# End of Apparition Report: Saturn 2010-2011

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**Start Date:** 2010 December 17
**Finish Date:** 2011 June 11

**Opposition:** 2011 April 3 **Disk Size (opp'n):** 19.3”

**B**= 7.3° to 9.8° **Ls**= 17° to 23°

**Total Number of Observations:** 24 **Number of Disk Drawings:** 35

**Instruments used:**

- [A]: 203mm (8”) Newtonian Reflector (Leicester, UK)
- [B]: 317mm (12.5”) Newtonian Reflector (Selsey, West Sussex)
- [C]: 508mm (20”) Dall Kirkham (University of Leicester, Leicester UK)

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## 1. Introduction

This is an end of apparition report summarizing the observations of Saturn made by the author during the apparition of 2010-2011. A number of interesting events took place in the course of 2010/11, the most notable event being the sudden appearance of a bright white storm in the NTropZ. The feature which became known as *The Dragon Storm* was one of the most dynamic and unusual storms observed on the planet in many decades and both amateurs and professionals wasted not time in observing it.

From the author's point of view, observations were hampered by the increasingly cloud conditions of the UK and of course Saturn's ever decreasing altitude which was really rather noticeable this year. Observations of Saturn started on 2010 December 17th, but the observation was hindered by the poor seeing conditions. Opposition occurred on 2011 April 03 in Virgo. The final observation of the planet was made on 2011 June 11th. The planet was still observable from the author's observatory for a short time after this, but another bout of bad weather made this the final observation of 2011. The planet will pass through Superior Conjunction on 2011 October 13th and will be visible in the eastern dawn sky after this.

In general, the author's own 203mm Newtonian was used, although the University of Leicester's 508mm (20”) Plane Wave DK telescope was also used a number of times to provide high resolution drawings and studies of Saturn and Titan. Patrick Moore's 12.5” Newtonian in Selsey was also used. As usual, drawings were made in black and white at the telescope, the details of colour, intensity and general appearance all recorded in the

observatory log book. The best and most reliable of these were then transferred into the Saturn Observing book (Vol. 3) in colour.

In addition to disk drawings and intensity estimates, a considerable amount of filter work was also undertaken by the author during the apparition. In particular intensity estimates were made in Integrated Light (IL) and with the W#80A (blue) and W#11 (Yellow-green) filters. Disk drawings were also made with a W#25A (Red), W#21 (Orange) and W#80A(blue). An examination of the planet with a W#47 (Violet) was also done on a number of occasions. Another new line of inquiry was made concerning the largest satelliteof Saturn, Titan. It seemed to a number of observers (David Gray, Alan W. Heath) that the satellite was somewhat darker and redder than usual. In order to establish if this was indeed the case Titan was examined in a number of filters and both the author and David Gray compared the satellite with suitable comparison stars (namely 34-Bootis and SS-Virginis).

All observations transferred to the Saturn observing book were sent on to Mike Foulkes (Director of the Saturn Section of the BAA), Julius Benton (Director of the Saturn Section ALPO), Kuniaki Horikawa of the OAA along with the ALPO Japan and other interested individual observers.

## 2. Features on the Disk.

During the 2010/11 apparition, Saturn's tilt varied between +7.3° to +9.8° and so the northern hemisphere was favored. We now examine the various features observed on the planet going from south to north. The Dragon Storm is treated in the next section.

**South Polar Region [SPR].** This region was hard to examine in close detail as Saturn's northerly tilt prohibited such observations. In general the SPR presented itself as a greyish coloured region, though sometimes a bluish tint was present. Normally the region appeared uniform although occasional mottlings could be made out.

**South Temperate Zone [STZ].** The southern most zone which could be distinguished with any real clarity. The STZ was normally a light yellowish colour and normally brighter than the surrounding areas (namely the SPR and STB) although sometimes it could not be distinguished. It showed some variation in intensity in both IL, W80A and W11.

**South Temperate Belt [STB].** A rather faint light brownish-grey coloured belt. The STB seemed harder to pick up this year, probably due to the planet's northerly presentation. In general the belt was apparent in most observations and was quite uniform in appearance.

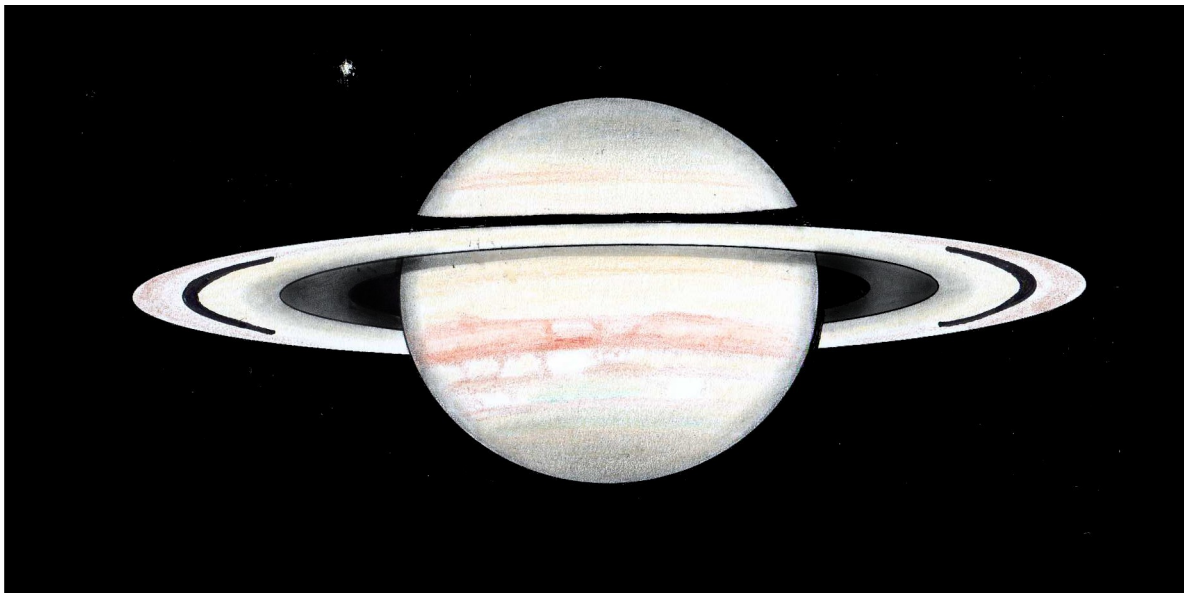
**South Tropical Zone [STropZ].** A bright zone, second only perhaps to the EZ. There was quite a bit of variation in intensity in this zone; it appeared to be brightest on 2011 May 12 when it was estimated to have a value of 0.75 and at it's darkest on 2011 April 11 when it had an estimated intensity estimate of 2.00.

**South Equatorial Belt [SEB].** Due to the northerly tilt of the planet, only the

SEB(s) was really discernible. Sometimes the belt was rather faint, other times it was easy to discern. It normally took the form of a continuous orange-brown band running under the STropZ.

**Equatorial Zone North [EZ(n)].** Normally the brightest zone on the disk. Interestingly the zone was brightest in the blue W#80A filter, and darkest in the W#11 (yellow) filter. Sometimes it appeared that an EB was present, however this may have been a contrast effect; while the EZ(s) was largely obscured, a small section of it was visible just under the rings, and it did appear to be darker and browner than the EZ(n). Occasionally brighter regions, perhaps oval in shape, were suspected in the EZ(n).

