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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Founded in 1947

Volume 58, Number 4, Autumn 2016

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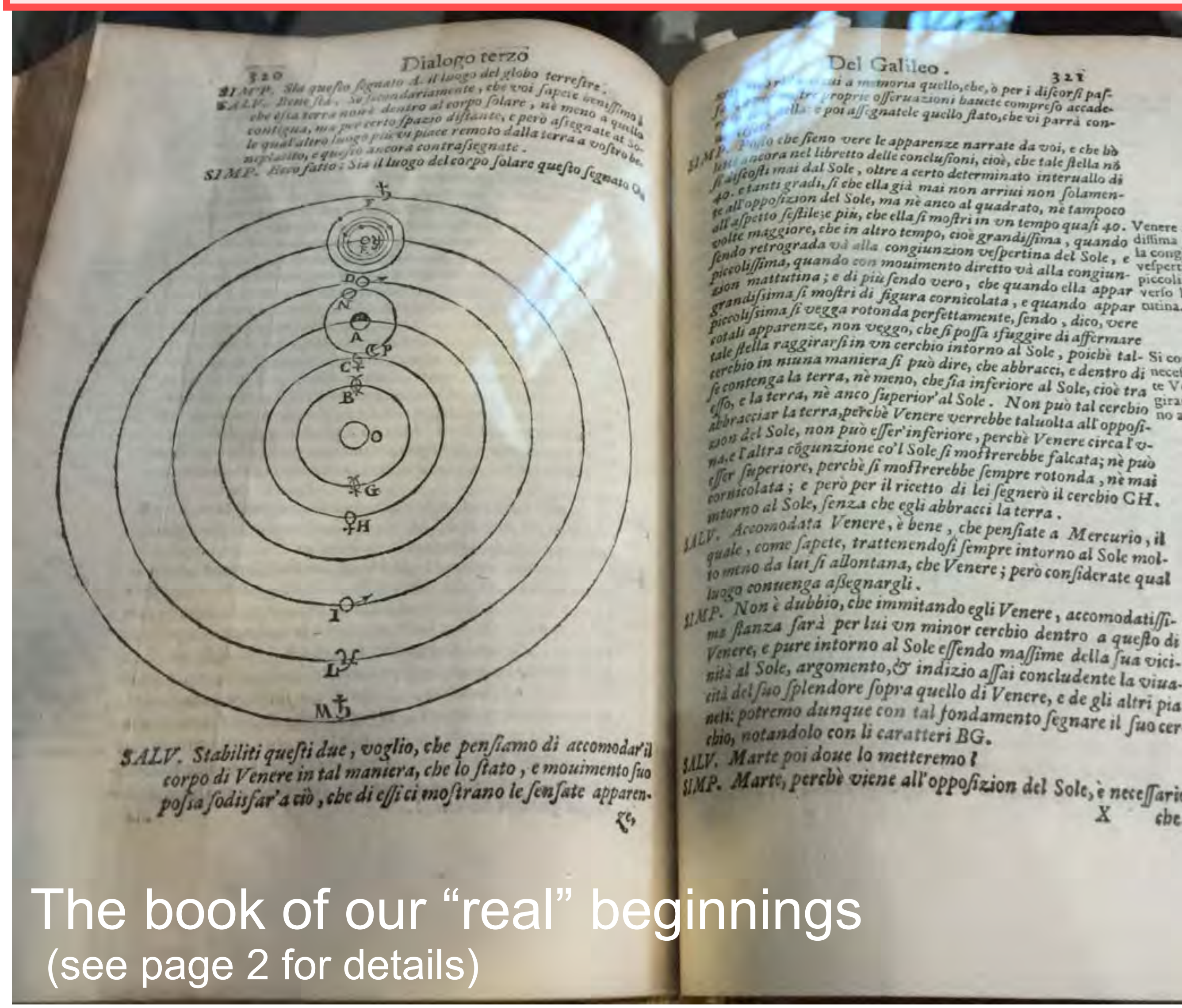

The book of our “real” beginnings

(see page 2 for details)

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 58, No.4, Autumn 2016
This issue published in September 2016 for distribution in both portable document format (pdf) and hardcopy format.

This publication is the official journal of the Association of Lunar & Planetary Observers (ALPO).

The purpose of this journal is to share observation reports, opinions, and other news from ALPO members with other members and the professional astronomical community.

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http://www.alpo-astronomy.org

Founded in 1947

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Association of Lunar & Planetary Observers (ALPO)

Point of View
Another Great ALCon

By Michael D. Reynolds, executive director, the ALPO

The Astronomical League's ALCon 2016 event in Arlington, Virginia, was an excellent meeting. The Northern Virginia Astronomy Club, the sponsoring club, did a terrific job in all aspects. Your ALPO was well-represented throughout, with six ALPO member talks on the main docket.

I enjoyed the talks and workshops that I attended. NASA Administrator General Charles Bolden was the keynote at the Saturday evening awards banquet. General Bolden's talk was one of the best I have heard; he was personal, informative, and up-front in regard to NASA's challenges. While many high-level banquet speakers quickly leave at the event's end, not so with General Bolden: he stayed around for handshakes, autographs, and the newest craze of selfies until the very end.

We had an excellent ALPO Board meeting, discussing a number of issues, from the Journal to future ALPO meetings.

It was truly my honor to present the 2016 Walter Haas Observers Award to Randy Tatum, and the Peggy Haas Service Award to Jeff Beish. Congrats to both!

ALCon reminded all of us that we are closing in on the year of the eclipse. Anticipation is growing for next year's August 21st total solar eclipse, as you might imagine.

The ALPO meeting next year will be after the eclipse and most likely in October. That will give everyone a chance to observe the eclipse, and then share their results at the 2017 ALPO meeting.

Of course your ALPO has much more going on, as we look at wrapping up the Mars apparition, Saturn, Jupiter, and a host of other observing programs.

I want to close by thanking Rik Hill and the ALPO Solar Section, ALPOSS. They have done an incredible job with the Solar Section. And my – our – many thanks to Kim Hay for her ALPOSS leadership over the many years, as she steps away from the Section, and hopefully only for a short spell.

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News of General Interest

Our Cover

This month's cover image (by Ken Poshedly while attending this year's ALCon 2016 event) features two pages of Galileo Galilei's book, "Dialogue Concerning the Two Chief World Systems." The book sits in a protective glass display case at the U.S. Naval Observatory in Washington, DC. As ALPO members surely know, Galileo is recognized by many as the father of telescopic observational astronomy.

According to the explanatory card inside the case, "This is the book that caused the troubles that the Inquisition suppressed in 1633. At its publication, the book was praised by every scientist in Europe as a literary and philosophical masterpiece. This work is a compelling and unabashed plea for the Copernican system. Not everyone, however, believed the work to be worthy of admiration. Galileo was charged with heresy and stood trial in Rome in 1634. He was found guilty and was thus ordered to recant. He stated that he 'adjured, cursed and detested' his past errors. The court sentenced him to house arrest at his estate near Florence, where he died eight years later.

The book was "Purchased in memory of LeRoy E. Doggett, astronomer at the U.S. Naval Observatory from 1965 until his death in 1996, with donations made to the LeRoy Doggett Memorial Fund."

Digital Journal of the ALPO Now Available to All ALPO Members

As per the unanimous vote by the ALPO board of directors at its August 13 meeting, those whose ALPO membership includes only the paper (hard copy) of our *Journal* will now be able to download the full-color digital version as well, complete with its electronic bookmarks and hyperlinks.

Thus, all members will now receive a formal email notification email as the newest issue is made available. The email will include a hyperlink on which to click After clicking on the hyperlink, a"pop-up window" will appear. Simply provide the requested data as requested to begin the download.

ALPO Publications Section Gallery with DJALPO Repository Nearing Reality

By Ken Poshedly

A true online ALPO Publications Section Gallery — complete with back issues of our quarterly Journal — is now a work-in-progress. While lots has been done, there's lots more to do.

Work on the newest addition to the ALPO web site — with advice from our own ALPO Online Section Coordinator Larry Owens — began in July by myself and so far includes a few of the most recent issues of the *Journal*, plus various observing forms and monographs.

Here's the folder structure so far:

- Digital journals of the ALPO folder

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- •• DJALPO 2016 subfolder (content yet to be added)
- •• DJALPO 2015 subfolder (includes Volume 57, issues 1 thru 4)
- • ALPO Observing Section Publications folder
  - •• Solar Observing Materials subfolder (with content)

- •• Mercury Observing Materials subfolder (with content)
- •• Venus Observing Materials subfolder (with content)
- •• Lunar Observing Materials subfolder (with content)
- •• Mars Observing Materials subfolder (with content)
- •• Jupiter Observing Materials subfolder (with content)
- •• Saturn Observing Materials subfolder (with content)
- •• Remote Planets Observing Materials subfolder (with content)
- •• Comets Observing Materials subfolder (with content)
- •• Meteors Observing Materials subfolder (with content)
- • ALPO Monographs folder
  - •• (with various content)

Over the coming weeks and months, outdated observing forms will be replaced with new ones and missing materials will be added, especially issues of the ALPO journal back to Volume 1.

To access the ALPO Publications Section Gallery, go to the ALPO home page at http://www.alpo-astronomy.org/, then click on "ALPO Section Galleries" at the very top-right corner of the web page. Next, click on the image right above "Publications Section".

Articles for Publication in This Journal

The ALPO appreciates articles for publication and encourages its membership to submit written works (with images, if possible).

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As with other peer-reviewed publications, all papers will be forwarded to the appropriate observing section or interest section coordinator.

Thus, the best method is to send them directly to the coordinator of the ALPO section which handles your topic.

A complete list of ALPO section coordinators and their regular addresses and e-mail address is in the ALPO Resources section of this Journal.

Online JALPO Passwords
Passwords for access to certain older online (pdf) issues of the JALPO can be obtained from this editor at ken.poshedly@alpo-astronomy.org

All online (pdf) issues of our Journal from JALPO43-1 (Winter 2001) through JALPO56-1 (Winter 2014) can be accessed at http://www.alpo-astronomy.org/djalpo/

And Finally . . .

- Various sources report that asteroid 2016 QA2 passed within 50,000 miles (80,000 kilometers) or so of Earth on Sunday, Aug. 28, just a day after the asteroid was discovered.

  The object is estimated to be between 80 and 180 feet (25 to 55 meters) wide, only a little larger than the Chelyabinsk bollide that exploded over that Russian city in February 2013.

  More at http://www.space.com/33891-newfound-asteroid-buzzes-earth-2016-qa2.html

- CNN reported in early July that "astronomers have discovered a planet with three suns, where an observer would experience either constant daylight or triple sunrises and sunsets depending on the seasons, which last longer than a human lifetime."

  The reports says that "HD 131399Ab" is the first such object located "in a stable orbit in a triple-star system."

  More at http://www.cnn.com/2016/07/07/health/planet-orbits-three-suns/

- Astronomers are just thrilled with images of Jupiter taken by the Juno spaceraft.

  More at http://www.cnn.com/2016/09/03/health/jupiter-north-pole-irpt/index.html

ALPO Interest Section Reports

ALPO Online Section

Larry Owens, section coordinator
Larry.Owens@alpo-astronomy.org

Follow us on Twitter, "friend" us on FaceBook or join us on MySpace.

