# Saturn in 2000–2001

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*A report of the Saturn Section. Director: M.Foulkes*

Saturn displayed numerous belts and zones in 2000–'01, but its atmosphere was so quiet that hardly any rotation periods for features could be derived. However, a short-lived white oval in the STropZ showed a period close to System II. There were some further intensity variations in the far south. The planet's ring system had become nearly fully open upon the south face, and it was possible to see many fine details, including the division between rings B and C.

## Introduction

Saturn was extremely well-placed for observers at north temperate latitudes, coming to opposition on 2000 Nov 19, when its declination was +17°. The saturnicentric latitude of the sub-Earth point reached –23.6° at opposition, so that the N. limb of the planet was completely hidden by the rings. Limiting solar conjunctions occurred on 2000 May 10 and 2001 May 25, and our observers (Table 1) covered the period from 2000 Jul 8 (Ikemura) to 2001 Apr 9 (Dal Prete).

Numerous belts and zones were revealed upon the images obtained even with medium-sized instruments, but atmospheric activity was at a minimum (Figures 1–11). Images taken with a 65cm Cassegrain by Akutsu showed no obvious spots, and Gray could time only ten CM (Central Meridian) transits with his 41cm Dall–Kirkham during 57 observing sessions. The visual photometry programme (Table 2) continued, while both visual and imaging data were again used to derive average saturnicentric belt latitudes (Table 3). In addition to visible waveband work, infrared and methane band images were submitted (Figure 7). Akutsu also submitted an ultraviolet image.

This report continues the narrative from 1999–2000.[1] A short description was published at the time by David Graham.[2] The ALPO[3] and UAI[4] also produced reports for 2000–'01. Schmude[5] carried out photoelectric photometry. A growing number of observers were posting images upon their personal web pages; the existing ALPO Japan (JALPON) website[6] began to include the work of several international observers, while the year 2001 also saw the creation of the International Outer Planets Watch website,[7] which hosts images of Saturn and the other gas giants. The HST[8] secured a small number of images. The *Cassini* spacecraft remained in transit to the ringed planet.

**Figure 1.** 2000 Aug 15d 03:30UT, 305mm SCT, ×406, $\omega_1$= 271°, $\omega_2$= 029°. *D. A. Peach*. Coloured drawing shows a lighter SPC and a dark SPB, STB, and double SEB as well as the Encke Gap on the *f.* ansa only.

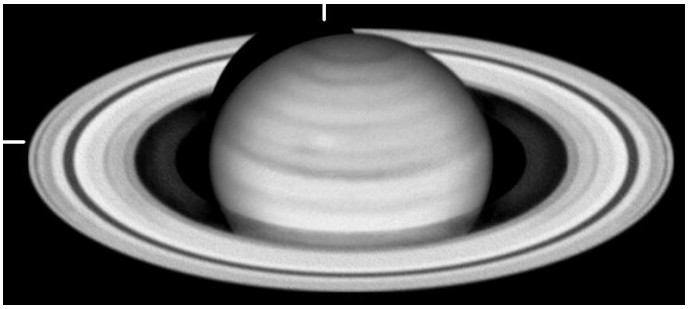

**Figure 2.** 2000 Aug 22d 02:50UT, 415mm DK, ×348, $\omega_1$= 038°, $\omega_2$=291°. *D. Gray*. Faint white spot in the STropZ (indicated). The Earth being higher than the Sun above the rings, the ShGR can be seen to the south of the planet's S. pole ($D_e$= –24°.3, $D_s$= –23°.1). Fine ring details include the Encke Gap and Encke complex.

## The globe

### General

There was a good deal of similarity to the last apparition, and the continuing rather bland visual aspect – with the S. Equatorial Belt being the only really obvious belt – continued. The only significant differences lay in the ongoing changes in the relative intensities of the belts and zones in the polar and temperate regions.

### Colours

Gray described the S. polar cap along with its darker N. rim (the SSPB) as 'very deep slate', McKim found it grey and Peach called it grey or blue-grey. The unusual reddish colour noticed in the S.

**Figure 3.** 2000 Sep 2d (time not stated), 254mm refl. *M. Di Sciullo*. RGB image showing fine details in rings A and B, in close accord with Figure 2.