**North Equatorial Belt [NEB].** This was a double feature; a thin NEB(s) component in the south separated from the broader darker NEB(n) by the brighter NEBz. On a number of occasions it seems that there were thin extensions from the NEB(n) extending across the NEBz into the NEB(s) as was the case on the night of 2011 April 24-25 (Figure 1)



Disk Drawing: 0012UT, x250, Seeing: AIII, Transp: Average
CM1: 136.5 CM2: 128.1 CM3: 119.2

**Figure 1:** *Drawing of Saturn made on 2011 April 25 by the author using a 203mm Newtonian reflector. The extensions in the NEB(n) across the NEBz into NEB(s) are visible.*

On a few occasions, a darker veil connecting both components of the NEB was apparent. The veil was seen twice and as can be seen in the observation given in figure 2, it appeared to keep with the planet's rotation (System II), suggesting further its reality.

**North Tropical Zone [NTropZ].** Another bright zone. The NTropZ also manifested some interesting colours; sometimes it was a peachy yellow colour, other times it (along with much of the northern hemisphere) contained a distinct greenish blue hue.

The NTropZ was of course the site of the North Tropical Disturbance (discussed in the next section). This storm really had a dramatic effect on the region- it seemed that for a long section in longitude proceeding the storm the northern edge of the NEB had a distinct fragmentary appearance. On the night of 2011 May 05 a veil connecting the NTB with the NEB(n) appeared to be visible.

Also of interest, there was a white oval in the region which appeared just above another very similar white oval in the NTZ, the pair were separated by the NTB. The author was able to observe these 'double ovals' with the University of Leicester's 508mm DK and make a high resolution drawing of them (Figure 4). These ovals were imaged on a number of occasions.

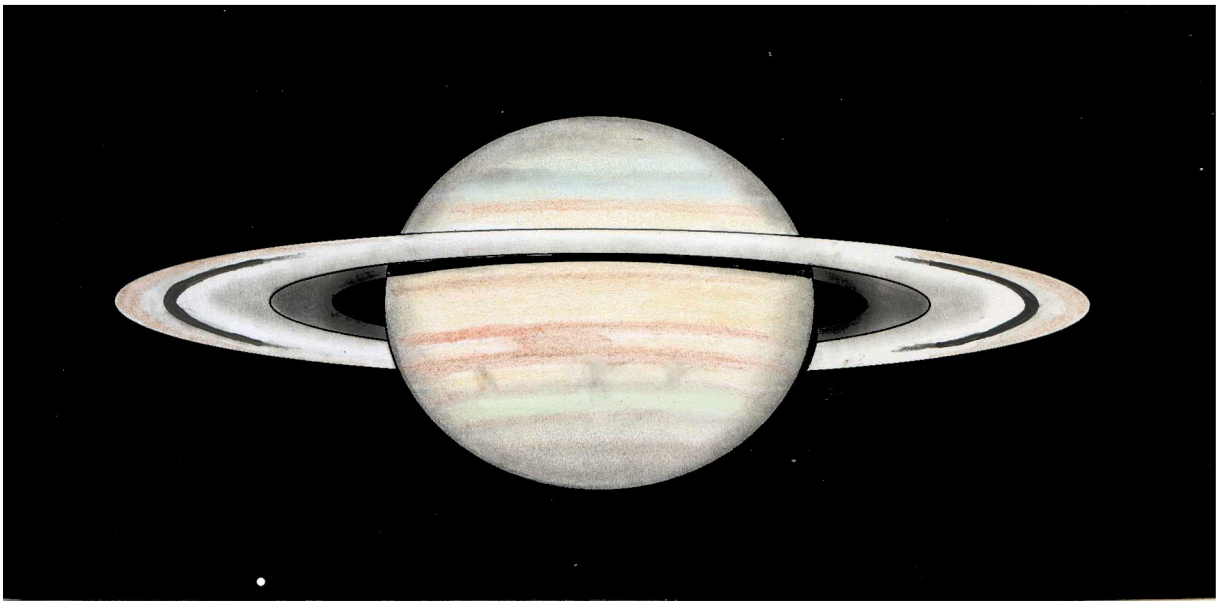
Long after the NTD, the NTropZ continued to show regions of different intensities, some as bright as the EZ in places. One often had the visual impression of great turbulence and chaos in the region.

**North Temperate Belt [NTB].** An interesting feature, particularly at those longitudes where it intersected the dragon storm. At the longitudes away from the storm the belt was a uniform band, normally a light brown in colour. However, near to the Dragon Storm (and the other white ovals) the belt was decidedly fragmented and was not complete in some sections (see Figures 1 and 3)- this was clear in images sent to the BAA Saturn Section and the ALPO. Also, the regions where the NTB had fragmented tended to be greyish in colour rather than it's traditional light brown/tan colour.

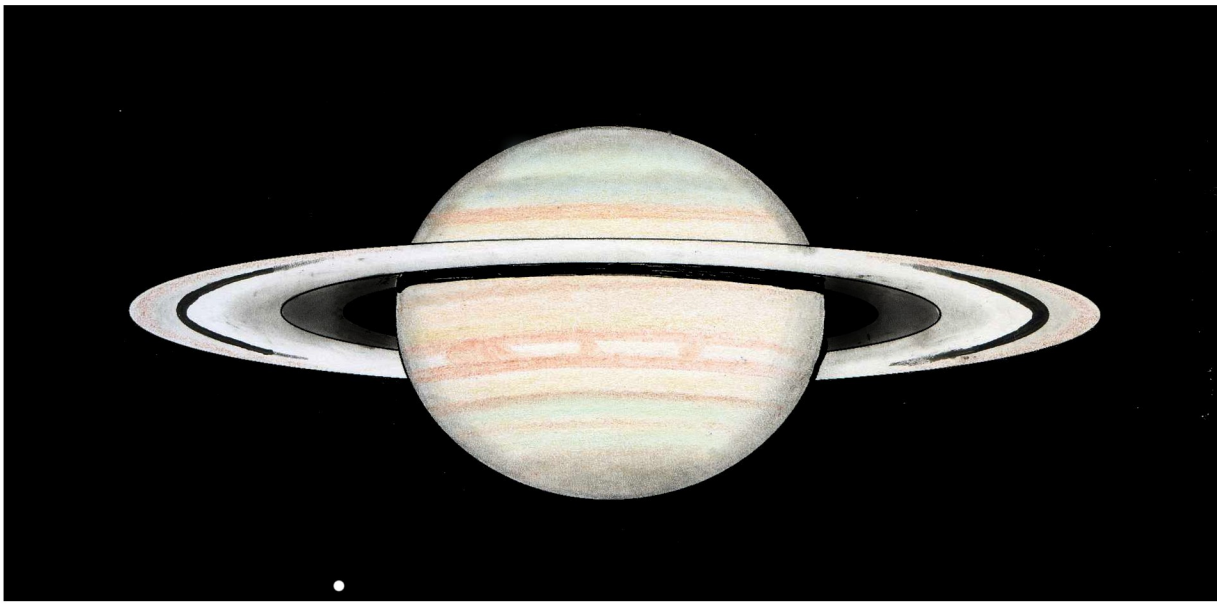
**North Temperate Zone [NTZ].** Another bright northerly zone showing some variation in intensity. Often this region had a greenish blue tint to it which appeared in both drawings and images. The NTZ also seemed to contain a number of brighter regions (see Figure 3). The Dragon storm's influence seems to have extended into the NTZ

**North North Temperate Belt [NNTB].** A faint greyish brown band, normally always present. Near the storm, the NNTB took on a darker, fragmentary appearance.

**North Polar Regions [NPR].** Normally a grey or greyish brown colour. On a number of occasions a darker North Polar Cap seemed to be present in the region. The region demonstrated some variation in intensity over the course of the apparition.