To all section coordinators: If you need an ID for your section's blog, contact Larry Owens at larry.owens@alpo-astronomy.org

For details on all of the above, visit the ALPO home page online at www.alpo-astronomy.org

Computing Section

Larry Owens, section coordinator
Larry.Owens@alpo-astronomy.org

Important links:

- To subscribe to the ALPOCS yahoo e-mail list, http://groups.yahoo.com/group/alpocs/
- To post messages (either on the site or via your e-mail program), alpocs@yahoogroups.com
- To unsubscribe to the ALPOCS yahoo e-mail list, alpocs-unsubscribe@yahoogroups.com
- Visit the ALPO Computing Section online at www.alpo-astronomy.org/computing

Lunar & Planetary Training Program

Tim Robertson, section coordinator
cometman@cometman.net

The ALPO Lunar & Planetary Training Program is open to all members of the ALPO, the beginner as well as the expert observer. The goal is to help make members proficient observers. The ALPO revolves around the submission of astronomical observations of members for the purposes of scientific research. Therefore, it is the responsibility of our organization to guide prospective contributors toward a productive and meaningful scientific observation.

I, Tim Robertson, as program coordinator, heartily welcome you to

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the ALPO and our training program and look forward to hearing from you!

To began the first phase of training at the basic level, interested persons should contact me at the following address:

Timothy J. Robertson
ALPO Training Program
195 Tierra Rejada #148
Simi Valley, California 93065

Or send e-mail to me at: cometman@cometman.net

For more information about the ALPO Lunar & Planetary Training Program, go to: www.cometman.net/alpo/

ALPO Observing Section Reports

Mercury / Venus Transit Section

John Westfall, section coordinator
johnwestfall@comcast.net

Visit the ALPO Mercury/Venus Transit Section online at www.alpo-astronomy.org/transit

Meteors Section

Robert Lundsford, section coordinator
lunro.imo.usa@cox.net

Visit the ALPO Meteors Section online at www.alpo-astronomy.org/meteorblog/ Be sure to click on the link to viewing meteors, meteor shower calendar and references.

Meteorites Section

Report by Dolores H. Hill, section coordinator
dhill@lpl.arizona.edu

This Section report includes spring and summer 2016. The ALPO Meteorites Section continues to consult with members about meteorites to facilitate education and further investigation. ALPO members who collect meteorites are encouraged to report unusual features in their meteorite samples.

For example, Mike Farmer (not an ALPO member) recently acquired stones from the Allende meteorite retrieved on the day of the famous fall on February 8, 1969. Some of them show unusual patches of translucent, glassy fusion crust that appear to be associated with very large calcium-aluminum-rich inclusions (CAIs) that melted during passage through Earth's atmosphere. So even though two tons of specimens were recovered and it is considered one of the best studied meteorites, there are still surprises and discoveries to be made.

We received a referral from Robert Lundsford of a possible meteorite fall witnessed on Jan. 23, 2016 by Kendall and Jennifer Hamilton in Alaska. Randy Tatum inquired about a possible meteorite under investigation from the East Coast.

The Meteoritical Bulletin listed 844 newly approved and/or revised meteorites in the official meteorite count from February-July 2016. Newly classified falls include *Aouinet Legraa* (Algeria; probable fall July 17, 2013; eucrite; 58 kg) and Buritizal (Brazil; confirmed fall August 14, 1967; LL3.2; 210g.

The meteorite masses ranged from the very small ALH 12073 eucrite from Antarctica (0.5 g) to the 58 kg *Aouinet Legraa*, also a eucrite.

Visit the ALPO Meteorites Section online at www.alpo-astronomy.org/meteorite/

Comets Section

Report by Carl Hergenrother, section coordinator
chergen@lpl.arizona.edu

The ALPO Comets Section continued to be active this summer. Over the past few months (June through mid-August), visual and CCD magnitude estimates of comets 252P/LINEAR, C/2013 X1 (PANSTARRS), C/2014 Q2 (Lovejoy), C/2014 S2 (PANSTARRS) and C/2016 V2 (Johnson) were submitted by Carl Hergenrother, John Sabia and Willian Souza.

CCD images of comets 29P/Schwassmann-Wachmann, 53P/Van Biesbroeck, 252P/LINEAR, C/2013 X1 (PANSTARRS), C/2014 Q2 (Lovejoy), C/2016 V2 (Johnson) and C/2016 A8 (LINEAR) were submitted by Charles Bell, Carl Hergenrother, Manos Kardasis, Gianluca Masi, Efrain Morales Rivera and John Sabia.

Drawings of 1P/Halley and C/1987 P1 (Bradfield) were submitted by Michael Mattei.

The best observed comet since June was long-period C/2013 X1 (PANSTARRS). It peaked at magnitude 6.3 to 6.5 in late June

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though its southerly location made it a difficult object for northern mid-latitude observers. By the time you read this report, PANSTARRS will have faded to 10th magnitude or fainter. Barring a surprise discovery or outburst, the fading of PANSTARRS brings the end of an amazing run of relatively bright comets over the past few years. We have to go back to late 2012 to find a period when there wasn't at least one comet brighter than 10th magnitude in the sky. Luckily, a new streak of reasonably bright comets will begin this December and extend well into 2017.

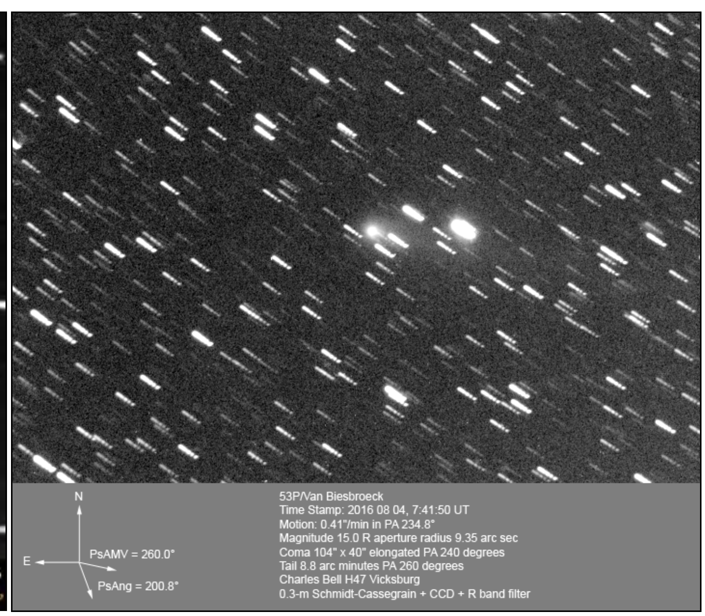
The next bright comet will be 45P/Honda-Mrkos-Pajdusakova (H-M-P). Returning once every 5.3 years, H-M-P will be making its 12th observed apparition since its discovery in 1948. CCD observers are asked to try and image H-M-P starting in October, though it may be as faint as 20th magnitude at the time. It will rapidly brighten to magnitude 17 by November 1, then magnitude11 by December 1 and then 7.5 by January 1.

Visual observers should be able to start observing it with small aperture telescopes or binoculars in mid-December. During the entire period, it will be an evening object low in the southwestern sky. So while you are out observing Venus, Saturn and Mars, think about making a few observations of H-M-P. Perihelion occurs on December 31 at 0.53 AU from the Sun. By mid-January, H-M-P will be too close to the Sun to be observed, but in February it rapidly races into the morning sky and passes within 0.084 AU of Earth on February 11.

CCD observers can also monitor other inbound comets expected to become bright in 2017:

- 41P/Tuttle-Giacobini-Kresak will get up to 5th-6th magnitude in April as it passes 0.14 AU from Earth. By the end of 2016, it will be 17th magnitude.
- 2P/Encke rounds the Sun every 3.3 years and this time, it passes perihelion in March. It starts at 17th magnitude in October and brightens to 14th magnitude by the end of the year.
- Long-period comet C/2015 V2 (Johnson) is currently 14th magnitude and well-placed for imaging over the next few months as it approaches its June perihelion when it will be magnitude 6 to 7.

At any one time, there are usually 6-12 comets brighter than magnitude 13. Visual observers with access to large aperture telescopes are encouraged to make drawings and magnitude estimates for these comets. CCD imagers will never run out of cometary targets and are encouraged to image and measure



Comets C/2016 A8 Linear 252P/LINEAR and 53P/Van Biesbroeck. See images and text for details.

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brightnesses for all comets within range of their instruments.

The ALPO Comets Section Gallery images of C/2016 A8 (LINEAR) by Efrain Morales Rivera and 53P/Van Biesbroeck by Charles Bell are examples of fainter comets that can be routinely followed with CCDs. A thorough list of observable comets is maintained by Seiichi Yoshida on his comet website at *http://www.aerith.net/comet/weekly/current.html*.

Drawings and images of current and past comets are being archived in the ALPO Comets Section image gallery at *http://www.alpo-astronomy.org/gallery/main.php?g2_itemId=4491*

Please consider reporting all your comets observations, past and present, to Comet Section Coordinator Carl Hergenrother at the email address listed at the beginning of this report.

Visit the ALPO Comets Section online at *www.alpo-astronomy.org/comet*

Solar Section

Report by Rik Hill, section coordinator & science advisor
rhill@lpl.arizona.edu

So far in 2016, we have more than doubled our membership to a total of 25 from around the world. Observations have increased — even in the face of decreasing solar activity. For the last rotation, (Carrington Rotation 2178), we took in 400 observations, and for CR 2179 the number was over 450. This represents an over six-fold increase in data in the last year.

The ALPO Solar Section collected images of the recent Mercury transit in our Archive to assist with the Astronomical League program to calculate the distance of the Astronomical Unit, based on the parallax shown between Mercury images taken at the same time, but different locations on Earth. Congratulations are to be extended to the League in this effort and to all the individual observers! This shows the value of our Solar Archive to amateur astronomy projects.

There have been several staff changes since the last Board Meeting. In May, Pamela Shivak joined the Section staff to act as a social media outreach person to post things on places like FaceBook, highlighting our activities and observations. She is well-known among solar observers around the world and very active on social media. Kim Hay, the former coordinator (and before that, assistant coordinator) for the Solar Section, has decided to resign from her position as assistant coordinator with the Solar Section. We are all grateful to her for her dedication in keeping things going for so long. Thanks Kim!

The current staff of the ALPO Solar Section is:

- Richard "Rik" Hill, coordinator & scientific advisor
- Theo Ramakers, acting assistant coordinator
- Rick Gossett, acting assistant coordinator (moderator, ALPO Solar Section Yahoo email list)
- Pamela Shivak, acting assistant coordinator (publicity & social media)

To join the Yahoo Solar ALPO e-mail list, please go to *https://groups.yahoo.com/neo/groups/Solar-Alpo/info*

For information on solar observing – including the various observing forms and information on completing them – go to *www.alpo-astronomy.org/solar*

Mercury Section

Report by Frank J. Melillo, section coordinator
frankj12@aol.com

The Mercury section received some interesting observations last Spring. It was also the first time that I myself imaged Mercury on four nights during the same evening apparition.

Each time I imaged Mercury, it was just around sunset while it was a bit higher above the tree-line near where I live. I also received a few observations from others.