**Table 1. Observers**

| *Observer* | *Location(s)* | *Instrument(s)* |
|---|---|---|
| T.Akutsu | Tochigi, Japan | 320mm refl. |
| | Hoshi-no-mura Observatory | 650mm Cass. |
| S. Beaumont | Windermere, Cumbria | 203mm SCT & 300mm refl. |
| N. D. Biver | Versailles, Paris, France | 256mm refl. |
| A. Cidadão | Oeiras, Lisbon, Portugal | 254mm SCT |
| E. Colombo | Gambarana, Italy | 150mm refl. |
| E. Y. Crandall | Winston-Salem, NC, USA | 254mm refl. |
| I. Dal Prete | Pescatina, Italy | 203mm refl. |
| M. Foulkes | Hatfield, Herts., | 203mm SCT & 254mm refl. |
| (with D.Hatch) | COAA, Portugal | 508mm refl. |
| M. Frassati | Crescentino (VC), Italy | 203mm SCT |
| D. L. Graham | Ripon, N. Yorks. | 152mm OG & 152mm MKT |
| D. Gray | Spennymoor, Co. Durham | 415mm DK |
| A. W. Heath | Long Eaton, Notts. | 254mm refl. |
| T. Ikemura | Nagoya, Japan | 310mm refl. |
| R. J. McKim | Upper Benefield, Northants. | 216mm refl. & 410mm DK |
| K. Maeda | Kyoto, Japan | 350mm refl. |
| I. Miyazaki | Okinawa, Japan | 400mm refl. |
| M. P. Mobberley | Bury St Edmunds, Suffolk | 355mm refl. |
| D. M. Moore | Phoenix, AZ, USA | 254mm refl. |
| D. Niechoy | Göttingen, Germany | 203mm SCT |
| P. W. Parish | Rainham, Kent | 102mm OG |
| D. C. Parker | Miami, Florida, USA | 410mm refl. |
| D. A. Peach | King's Lynn, Norfolk | 305mm SCT |
| R. W. Schmude | Barnesville, GA, USA | 102mm OG |
| M. Di Sciullo | Coconut Creek, FL, USA | 254mm refl. |
| W-L. Tan | Singapore | 128mm OG & 203mm & 279mm SCT |
| D. W. Wright | Caterham, Surrey | 133mm OG |

*Abbreviations:* SCT= Schmidt–Cassegrain; DK= Dall–Kirkham Cassegrain; MKT= Maksutov–Cassegrain.

Polar Region (SPR) during the previous apparition was not reported again, with Ikemura on Jul 9 specifically commenting upon the lack of any such colour remaining there. The SPR looked grey-ochre to Gray, and it was grey or greyish brown to Foulkes. Gray saw a deep slate tint in the SPB.

Peach (Aug 29) and Maeda (Sep 9) reported a reddish tint in the SSTeZ, but to the writer this tint was not obvious upon their images. This was the area that some observers had reported to be greenish at the last opposition, but no observer saw any green tint this time. Instead, Gray found a warm grey-ochre tint to the SSTeZ. Historically, cold tints near the pole are not atypical, as the Rev T. W. Webb stated that 'there is a decided difference of tint between the zones of lower and higher latitudes, the latter being of a bluish or greenish grey, the former being occupied by one or more broad bands of a faint brown or ruddy cast.'[9]

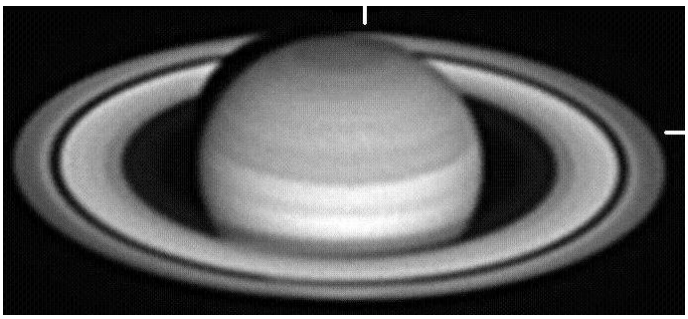

**Figure 4.** 2000 Sep 4d 09:36UT, 254mm refl., $\omega_1$= 092°, $\omega_2$=277°. *M. Di Sciullo*. Extremely faint STropZ details, the most prominent white spot being indicated. Note also the ring details.

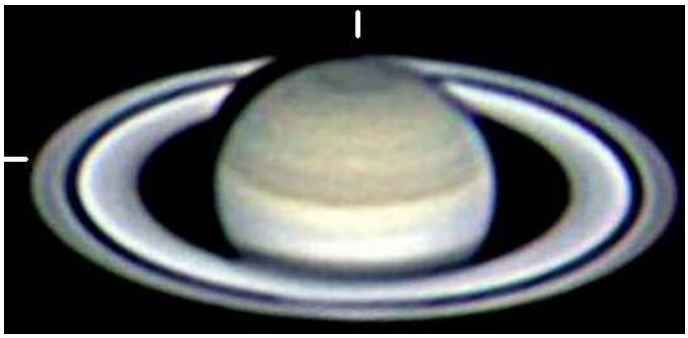

**Figure 5.** 2000 Sep 13d 06:48UT, 410mm refl., $\omega_1$= 033°, $\omega_2$=291°. *D. C.Parker.* RGB image, showing the small STropZ white spot (indicated) at the CM.

**Figure 6.** 2000 Oct 6d 04:10UT, 305mm SCT, $\omega_1$= 281°, $\omega_2$= 159°. *D. A. Peach*. RGB image: the original shows the tiny dark spot (SSPC) in the centre of the SPC, visible only with difficulty.