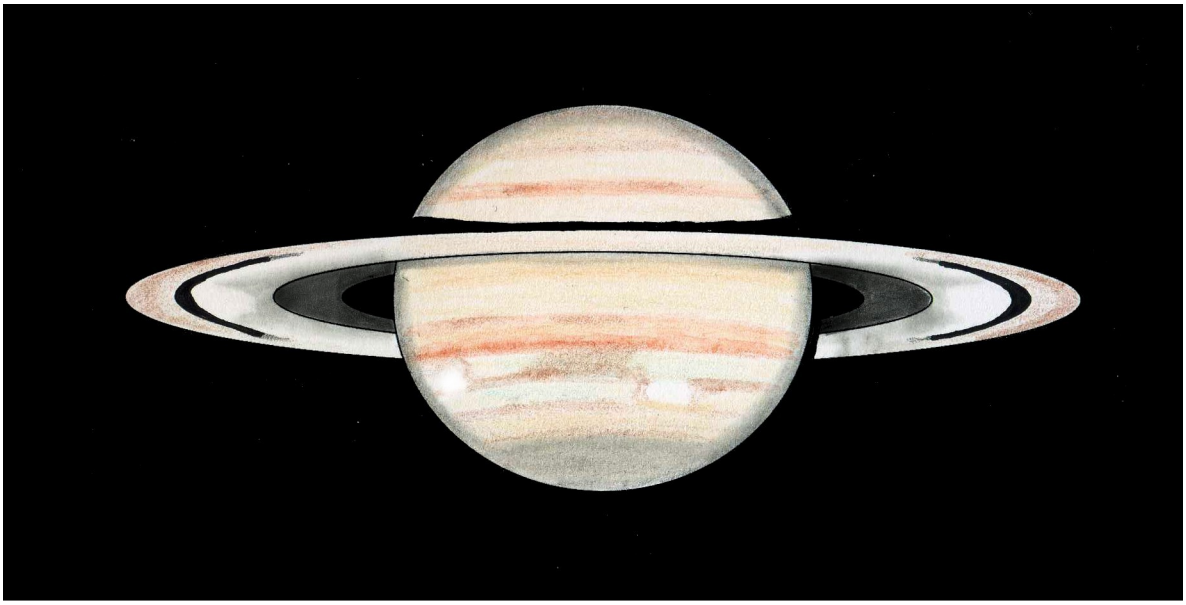


Drawing 1: 2319UT, x200, Seeing= AIII, Transp.= Average
CM1: 276 CM2: 65.4 CM3: 75.9



Drawing 2: 0031UT, x200, Seeing= AII-III, Transp= Good
CM1: 318.2 CM2: 106 CM3: 116.4

**Figure 2:** *Two drawings of Saturn made by the author with a 203mm Newtonian on 2011 April 08-09. A veil like shading in the NEBz appears to move with the planet's rotation.*



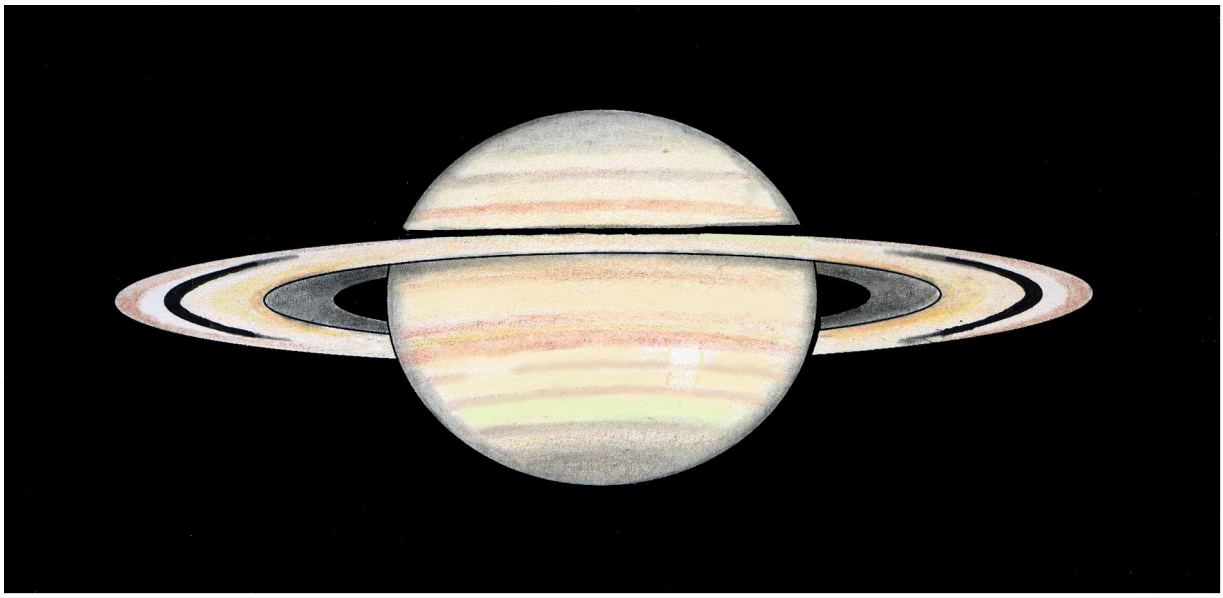
Drawing 1 (IL): 2235UT, x250, Seeing: AII-III Tr: Average
CM1: 7.3 CM2: 5.6 CM3: 343.6

**Figure 3:** *Observation of Saturn made on 2011 May 05 with the author's 203mm Newtonian Reflector. A veil structure, this time in the NTropZ can be seen in the region.*

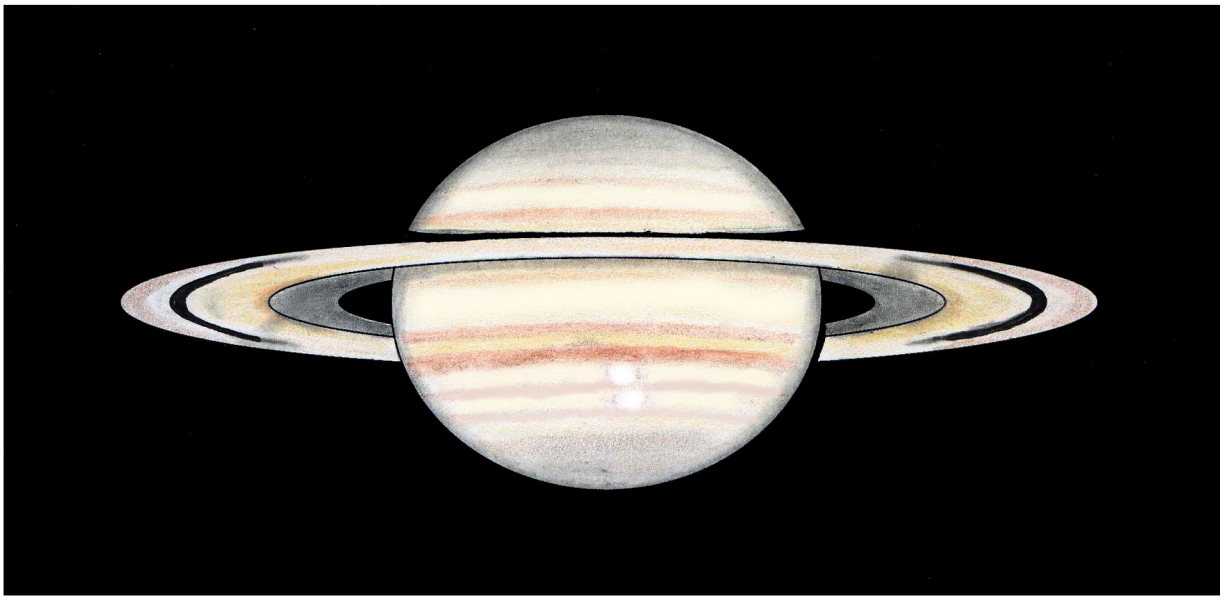
## 3. The Dragon Storm.

