

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

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## Context

- Pro observatories with  $>3\text{m}$  diameter telescopes rarely observe planets, and when they do they observe in infrared wavelengths  $> 1\mu\text{m}$  - J,H,K,L,M bands)
- Older professional telescopes in the meter range, working mostly in lower wavelengths, not always fully used
- « Advanced amateurs » experience is recognized by pros in terms of acquisition methods and techniques and planetary images processing
- Pros asking amateurs for observational support

## Observatory

➤ Pic du Midi de Bigorre observatory, 2877m, is in an exceptional site with one of the best seeing on Earth, with one 2m and one 1m telescopes plus smaller ones



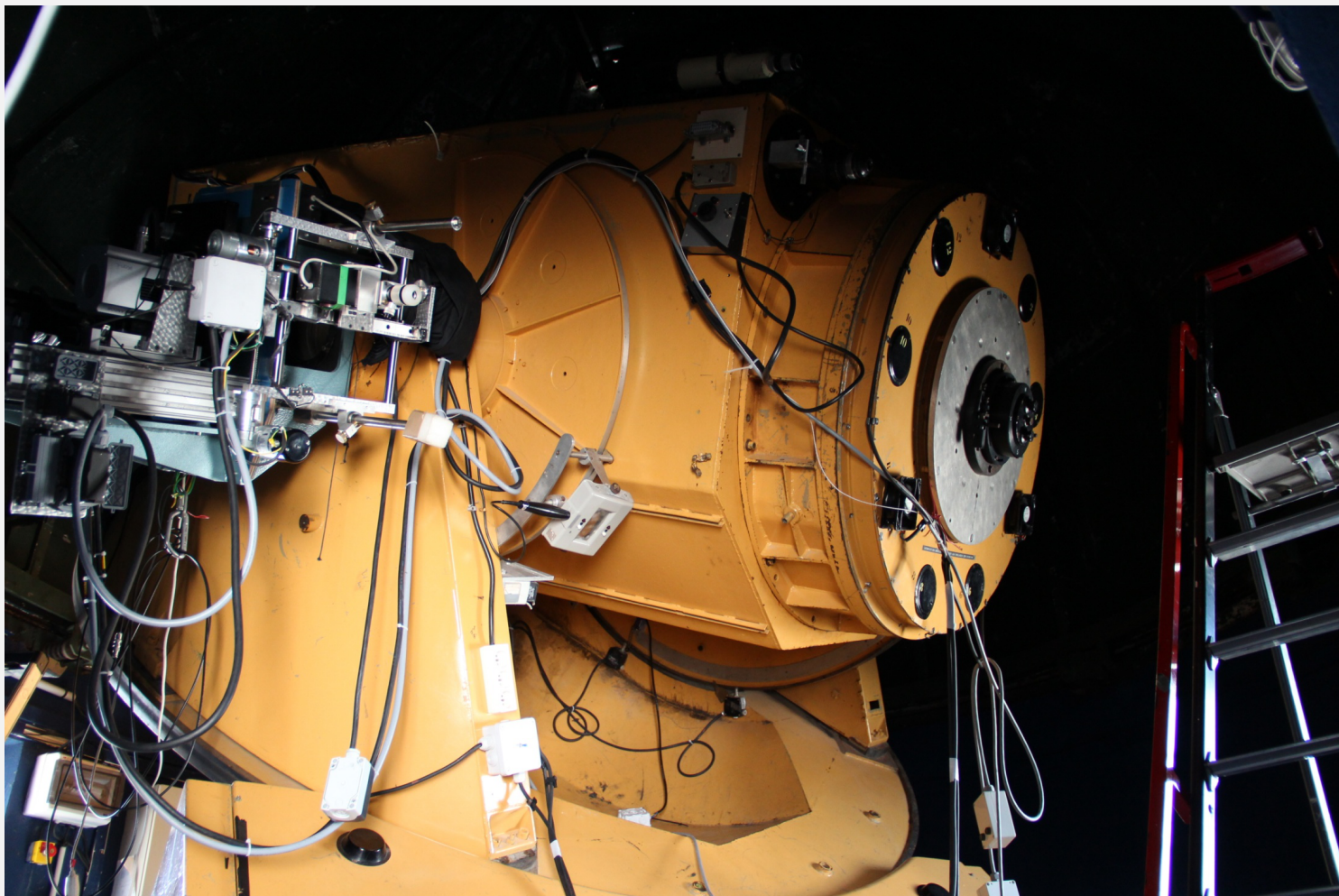
## One meter telescope

- 106cm Cassegrain telescope, focal length 17,5 meters (Nasmyth focal point), build 51 years ago, with highest quality optics made by Jean Texereau
- After participating to the lunar cartography for Apollo missions, moved to professional researches on solar system bodies.
- Nowadays, focuses on programs on giant planets monitoring, asteroid/NEOs/TNOs astrometry, exceptional events observations