Mercury went through Inferior Conjunction with the Sun on May 9. But it was a special treat for most of us. On that day, Mercury passed in front of the Sun in the United States. Nearly 43 years later, since my first time seeing it as a kid in 1973, I had a second opportunity to observe the transit of Mercury. While the weather cooperated most of the time, I was clouded out during the last half hour of the transit. I did some imaging and include one of those images with this report. Mercury was neatly round against the Sun and the apparent disc diameter was just about 12 arc-seconds. Mercury was at aphelion on

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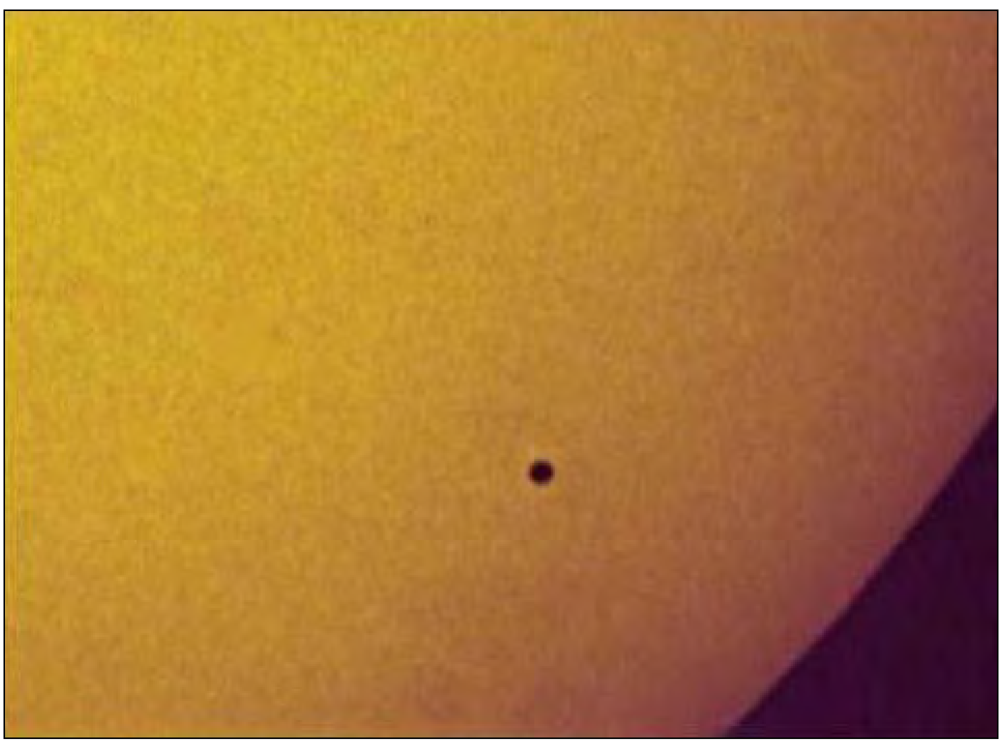
May 19, a point in its orbit farthest away from the Sun, yet closest to Earth if it occurs at or near Inferior Conjunction. Therefore, it took place at the time when Mercury was closest to Earth resulting in a larger disc diameter during transit. More reports of the transit will be in future issues.

If you are planning to observe Mercury, you will have the opportunity to observe the upcoming favorable morning apparition from late September to mid-October. It will pass through Inferior Conjunction with the Sun (of course, no transit) on September 12. Mercury will move rapidly away from the Sun and will reach its greatest elongation on September 28, which will be 18 degrees west of the Sun. On that morning, Mercury will shine at -0.5 magnitude and display a half-phase at 7 arc-seconds in diameter. If you continue to observe Mercury with the naked-eye well into October, you will find Jupiter creeping up behind the Sun and will pass south of Mercury on October 11th. Both planets will be within about ¾ of a degree of each other. Mercury will be bright at -1.1 magnitude, but Jupiter will shine a touch brighter at -1.7 magnitude. In fact, Jupiter's magnitude at -1.7 is nearly the faintest possible! A nice pair of binoculars will show a fine view of both planets about 30 minutes before sunrise. After that, Mercury heads toward Superior Conjunction with the Sun on October 27.



Transit of Mercury, May 9, 2016, as imaged by ALPO Mercury Section Coordinator Frank Melillo, Holtsville, NY, USA, at 17:57 UT. Equipment details: Celestron 8-inch SCT at prime focus, f/10; 2.5-inch off-axis solar filter; 1/2 second exposure with Starlight Xpress MX-5 ccd camera. North at top, West at right.

Visit the ALPO Mercury Section online at www.alpo-astronomy.org/mercury

Venus Section

Report by Julius Benton, section coordinator
jlbaina@msn.com

Venus is now visible in the western twilight sky after sunset at apparent visual magnitude of -3.8 (as of early October) as a gibbous disk about 85.5% illuminated with an apparent diameter of about 12.0 arc-seconds. During the current 2016-17 Eastern (Evening) Apparition, Venus is passing through its waning phases (a progression from fully illuminated through crescent phases). Thus, observers witness the leading hemisphere of the planet at the time of sunset on Earth. Venus will attain Greatest Elongation east of 47° on January 12, 2017 and reach theoretical dichotomy (predicted half-phase) on January 14th. The planet will portray its greatest brilliancy on February 18 at apparent visual magnitude -4.8.

The accompanying Table of Geocentric Phenomena in Universal Time (UT) is presented for the convenience of observers for this apparition.

As of this report, the ALPO Venus Section has accumulated in excess of a hundred visual drawings and digital images from observers around the world for the 2015-16 Western (Morning) Apparition that ended with Superior Conjunction on June 6, 2016. It is likely, however, that additional observations will be added

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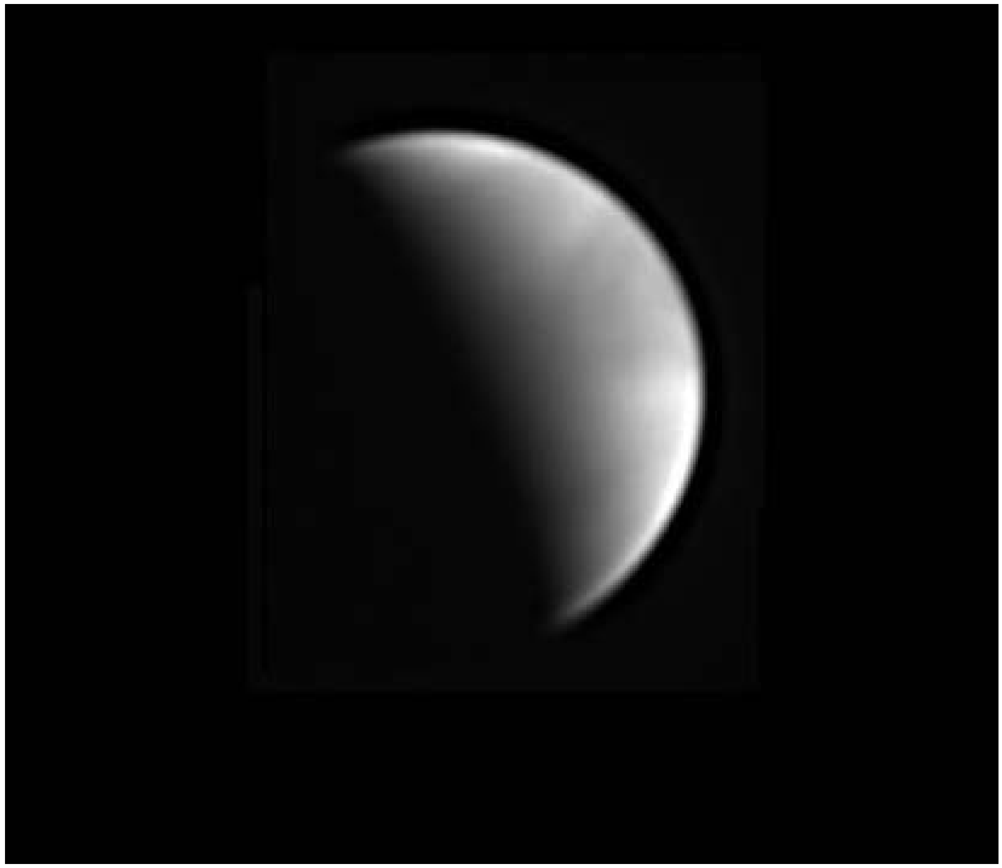

Paul Maxson of Phoenix, AZ, USA, contributed this excellent of Venus last year on October 16, 2015 at 13:40 UT using a UV filter with a 25.0 cm (9.8 in.) Dall Kirkham telescope in good seeing conditions. Banded and roughly horizontal V, Y, or ψ (psi) shaped dusky clouds are apparent in this image. The apparent diameter of Venus is 27.1 arc-seconds, phase (k) 0.450 (45.0% illuminated), and visual magnitude -4.5. South is at top of image

to the database as participants finalize their reports and submit them.

For the 2015-16 Western (Morning) Apparition, observers routinely imaged atmospheric features in the form of radial, amorphous, irregular, and banded dusky markings at UV and near-IR wavelengths. Visual observers also reported analogous dusky features on the disk of the planet in integrated light (no filter) and with color filters. A report on the 2015-16 Western (Morning) Apparition will appear in this Journal at a later date.

For the 2016-17 Eastern (Evening) Apparition, with Venus reaching a maximum angular distance from the Sun of 47°, the effects arising from the excessive brilliance of the disk at that time is troublesome when observing Venus against a dark sky. Well in advance of and following greatest elongation, Venus is frequently low in the western sky where atmospheric differential refraction and prismatic dispersion produce poor seeing conditions. So, at such times, many observers have adopted a practice of viewing Venus only when it has attained an altitude of about 20° or more above the horizon, which is not always possible.

Consequently, although it may seem difficult locate Venus during daylight, the planet is comparatively bright, and in practice and assuming a clear sky, observers can usually find the planet if they know exactly where to look. Also, if the planet is viewed under darkened sky conditions, the presence of a slight haze or high cloud often stabilizes and reduces glare conditions while improving definition.

