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Saturn northern hemisphere's atmosphere and polar hexagon in 2013

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Abstract

In 2013, two years after the dramatic events of the Great White Spot (GWS), amateur astronomers continued to follow the evolution of the "GWS zone" centered around 41° planetographic on Saturn. They could also detect the hexagonal wave surrounding Saturn's north pole with a spot at its edge.

1. Introduction

In 2010, an unexpected GWS occurred in the northern hemisphere of Saturn only 20 years after the last occurrence (cf. [1], [2]). In the North Temperate Zone much activity has been observed throughout the 2010/11 apparition by amateurs, until the storm's demise in August 2011. Strong associated SEDs were also observed by Cassini's RPWS instrument from December 2010 to July 2011 (cf. [3]), a clear sign of strong thunderstorm activity within the GWS. Amateurs continue to follow the evolution of this zone and other features, during the 2013 apparition.

2. Amateur data

Amateurs use mostly reflectors with an aperture from 15 to 40 cm. Their image coverage is good during 6 months around Saturn's opposition. The data comes from different sources (French Astronomical Society, ALPO Japan, IOPW, …). Observations by about 100 observers from all around the world, starting at the end of November 2012 have been studied, yielding more than 220 individual measurements of white or dark spots, and the polar hexagon, usually in visual wavelengths or in near infrared (up to 830nm long-pass filters). This allowed to cover in detail the evolution of Saturn's northern hemisphere's atmosphere in 2013. WinJUPOS software, used by amateur astronomer associations on Jupiter and Saturn (cf. [4]), was used to measure the position of features, and derive their drift rates in longitude.

3. Results

3.1 Dark spot in the northern tail

Throughout the apparition, a dark spot was clearly visible at a planetographic latitude around 44.1° (see Fig. 1). It drifted at -3.44° (Longitude system III)/Julian Day (estimated from 22 observations). This is the dark oval originally spawned by the 2010/11 storm (cf. [5]), drifting northwards and into a prograde jet stream, and also observed in the previous 2012 apparition (cf. [6]), with a variable drift rate between -2.9°/JD and -3.8°/JD.

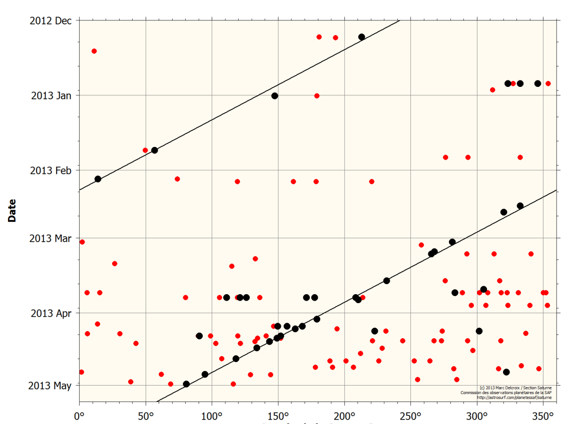

Figure 1: White (in red) and dark (in black) spots in the [+40°,+50°] latitude range. Many white and spots have been observed, as well as dark spots including a persistent one following a constant drift rate line.

3.2 White spot in the southern tail

During the entire apparition, the zone where the southern tail had developed in 2011 showed an intriguing aspect, with several very diffuse brighter zones spread both in longitude and latitude, similar to the aspect it had in 2011 (cf. [6]). A single persistent white spot could be made out more clearly at 37° latitude, drifting at +0,07°/JD from March.

3.3 Polar hexagon observations

A small white spot at the edge of the polar hexagon was observed twice at the end of March/beginning of April, despite its northern 72.9° latitude making it difficult to observe. It was drifting at -0,9°/JD. In the beginning of the 90’s professional observations (from Pic du Midi or HST) could clearly make out the large hexagon centered on the North pole. Cassini took stunning images of that hexagon, and for the first time in 2012/13 amateurs also imaged it clearly. North polar projections allowed them to tentatively measure of its 6 vertices. Despite the lack of accuracy due to the position on the edge of Saturn viewed from Earth, these vertices seem fixed in system III longitude, suggesting that the hexagon is a stationary wave in Saturn’s atmosphere (see Fig. 2).

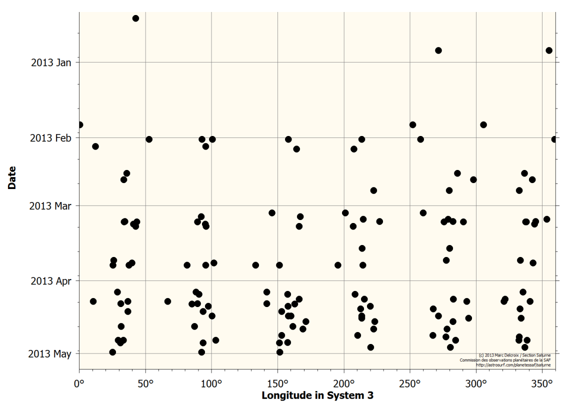

Figure 2: position of the polar hexagon vertices.

4. Professional observations

In 2013 mid-infrared observations of Saturn from professional telescopes still indicates a strong emission from the “beacon” spawned by the 2010 GWS in Saturn’s stratosphere, now cooling and shrinking, and continuing to drift westward at 3°/JD with a weaker response in the troposphere. It does not appear to be associated with features tracked by amateurs in visible light (cf. [7]). No direct thermal signature of the visible dark anticyclone (observed both by amateurs and Cassini imaging system) was evident. The North Polar hexagon feature boundary is evident in the stratosphere; while the North Polar Hot Spot is observed in the stratosphere and barely defined in the troposphere. No SEDs were detected by Cassini’s RPWS during this apparition up to May 2013. Nonetheless it seems coherent with the fact that no very bright white spot was observed during this time frame.

5. Summary and Conclusions

Amateur observations proved useful to observe the whole latitude range where the 2010 GWS occurred. The aspect of this zone is very similar during this apparition as the last, with many small white spots in the northern tail and diffuse white spots in the southern tail. The remarkable dark spot in the northern tail monitored throughout 2012/13 is the remnant of the vortex spawned by the GWS in 2011. Additionally with the higher inclination of Saturn, the polar zone including the polar hexagon could be detailed by amateurs, showing that the hexagon is a stationary wave within Saturn’s atmosphere. The synergy between observations of professional and amateur astronomers provides stronger insight into Saturn’s atmosphere.

Acknowledgments

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