- Under François Colas initiative, telescope is accessible to a few advanced amateur astronomers for participation to these programs, especially survey of Jupiter, Saturn, Uranus and Neptune



## Instrumentation

- Since early 2000's, use of fast digital cameras with lucky imaging techniques, perfectly suited for planets with small apparent diameter (Mars, Uranus, Neptune)
- Saturn and Jupiter need bigger (medium) size sensors – starting 2013 additional use of Andor NEO sCMOS and slow scan CCD camera for longer exposures



## Amateurs

- Changes for amateurs using that telescope: handling of an instrument of that size, higher resolution and sampling, more sensitive in usually difficult wavelengths ( UV or CH<sub>4</sub> 889nm absorption band)

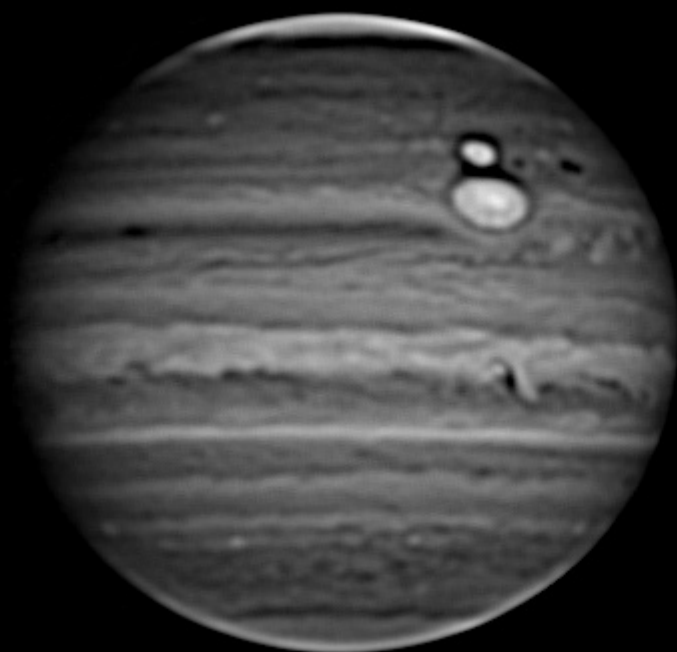


# Jupiter

- Hi-res images in 889nm methane absorption bands, associated with visible/IR images for identifying features above the cloud level
- Participation to the DeTeCt project for constraining the small bodies impact rate at Jupiter, or attempt to detect traces of impacts (*Delcroix et al. 2013, EPSC2013*)

**Jupiter - 2012-09-17**

diam. 40.8" - mag. -2.4 - alt. 49° - CM I 323.5° CM II 156.9° CM III 196.4° -  $D_{\text{sun}}=3.0^\circ$ ,  $D_{\text{earth}}=3.0^\circ$