Readers of this *Journal* are likely acquainted with our ongoing collaboration with professional astronomers as exemplified by our sharing of visual observations and digital images at various wavelengths during ESA's Venus Express (VEX) mission that began in 2006 and concluded in 2015. It was a

Geocentric Phenomena of the 2016-17 Eastern (Evening) Apparition of Venus in Universal Time (UT)

Superior Conjunction	2016	Jun 06 (angular diameter = 9.7 arc-seconds)
Greatest Elongation (East)	2017	Jan 12 (47°)
Predicted Dichotomy		Jan 14.56^d (exactly half-phase predicted)
Greatest Illuminated Extent		Feb 18 (m_v = –4.8)
Inferior Conjunction		Mar 25 (angular diameter = 59.8 arc-seconds)

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Lunar Calendar for October thru December 2016

2016		UT	EVENT
Oct	01	00:12	New Moon
	03	17:30	Moon-Venus: 5.6° S
	04	11:02	Moon Apogee: 406,100 km
	06	08:04	Moon-Saturn: 4.2° S
	08	06:03	Moon Extreme South Dec.: 18.5° S
	09	04:33	First Quarter
	13	09:43	Moon Descending Node
	16	04:23	Full Moon
	16	23:36	Moon Perigee: 357,900 km
	19	06:18	Moon-Aldebaran: 0.3° S
	20	23:38	Moon Extreme North Dec.: 18.6° N
	22	19:14	Last Quarter
	25	04:01	Moon-Regulus: 1.7° N
	26	01:45	Moon Ascending Node
	28	09:33	Moon-Jupiter: 1.6° S
	30	17:38	New Moon
	31	19:29	Moon Apogee: 406,700 km
Nov	02	19:38	Moon-Saturn: 4.1° S
	04	13:04	Moon Extreme South Dec.: 18.7° S
	07	19:51	First Quarter
	09	15:57	Moon Descending Node
	14	11:23	Moon Perigee: 356,500 km
	14	13:52	Full Moon
	15	16:50	Moon-Aldebaran: 0.4° S
	17	09:32	Moon Extreme North Dec.: 18.8° N
	21	08:33	Last Quarter
	21	10:08	Moon-Regulus: 1.4° N
	22	02:48	Moon Ascending Node
	25	01:47	Moon-Jupiter: 2.1° S
	27	20:08	Moon Apogee: 406,600 km
	29	12:18	New Moon
Dec	01	19:56	Moon Extreme South Dec.: 18.9° S
	03	12:34	Moon-Venus: 6.3° S
	05	10:39	Moon-Mars: 3.1° S
	06	17:35	Moon Descending Node
	07	09:03	First Quarter
	12	23:27	Moon Perigee: 358,500 km
	13	04:14	Moon-Aldebaran: 0.4° S
	14	00:05	Full Moon
	14	21:43	Moon Extreme North Dec.: 18.9° N
	18	18:14	Moon-Regulus: 1.1° N
	19	04:46	Moon Ascending Node
	21	01:56	Last Quarter
	22	16:37	Moon-Jupiter: 2.7° S
	25	05:55	Moon Apogee: 405,900 km
	29	03:30	Moon Extreme South Dec.: 19° S
	29	06:53	New Moon

Table courtesy of William Dembowski and NASA's SkyCalc Sky Events Calendar

tremendously successful Pro-Am effort involving ALPO Venus observers around the globe.

It should be noted that it is still not too late for those who want to send their images to the ALPO Venus Section and the VEX website (see below). These observations remain important for further study and will continue to be analyzed for several years to come as a result of this endeavor.

The VEX website is at:

http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856.

A follow-up on the Pro-Am effort is underway with Japan's (JAXA) Akatsuki mission that was to start full-scale observations this past in April, and more will be announced about this endeavor soon in this *Journal*.

The observation programs of the ALPO Venus Section are listed on the Venus page of the ALPO website at *http://www.alpo-astronomy.org/venus* as well as in considerable detail in the author's ALPO Venus Handbook available from the ALPO Venus Section as a pdf file.

Observers are urged to attempt to make simultaneous observations by performing digital imaging of Venus at the same time and date that others are imaging or making visual drawings of the planet. Regular imaging of Venus in both UV, IR and other wavelengths is important, as are visual numerical relative intensity estimates and reports of features seen or suspected in the atmosphere of the planet (for example, dusky

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atmospheric markings, visibility of cusp caps and cusp bands, measurement of cusp extensions, monitoring the Schröter phase effect near the date of predicted dichotomy, and looking for terminator irregularities).

Routine use of the standard ALPO Venus observing forms will help observers know what should be reported in addition to supporting information such as telescope aperture and type, UT date and time, magnifications and filters used, seeing and transparency conditions, etc.

Venus observers should monitor the dark side of Venus visually for the Ashen Light and use digital imagers to capture any illumination that may be present on the plane as a cooperative simultaneous observing endeavor with visual observers. Also, observers should undertake imaging of the planet at near-IR wavelengths (for example, 1000nm), whereby the hot surface of the planet becomes apparent and occasionally mottling shows up in such images attributable to cooler dark higher-elevation terrain and warmer bright lower surface areas in the near-IR.

The ALPO Venus Section encourages readers worldwide to join us in our projects and challenges ahead.

Individuals interested in participating in the programs of the ALPO Venus Section are encouraged to visit the ALPO Venus Section online http://www.alpo-astronomy.org/venusblog/

Lunar Section

Lunar Topographical Studies / Selected Areas Program
Report by Wayne Bailey, program coordinator
wayne.bailey@alpo-astronomy.org

The ALPO Lunar Topographical Studies Section (ALPO LTSS) received a total of 141 new observations from 16 observers during the April-May quarter. Eight contributed articles were published in addition to numerous commentaries on images submitted.

The *Focus-On* series in the newsletter *The Lunar Observer* continued under Jerry Hubbell, with articles on Kepler and Palus Emidemiarum-Capuanus. Upcoming *Focus-On* subjects include Montes Apennines-Palus Putredinis and the Schiller-Zuchius Basin.

We are currently considering whether to make any changes to the Lunar Topographic Studies/Selected Areas programs. Anyone with suggestions for additional programs, changes to existing programs, or suggested eliminations is welcome to send them to me at the e-mail above.

All electronic submissions should now be sent to both me at wayne.bailey@alpo-astronomy.org and also to Jerry Hubbell (jerry.hubbell@alpo-astronomy.org).

Hard copy submissions should continue to be mailed only to me at the address provided in the *ALPO Resources* section of this *Journal*.

For more info (including current and archived issues of *The Lunar Observer*) visit moon.scopesandscapes.com

Lunar Meteoritic Impacts
Brian Cudnik, program coordinator
cudnik@sbcglobal.net

Please visit the ALPO Lunar Meteoritic Impact Search site online at www.alpo-astronomy.org/lunar/lunimpacts.htm.

Lunar Transient Phenomena
Report by Dr. Anthony Cook, program coordinator
tony.cook@alpo-astronomy.org

We welcome new observers, whether they are experienced visual observers or high-resolution lunar imagers, in order to solve additional past historical lunar observational puzzles.

A list of dates and UTs to observe repeat illumination events can be found on: http://users.aber.ac.uk/atc/lunar_schedule.htm

If you think that you see an LTP, please follow through the rigorous checklist also on that web site before contacting me.

Twitter LTP alerts are available on: http://twitter.com/lunarnaut.

Finally, please visit the ALPO Lunar Transient Phenomena site online at http://users.aber.ac.uk/atc/alpo/ltp.htm

Mars Section

Report by Roger Venable, section coordinator
rjvmd@hughes.net

The Red Planet is now at as southerly a declination as it can have. This favors observers located in Earth's Southern Hemisphere, and good images continue to be produced by

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Anthony Wesley in Australia, Clyde Foster in South Africa, and some others.

Several observers in the Northern Hemisphere are continuing to observe it, but for them it is getting a bit harder to image each evening. In the last few months, we have enjoyed watching the development of the North Polar Hood and the North Polar Cap beneath it, and the dissipation of the South Polar Hood to reveal the South Polar Cap.

Several small dust storms have been detected, notably over Mare Acidalium, and these have been remarkable in that they have had a brown color, darker than most dust storms appear.

I thank the many observers who have contributed images, drawings, and descriptive notes during this apparition.

New observers will likely benefit from Jeff Beish's remarkably complete observing manual, accessible from the ALPO website at www.alpo-astronomy.org . On the home page, click on "Mars Section" in the list at the left, and on the resulting Mars Section page, scroll down and find "Mars Observer's Cafe" in the list. This link will lead you to a whole book of observing information.

Please join 1,424 of us on the Yahoo Mars observers' list at https://groups.yahoo.com/neo/groups/marsobservers/info . When you make an observation, please either share it with the group by posting it in the photos section of the Yahoo list, or send it directly to me at rjvmd@hughes.net . I look forward to hearing from many of you this year.

Visit the ALPO Mars Section online and explore the Mars Section's recent observations: www.alpo-astronomy.org/mars

Minor Planets Section

Frederick Pilcher,
section coordinator
pilcher35@gmail.com

Some of the highlights published in the *Minor Planet Bulletin*, Volume 43, No. 3, 2016, July-September, are presented. These represent the recent achievements of the ALPO Minor Planets Section.

Toni Santana-Ros, Anna Marciniak, and Przemyslaw Bartczak of the astronomy department of Adam Mickiewicz University, Poznan, in collaboration with the European Space Agency (ESA) announce the Gaia Ground-based Observational Service (Gaia-GOSA) for asteroids.

All amateurs with CCD capability are invited to obtain a sequence of CCD images of asteroids as the Gaia satellite also observes the respective fields and obtains precise comparison magnitudes. The participant should describe his equipment and the nights on which he is able to observe. ESA will then select asteroids suitable for the equipment and available nights of observation. The observer does not need to construct the lightcurve, only upload the data and ESA will draw the lightcurve. I invite readers who are not members of the ALPO Minor Planets Section, in addition to those who are, to register at www.gaiagosa.eu and participate.

Lorenzo Franco has published a shape and spin axis model for 53 Kalypso. A sidereal rotation period 9.035058 +/- 0.000008 hours is established. As usually occurs with lightcurve inversion modeling, there are two possible and equally likely north pole orientations at celestial longitude and latitude 168 degrees, +12 degrees; and 349 degrees, +8 degrees; respectively.

Amadeo Aznar Macias, Valencia, Spain, assisted by Julian Oey, Roger Groom, and Petr Pravec, has found that 5674 Wolff is a fully synchronous binary system with the rotation periods of both components synchronized with the orbital revolution period of 93.7 hours. The secondary is nearly as large as the primary with the ratio of diameters D2/D1 >= 0.80. This solution is especially robust because both the narrow dips caused by occultations\transits\eclipses and the smooth variation caused by rotation of elongated bodies appears in the lightcurves.

A team of CCD photometrists including Frederick Pilcher, Vladimir Benishek, Jens Jacobsen, Leif Hugo Kristensen, Kim Lang, Frank R. Larsen, Caroline Odden, with data analysis by Petr Pravec have found that main belt asteroid 1016 Anitra is a nonsynchronous binary. The rotation period of the primary component is 5.92951 hours and of the smaller satellite is 2.60914 hours. Four additional attenuations of duration one to several hours suggest that transits, occultations, or eclipses within the system were observed, but the data are insufficient to define the orbit.

Robert Stephens required observations of 19204 Joshuatree in

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3 oppositions 2006, 2013, and 2016 to finally unravel strange results as the superposition of lightcurves of a very slowly rotating primary with period 480 hours and a rapidly rotating secondary with period 21.25 hours.

Binary properties of several other asteroids were found or observed again: 1453 Fennia, 2048 Dwornik, 3122 Florence, 8077 Hoyle, 27776 Cortland, (58155) 1998 VD, and (463380) 2013 BY45.

Rotation periods less than about 2.2 hours, the centrifugal breakup limit at which centrifugal force at the equator exceeds gravity, are almost never observed for asteroids larger than 300 meters diameter, but occur for most asteroids of smaller size as observed during their brief close approaches to Earth. This strongly suggests that asteroids larger than 300 meters are rubble piles that disrupt with rapid rotation, but smaller ones are solid rocks. Three additions to the set of super-fast rotators were reported in *Minor Planet Bulletin* 43-3:2015 QT3, 2016 DV1, and 2016 GE1, and from their brightness all are inferred to be smaller than 300 meters.