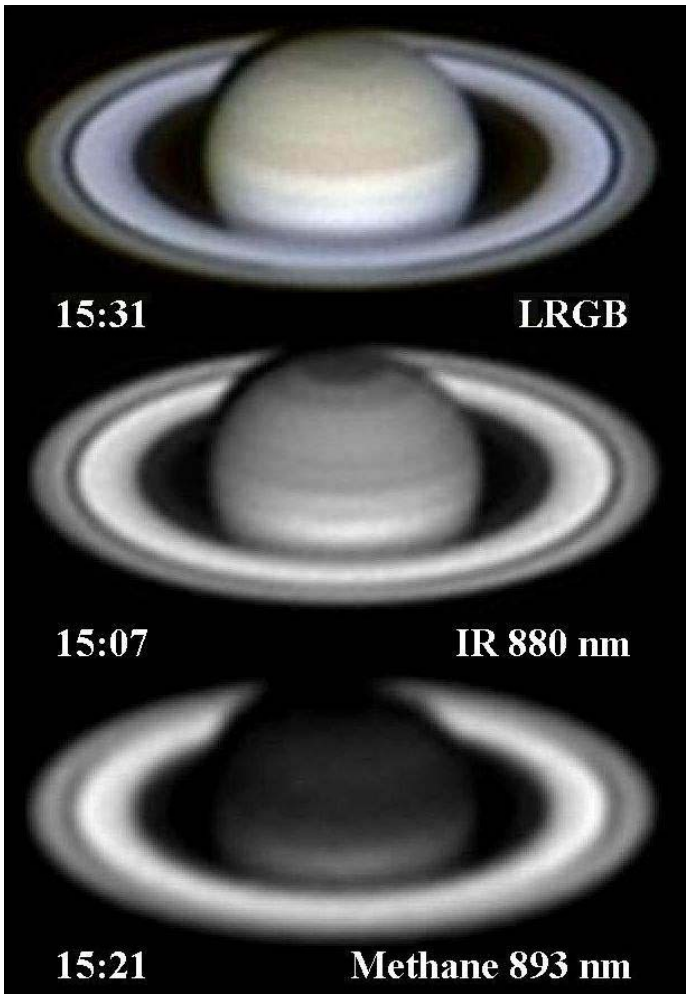


**Figure 7.** 2000 Oct 7d 15:07–15:31UT, 650mm refl., $\omega_1$= 071–085°, $\omega_2$= 262–276°. *T. Akutsu*. LRGB composite, infrared (880nm) and methane (893nm) waveband images. The SPC becomes darker in IR, and the EZ(S) darkens greatly in the methane image.

To Gray, the SSTB and STB were brown or grey-brown. Observers agreed that the other S. hemisphere zones – the STropZ and STeZ – showed a slight yellowish or cream-yellow tint, while the Equatorial Zone looked rather yellowish in the south and whitish in the north. The South Equatorial Belt was strongly brown or reddish-brown.

In integrated light the SPC and SEB(N) were of similar intensities, but in the infrared images the SPC appeared extremely dark, by far the darkest region of the globe.

Filter images confirm the presence of subtle tints. In Figure 8, the SPR, SPB, STB and SEB(S) are all darker in red than in green light, but the SSTB is darker and best seen in green light. The SEB(N) is darkest in green and blue light.

### South Polar Region

In 1999–2000 the latitudes of the S. Polar Region had become lighter than previously, contrasting with the dark S. Polar Cap. The SPR remained light in 2000–'01, being hardly darker than the STeZ or STropZ. This apparition the SPC exhibited a broad, dark edge, which we have called the S. S. Polar Belt.

Within the SPC, a tiny dark ellipse (which we will refer to as the SSPC for lack of a better term) was sometimes caught at the geometric S. pole, appearing only a few degrees in diameter. (No image was suitable for exact measurement.) Although more often seen than in 1999–2000, being further from the limb darkening, its visibility remained inconstant. Ikemura may have imaged it on Jul 8, and Akutsu certainly did so on Aug 8. The only drawing by Gray to show it was for Sep 4; on the same date Di Sciullo's image (Figure 4) shows it rather vaguely. Peach drew it on Aug 13, but not clearly on other dates in August. He imaged it on Sep 24, Oct 6 (Figure 6) and 9. McKim saw the SPC darkening sharply towards the centre on Nov 3 and Dec 3, but could not see any SSPC on Jan 16 or Feb 14 (Figure 10) under excellent conditions even with very high magnification. The HST imaged it, but only faintly, at opposition (Figure 9). The sightings are therefore sporadic and confined to Jul 8–Dec 3. A few of Ikemura's images suggest instead a sometimes eccentric light cloud around the S. rotational pole on Jul 17, Aug 15, 16, 28, Oct 11 and Dec 1, but this was always at the limit of visibility; Peach's Feb 14 image is similar.

The SPR was again bordered by a dusky and quite conspicuous SPB. Di Sciullo's high resolution images (Figures 3 & 4) showed the presence of a narrow belt, midway in prominence and location between the SPB and SSTB, which we have labelled SSSTB in Table 3. The SSSTB was also seen in 1998–'99.[10]

### S. S. Temperate Belt and Zone

The SSTB was much fainter than the SPB, having become very hard either to see or to image. In August Gray twice recorded a darker section in the belt. The SSTeZ was featureless.