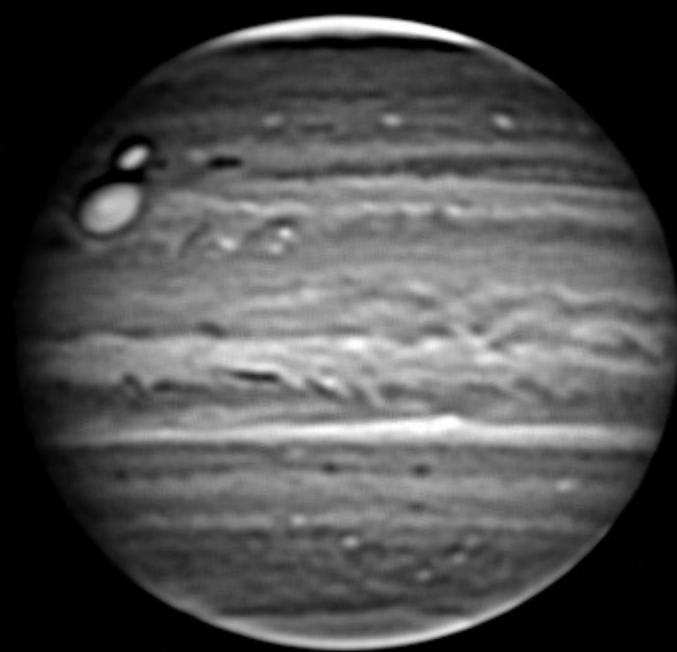


CH<sub>4</sub> 889nm (+/-9nm) 02:21.3 UT  
(21.8min derotation)



**Jupiter - 2012-09-15**

diam. 40.6" - mag. -2.4 - alt. 52° - CM I 24.0° CM II 232.5° CM III 271.5° -  $D_{\text{sun}}=3.0^\circ$ ,  $D_{\text{earth}}=3.0^\circ$