As reported by Delcroix[1], George Fischer of the RPWS Cassini team issued an alert that the Cassini spacecraft had detected very strong lightening on Saturn on 2010 December 5-6. These electrostatic discharges were very powerful and may be the result of a seasonal change- the northern hemisphere of the planet had passed the Vernal Equinox in 2009. The storm was soon observed by amateurs, indeed Chris Go[2] of the Philippines managed to image the storm on 2010 December 13, at which point it took the form of a small, very bright white oval shaped region. By the time Damian Peach[3] imaged the storm on 2010 December 26, it had clearly evolved; it had both brightened and disrupted the NTropZ considerably. Dr. Richard McKim produced an excellent drawing[10] showing how the storm appeared to him on 2011 January 01 using his 410mm DK.

Alas the weather conditions were rather poor in the UK at the start of 2011, this meant that the clear weather and the longitude of the storm did not favorably coincide for the author until 2011 March 28-29, by which time the storm had evolved considerably since it's first sighting in December 2010. Even in average seeing conditions at a power of x250 it was clear that the storm was very unusual; it was rather bright- especially at it's centre, and looked like a bright comet in the NTropZ. It had clearly disturbed the northern edge of the NEB, and sections of the NTB. The effect was even more pronounced when a W#80A filter was used (see Figure 5). The storm was next observed on 2011 April 6 and again 2011 April 22-23, during which time it continued to present a cometary appearance and was still the brightest object on the disk



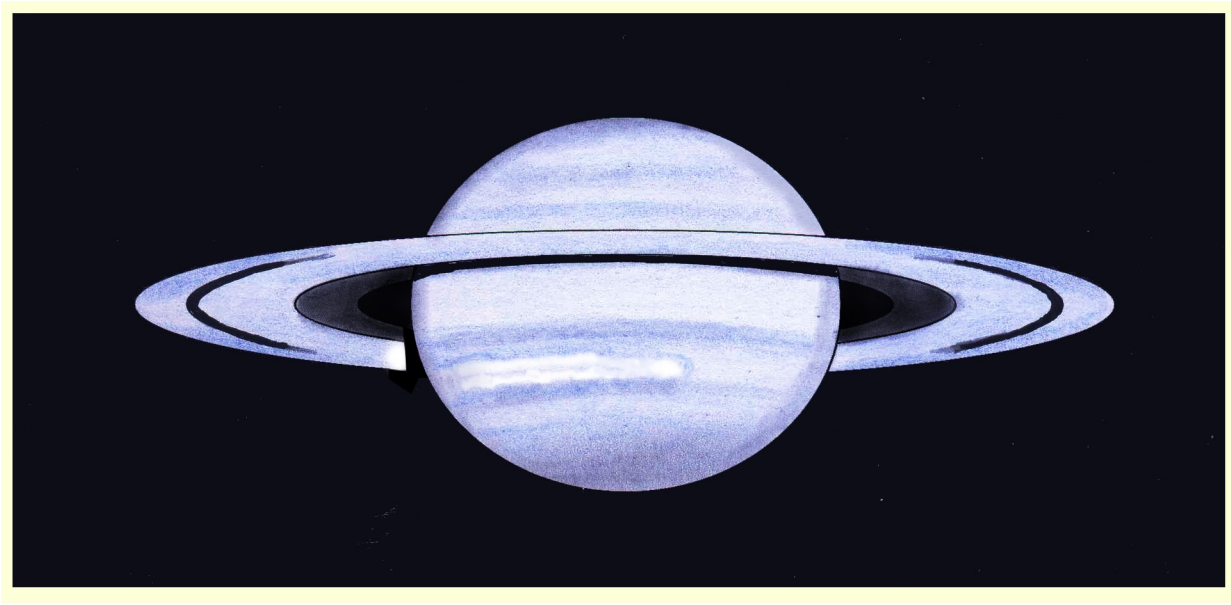
Disk Drawing 1: 2240UT, x227, Seeing: AIII, Transp: Average
CM1: 181  CM2: 336  CM3: 333.3



Disk Drawing 2:  2347UT, x283, Seeing: AIII,  Transp: Average
CM1: 220.3  CM3: 13.8  CM3: 11.0

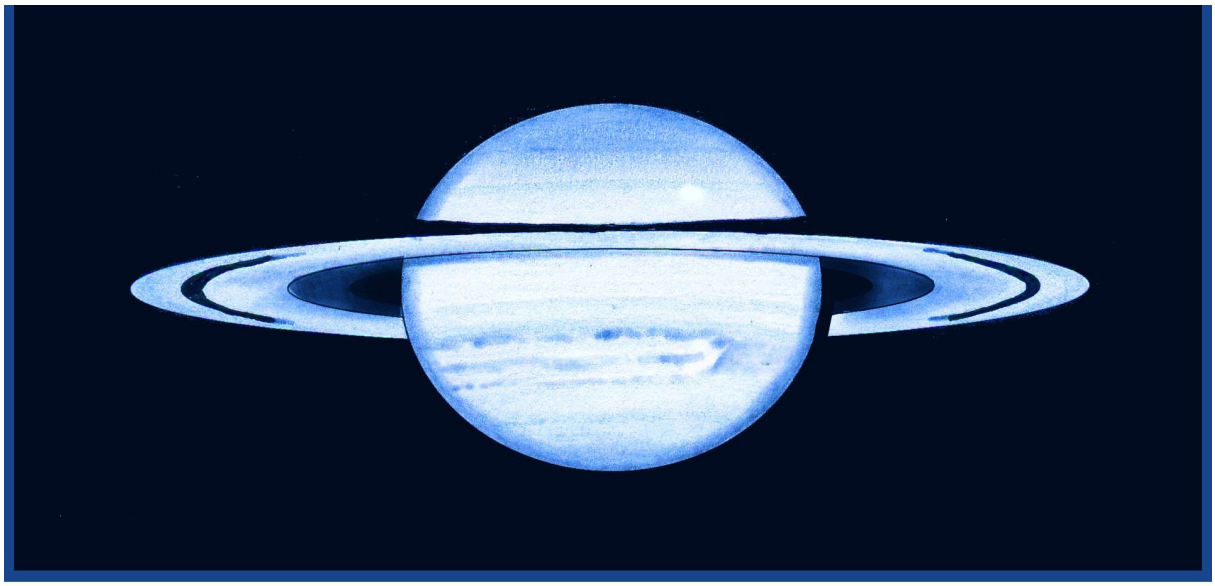
**Figure 4:** *Observation made by the author (with Hugh Sasse) with the University of Leicester's 508mm (20") Dall-Kirkham telescope. The two white storms in the NTropZ and NTZ are clearly visible.*

Although predominately white, a greenish tint could be detected at times. Another good view was obtained on the 2011 May 12, when the storm was again well placed on the disk.



Drawing 2 (#80A): 2353UT, x250, S= AII-III. Transp: Poor: Hazy
CM1: 7.8 CM2: 151.8 CM3: 175.5

**Figure 5:** *First drawing of the Dragon Storm using a W#80A filter. The bright core and comet like appearance of the storm is very apparent. Drawing made by the author on 2011 March 28 using a 203mm Newtonian.*



Drawing 2: (W80A): 2322UT, x167, Seeing: AIII, Tr: Good
CM1: 184.9 CM2: 316.1 CM3: 285.6

**Figure 6:** *The storm on 2011 May 12th by the author with a 203mm Newtonian. Again the W#80A is used to enhance the view of the storm.*

By now the storm has progressed around the NTropZ. It's effects on the surrounding belts was striking: much of the northern edge of the NEB seemed to be fragmented and churned up in appearance (rather than their usual smooth uniform look), the NTropZ was incredibly bright, and the NTB also seemed to be broken into various irregular section. And changed to a greyish colour in many places.

The final observation of the storm was made on 2011 May 24th; some five months after Cassini had detected the powerful electro static discharge, the storm was still continuing! Joerg Mosch has published drift charts of the NTD on the ALPO Japan website[5]. From his measurements (using over 280 videos!) Mosch, using WINJUPOS 9.1.5 has determined that the storm had a drift rate of some 2.8° per day, and went around the whole of the planet once in just 160 days.