**Table 2. Visual intensity estimates, 2000–'01**

| *Feature* | *SB* | *IDP* | *MF* | *MFr* | *DGy* | *AH* | *RM* | *RS* | *Ave.* | *No.* |
|---|---|---|---|---|---|---|---|---|---|---|
| SPC | 4.4 | 5.7 | 4.5 | 4.5 | 5.3 | – | 4.5 | 5.0 | 4.8 | 110 |
| SSPB | – | – | – | – | 6.2 | – | – | – | 6.2 | 52 |
| SPR | 3.8 | 4.0 | 3.6 | 4.2 | 4.5 | – | 3.9 | 4.0 | 4.0 | 88 |
| SPB | 4.0 | 5.0 | 5.0 | – | 5.7 | – | 4.1 | – | 4.8 | 67 |
| SSTeZ | – | 3.0 | – | – | 3.6 | – | – | 3.0 | 3.2 | 61 |
| SSTB | – | – | – | – | 4.6 | – | – | – | 4.6 | 57 |
| STeZ | 3.6 | 3.1 | 2.8 | 3.5 | 2.3 | 3.0 | 3.6 | 3.2 | 3.1 | 133 |
| STB | 4.0 | 4.0 | – | 3.7 | 3.9 | – | 4.0 | 4.2 | 4.0 | 68 |
| STropZ | 3.0 | 2.8 | 2.7 | 3.0 | 2.8 | – | 3.5 | 3.2 | 3.0 | 121 |
| SEB(S) | – | 4.2 | – | 4.5 | 5.2 | – | 4.3 | 4.6 | 4.6 | 90 |
| SEBZ | – | 3.4 | – | 4.5 | 4.6 | – | 4.2 | 4.0 | 4.1 | 81 |
| SEB(N) | 5.1 | 4.3 | 5.0 | 5.2 | 5.8 | 4.2 | 4.6 | 4.8 | 4.9 | 134 |
| EZ(S) | 1.0 | 1.6 | 1.0 | 1.7 | 1.8 | 1.5 | 1.4 | 1.7 | 1.5 | 132 |
| EB | – | 3.0 | 3.1 | 2.9 | 3.3 | 2.5 | 3.0 | 3.0 | 3.0 | 93 |
| EZ(N) | – | 1.3 | 1.0 | 1.7 | 1.3 | – | 1.4 | 1.7 | 1.4 | 93 |
| Ring A1 | 3.0 | 3.2 | 3.9 | 3.2 | 4.2 | 3.0 | 3.2 | 2.8 | 3.3 | 130 |
| Encke's divn. | – | – | – | – | 7.8 | – | 5.7 | – | 6.8 | 23 |
| Encke complex | – | 4.1 | – | – | 5.0 | 3.9 | 4.0 | – | 4.2 | 72 |
| Ring A2 | – | 2.2 | 3.3 | – | 3.0 | 2.2 | 3.2 | – | 2.8 | 91 |
| Cassini's divn. | 6.6 | 9.0 | 10.0 | 8.0 | 9.0 | 9.9 | 10.0 | 8.5 | 8.9 | 122 |
| Ring B1 | 1.0 | 1.2 | 1.0 | 2.2 | 1.3 | 1.0 | 1.2 | 1.2 | 1.3 | 132 |
| Ring B2 | – | 2.4 | 2.9 | 3.0 | 2.5 | 1.5 | 2.6 | 2.3 | 2.4 | 105 |
| Ring B3 | – | 3.8 | – | – | 4.1 | – | 3.1 | – | 3.7 | 77 |
| Ring C | – | 7.0 | 8.3 | 7.0 | 7.0 | 8.5 | 7.4 | 9.0 | 7.7 | 147 |
| Ring $C_m$ | – | 7.0 | 7.5 | – | 4.7 | – | 8.1 | 6.2 | 6.7 | 89 |
| ShRG | 7.8 | 8.0 | – | – | 7.0 | 8.8 | – | – | 7.9 | 59 |
| ShGR | 9.0 | 10.0 | 10.0 | – | – | 9.5 | 10.0 | 9.8 | 9.6 | 56 |
| Total used | 197 | 116 | 141 | 22 | 1,459 | 140 | 330 | 78 | – | 2,483 |

*Key to observers:*
SB, Beaumont; IDP, Dal Prete; MF, Foulkes; MFr, Frassati; DGy, Gray; AH, Heath; RM, McKim; RS, Schmude.