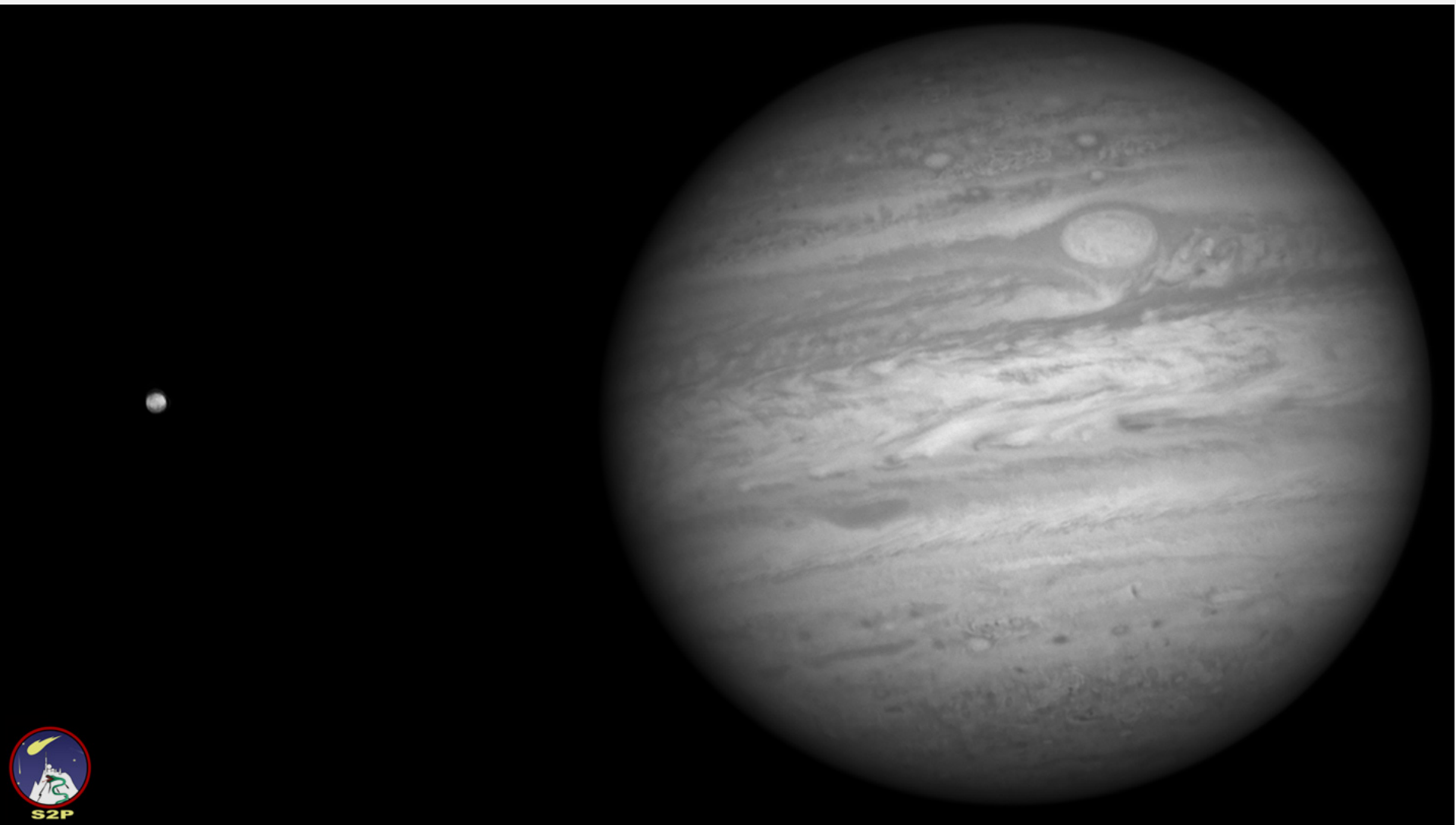


CH<sub>4</sub> 889nm (+/-9nm) 02:48.1 UT  
(34.3min derotation)