In addition to asteroids specifically identified above, lightcurves with derived rotation periods are published for 141 other asteroids as listed below:

123, 240, 314, 333, 344, 346, 347, 407, 458, 570, 619, 633, 730, 800, 841, 862, 866, 871, 901, 967, 1048, 1077, 1166, 1172, 1173, 1186, 1196, 1234, 1249, 1271, 1412, 1685, 1727, 1859, 1863, 1867, 1946, 2150, 2207, 2258, 2333, 2336, 2357, 2650, 2674, 2729, 2813, 2893, 2895, 2925, 3012, 3069, 3115, 3299, 3317, 3376, 3494, 3562, 3708, 3829, 3867, 3870, 3895, 3913, 3958, 3998, 4233, 4348, 4520, 4707, 4709, 4715, 4722, 4749, 4791, 4867, 5130, 5446, 5709, 5863, 6173, 6310, 6394, 6859, 7350, 7694, 7822, 9060, 10399, 11054, 11089, 11388, 13478, 13504, 15977, 16669, 20826, 21056, 22180, 23183, 23187, 24756, 25332, 25891, 29298, 31221. 32772, 33319, 41588, 53435, 56482, 68216, 85628, 85953, 85990, 101429, 137805, 152575, 155341, 162038, 163696, 205706, 267223, 275974, 337866, 345705, 348400, 385250, 446833, 450160, 2010 VU198, 2013 VA10, 2015 PS, 2015 WH9, 2015 XB379, P/2016 BA14, 2016 BC14, 2016 EV27, 2016 CC30, 2016 BA40.

Secure periods have been found for some of these asteroids, and for others only tentative or ambiguous periods. Some are of asteroids with no previous lightcurve photometry,

Jupiter as imaged by Anthony Welsey, showing the GRS, Io and its shadow.

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others are of asteroids with previously published periods that may or may not be consistent with the newly determined values.

Newly found periods that are consistent with periods previously reported are of more value than the unitiated may realize. Observations of asteroids at multiple oppositions widely spaced around the sky are necessary to find axes of rotation and highly accurate sidereal periods.

The *Minor Planet Bulletin* is a refereed publication and that it is available online at http://www.minorplanet.info/mpbdownloads.html.

Annual voluntary contributions of $5 or more in support of the publication are welcome.

Please visit the ALPO Minor Planets Section online at http://www.alpo-astronomy.org/minor

Jupiter Section

Report by Ed Grafton, section coordinator
ed@egrafton.com

Jupiter reaches solar conjunction on September 26, 2016 when it will be hidden by the glare of the Sun and only about 30 arc seconds in apparent diameter. On July 22, 2016, Anthony Wesley captured Jupiter and Io and its shadow when Jupiter was 32 arc seconds in diameter.

Visit the ALPO Jupiter Section online at http://www.alpo-astronomy.org/jupiter

Galilean Satellite Eclipse Timing Program

Report by John Westfall, program coordinator
johnwestfall@comcast.net

Contact John Westfall via e-mail at *johnwestfall@comcast.net* or via postal mail at 5061 Carbondale Way, Antioch, CA 94531 USA to obtain an observer's kit, also available on the Jupiter Section page of the ALPO website.

Saturn Section

Report by Julius Benton, section coordinator
jlbaina@msn.com

The 2015-16 apparition of Saturn is ongoing this fall with the planet still visible in the western sky for several hours after sunset in the evening sky. With opposition approaching on December 10, the best opportunities to view and image the planet will diminish rather quickly coupled with its southerly declination of about -21° for northern hemisphere observers.

Two tables of Geocentric Phenomena in Universal Time (UT) are presented for the convenience of observers this time; one for the 2015-16 apparition and, for advanced planning purposes, another for the 2016-17 apparition.

So far this apparition, the ALPO Saturn Section has received a several hundred excellent images and visual observations, with reports continuing of occasional white spots in the northern and southern halves of the Equatorial Zone (denoted as EZn and EZs, respectively).

Small white spots have been imaged in the North Temperate Zone (NTeZ) at approximate saturnigraphic latitude +44°, the North Tropical Zone (NTrZ) near saturnigraphic latitude +30°, and the North Equatorial Belt Zone (NEBZ) at about saturnigraphic latitude +24°.

Dark spots have also been imaged in the Equatorial Band (EB) and North North North Temperate Zone (NNNTeZ) at saturnigraphic latitudes 0° and +63°, respectively.

With the rings tilted about +26° towards Earth, observers have experienced near-optimum views of the northern hemisphere of the globe and north face of the rings this observing season.

It will be curious to see how discrete activity seen or imaged on Saturn during this apparition develops and possibly persists throughout the remaining months of the observing season plus what new atmospheric phenomena might emerge.

Pro-Am cooperation with the ongoing Cassini mission continues during the 2015-16 apparition.

ALPO Saturn observing programs are listed on the Saturn page of the ALPO website at http://www.alpo-astronomy.org/saturn as well as in more detail in the author's book, *Saturn and How to Observe It*, available from Springer, Amazon.com, etc., or by writing to the ALPO Saturn Section for further information.

Observers are urged to pursue digital imaging of Saturn at the same time that others are imaging or visually monitoring the planet (that is,

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simultaneous observations). Also, while regular imaging of the Saturn is very important, far too many experienced observers neglect making visual numerical relative intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time.

The ALPO Saturn Section thanks all observers for their dedication and perseverance in regularly submitting so many excellent reports and images. Cassini mission scientists, as well as other professional specialists, continue to request drawings, digital images, and supporting data from amateur observers around the globe in an active Pro-Am cooperative effort.

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn pages on the official ALPO Website at *www.alpo-astronomy.org/saturn*

All are invited to also subscribe to the Saturn e-mail discussion group at *Saturn-ALPO@yahoogroups.com*

Geocentric Phenomena for the 2015-16 Apparition of Saturn in Universal Time (UT)

Conjunction	2015 Nov 30^{d} UT
Opposition	2016 Jun 03^{d}
Conjunction	2016 Dec 10^{d}
Opposition Data:	
Equatorial Diameter Globe	18.4 arc-seconds
Polar Diameter Globe	16.4 arc-seconds
Major Axis of Rings	41.6 arc-seconds
Minor Axis of Rings	18.2 arc-seconds
Visual Magnitude (m_V)	0.0
B =	+25.9°
Declination	-20.6°
Constellation	Ophiuchus

Geocentric Phenomena for the 2016-17 Apparition of Saturn in Universal Time (UT)

Conjunction	2016 Dec 10^{d} UT
Opposition	2017 Jun 15^{d}
Conjunction	2017 Dec 21^{d}
Opposition Data:	
Equatorial Diameter Globe	18.3 arc-seconds
Polar Diameter Globe	16.3 arc-seconds
Major Axis of Rings	41.5 arc-seconds
Minor Axis of Rings	18.5 arc-seconds
Visual Magnitude (m_V)	0.0
B =	+26.5°
Declination	-22.0°
Constellation	Ophiuchus

Remote Planets Section

Report by Richard W. Schmude, Jr., section coordinator
schmude@gordonstate.edu

Uranus and Neptune will be well-placed for observation during early fall. According to the *Astronomical Almanac for the Year 2016*, Uranus will reach opposition on October 15 while Neptune will have already reached opposition on September 2. [Editor's Note: *skyandtelescope.com* is a great source to find specific locations of sky objects.)

John Sussenbach, along with Milika & Nicholas, have already posted images of Neptune on the ALPO Japan Latest website showing a bright spot on Neptune. These images were recorded in July and June 2016, respectively. The writer also collected his first brightness measurements of Uranus in July 2016.

The writer has finished the 2015-2016 Remote Planets report. This report should be in the hands of the Journal editor by early September.

The writer has also started archiving images of Uranus, Neptune and Pluto. This archive is on the ALPO website. I am asking everyone to please name your images as follows:

UYYYY-MM-DD-TTTT-observer (for Uranus images)

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NYYYY-MM-DD-TTTT-observer (for Neptune images)

PYYYY-MM-DD-TTTT-observer (for Pluto images)

Obviously, the letters U, N and P are the first letters for Uranus, Neptune and Pluto. This will ensure that images are placed in chronological order into the archive by planet.

Finally, a reminder that the book *Uranus, Neptune and Pluto and How to Observe Them*, which was authored by this coordinator, is available from Springer at www.springer.com/astronomy/popular+astronomy/book/978-0-387-76601-0 or elsewhere (such as www.amazon.ca/Uranus-Neptune-Pluto-Observe-Them/dp/0387766014) to order a copy.