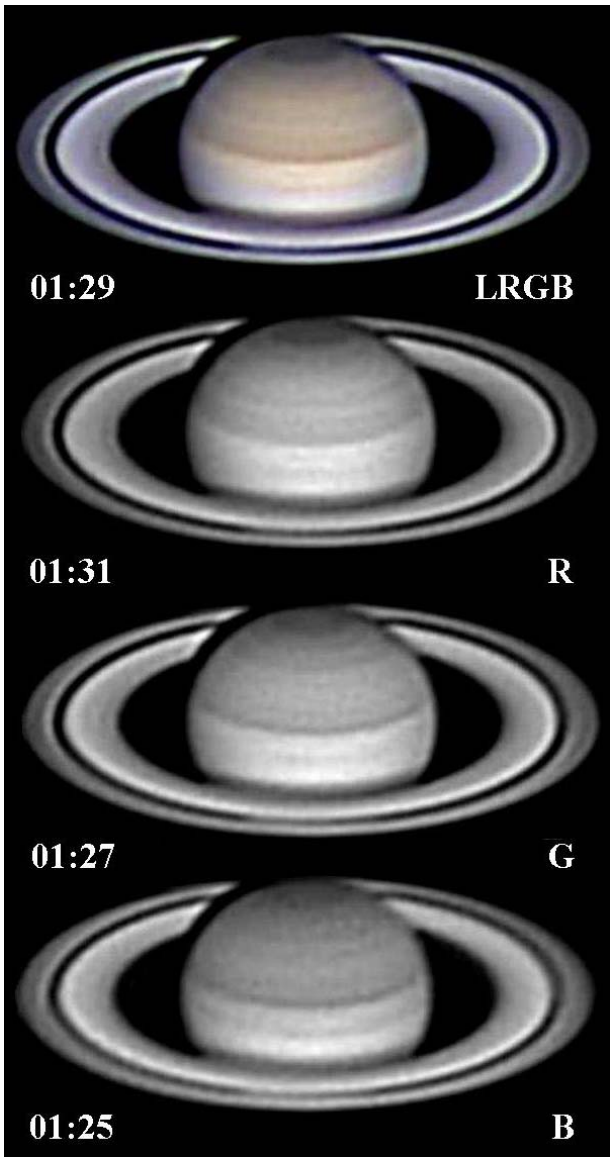


**Figure 8.** 2000 Oct 13d 01:25–01:31UT, 305mm SCT, $\omega_1$= 336–339°, $\omega_2$= 351–355°. *D. A. Peach*. The RGB composite image shows the very thin and faint EZ(S)B as well as a tiny white oval in the EZ(S) just *p*. the CM, while the R, G and B images reveal subtle colour and contrast differences.

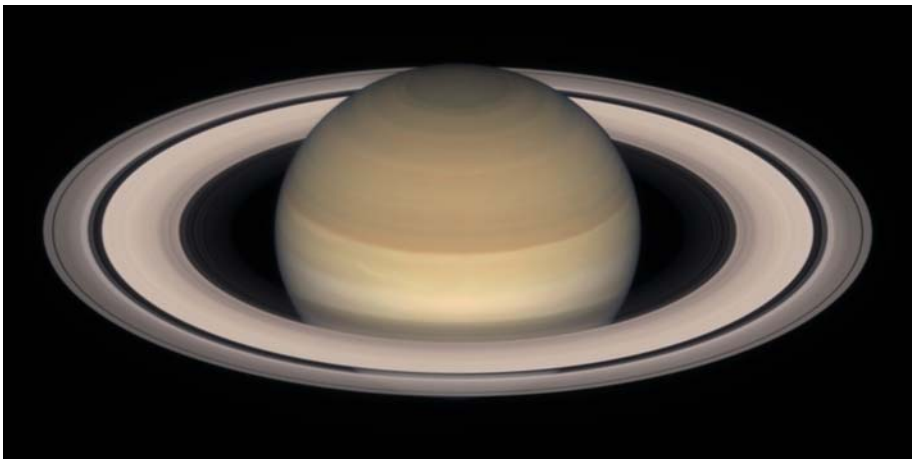

**Figure 9.** Image taken with the Wide Field & Planetary Camera 2 onboard the Hubble Space Telescope, acquired very close to, or upon, the date of opposition, 2000 Nov 19. Note the very small dark spot (SSPC) at the S. rotational pole, the lack of detail upon the belts and the many fine ring details. There is a tiny sliver of N. hemisphere visible (but not in the reproduction here). The resultant colour of this combination of filter images is not very close to the eyepiece impression. (Further details are available online.[8])

### South Temperate Zone

The STeZ was bland, though Dal Prete suspected some structure on Oct 22.

### South Temperate Belt

The faint STB was generally featureless too, but occasionally it exhibited darker sections, one of which just preceded the STropZ white oval to be mentioned below. This oval was seen to slightly indent the STBn on Sep 4 (Di Sciullo).

### South Tropical Zone

The zone showed a low level of activity. Gray twice observed the same fairly large but diffuse light oval, which showed a nearly constant System II longitude: $\lambda_2$ (*f.* end)= 289° (CM transit) on Aug 2, with a similar (but estimated) longitude on Aug 22 (Figure 2). On Sep 4 Di Sciullo (Figure 4) secured an image showing a series of three extremely faint white ovals centred at $\lambda_2$= 277°, of which the *f.* one was the most prominent and somewhat more southerly, and located at $\lambda_2$ (*f.* end)= 288°: this was the feature discovered by Gray, at latitude –35°. Parker imaged it at $\lambda_2$ (*f.* end)= 296° on Sep 13 (Figure 5), the oval appearing 10° long, not especially light, and better contrasted in green and red light. On that date (though at lower resolution) it appeared to be the only white oval present. Akutsu's images for Sep 21 also show it, but extremely faintly. A rotation period was derived:

| *Spot* | *Limiting dates* | *No. obs.* | *Limiting longitudes* | $\Delta\lambda_2$ *(°/day)* |
|---|---|---|---|---|
| WS1f | Aug 22–Sep 13 | 4 | 289–296° | +0.159 |
| *STropZ average period*: | | | | 10h 38m 33s |