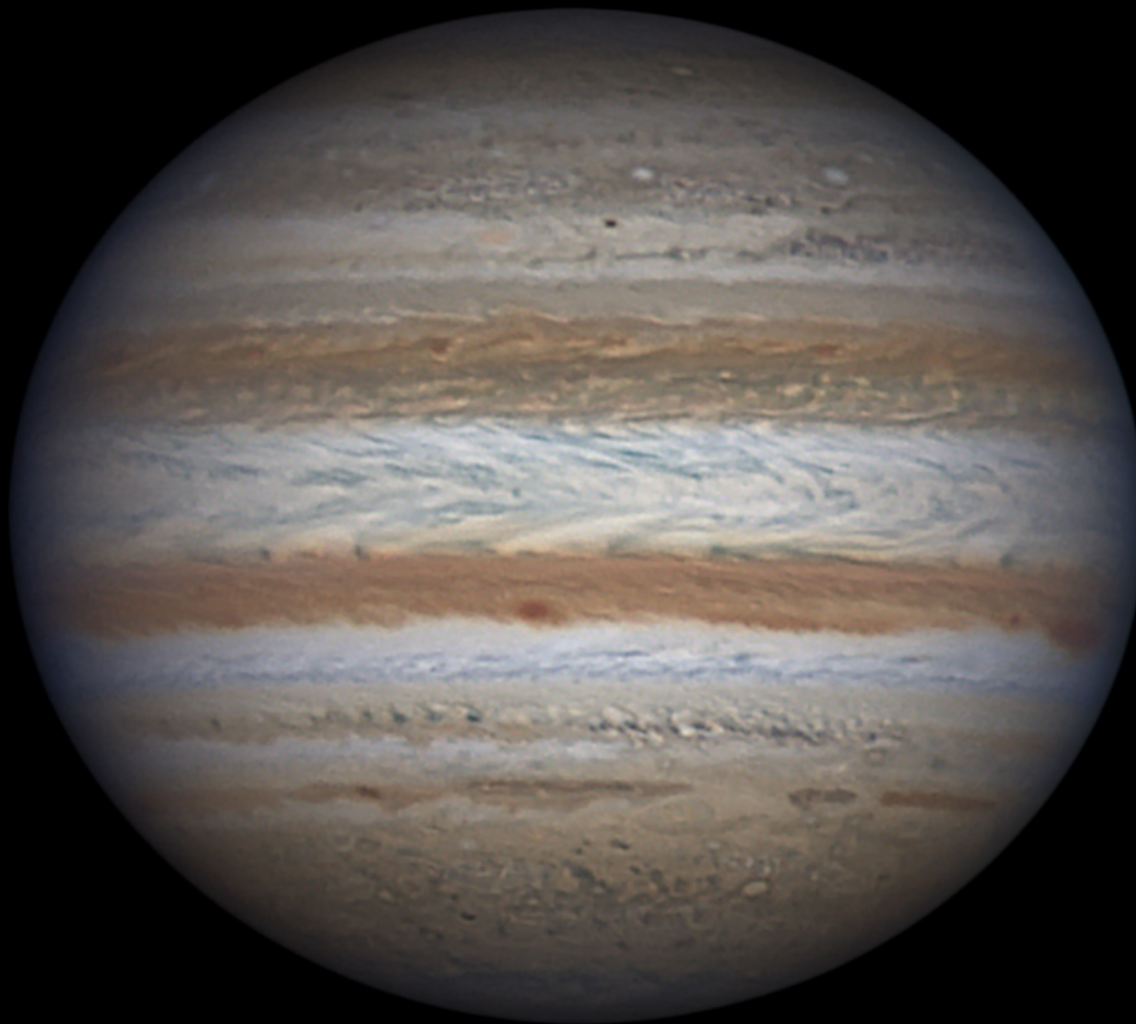


## Jupiter

- Share of planetary observations with professionals (IOPW) and amateur organizations (SAF, BAA, ALPO)



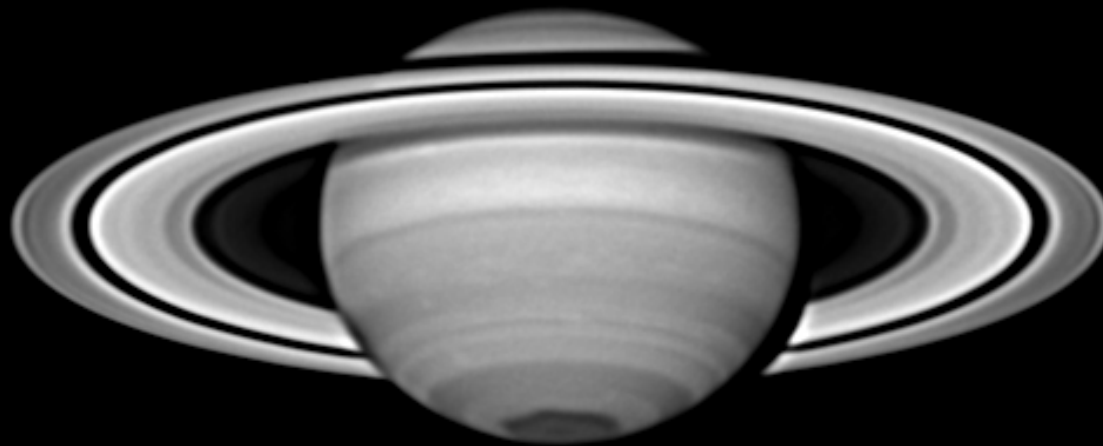
# Jupiter



## Saturn

- Details on the remnants of 2010's Great White Spot, and on the Northern polar hexagon (*Delcroix et al. 2013, EPSC2013*)

**Saturn, Mimas & Tethys - 2013-06-30 - R+IR>610nm 21h54.6UT (3.5min derotation)**  
diam 17.7" - mag 0.5 - alt. 28° - CM III 111.2° -  $D_{\text{sun}} = 19.0^\circ$ ,  $D_{\text{earth}} = 17.1^\circ$ ,  $L_{\text{sun}} = 47^\circ$



