

2014 Uranus storm activity observations by amateur astronomers

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Abstract

In 2014, for the first time several amateur astronomers have been able to follow a very bright storm on Uranus, bringing useful information for the professional community.

1. Introduction

In 2011 a bright spot on Uranus was observed from Pic du Midi one meter professional telescope (T1M) by an amateur (see [1], [2]). On Aug. 5th 2014, seven years after equinox, major storm activity was discovered with a Keck telescope, followed by amateur observations of one specific spot, re-observed later by many professional telescopes.

2. Amateur data

Amateurs use mostly reflectors with an aperture from 28 to 40 cm. Their observations are in 4 months around Uranus's opposition but this planet is not often observed, as it was not considered that details could be imaged with amateurs' small apertures telescopes. The data comes from different sources (French Astronomical Society, forums, social networks, mailing lists...). Observations by a few amateurs from France, Australia and USA from August to November 2014 have been studied, included some from the T1M at Pic du Midi, yielding 63 individual measurements of suspected white spots, in near infrared long-pass filters. This allowed to track one particular spot in the northern hemisphere. WinJUPOS software, used by amateur astronomer associations on Jupiter and Saturn, was used to measure the position of features, and follow the drift rate in longitude of this spot from amateur measures.

Measuring Uranus amateur images is a challenge, for different reasons:

- the size of the planet on the amateur images is very small (usually around 50 pixels), and the images noisy as the planet is not bright.

- the orientation of the planet: on the contrary of Jupiter with its details or Saturn with its ring, the planet itself do not show how it is tilted on the image. The only solutions are that the author of the image would leave satellites in the image (best solution, as with WinJUPOS it is possible then to both tilt and size the contour correctly in such a case), or show the orientation (for example by letting the mount drift on AD on one image).

3. Results

3.1 Non confirmed spot observations

In Aug. 2014, a Russian amateur, Alexander Obukhov, made 3 images on Aug. 10th, 16th and 19th 2014 which showed possible spots along with some banding (see figure 1). Unfortunately the spots could not be confirmed between the observations and with other observations, still given the quality of the images and the correct position of the bands (around +3°N and +50°N planetographic), these seem possible. One of them, located at +21°N (planetographic), +265° Syst.I could match a spot observed with the Keck on Aug. 5th/6th, 2014.

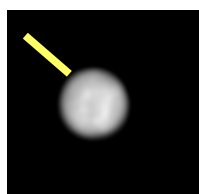


Figure 1: red/infrared (>610nm) Uranus on 2014.08.10 23h43UT (28cm telescope). Suspect spots and banding are visible. North pole lower right corner.
Alexander Obukhov

Measuring this image was made possible because the author included a virtual globe showing the orientation.

3.2 Long lived spot observation

After the Keck observations, professionals (Larry Sromovsky) issued an alert to the amateur community (through the author), suspecting that one specific bright spot (K0) could be observed. That

was not confirmed, despite an ephemeris calculated by the author (except maybe on figure 1).

This is only one month later, on Sept. 11th 2014, that Régis De Benedictis (France) could observe another convincing spot (see figure 2), confirmed on Sept. 27th 2014 by Yann Le Gall (France) and Pascal Bayle (France), at a position matching the drift of a spot (K1) identified on the Keck images.

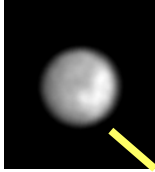


Figure 2: infrared (>685nm) Uranus on 2014.09.11 02h53UT (36cm telescope), showing spot K1. North pole lower right corner. Régis De-Benedictis, processed by M. Delcroix

Thanks to an ephemeris for K1 calculated from Sept. 11th image, HST usage was requested for targeting Uranus (on Oct. 14th). It was observed 19 times by 10 amateurs (see table 1) incl. on Oct. 4th by Marc Delcroix at Pic du Midi's one meter professional reflector (see figure 3), and by other professional facilities (VLT, GTC, WHT, Palomar...).

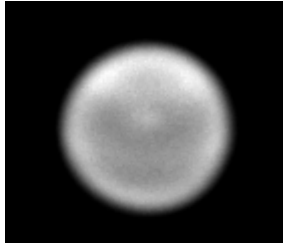


Figure 3: IR (>685nm) Uranus on 2014.10.04 00h52.7UT (106cm Pic dud Midi telescope), showing K1at CM. North up. S2P/ IMCCE/ OMP/ M. Delcroix/F. Colas

Date (2014)	Observer	Telescope	Filter	Lat. (pg)
Sep.11	R.De-Benedictis (FR)	36cm	IR>685nm	+35.1°
Sep.27	Y.Le-Gall (FR)	36cm	IR>685nm	+33.3°
Oct.01	Y.Le-Gall (FR)	36cm	IR>685nm	+33.3°
Oct.02	A.Wesley (Aus)	41cm	IR>650nm	+32.3°
Oct.04	M.Delcroix (FR)	106cm	IR>685nm	+34.6°
Oct.09	D.Milika (Aus)	36cm	RIR>610nm	+38.5°
Oct.18	A.Wesley (Aus)	41cm	IR>650nm	+34.0°
Nov.11	P.Gorzynski (USA)	36cm	IR>685nm	+34.6°

Table 1: best K1 observations (per rotation) from amateurs

The first 7 observations of table 1 are well aligned (see figure 4) on a drift rate line of $-18,1^\circ/\text{JD}$ (Julian day) ($\pm 0,2^\circ/\text{JD}$), at a $34,4^\circ$ planetographic latitude ($\pm 0,8^\circ$), also in accordance with the Keck observation. The last one on Nov.11 is not on the

same line, but coherent with professional observations. K1 drift might have changed, maybe due to a small change in latitude.

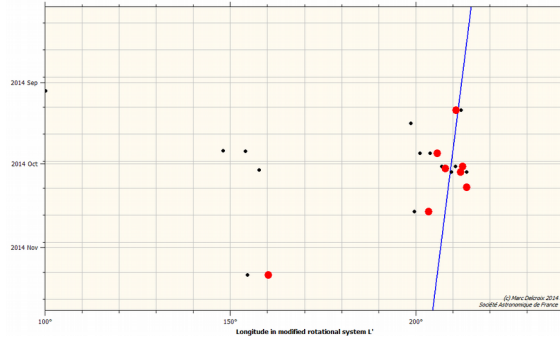


Figure 1: White spots in the $[25^\circ, 45^\circ]$ latitude range. Larger red dots are measures from table 1, following a constant drift rate line (except for the last one).

4. Summary and Conclusions

In 2014, amateurs proved successfully their ability of observing a very bright spot at $\sim 34^\circ\text{N}$ latitude on Uranus in infrared wavelength for two months, despite the small apparent diameter of the planet and its' faint luminosity. Their observations allowed to estimate the spot's drift rate of $-18,1^\circ/\text{JD}$, coherent with the known wind profile and an initial observation with Keck, and helping professionals to use other telescopes to target it. This proves the interest of having this difficult planet as a target for regular amateur observations, if they use methods for identifying proper orientation on their images.

Such regular observations would be useful for targeting professional studies as these planets are not observed very often with professional telescopes.

Acknowledgments

To all other dedicated amateurs who provided their images, especially Régis De-Benedictis (France) and Yann Le-Gall (France).

References

- [1] Sromovsky L. et al.: Episodic bright and dark spots on Uranus, Icarus vol.220 issue 1 pp 6-22, 2012
- [2] Delcroix M. et al., Amateur observations with one meter professional telescope at Pic du Midi, EPSC2014

[3] de Pater I. et al., Record-breaking storm activity on Uranus in 2014, *Icarus* vol.252 pp121-128, 2015