This is slower than our 1998–'99 average[10] for several features, as were several other periods deduced over the next few apparitions.[11]

### South Equatorial Belt

Gray observed some dark patches at the SEB(N) N. edge on Aug 6 and 17, Frassati likewise saw several on both Sep 2 and Jan 26, and Heath too on Jan 27. Dal Prete saw details in the belt on Dec 1, Jan 14 and Feb 10, as did Schmude on Feb 8 and Mar 19. Beaumont occasionally spotted diffuse condensations, while McKim found that under the finest conditions a general mottling of the SEB was detectable. The same impression comes from some of the best images. Tiny SEB(N) projections are at the limit of visibility upon images by Di Sciullo (Sep 4; Figure 3), Miyazaki (Aug 18) and Peach (Oct 6, 9, 13; Figures 7–8). The small projection seen by Gray on Aug 17 was at the same longitude as that imaged by Miyazaki next day, but no other deductions can be made.

The SEB was as broad as usual but not always obviously double, as the S. component was often only marginally fainter than the intermediate zone. The N. part (SEB(N)) was always the broadest and darkest.

### Equatorial Zone

There was again a very thin belt, again designated EZ(S)B, close to the edge of the SEB (Figures 4, 8). It had become excessively faint and was not recorded even in some of the best images. The normal Equatorial Band (EB) near the centre of the EZ was broad and conspicuous, and lay somewhat further south than it did in 1999–2000. Darker sections were reported by Frassati on Sep 2, Gray on Aug 17 and Schmude on Dec 31, Feb 8 and Mar 19.

Some very small, short-lived white ovals were seen in the EZ(S) by Frassati (Sep 2, indenting the SEB(N)), Peach (Oct 13 (Figure 8)), Ikemura (Nov 3). None was observed twice.

Throughout the apparition, the EZ(N) was as bright as or a little lighter than the yellowish EZ(S). On Apr 2, Dal Prete reported several small white ovals in the EZ(N). In Akutsu's infrared images of Jul–Dec (none were obtained outside this period) the brightness difference is enhanced, while in the methane band images (Aug–Dec) the difference was even more pronounced, with the EZ(S) almost as dark as the SEB. Refer to Figure 7.

The best images by Di Sciullo and Peach show a thin belt north of the EB which we have denoted as the EZ(N)B in Table 3. The HST opposition image (Figure 9) and Wright's sketches also show it.

### N. hemisphere

When viewed at very large size on a computer screen, the HST opposition image (Figure 9) shows the smallest sliver of very dull grey north limb projecting beyond the ring ellipse: absence of ShGR dictates that this must have been taken at opposition or within a day of it. The N. hemisphere could not have been resolved by our observers: modelling by means of the *WinJUPOS* soft-

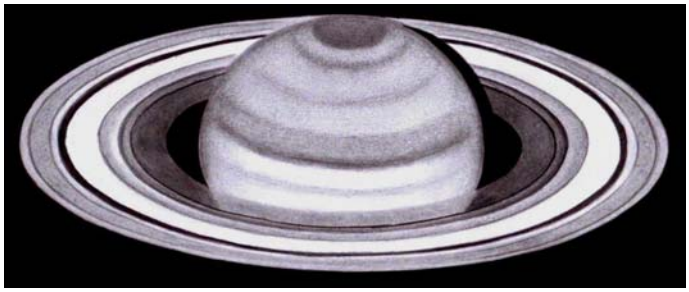

**Figure 10.** 2001 Feb 14d 18:00UT, 410mm DK, ×410 and ×820, $\omega_1$= 135°, $\omega_2$= 083°. *R. J. McKim*. Fine detail is visible in rings A and B. In redrawing for publication, the observer has slightly lightened ring C to allow the fine dark line dividing rings B and C to be better seen.