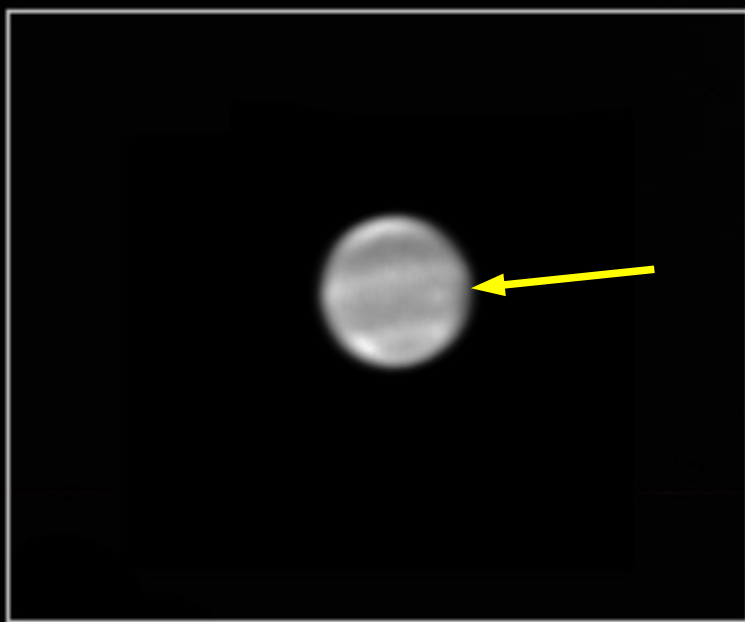
T1M Pic du Midi, France - Atmospheric Dispersion Corrector - ZWO ASI 120MM (bin x2) - 0.086"/pixel  
(c) S2P/IMCCE/OMP/F. Colas/M. Delcroix

## Saturn



# Uranus

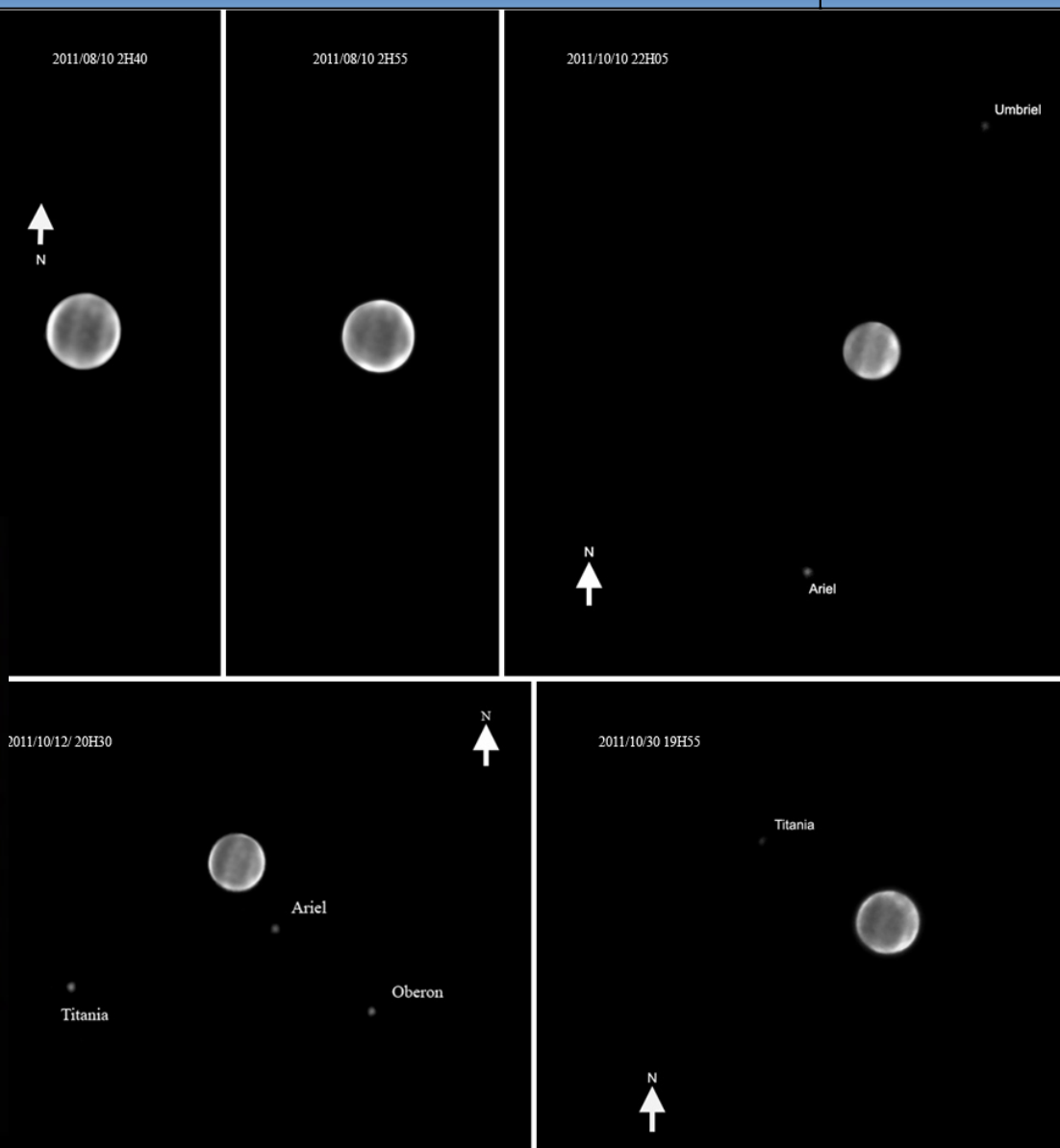
➤ First amateur observation of a spot on Uranus, additional to banding by Jean-Luc Dauvergne for the first detection of 2011's Uranus white spot  
(Sromovsky et al. 2011, Icarus)