Analysis of the dragon storm is still ongoing but there have been some published results already: At the time of writing, Peter Read's article in Nature[6] is the latest review. In their paper in in *Nature*[7], Sanchez-Levega *et al* have suggested (using numerical simulations based on observations of the storm) that the winds of Saturn continue unperturbed down to at least the water, warmer, cloud deck. Interestingly solar radiation cannot penetrate at this depth. They also suggest that the storm was a manifestation of seasonal changes now occurring on the planet (although it is admitted this is much earlier than would normally be expected, if a cycle of 1 Saturnian year is adopted).

Fischer *et al* in their paper in *Nature*[8], present their findings with regard to the enormous lightening discharges the Cassini spacecraft detected. They explain the spectacular visible white plume as the result of high altitude clouds which moved up and past the ammonia cloud layer due to the strong vertical convection that such thunderstorms generate. The team reported a peak rate of up to 10 lightning flashes a second, and suggest the storm is probably the result of seasonal changes. The storm was one of the most powerful and dramatic to occur on Saturn for many decades, perhaps the most powerful of the six Great White Spots previously recorded on the planet!

## 4. The Rings

Unlike the previous two apparitions, the rings were reasonably well presented and opened to almost 10° at the start of observation. The opposition effect was duly observed and the rings were quite dazzling on 2011 April 6th. Indeed, the rings were still rather bright on 2011 April 8-9, some 5-6 days after opposition. The Terby White Spot was frequently seen on the ansae both before and after opposition, although it seems that there has to be a easily detectable ShGR for the TWS to be observed.

As we shall see, a number of interesting observations of the rings were made during this period. We summarize the observations here, starting with the A-Ring and moving inwards:

**A-Ring:** This was the brightest ring after the B-Ring. It's outer 1/3 section was normally darker than the rest of it and it seems a brownish tint was often present. There was some variation in intensity over the course of the apparition and interestingly, the A-Ring did

appear to be darker in the W#80A filter. Than in integrated light (IL).

Interestingly, on the nights of 2011 May 24 and 2011 June 11, a greenish tint appeared to be present in both the A and B rings but on the following ansae *only* on both occasions. The colour on 24th May seemed particularly strong. Of course Saturn was at a low altitude during these times so the colour may well have been spurious.

**Cassini Division:** This was always observed and appeared to be black in colour. If the conditions were good then it was possible to trace the Division for quite a way beyond the ansae centre.

**B-Ring:** The brightest of the three main rings. The B-Ring was itself split into 3 further rings. The bright white B1-Ring, the darker and greyer B2-Ring and when conditions were very good or a larger aperture was used, a light, yellowish B3-Ring could also be observed. The B1-Ring seemed to demonstrated some considerable variation in intensity. At it's brightest (in IL) it reached an intensity of 0.5, while at it's faintest it was at a value of 1.5. The B2-Ring seemed to be less variable in intensity.

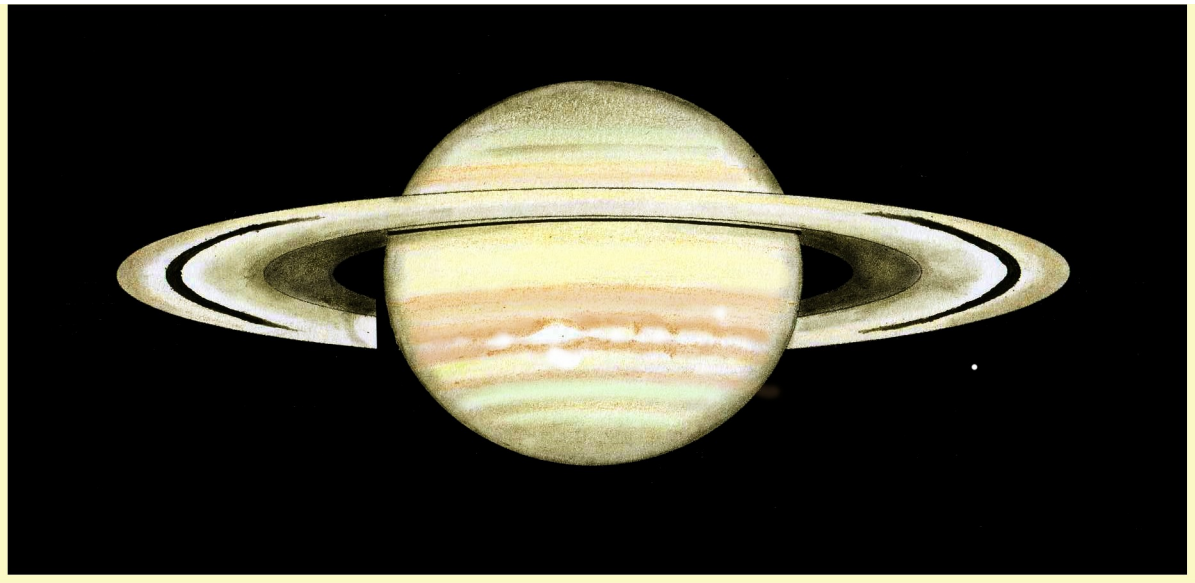
**Spokes.** On a number of occasions, faint spokes were apparently seen in the bright B1-Ring. The author first observed a spoke in the B1-Ring on the the night of 2011 March 22-23 (see Figure 7). The spoke was visible on the fol. ansae and seemed to contain a brownish tint. A spoke was next suspected on the night of 2011 March 28-29, this time on the proc. ansae and again on 2011 April 8-9 (both observations made with a 203mm Newtonian).

The best view of spokes in the rings was probably had on the night of the 2011 April 19-20 using the University of Leicester's telescope (see Figure 4). The final time spokes were observed on the ansae with any certainty was on the night of 2011 May 05. This time the author, using his 203mm Newtonian, was able to observe spokes on both sides of the ansae (see Figure 3).

The author was not alone in observing spokes; of the other observers, David Gray[9] made several drawings showing spokes, and Damian Peach was able to make a time lapse movie showing not just a spoke, but movement of the spokes along the B1-Ring.

**C-Ring.** The darkest of the three main rings, and best observed at the ansae edges. The ring was normally a dark grey/charcoal colour, and the bright EZ brightened the C-Ring as it passed over the planet's EZ. The ring seemed to vary in brightness a little, and on some occasions one side appeared to be slightly brighter than the other- this was the case on 2011 April 10-11 when the C-Ring on the proc. Side seemed to be a friction lighter than on the fol. Side.

The ShGR and the ShRG were present throughout the apparition (except close to opposition) appearing jet black and providing a beautiful contrast against the bright features.



Disk Drawing: 0026UT, x250, Seeing= AIII, Transp.= Average
CM1: 0.9 Cm2: 337.9 CM3: 8.9

**Figure 7:** *Spokes observed in the B1-Ring by the author on 2011 March 22-23 with his 203mm Newtonian Reflector. The spoke is visible on the fol. Ansae.*

## 5. Filter Work

Unlike in previous apparitions, the author employed the use of a number of different planetary filters to examine specific features like storms, belts as well as the whole planet. The following results were obtained when the whole planet was studdied in various wavelengths:

- **W#80A (Blue, 73% Transmission).** It was found that this filter nicely enhanced the bright zones, and the the Dragon Storm. It is interesting to note that the A-Ring did normally appear to be noticeably darker in this filter.
- **W#21 (Orange, 46% Transmission).** This seemed to be one of the best filters to use for visual observation of Saturn. The W#21 seemed to help enhance the fine details in both the belts and the rings and was used on several occasions.
- **W#25A(Red, 14% Transmission).** An interesting filter- it seemed that this filter may have helped with image definition when the seeing was poor. The various storms in the NTropZ and NTZ also seemed to be enhanced by this filter.
- **W#47 (Violet 3% Transmission).** This filter strongly rejects red yellow and green wavelengths. When viewed with this filter, no details (belts, storms etc) could be made out on the disk or rings. Interestingly, the B1-Ring seemed to be the brightest feature on Saturn in this filter and a curious effect took place when either ansae was viewed alternately- when looking closely at one ansae, the other one appears to dim!