**Table 3. Saturnicentric latitudes, 2000–'01**

| *Feature* | *TA* | *AC* | *DG* | *RM* | *DAP* | *MDS* | *Avge.* |
|---|---|---|---|---|---|---|---|
| SSPBs | −78.5 | – | – | – | −80.6 | −80.7 | −79.9 |
| SSPBn | −71.0 | −72.2 | −74.6 | −70.2 | −73.3 | −70.7 | −72.0 |
| SPCn | −71.0 | −72.2 | −74.6 | −70.2 | −73.3 | −70.7 | −72.0 |
| SPRn | −62.2 | −62.0 | −64.8 | −62.9 | −64.4 | −62.9 | −63.2 |
| SPBs | −62.2 | −62.0 | −64.8 | −62.9 | −64.4 | −62.9 | −63.2 |
| SPBc | −60.2 | −58.9 | −62.4 | −60.2 | −62.6 | −60.8 | −60.8 |
| SPBn | −58.2 | −55.8 | −59.9 | −57.4 | −60.7 | −58.6 | −58.4 |
| SSSTBs | – | – | – | – | – | −55.8 | −55.8 |
| SSSTBn | – | – | – | – | – | −53.6 | −53.6 |
| SSTBs | −51.5 | −50.3 | −51.2 | – | −52.6 | −49.9 | −51.1 |
| SSTBn | −48.6 | −45.4 | −46.5 | – | −48.4 | −46.5 | −47.1 |
| STBs | −40.8 | −40.7 | −40.1 | −45.3 | −41.2 | −40.6 | −41.4 |
| STBc | −39.0 | −37.8 | −38.1 | −42.8 | −39.0 | −38.5 | −39.2 |
| STBn | −37.3 | −34.8 | −36.1 | −40.4 | −36.7 | −36.4 | −37.0 |
| SEB(S)s | −30.2 | −30.2 | −28.6 | −29.8 | −29.6 | −28.8 | −29.5 |
| SEB(S)n | −26.8 | −26.1 | −24.9 | – | −26.2 | −25.0 | −25.8 |
| SEB(N)s | −21.4 | −20.8 | −20.1 | −22.8 | −20.9 | −19.6 | −20.9 |
| SEB(N)n | −15.8 | −16.0 | −16.1 | −14.4 | −16.1 | −15.7 | −15.7 |
| EZ(S)Bs | – | – | – | – | −13.4 | −12.2 | −12.8 |
| EZ(S)Bn | – | – | – | – | −11.3 | −10.3 | −10.8 |
| EBs | −8.8 | −6.8 | −6.4 | −6.3 | −6.7 | −6.0 | −6.8 |
| EBc | −6.2 | −4.9 | −4.1 | −4.2 | −4.2 | −4.0 | −4.6 |
| EBn | −3.5 | −3.0 | −1.8 | −2.0 | −1.6 | −2.1 | −2.3 |
| EZ(N)Bs | – | – | – | – | – | +1.8 | +1.8 |
| EZ(N)Bn | – | – | – | – | +3.0 | +4.0 | +3.5 |
| Total | 48 | 22 | 72 | 27 | 45 | 52 | 266 |

*Key to observers:*
TA, Akutsu (the four best images); AC, Cidadao (the two best images); DGy, Gray (drawings); RM, McKim (drawings); DAP, Peach (the three best images); MDS, Di Sciullo (the three best images). Gray reduced his own work; other data were reduced by McKim.

ware[12] showed that the N. limb began to project from Nov 8 onwards for some months, but that it remained almost entirely within the shadow of the rings.

## The rings

### General

The 1999–2000 report fully described the details of the widely open rings. During the current cycle with the S. face of the rings on view, we have had no reported sightings of the D ring interior to ring C, observed by J. B. Murray at Pic du Midi in 1973.[13]

### Ring A

Ring A1 looked grey-mauve to Gray, with the inner part (A2) whiter. Foulkes saw the ring bluish-grey, and Peach steel-grey. The Encke complex was seen visually by several observers including Heath and Wright. Biver, Gray (Figures 2, 11), McKim (Figure 10) and Peach saw the narrow Encke Gap visually, which Peach sometimes reported to be only partially visible: it was apparent to him only in the *f*. ansa on Aug 2, 13 and 15 (Figure 1). The Encke Gap was imaged by Peach (Figure 8) and recorded with particular clarity by Di Sciullo (Figures 3–4).

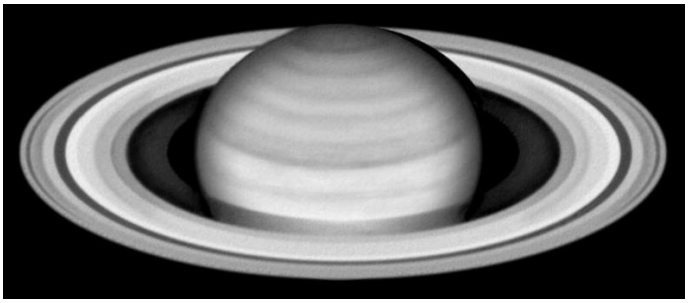

**Figure 11.** 2001 Feb 17d 18:40UT, 415mm DK, ×348, $\omega_1$= 171°, $\omega_2$=021°. *D. Gray*. Many fine details in the rings, with the ShGR no longer falling to the south of the S. pole due to the Sun being higher than the Earth to the south of the ring-plane ($D_e$= −23°.8, $D_s$= −24°.7). The globe shows numerous belts and zones, but the planet's atmosphere is quiescent.

### Cassini's Division

On its southern side of the ring ellipse, the Cassini Division was still interrupted by the globe. It was again easy to see the N. globe through the Cassini Division in some of the best images, and Frassati noted this effect visually on Jan 26.