Uranus in infrared

T1M / PIC DU MIDI OBSERVATORY

August 10 th 2011 at 2h40



# Uranus

- Belts (North polar belt, equatorial belt) best resolved with 685nm long-pass IR filter in 2012 – motivating amateurs with amateur equipment to attempt it successfully with 610nm long-pass IR filter in 2013 and to image a spot in 2014

Uranus, Ariel, Umbriel, Titania & Miranda - 2012-08-08

diam. 3.6" - mag. 5.8 - alt. 44° - CM 21.3° -  $D_{\text{sun}}=18.1^\circ$ ,  $D_{\text{earth}}=20.4^\circ$ ,  $L_{\text{sun}}=6^\circ$

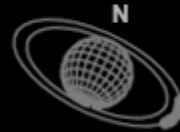


# Neptune

## Neptune & Triton (NI) - 2012-08-07

diam. 2.4" - mag. 7.8 - alt. 32° - CM 244.6° -  $D_{\text{sun}} = -27.1^\circ$ ,  $D_{\text{earth}} = -27.1^\circ$ ,  $L_{\text{sun}} = 332^\circ$

Triton



Simulation  
(PDS Rings Planet Viewer)

R+IR>610nm 23:33.4 UT



(c)S2P/IMCCE/OMP/F.Colas/JL.Dauvergne/M.Delcroix/  
T.Legault/ C.Viladrich

Pic du Midi observatory, France  
1 meter telescope - 0.06"/pixel - Basler acA640-100gm



Triton

T1M Pic du Midi, France - Atmospheric Dispersion Corrector - Basler aca640-100gm - 0.064"/pixel

(c) S2P/IMCCE/OMP/F. Colas/M.Delcroix

➤ First observation of a  
2013 spot on Neptune by  
Marc Delcroix  
(*Delcroix et al. 2014*,  
*EPSC2014*)

## Conclusion

- Amateur observations at professional one meter telescope at Pic du Midi is a showcase of useful pro-am collaboration in planetary observations
- Brings results in planetary science works with professionals
- Drives on the other side amateurs with their own equipment to attempt difficult targets
- Access to this instrument is an excellent retribution for amateurs who collaborate with professionals

*presentation will be available for download at :*

- <http://astrosurf.com/delcroix>