Visit the ALPO Remote Planets Section online at www.alpoastronomy.org/remote

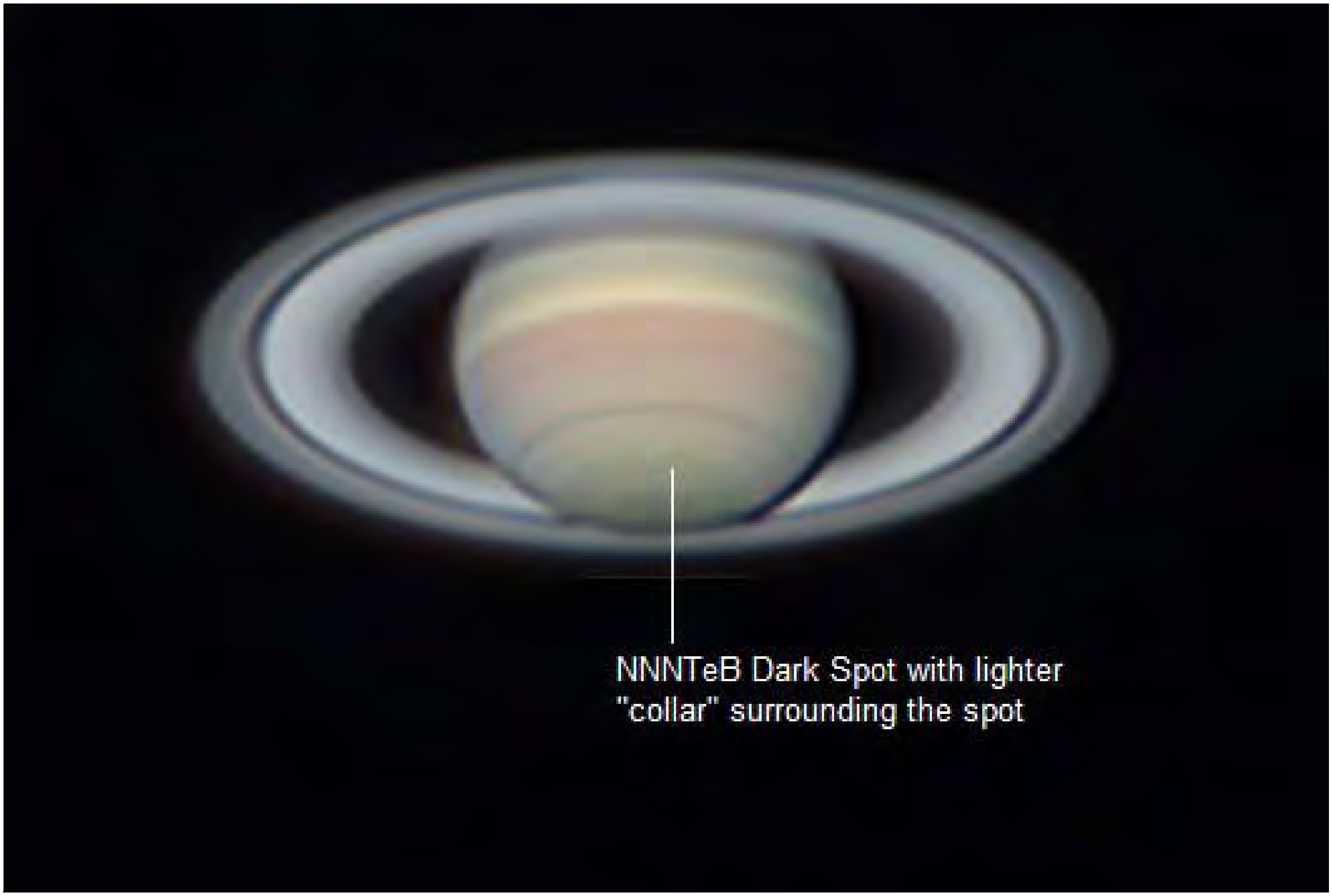

Image of Saturn taken at RGB wavelengths on July 3, 2016 at 10:39 UT by Trevor Barry of Broken Hill, Australia, using a 40.6cm (16.0 in.) Newtonian. There is a slightly elongated dark spot in the NNNTeB approaching the CM at measured saturnigraphic latitude +63.6° surrounded by a lighter "collar" and presumably the same long-lived feature imaged frequently by observers in the immediately preceding apparition. Numerous other belts and zones are seen on the globe, including the North polar hexagon and the major ring components. Cassini's division (A0 or B10) clearly runs all the way around the circumference of the rings (except where the globe blocks our view of the rings). Also visible is Encke's “complex” (A5) and other "intensity minima" at the ring ansae. The dark shadow of the globe on the rings is situated toward the West (right) in this image taken after opposition. Seeing was slightly above average (S=5.5) with good sky transparency (no numerical rating was given). The apparent diameter of Saturn's globe was 18.1" with a ring tilt of +26.0°. CMI = 315.8°, CMII = 252.5°, CMIII = 116.4°. S is at the top of the image.

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Obituary: Antonín Rükl, 1932–2016

By Ken Poshedly

A world-renowned lunar cartographer, whose beautiful atlases have become prized possessions, has died at age 83.

Antonín Rükl, noted lunar cartographer, selenographer, prolific author, and retired director of the Prague Planetarium, passed away on July 12 at his home in Prague, Czech Republic.

Mr. Rükl's loss is being deeply felt by anyone who loves looking at the Moon. Among the books he authored, his legendary *Atlas of the Moon*, originally published in 1991 and most recently revised in 2007, remains one of the most sought-after books of its kind.

His astronomical maps, atlases and picture publications were published not only in the Czech Republic but were also translated into many languages and published abroad.

Besides his much-admired lunar atlas, an incomplete list of Mr. Rükl's other books includes *Skeleton Map of the Moon, 1:6000000* (1965), *Maps of Lunar Hemispheres, 1:10000000* (1972), *Moon, Mars and Venus* (1976), *The Amateur Astronomer* (1985), *Hamlyn Encyclopedia of Stars and Planets* (1988), *Hamlyn Atlas of the Moon* (1991), *The Constellation Guide Book* (1996), and *A Guide to the Stars, Constellations and Planets* (English edition, 1998).

Known worldwide for his lunar cartography, Antonín Rükl received Cena Františka Nušla in 2012 — the Czech Republic's highest award for astronomical achievement. *Photo by Vladimír Libý*

Mr. Rükl was born in Cáslav, Czechoslovakia, on September 22, 1932. His keen interest in astronomy began as a student hobby when he was 17 years old. He graduated from Czech Technical University in Prague in 1956, after which he joined the Czech Technical University as a staff member, working at the Prague Planetarium in February 1960. Mr. Rükl became head of the planetarium shortly after its establishment, holding that position until late 1999 when he "semi-retired." Even then, according to a statement released after his death, Mr. Rükl continued to work on planetarium programs until his last days.

Besides a planetarium directors' conference in 1999 in Florida, Mr. Rükl's only other visit to the U.S. was as the keynote speaker at the Atlanta Astronomy Club's *Peach State Star Gaze* in April 2000. At that event, more than 200 attendees gathered to

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attend his two presentations on how he researched and prepared the scrupulously detailed maps for his lunar atlas. In addition to his knowledge and professionalism, what impressed everyone was his humble and unpretentious demeanor. For example, after the daytime talks, he walked the observing field each night on his own, chatting with attendees, autographing their copies of his lunar atlas, and even peering through their scopes at the evening's young Moon.

Prior to the PSSG event, Mr. Rükl had privately communicated to the event organizers that he himself had no telescope of his own and asked for advice on what he might consider purchasing. Instead, a group of AAC members pitched in to surprise Mr. Rükl with his own Meade ETX scope at the event. It was also there Mr. Rükl received a lifetime membership in the Association of Lunar & Planetary Observers. Also in 2000, minor planet 15395 was named for this beloved lunar specialist.

Afterward, he said that felt more honored here in the U.S. than he was back home. However, in 2012 he was given Cena Františka Nušla — the Czech Republic's highest award for astronomical achievement.

Mr. Rükl's wife, Sonja, passed away several years ago. They are survived by a daughter (Jana), a son (Michal), and four grandchildren.

An Invitation from SARA

By Stephen Tzikas

As a member of both the ALPO and the Society of Amateur Radio Astronomers (SARA), I have often looked for coinciding interests. One of the projects I have undertaken at SARA was the creation of SARA Sections on their website to focus interests and better organize them, as they relate to strategic planning, observing manuals, and observational databases.

The Solar System Section of the SARA website, found at: *http://radio-astronomy.org/node/196*, is where ALPO members can find projects related to the Solar System using radio receivers and antennae at affordable costs. SuperSID receivers allow the public to submit observations of solar activity to a University of Stanford database for use by professionals. Radio Jove receivers allow the public to collect data on Jupiter radio storms and submit them to NASA.

Radio meteors are another endeavor where, through simple and affordable self-defined radio (SDR), the public can observe meteors in radio frequency. Additionally, INSPIRE kits can be purchased and assembled to observe the natural radio of Earth's ionosphere.

Those familiar with the Astronomical League's observing programs may find a radio astronomy program to help guide and discipline such observations. Under the Analytical SARA Section at *http://radio-astronomy.org/node/200*, I compiled an occultation observing protocol. While this observing manual is meant for more advanced amateurs, it does offer information on observations of radio occultations involving the Moon, comets, and the planets.

If you are completely new to amateur radio astronomy, you may find helpful some of the information posted for beginners in the introduction to the SARA Sections located at *http://radio-astronomy.org/node/202*.

Annual membership in SARA is only $20, and even less for students ($5). Members receive an electronic journal, and can participate in an active listserv. SARA has two conferences annually; one is always at the National Radio Astronomy Observatory (NRAO) in Green Bank, WV, and one occurs at a western United States location. The NRAO location offers participants the use of a 40-foot radio telescope.

Membership in both the ALPO and SARA offers a person the opportunity to find items of similar focus and build upon synergies, helping to enhance the overall Solar System experience.

Feature Story:
ALPO Board Meeting Minutes, August 13, 2016, Washington, DC

Minutes provided by Matt Will,
ALPO Secretary / Treasurer
matt.will@alpo-astronomy.org

Call to Order

On Saturday, August 13, 2016, at 8:01 a.m. EDT (Eastern Daylight Time) ALPO Executive Director and Board Chairman, Mike Reynolds called the ALPO Board of Directors to order in the CC2 Room of the National Rural Electric Cooperative Association (NRECA) Center located in downtown Arlington, Virginia. The ALPO Board meeting was held during the 2016 AL/ALPO Arlington Conference (ALCon 2016).

Board Members Present

ALPO Board members Michael D. Reynolds (Executive Director and Chairman), Kenneth T. Poshedly, John E. Westfall, and Matthew L. Will (Secretary and Treasurer) were present in person at the Board meeting with Board member Julius L. Benton, Jr., participating via our AT&T teleconference line, away from the meeting site. Board members, Sanjay Limaye and Richard W. Schmude, Jr. (Associate Executive Director) could not attend or participate in this year's annual meeting due to prior commitments. Also in attendance were ALPO Lunar Section Coordinator Wayne Bailey, and ALPO member Stephen Tzikas.

Issue One: Approval of the Board Meeting Minutes of 2015

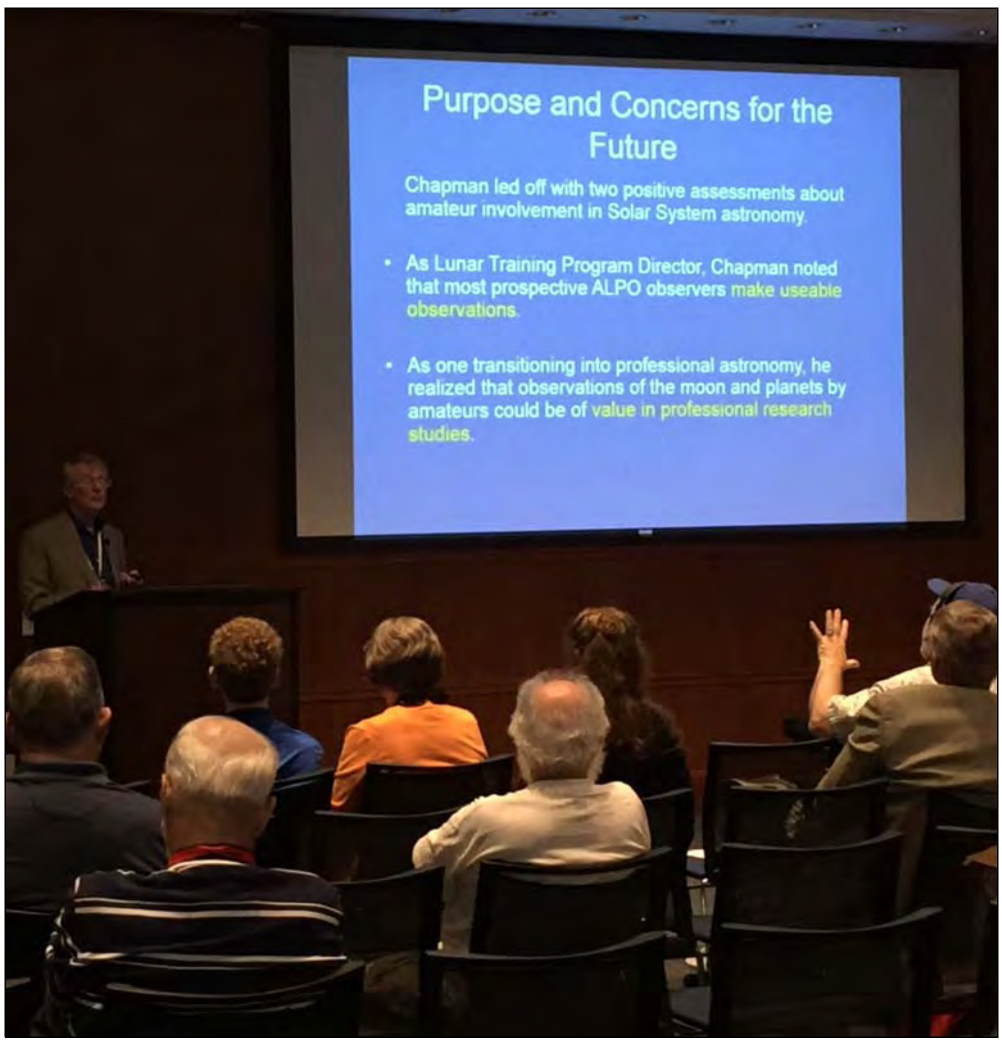
(Introduced by Matthew Will)

Board meeting minutes for our 2015 ALPO Board meeting were approved by all the Board members previous to this meeting, last fall.

