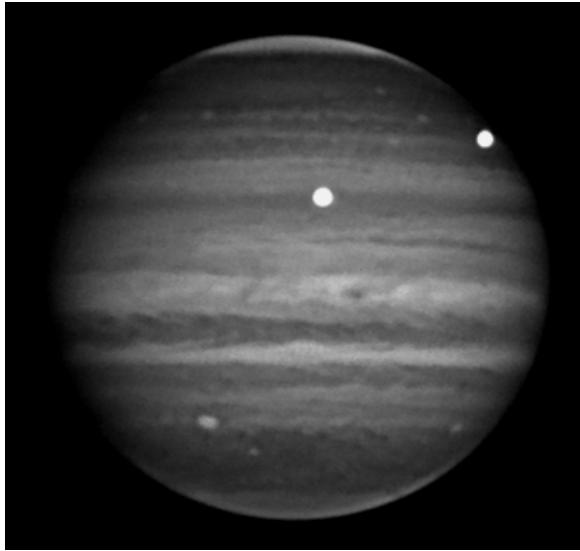


Figure 1: 889nm methane absorption band image of Jupiter taken on 2012.08.08 04h04UT

*J.-L. Dauvergne, M. Delcroix, C. Viladrich, T. Legault, F. Colas*

### 3.2 Saturn

Saturn being a planet less bright than Jupiter, it benefits from the big aperture of the T1M at Pic du Midi. Detailed images of the remains of 2010 Great White Spot or the North polar hexagon could be obtained like on figure 2 (see [1]).

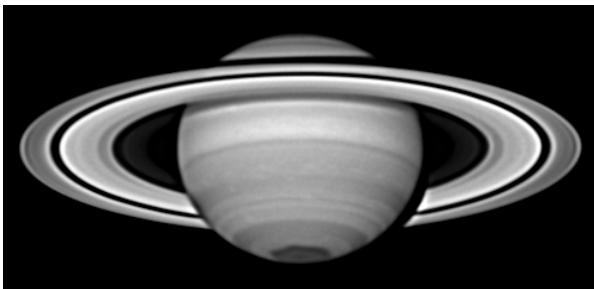


Figure 2: red+infrared (>610nm) image of Saturn taken on 2013.06.30 21h54UT  
*M. Delcroix*

### 3.3 Uranus

The T1M gives details on Uranus, not only bands but even bright spots, like the one of 2011 which first image was obtained at the Pic du Midi by an amateur (see figure 3). This first observation was extremely useful to predict observations and study its drift rate (see [2]). Also detailed observations in 2012 by M.Delcroix, J.L.Dauvergne, F.Colas, C.Viladrich with the T1M equipped with a 610nm long-pass filter pushed the amateurs to challenge their small apertures and image bands on Uranus, motivating them for observing more this difficult planet.

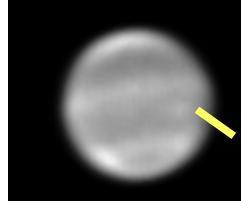


Figure 3: infrared image of Uranus taken on 2011.08.10 02h40UT  
*J.-L. Dauvergne and F. Colas*

### 3.3 Neptune

Similarly some details can be observed on Neptune with the T1M, like the first observation of 2013 bright spot which first image was obtained at the Pic du Midi by an amateur (see figure 4). This first observation was extremely useful to predict observations and study its drift rate (see [3]).



Figure 4: infrared (>685nm) image of Neptune taken on 2013.07.01 02h57UT  
*M. Delcroix, F. Colas*

### 4. Summary and Conclusions

Amateurs observations at the professional T1M telescope is a showcase of pro-am collaboration in planetary observations, where advanced amateur highly motivated with their observational and image processing skills leads regularly to planetary science works with professional astronomers.

### References

- [1] Delcroix M. et al.: Saturn northern hemisphere's atmosphere and polar hexagon in 2013, EPSC2013-1067, 2013
- [2] Sromovsky L. et al.: Episodic bright and dark spots on Uranus, Icarus vol.220 issue 1 pp 6-22, 2012
- [3] M.Delcroix et al.: 2013 bright spot on Neptune, EPSC2014