## 6. Titan

As mentioned earlier, a number of observers (including the author) were of the opinion that Titan had become both darker and redder when compared with previous apparitions. Whether this was simply due to the lower altitude or some real genuine effect has yet to be determined. In order to see if any variation was occurring both the author and David Gray decided to compare Titan with a comparison star. At first the M Class star 34 Bootis (also known as W Bootis) was chosen but it was clear that Titan was redder than this, as can be seen by the observation made on 2011 May 18th (Figure 8).


**Figure 8:** *Comparison drawing of Titan with 34 Bootis made on 2011 May 18th by the author with his 203mm Newtonian. It is clear that Titan was considerably redder than the comparison star.*

Gray then suggested the star SS-Virginis; a beautiful carbon star in the constellation of Virgo. On comparison with SS-Virginis, it was clear that Titan was nowhere near as red (see Figure 9).

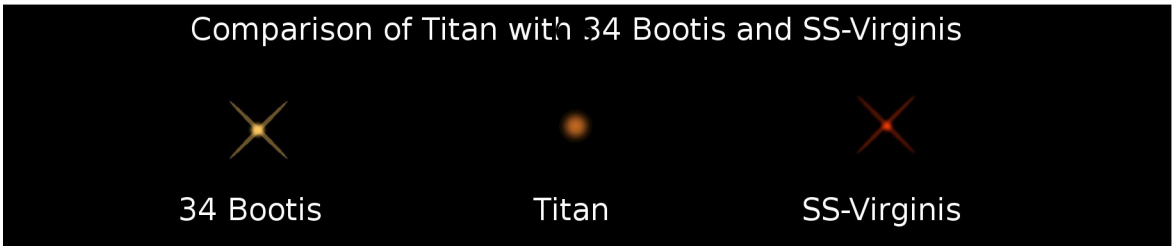



**Figure 9:** *Comparison of Titan with the star 34 Bootis and SS-Virginis by the author on 2011 May 24, 203mm Newtonian used. Titan is redder than 34 Bootis, but not as red as SS-Virginis.*

Alas, due to poor weather, these are the only two comparisons made although Gray was able to make more, and concluded like the author, that Titan did seem to appear redder in this apparition[9]. Certainly, many more such comparisons will be needed and the author now intends to make this comparison now a regular part of his Saturn observations.

## 7. Intensity Estimates

In this section we give the intensity estimates made for the individual features and their averages for the whole apparition. Intensities were made using the BAA scale varying from 0 (extremely bright) to 10 (black sky). Estimates were made in IL as well as in W#80A and W#11. The effects of using these filters on the various features can be seen in the three tables below.

### (a). Integrated Light.

| Month | Feb | March | March | March | April | April | April | April | May | May | May | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY | 8 | 8 | 24 | 28 | 9 | 11 | 20 | 22 | 5 | 12 | 24 | | |
| UT | 03:07 | 00:53 | 00:58 | 23:36 | 00:01 | 00:30 | 00:09 | 23:35 | 23:14 | 22:51 | 22:37 | | |
| INSTRUMENT | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 508 DK | 203 Newt | 203 Newt | 508 DK | 203 Newt | | |
| MAGNIFICATION | x250 | x167 | x250 | x250 | x200 | x250 | x227 | x200 | x250 | x350 | x167 | | |
| FILTER | IL | IL | IL | IL | IL | IL | IL | IL | IL | IL | IL | | |
| SEEING | AIII | AIII | AIII-IV | AIII-IV | AIII | AII-III | AIII-IV | AII-III | AII-III | AIII | AIII-IV | | |
| INTENSITY OBSERVATIONS | | | | | | | | | | | | INTENSITY AVERAGE FOR THE APPARITION | NUMBER OF OBSERVATIONS |
| THE PLANET | | | | | | | | | | | | | |
| SPR | 4.5 | 4 | 4 | 4.75 | 4 | 4.5 | 4.5 | 3.5 | 5 | 4 | 4.5 | 4.2954545455 | 11 |
| STZ | - | 1.75 | 2.5 | 1.75 | 2 | 2.75 | 1.5 | 1.5 | - | 1 | 1.5 | 1.8055555556 | 9 |
| STB | 5 | 4 | 5 | 4 | 4.5 | 3.5 | 3.75 | 3.5 | 4 | 3.75 | 4 | 4.0909090909 | 11 |
| STropZ | 1.75 | 1.75 | 2 | 1.75 | 1.75 | 2 | 1.25 | 1.5 | 1.25 | 0.75 | 1.5 | 1.5681818182 | 11 |
| SEB | 5 | 4.5 | 5 | 6 | 5.25 | 5.5 | 4.5 | 3.5 | 3.5 | 4 | 3 | 4.5227272727 | 11 |
| EB | | | | | | | | | | 3.75 | - | 3.75 | 1 |
| EZ(n) | 1 | 1.25 | 1.5 | 1 | 1.25 | 1.75 | 1 | 1 | 1.25 | 0.75 | 1 | 1.1590909091 | 11 |
| NEB(S) | 5.5 | 5 | 5.5 | 5.75 | 6 | 5 | 5 | 5 | 5 | 5.5 | 4 | 5.2045454545 | 11 |
| NEBz | - | 1.25 | 3 | 2 | - | 2 | 2.5 | - | 2.5 | 2 | 2 | 2.15625 | 8 |
| NEB(n) | 4.75 | 4.5 | 5.5 | 5.25 | 5.5 | 6 | 6 | 5.5 | 6 | 6 | 6 | 5.5454545455 | 11 |
| NTropZ | 1.5 | 1 | 1 | 1 | 1.5 | 2 | 1.5 | 1.5 | 1.5 | 1 | 1.5 | 1.3636363636 | 11 |
| NTB | 3.75 | 4 | 3.5 | 3 | 3.75 | 3.5 | 4.5 | 3.5 | 3.5 | 4 | 3 | 3.6363636364 | 11 |
| NTZ | - | 1.25 | 2 | 1.5 | 1.75 | 2.5 | 1.5 | 1.5 | 1.5 | 1 | 1.5 | 1.6 | 10 |
| NNTB | - | - | - | - | - | - | 3.25 | 3.5 | 3.75 | 4 | - | 3.625 | 4 |
| NPR | 4 | 4.5 | 4 | 4.5 | 4.5 | 4.25 | 4.5 | 4 | 5.5 | 4 | 3.75 | 4.3181818182 | 11 |
| NPC | 5 | - | - | - | - | - | - | - | - | 4.75 | 4 | 4.5833333333 | 3 |
| | | | | | | | | | | | | #DIV/0! | 0 |
| THE RINGS | | | | | | | | | | | | #DIV/0! | 0 |
| A-Ring | 3 | 6 | 3 | 3.5 | 3.5 | 3.25 | 3 | 3 | 3.75 | 3.5 | 3 | 3.5 | 11 |
| Cassini Division | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 10 | 10 | 10 | 10 | 9.9090909091 | 11 |
| B1-Ring | 0.5 | 0.5 | 1.5 | 1.5 | 0.75 | 1 | 1 | 0.75 | 1.25 | 0.75 | 0.75 | 0.9318181818 | 11 |
| B2-Ring | 3 | 3.75 | 3 | 2.5 | 2.5 | 2 | 2 | 2.75 | 3.75 | 2 | 2 | 2.6590909091 | 11 |
| B3-Ring | - | - | - | - | - | - | 4 | - | - | 4 | - | 4 | 2 |
| C-Ring | 8 | 8 | 8 | 7.5 | 8 | 7 | 7 | 8.75 | 6.75 | 7 | 7 | 7.5454545455 | 11 |