### Ring B

On opposition night, McKim found that ring B1 exhibited an icy blue whiteness: the usual enhancement of brightness at opposition. To Gray, rings B2 and B3 looked fawn or brown in tint. Dal Prete[2] and Niechoy recorded spokes on ring B on several occasions, the former considering them illusory. Gray did not observe spokes in this apparition. Heath wrote that T. R. Cave (327mm refl., Long Beach, CA, USA) had informed him by letter that he had actually followed the rotation of two very definite spokes upon the *p*. ansa in November.

Both Gray and McKim saw sharp divisions between the areas of differing brightness in ring B, and their drawings (Figures 2, 10, 11) are in excellent accord with several of the best images. The visual impression was of a sharp brightness change, with the ring then lightening towards the planet. Gray saw four such brightness steps, and McKim three. All four steps are shown in Di Sciullo's images in Figures 3 and 4, and even more detail is apparent in the HST image (Figure 9).

### Ring C

Gray compared the E. and W. ansae of ring C on 56 nights, and on only 8 occasions were they of equal brightness. More often there was an obvious difference, frequently of up to 0.75 intensity units, so that the *p*. ansa was the brighter 39 times and the *f*. one on only nine occasions. A difference of 1 intensity unit was seen on Nov 17 and Dec 10 only, and on these two occasions – coincidentally being Gray's records closest to opposition (Nov 19) – the *f*. ansa was unusually light (I= 5.0). To him ring C appeared a warm grey tone, but on Aug 22 it showed a coppery tint on the *p*. side only. There are references in the telescopic literature to occasional difference in colour between the two ansae. To Heath the ring was dark brown on Dec 13, and marginally lighter on the *f*. side.

On Feb 14 under exceptional seeing conditions McKim clearly saw the narrow black division between ring B3 and ring C (Figure 10). This division must be constantly visible given fine seeing, but observers often fail to look for it. The writer has noticed an apparent division at this location upon many CCD images, more or less regardless of conditions, and upon the less good images it must be completely spurious. A similar spurious dark annulus is often shown surrounding the ring system, again the result of image-processing and sharpening.

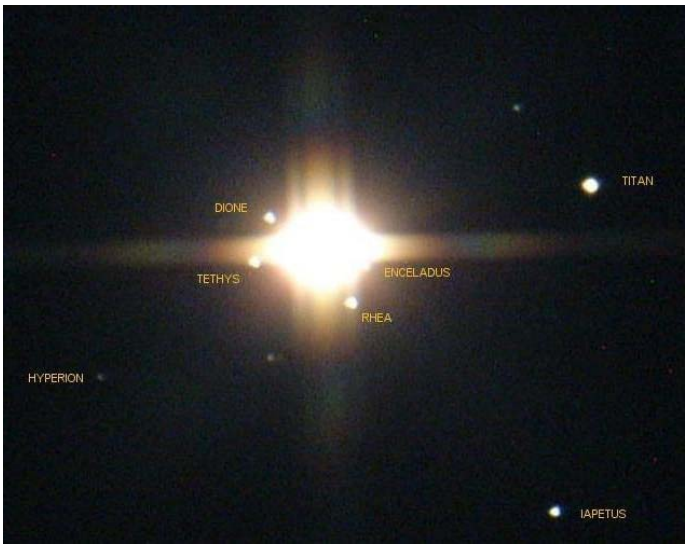


**Figure 12.** 2000 Oct 6d 00:00UT, 508mm refl. *D. Hatch*. Prime focus Fuji S1 DSLR image (20s) showing many satellites (labelled) including Enceladus and Hyperion.

### *Ring C crossing the globe and shadows*

Ring C crossing the globe ($C_m$) was normal. Foulkes and McKim saw the ShGR on the *p*. side on Nov 14; opposition was on Nov 19 (ShGR invisible); Crandall saw it on the *f*. side, Nov 23.

### *Bicoloured aspect of the rings*

Crandall alone reported the bicoloured aspect of the rings[14] on Dec 24 (E. ansa brighter in red; identical in blue and no filter) and Feb 20 (W. ansa brighter in blue; identical in red and no filter). On other dates the ansae appeared equal. Heath did not find any differences in his own work, but neither he nor Crandall made very many observations this apparition, and it must be stated that other observers compared the ansae without ever suspecting any difference.

## The satellites

Hatch obtained a DSLR image at the prime focus of the COAA 508mm refl. on Oct 6 which showed the bright satellites as well as Enceladus and Hyperion. Hyperion is rarely imaged by Section members: see Figure 12.

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## References & notes

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9 T. W. Webb, 'The Planet Saturn', *The Intellectual Observer*, **9**, 253 (1866). Webb's encyclopaedic article spans pp. 247–266, 366–381 and 466–469. Sometimes we find occasional notes of specific areas near the pole with a cold tint: for example, in 1915–'16 H. Thomson of the BAA Saturn Section observed the SPB (then called the 'Antarctic Belt') to be greenish: see W. H. Steavenson, *J. Brit. Astron. Assoc.*, **26**, 323 (1916).
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14 For background, see (for instance): T. A. Dobbins, A. W. Heath & V. Dikarev, *ibid.*, **113**(4), 201–207 (2003).

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