Issue Two: Observer's and Service Awards

(Introduced by Mike Reynolds)

The ALPO has two awards to honor persons providing outstanding work for our programs. The Walter H. Haas Observers Award is bestowed annually to an amateur astronomer for excellence in observational Solar System astronomy. This award is named after our late founder and director emeritus, and was established in 1985. The selection of this award is conducted by a committee convened by its committee chairman for this year, Richard Schmude. The composition of the committee changes from year to year so that the responsibility of selection is shared by a wider group of well-qualified members of the ALPO, while allowing others that



Matt Will as he takes a question from the audience regarding his talk about the ALPO. *Photo by Ken Poshedly.*

Randy Tatum (at left) accepts the Walter Haas Observer's Award for 2016 from ALPO Executive Director Mike Reynolds at the ALCon 2016 Saturday evening banquet. *Photo by Ken Poshedly.*

vote one year to be considered for the award in another year when not serving on the committee. The Award itself consists of an engraved plaque. The awardee also receives a two-year complimentary membership in the ALPO.

This year's recipient is Randy Tatum. Randy began observing the moon and planets in 1966 in elementary school and in high school began contributing observations to the ALPO. Randy is an astute observer of Jupiter, having been credited as co-discover of the 1975 SEB disturbance on Jupiter as well as having completed 1,000 transit timings of features on Jupiter in 1976. Randy served as an assistant recorder for the Jupiter Section from December 1981 through November 1984 and the Solar Section from November 1984 through July 1986. Randy was promoted to as full recorder for the Solar Section in 1986, and beginning in February 1993, Randy helped manage the entire Solar Section until October 1996. Randy began applying photography and videography to the Sun in 1978 and eventually transitioned to webcam imaging in 2003 for all Solar System bodies. So, Randy Tatum has not only had extensive experience in Solar imaging, but has contributed images to just about every ALPO observing section and has shared his vast knowledge freely with his fellow colleagues and with up and coming novices. Thank you, Randy, for your outstanding work in the field of Solar System imaging and your guidance and support to the greater astronomical community in this endeavor.

The Peggy Haas Service Award was established to recognize a member of the ALPO for outstanding service to our organization. This award was named after our founder's late wife for her past support of the ALPO in many meaningful and indispensable ways, from assisting her husband with the *Journal* to performing such functions the ALPO's Librarian for its book-lending service from 1966 to 1985. The award was inaugurated in 1997. The current executive director solely selects the recipient for this award. The Peggy Haas Award can recognize an ALPO officer, board member, volunteer staff member, or non-staff member who has contributed outstanding service in some way to the organization, in a capacity excluding observational skills (observational skills are recognized by the Walter H. Haas Award). Considered not to be an annual award, presentation will occur when appropriate and not at any specific time interval. The Award itself consists of an engraved plaque. The awardee also receives a lifetime membership in the ALPO. This year, Jeffery D. Beish was recognized for the Peggy Haas Service Award. Jeff Beish needs no introduction to many that follow Solar System astronomy. Jeff is well known for his dedication and service over the decades to the ALPO and Mars observers internationally. Jeff became an ALPO member in the 1970s and was an ALPO Mars Section assistant recorder from July 1981 through May 1986. After the untimely death of his mentor and Mars recorder "Chick" Capen, Jeff and fellow colleague Don Parker co-managed the Mars Section until 1996. Jeff has since served in both an official capacity as an assistant recorder and in an unofficial capacity as an advisor to the Mars Section providing scientific data and analysis, software, and technical support concerning the section and its needs. In later years, Jeff has provided support in the creation of Solar System ephemerides programs that supply such data for all Solar System bodies, for all ALPO observing sections and observers. Thank you Jeff for your outstanding service to the ALPO!

Issue Three: Review of ALPO Finances and Endowment

(Introduced by Matthew Will).

ALPO Secretary and Treasurer Matthew Will reported to the ALPO Board the ALPO's finances for the preceding year in the annual treasurer's report submitted to the Board last February. A supplemental report was submitted in July covering the first half of 2016.

The ALPO finished the Year 2015 in the black with a surplus of $542.25. For the first six months of 2016 the ALPO experienced a deficit of $1,272.28. The current deficit is due to some bills that are paid up front at the beginning of the year and expected lower revenue since the ALPO has more renewals due in the fall and winter months than in the spring and summer. Also, early renewals before last year's dues increase may have lower the number of renewals that might normally come in. This last factor will likely result in an anticipated, slight deficit in our finances at the end of the year. But ALPO finances should rebound in the following year as they usually do. The Springfield (IL) business account held $4,913.49 as of July 29th.

With the passing of both Donald Parker and Walter Haas, the ALPO has received contributions totaling $7,975.00 made in their names since February 2015. The ALPO is grateful for these contributions that have strengthened the ALPO Endowment to a value of $47,173.95 as of July 29th.

The ALPO membership has hovered around 370 members over the past few years. We currently have about 373 "paid" members.

Issue Four: *Journal of the Association of Lunar & Planetary Observers* Report

(Introduced by Ken Poshedly)

Ken Poshedly updated his work with the Publications Section's presence on the ALPO website. In the past, Ken has posted ALPO materials related to the *Journal* such as the indices for past issues and the ALPO monograph series on a web page dedicated to the *Journal*. Issues of the *Journal* past and current have been posted with the help of the ALPO Online Section. With the expansion of the Galleries web pages on the ALPO website, Ken announced that the Publication Section-related materials will now be assimilated on the Galleries web pages under convenient folder headings. In addition to the *Journal*, back issues and ALPO monographs, Ken is making available ALPO observing forms and related section publications as a one-stop link for ALPO observers, especially novices to collect the necessary materials for observing. Ken thanked our webmaster Larry Owens for his assistance in creating these folders in the Galleries area on the ALPO website. Ken welcomes comments concerning the reorganization of the Publications Section materials. Mike Reynolds and the rest of the ALPO Board thanked Ken for his efforts in reorganizing the Publications Section materials on this newly functioning web page

Ken Poshedly and the ALPO Board commented on past improvements to the *Journal*. The switch to using coated stock paper for pages inside the cover of the *Journal* has improved the clarity of graphics and observations without increasing overall printing cost. While saddle-stitch (stapled) binding occurs with most issues of the *Journal*, when the size of a *Journal* exceeds 70 pages, perfect (or flat-back) binding is used. John Westfall mentioned that it might be nice to have the *Journal* name, and issue volume and number on the spine of perfect-bound issues, however, perfect binding is not normally used for the *Journal* since most issues are under 70 pages.

Ken also said that he plans to reduce his responsibilities for the *Journal* in the following years. Ken has engaged with Ron Kramer of the Astronomical League and his staff of people that produce *The Reflector* for assistance in the production of the *Journal*. Ron has a talented staff that can assist in some aspects of *Journal* production.

Currently, the *Journal* offers color only to those that receive the digital version. The cost of printing in color is somewhat prohibitive, as it would mean a sizable increase in membership dues to cover the cost. In an earlier conversation with

ALPO Executive Director Mike Reynolds (at left) at the ALCon 2016 Saturday evening awards banquet accepting the Astronomical League's Leslie C. Peltier Award from Scott Roberts, founder of Explore Scientific, which sponsors the award. *Photo by Ken Poshedly.*

Kelly Beatty of Sky &Telescope, Ken said that Kelly had suggested to him that popular astronomical instrument manufacturers might be interested in sponsoring issues of the *Journal* printed in color. Wayne Bailey reminded the Board that he had made this same suggestion at last year's Board meeting and thought it could be feasible without too much effort.

Concerning outreach with the Astronomical League, both Mike Reynolds and Ken Poshedly expressed interest in rekindling a past reciprocal agreement between the League and the ALPO to advertise for free in each other's periodical. The ALPO did run an ad some time ago about our organization and has allowed for free advertising in the *Journal*, for past ALCONs.

Ken also expressed the continued need for section and program coordinators to submit reports on interim activities between apparition reports for the "Inside the ALPO" pages of the *Journal*, in a timely manner. This section of the *Journal* informs the general ALPO membership of ongoing developments with the sections or programs.

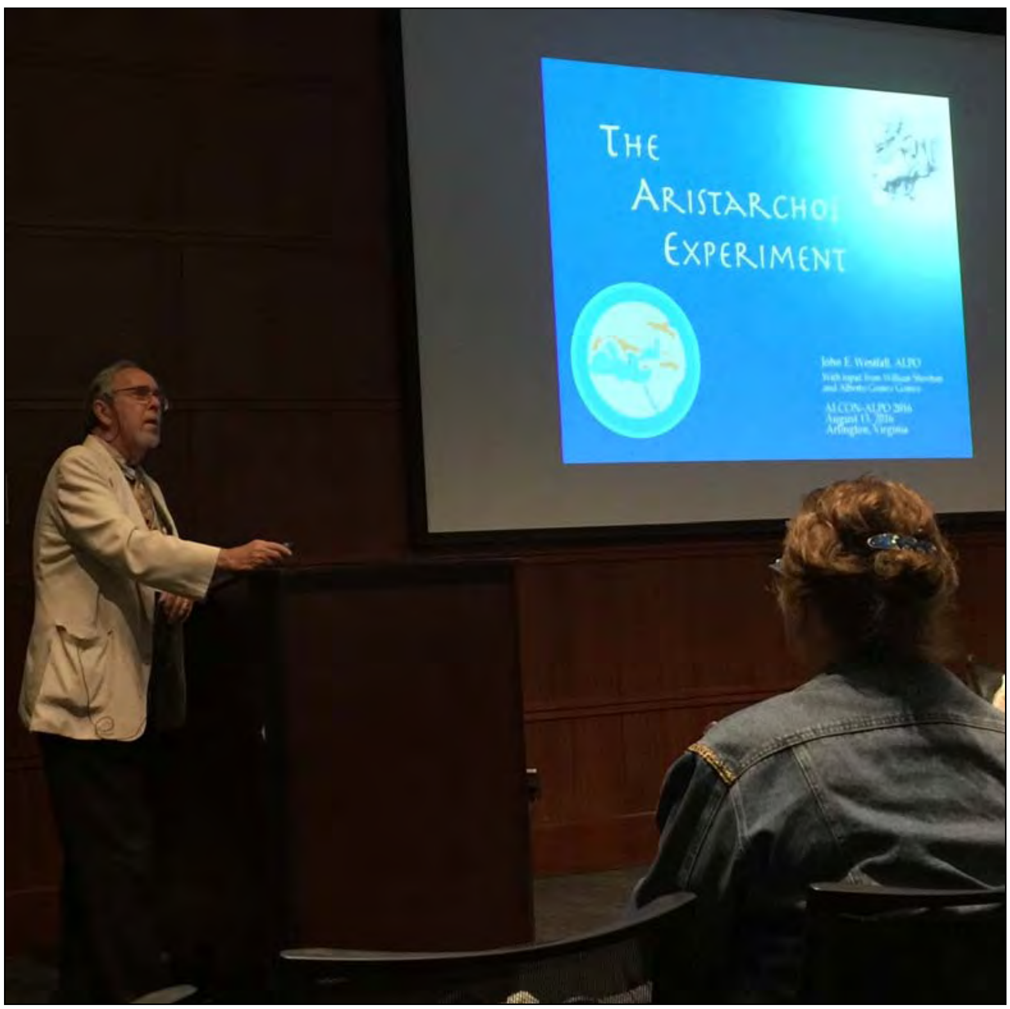
Ken is also looking to have a fall 2017 issue devoted to the August 2017 total solar eclipse, possibly delayed by one month, to fit in all the eclipse-related reports and observations.