**Table 1:** *Intensity estimates made by the author in integrated light.*

## (b). W#80A Filter:

| Month | March | March | April | April | April | May | May | May | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY | 24 | 28 | 9 | 11 | 22 | 5 | 12 | 24 | | | | | |
| UT | 00:58 | 23:36 | 00:01 | 00:30 | 23:35 | 23:14 | 22:51 | 22:37 | | | | | |
| INSTRUMENT | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 508 DK | 203 Newt | | | | | |
| MAGNIFICATION | x250 | x250 | x200 | x250 | x200 | x250 | x350 | x167 | | | | | |
| FILTER | #80A | #80A | #80A | #80A | #80A | #80A | #80A | #80A | | | | | |
| SEEING | AIII-IV | AIII-IV | AIII | AII-III | AII-III | AII-III | AIII | AIII-IV | | | | | |
| INTENSITY OBSERVATIONS | | | | | | | | | | | | INTENSITY AVERAGE FOR THE APPARITION | NUMBER OF OBSERVATIONS |
| THE PLANET | | | | | | | | | | | | | |
| SPR | 5 | 4 | 3 | 4 | 4 | 3.5 | 3 | 4.5 | | | | 3.875 | 8 |
| STZ | 1.5 | 1 | 1.5 | 1.25 | 1.25 | - | 1 | 1 | | | | 1.2142857143 | 7 |
| STB | 3 | 3 | 2.75 | 3 | 3 | 3 | 3 | 3.25 | | | | 3 | 8 |
| STropZ | 1 | 1 | 1 | 1 | 1.25 | 1 | 0.5 | 1 | | | | 0.96875 | 8 |
| SEB | 4.5 | 4 | 3 | 4 | 3 | 3 | 3 | 2 | | | | 3.3125 | 8 |
| EB | | | | | | | 3 | - | | | | 3 | 1 |
| EZ(n) | 0.5 | 1 | 1.25 | 1 | 1 | 1 | 0.5 | 1 | | | | 0.90625 | 8 |
| NEB(S) | 4.75 | 3.5 | 3.5 | 4 | 5.25 | 3 | 5 | 4 | | | | 4.125 | 8 |
| NEBz | 1 | - | - | 1.5 | - | - | 1 | 2 | | | | 1.375 | 4 |
| NEB(n) | 4.75 | 3.5 | 3 | 4 | 5.75 | 4 | 5 | 5 | | | | 4.375 | 8 |
| NTropZ | 0.5 | 1 | 1.25 | 1.5 | 1.25 | 1.5 | 1 | 1 | | | | 1.125 | 8 |
| NTB | 3 | 2.75 | 2.75 | 3 | 3 | 3 | 3 | 3 | | | | 2.9375 | 8 |
| NTZ | 1 | 0.5 | 1.5 | 1.5 | 1 | 1 | 1 | 1.25 | | | | 1.09375 | 8 |
| NNTB | - | - | - | - | 3.25 | 3 | 3 | - | | | | 3.0833333333 | 3 |
| NPR | 4 | 4.75 | 3.5 | 3 | 3.25 | 3 | 3 | 3 | | | | 3.4375 | 8 |
| NPC | - | - | - | - | - | - | 3.25 | 3.5 | | | | 3.375 | 2 |
| | | | | | | | | | | | | #DIV/0! | 0 |
| THE RINGS | | | | | | | | | | | | #DIV/0! | 0 |
| A-Ring | 4.5 | 4 | 2.5 | 2 | 2 | 4.5 | 4 | 4 | | | | 3.4375 | 8 |
| Cassini Division | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | 10 | 8 |
| B1-Ring | 2 | 1.25 | 0.25 | 0.75 | 0.75 | 1 | 0.5 | 1 | | | | 0.9375 | 8 |
| B2-Ring | 2.5 | 2 | 1.5 | 2.5 | 2.75 | 2 | 1 | 2 | | | | 2.03125 | 8 |
| B3-Ring | - | - | - | - | - | - | 4 | - | | | | 4 | 1 |
| C-Ring | 8 | 7.5 | 8 | 9 | 9 | 6.75 | 8 | 8 | | | | 8.03125 | 8 |

**Table 2:** *Intensity estimates made by the author with a W#80A filter.*

## (c). W#11 Filter:

| Month | March | Apil | April | April | May | May | May | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY | 28 | 9 | 11 | 22 | 5 | 12 | 24 | | | | | | |
| UT | 23:36 | 00:01 | 00:30 | 23:35 | 23:14 | 22:51 | 22:37 | | | | | | |
| INSTRUMENT | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 508 DK | 203 Newt | | | | | | |
| MAGNIFICATION | x250 | x200 | x250 | x200 | x250 | x350 | x167 | | | | | | |
| FILTER | W#11 | W#11 | W#11 | W#11 | W#11 | IL | IL | | | | | | |
| SEEING | AIII-IV | AIIII | AII-III | AII-III | AII-III | AIII | AIII-IV | | | | | | |
| INTENSITY OBSERVATIONS | | | | | | | | | | | | INTENSITY AVERAGE FOR THE APPARITION | NUMBER OF OBSERVATIONS |
| THE PLANET | | | | | | | | | | | | | |
| SPR | 4.25 | 3 | 4.25 | 4 | 3.75 | 3 | 4.5 | | | | | 3.8214285714 | 7 |
| STZ | 2.5 | 0.5 | 2.5 | 1.25 | - | 1.5 | 1.25 | | | | | 1.5833333333 | 6 |
| STB | 3.75 | 3 | 3 | 2 | 3 | 2 | 3.75 | | | | | 2.9285714286 | 7 |
| STropZ | 2.5 | 1.5 | 2.5 | 1.25 | 1.25 | 1 | 1.25 | | | | | 1.6071428571 | 7 |
| SEB | 3.5 | 4 | 5.25 | 2 | 3 | 3.5 | 3.25 | | | | | 3.5 | 7 |
| EB | | | | | | 2 | - | | | | | 2 | 1 |
| EZ(n) | 1 | 1 | 1.75 | 1 | 1 | 2 | 1 | | | | | 1.25 | 7 |
| NEB(S) | 6 | 4 | 5 | 5 | 5.75 | 5 | 4 | | | | | 4.9642857143 | 7 |
| NEBz | 2 | - | 2.5 | - | - | 2 | 2.5 | | | | | 2.25 | 4 |
| NEB(n) | 6 | 4 | 3 | 5.5 | 6.25 | 5.5 | 5.5 | | | | | 5.1071428571 | 7 |
| NTropZ | 2 | 2 | 2.5 | 1.25 | 2 | 1.75 | 1 | | | | | 1.7857142857 | 7 |
| NTB | 3.5 | 3 | 3 | 3 | 3.25 | 3 | 3 | | | | | 3.1071428571 | 7 |
| NTZ | 2 | 2.5 | 2.5 | 1.25 | 1.25 | 1.5 | 1.25 | | | | | 1.75 | 7 |
| NNTB | - | - | - | 3 | 4 | 3.75 | - | | | | | 3.5833333333 | 3 |
| NPR | 4.5 | 3 | 5 | 3.25 | 3 | 3.75 | 3 | | | | | 3.6428571429 | 7 |
| NPC | - | - | - | - | - | 4 | 3.25 | | | | | 3.625 | 2 |
| | | | | | | | | | | | | #DIV/0! | 0 |
| THE RINGS | | | | | | | | | | | | #DIV/0! | 0 |
| A-Ring | 2 | 3.75 | 2 | 3.5 | 3.5 | 2.75 | 3.5 | | | | | 3 | 7 |
| Cassini Division | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | 10 | 7 |
| B1-Ring | 0.5 | 1.5 | 0.75 | 1.25 | 1.5 | 1 | 1.25 | | | | | 1.1071428571 | 7 |
| B2-Ring | 2 | 2 | 2.5 | 2 | 2 | 2 | 2.5 | | | | | 2.1428571429 | 7 |
| B3-Ring | - | - | - | - | - | 3.75 | - | | | | | 3.75 | 1 |
| C-Ring | 7 | 8 | 9 | 8.5 | 8 | 6.75 | 7 | | | | | 7.75 | 7 |

**Table 3:** *Intensity estimates made by the author using a W#11 filter.*

## 8. Colour Estimates.

**THE BAA SATURN SECTION: COLOUR INTENSITY REPORT FORM**

**OBSERVER:** Paul G. Abel **LOCATIONS:** Leicester: 52º 36.6'N, 1º7.7' W & Selsey, West Sussex
**YEAR** 2010-2011

**INTEGRATED LIGHT:**

| Month | Feb | March | March | March | April | April | April | April | May | May | May | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY | 8 | 7 | 24 | 28 | 8 | 11 | 20 | 22 | 5 | 12 | 24 | | |
| UT | 02:47 | 00:44 | 01:25 | 22:45 | 23:19 | 00:14 | 23:47 | 22:47 | 22:35 | 22:25 | 23:18 | | |
| INSTRUMENT | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 203 Newt | 508 DK | 203 Newt | 203 Newt | 508 DK | 203 Newt | | |
| MAGNIFICATION | x250 | x167 | x250 | x250 | x200 | x250 | x227 | x200 | x250 | x350 | x167 | | |
| FILTER | IL | IL | IL | IL | IL | IL | IL | IL | IL | IL | IL | | |
| SEEING | AIII | AIII | AIII-IV | AIII-IV | AIII | AII-III | AIII-IV | AII-III | AII-III | AIII | AIII-IV | | |
| INTENSITY OBSERVATIONS | | | | | | | | | | | | AVERAGE COLOUR ESTIMATE | NUMBER OF OBSERVATIONS |
| THE PLANET | | | | | | | | | | | | | |
| SPR | grey | grey | grey | Grey | grey | Grey | grey | grey | grey | Grey-blue | Grey-blue | grey | |
| STZ | Yel-grey | yellow | Yel-grey | Yel-grey | Yel-grey | Yel-grey | lt yel | yel grey | yel | Yel-blue | Yel-grey | lt yel grey | |
| STB | Blue-grey | light brow | grey | grey | grey | grey | lt brow | grey | lt brow | lt brow | lt brow | lt brown | |
| STropZ | yellow | yellow | yel | yel | yel | lt yel | Yel-tan | lt yel | lt yel | lt yel | yel | Yellow | |
| SEB | - | - | Oran-brow | Oran-bro | Oran-brow | Oran-brow | Oran-brow | Oran-brow | Oran-brow | Oran-brow | Oran-brow | Orange-brown | |
| EB | - | - | - | grey | lt brow | - | lt brow | - | - | grey | - | lt brown | |
| EZ(n) | light yel | light yel | yellow | Yell-tan | Yell-tan | Yel-tan | | Yel-tan | Yel-tan | Yel-tan | Yel-tan | Yellow-tan | |
| NEB(S) | Oran-brow | Oran-brow | lt ora-bro | Oran-bro | Oran-brow | Oran-brow | Yel-tan | Oran-brow | Oran-brow | Oran-brow | Oran-brow | Orange-brown | |
| NEBz | yellow | salmon | Yellow-bro | lt salmon | yel | Yel-tan | oran brow | Yel-pink | lt pink | lt salmon | light pink | light pink | |
| NEB(n) | Oran-brow | oran brow | Oran-brow | Oran-brow | Oran-brow | Oran-brow | yel | Oran-brow | Oran-brow | Oran-brow | oran brow | orange brown | |
| NTropZ | yellow | Yellow-grn | Yel-rose | Yell-grn | lt yell | Yel-grn | oran brow | white | Yel-grn | Yel-white | Yel-grn | yellow green | |
| NTB | grey | Oran-brow | grey | lt bro | brow | Oran-brow | lt yel | oran brow | lt brow | grey | lt brow | light brown | |
| NTZ | yellow | Yel-grn | Yel-grn | Yel-grn | Yel-grn | Yel-grn | brow | Yel-grn | Yel-grn | Yyel-grn | Yel-grn | Yellow-green | |
| NNTB | - | Oran-br | grey | - | lt brwn | bow | Yel-grn | lt brow | lt brow | grey | Brow-grey | light brown | |
| NPR | grey | grey | grey | grey | grey | grey | grey | Brow-grey | grey | Brow-grey | Brow-grey | grey | |
| NPC | - | - | grey | grey | grey | grey | grey | grey | - | - | grey | grey | |
| | | | | | | | | | | | | | |
| THE RINGS | | | | | | | | | | | | | |
| A-Ring | grey | Blue-grey | light brown | light brwn | lt brow | lt brow | lt brow | lt brow | lt brow | lt brow | lt brow | light brown | |
| Cassini Division | black | black | black | black | black | black | black | black | black | black | black | black | |
| B1-Ring | white | white | lt. yellow | Yellow-cre | lt. yell | lt. yel | lt yel | lt yel | cream | lt yel | lt yel | lt yellow | |
| B2-Ring | grey | grey | grey | grey | grey | grey | grey | grey | grey | grey | gret | grey | |
| B3-Ring | - | - | - | - | - | - | Yel-grey | - | - | - | - | Yel-grey | |
| C-Ring | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | charcoal | |

lt.= Light, Yel= Yellow, Grn= Green, Brow= Brown

**Table 4:** *Colour estimates for 2010/11*

## 9. Conclusions

The 2010/11 apparition was an excellent apparition, and will always be remembered because of the great Dragon Storm which was naturally the main high light of the apparition. It was certainly the most unusual and dramitc storm ever observed by the author. Even though Saturn did not achieve the high altitudes of previous years, the author still managed to obtain a reasonable number of drawings, and a small number of high resolution drawings using the University of leicester's 508mm DK. Many other observers in the UK were also able to obtain many high resolution images and drawings of the planet, it's rings and the various storms.

Certainly the analysis of observations of the dragon storm will help to shed some light on the many fascinating myseries of the planet Saturn and it's complex weather systems!

**References:**

[1]. "Saturn's North Tropical Storm Evolution from 2010.12.05 to 2010.12.19" M. Delcroix., ALPO Japan website: http://alpo-j.asahikawa-med.ac.jp/kk10/s101223r.htm

[2]. Saturn Section website: http://www.britastro.org/saturn/subpages/saturngallery/2010-2011/general-2011.html

[3]. Chris Go's Website: http://saturn.cstoneind.com/

[4]. Damian Peach's website: http://www.damianpeach.com/sat11.htm

[5]. "Saturn NED Drift Charts 2010/2011" ALPO Japan website, http://alpo-j.asahikawa-med.ac.jp/kk11/s110728r.htm

[6]. "Saturn: Storm clouds Brooding on Towering Heights.", P Read, *Nature*, **475**, 44-45, 2011 July 07.

[7]. "Deep Winds Beneath Saturn's Upper Clouds form a Seasonal-Long Lived Planetary Scale Storm.", A. Sanchez-LaVega et al, Nature, **475**, 71-74, 2011 July 07.

[8]. "A Giant Thunderstorm on Saturn.", G. Fischer et al, Nature, **475**, 75-77, 2011 July 07

[9]. ALPO Japan Saturn Observations for 2010-11:http://alpo-j.asahikawa-med.ac.jp/Latest/Saturn.htm

[10]. BAA Saturn Section website: http://www.britastro.org/saturn/subpages/saturngallery/2010-2011/general-2011.html