Members receiving the digital *Journal* are alerted by email when the latest issue of the *Journal* is ready for download. Ken said that he is using the Mail Chimp email service that allows him to automate the announcement for release of the *Journal*. This tool that Ken uses also has features that inform Ken about the success rate for the delivery of these email announcements and if the email messages are being opened. Typically, about 60 percent of email announcements are opened within the first few days. This does not necessarily mean that the ALPO membership is apathetic about reading the *Journal*. There could be good reasons for members not responding immediately to these email announcements, such as email volume to their accounts, finding the time to download the *Journal* and read it, and other distractions in their daily lives.

A topic that comes up in business meetings is the availability of the Journal going back into the past on digital media. Currently, issues going back to 2001 or Volume 43 can be downloaded from the ALPO website. Articles later than 1983 can be obtained for free from the ADS (Astrophysics Data System) maintained under the Smithsonian Astrophysical Observatory under an NASA grant, *http://adsabs.harvard.edu/journals_service.html*. According to Wayne Bailey, former ALPO member Bob O'Connell has made an effort to scan in articles concerning lunar observations and studies from the *Journal*, though these scanned articles are not publicly available. (NOTE: Wayne Bailey has forwarded a CD of these articles to Ken for placement on the Publications Section online gallery.)

Issue Five: Journal Distribution Policy, Making Both the Digital and Paper Available to the Membership

(Introduced by Mike Reynolds and Matt Will)



John Westfall as he takes he explains "The Aristarchus Experiment" at ALCon 2016. *Photo by Ken Poshedly. Photo by Ken Poshedly.*

The ALPO offers multi-tiered memberships. For regular membership dues, the ALPO offers the paper or “hard copy” Journal at one rate, $39.00 per year ($72.00 for two years), and the digital version of the Journal at a discount of $14.00 per year ($24.00 for two years). For members volunteering to contribute more funds to the ALPO, we have Sustaining, Sponsor, Patron, etc. memberships where members can receive both versions of the Journal as a way of saying thank you.

One longtime member of the ALPO complained that our policy of keeping digital and paper memberships on separate tracks was unfair to regular dues-paying members that received the paper membership, but had the capability of downloading the digital Journal and that the regular dues-paying members had a right to both. He argued that the digital Journal is being produced for free and that the printed Journal is being printed for costs. The above statements touch on three questions. One, should the distribution policy be changed to accommodate our regular dues-paying members? Two, can the ALPO afford to support dual-media memberships? Three, are ALPO members merely subscribers to its Journal, or are ALPO members supporting an organization that includes all its organizational functions and costs and not just the printing of its Journal?

On question one, when Matt Will was the newly minted Membership Secretary, he inherited a distribution policy in 2001 that was designed to encourage members to migrate from the printed Journal to the digital, with the assumption that sometime in the future the hard copy version would no longer be needed. The digital Journal was a relatively new concept, having been introduced to the membership that year. Use and popularity for the digital *Journal* rose over the next few years and has plateaued over the last decade at 55 percent acceptance for those using the digital version as their sole media for the *Journal*.

These days, as reported by various publishers in the print business, readers like both hard-copy and digital media for books and periodicals. Our digital version of the *Journal* certainly enhances a member’s experience reading the *Journal* with color images and graphics and references with embedded links associated with articles in the *Journal*. Indeed the British Astronomical Association offers both to its regular members. So, it is reasonable to say that this is an emerging practice and that the regular membership would benefit from a dual-media membership.

To question two, could the ALPO afford to offer both versions? Currently, we offer both versions for higher-level memberships, so there might be some fall off if these members can get both versions as regular dues paying members. Digital-only members might want to move to getting both versions of the *Journal*, further reducing income to the organization. In contrast, the ALPO could shoulder a loss in income since our Springfield account is floating a higher-than-normal balance. The next dues increase will probably not come before 2018. The ALPO has been scheduling dues increases every three years at incremental increases to avoid sizable increases over longer periods of time. The next increase might be higher than expected if more digital members make the switch to dual media. A shifting of membership category numbers is difficult to predict.

The chart below shows how our income and expenses work.

Income for 2015		Expenses for 2015	
Hard Copy Memberships and Higher Level Memberships	$8,051.00	Printing and Postage for the Hard Copy *Journal*	$8,204.01
Digital Memberships	$2,349.00	Incidental and Support Costs	$2,530.81
Other Income	$ 788.00		

In regard to question three, as one can see, we need funds from the digital *Journal* to support our organizational costs beyond printing and mailing the hard-copy *Journal*. These include costs to meet our legal obligations as a nonprofit organization, membership acknowledgments, literature distribution, promotional items like the awards, and pre-publication costs. Some extra income from advertisements and the sale of hard-copy back issues fill in spending gaps for both publication and non-publication expenses. So, your ALPO membership is not merely paying for the printing and publishing of the hard copy *Journal*. Your ALPO membership helps to keep the ALPO operating as a fully functioning organization. Also, your membership is an endorsement for the entire ALPO. Without the observing sections and programs, we don’t have a *Journal*. Likewise, without a *Journal* where submitted papers and articles are peer-reviewed and fact-checked, the observing sections and programs don’t have a credible venue to publish their apparition reports and scientific papers.

Mike Reynolds made the motion to redefine the paper membership to offer dual-media in place of the normal hard copy-only option with the next release of the *Journal*. John Westfall seconded the motion with all five Board members present voting in the affirmative.

The ALPO Board believes that this policy will increase value in an ALPO membership and make ALPO membership more dynamic. Clearly, in today’s society, hard-copy media is not being “thrown overboard” in favor of electronic media if the book publishing industry is a good example. People still want both and the use of electronic media expands their reading experience. Organizations like ours that survive are nimble enough to act on trends in media technology and adapt usage to meet members' needs.

ISSUE SIX: ALPO Memberships for Observers that Can't Afford or Don't Have the Means to Pay for Membership

(Introduced by Mike Reynolds and proposed through an email from Rik Hill)

ALPO Solar Section Coordinator Rik Hill proposed that the ALPO create a fund for sponsoring memberships in the ALPO for observers that could not afford or have the means to pay for an ALPO membership. Rik proposed that a committee be founded to administrate this program.

The ALPO has made strides in the past, to make paying for an ALPO membership easier through online purchases of memberships using a credit card that eliminates the more costly expense for foreign members of paying by a check using US banking codes. Unfortunately, there are observers that submit ALPO observations from abroad that don't have the means or can afford purchasing an ALPO membership.

Mike thought that we should give those living in areas abroad who don't have affordable access to purchasing a membership online or by check, consideration for this proposed program. More than just receiving the *Journal*, ALPO membership is advantageous for members of the ALPO Solar Section to upload images to the Solar Section gallery web page on the ALPO website, whereas observers without an ALPO membership cannot. Currently, Rik Hill has been sponsoring a few memberships on his own for his most productive observers. Matt Will and other section coordinators have been sponsoring a few members based on their past value to the organization. But these are special exceptions with many more deserving consideration.

Matt Will said that finances would be needed to support a membership for those that would want the paper membership as demonstrated under Issue Five of the current minutes, whereas with digital membership cost, it would be desirable to recoup funds for the overall financial health of the organization. It would not be necessary to administer the fund through a committee. Mike proposed that the fund be created through an announcement on the website and in a future issue of the *Journal* to solicit such funds. Vetting of deserving observers for these sponsorships would have to be done through ALPO coordinators since the Membership Secretary would not have any prior knowledge of the observer's value to the section or program that they contribute to. Funding would be limited to what the fund could afford. Matt agreed to send an email message to the ALPO staff in regard to this fund being set up for the use of deserving observers that could not afford an ALPO membership.

ISSUE SEVEN: Imaging Archiving On the ALPO Website and Closure of the Arkansas Skies Observatory (ASO) Website

(Introduced by Mike Reynolds and Matt Will)

For more than a decade, the ASO had maintained a lunar and planetary observing archive where observers could upload observations, both images and drawings, to the server that maintained such observations, managed, of course, by the ASO. Over the course of many years, observers would upload images, some of which had attached viruses. The site was available to anyone for uploading images and many that were not paid ALPO members uploaded images whether or not they participated in ALPO observing programs. The ASO became aware of this situation and emailed Mike Reynolds and Matt Will about it last April. The ASO wanted the ALPO to take responsibility for screening observers uploading observations on their server that maintains the lunar and planetary observations. The ALPO responded that this was something that could not be agreed to immediately, considering the potentially complicated logistics and volume of web traffic since presumably a majority of the postings of lunar and planetary observations are probably not from paid ALPO members. There seemed to be a misunderstanding from the ASO that all posting came from purely ALPO members. Furthermore, there seem to be no clear means about how one might prevent a virus attachment from being passed on to the server, even from an ALPO member, if the security on the server is inadequate and would have to be vetted on a separate computer system.

ALPO Staff Appointments — 2016

Staff Member	Section	Title	Date of Appointment
Richard Hill	Solar	Acting Coordinator	Jul 2015
Rick Gossett	Solar	Acting Assistant Coordinator	Sep 2015
Theo Ramakers	Solar	Acting Assistant Coordinator	Sep 2015
Pamela Shivak	Solar	Acting Assistant Coordinator	May 2016
Theo Ramakers	Computing	Acting Assistant Coordinator	Mar 2016
Theo Ramakers	Online	Acting Assistant Webmaster	Mar 2016

With the issue unresolved, the ASO has closed down the server for lunar and planetary submittals. Currently, all section coordinators in the ALPO accept observations sent electronically through email or other means, agreed to in advance by both the coordinator and the observer. The ALPO Solar Section has utilized the ALPO Galleries web page to allow paid ALPO members to directly upload images to the Galleries. ALPO Board member Julius Benton, Jr. commented that as a coordinator for two active observing sections, he prefers to review observations before posting. Lunar Coordinator Wayne Bailey said that he also prefers this approach too. This might beg the question for what purpose should the Galleries serve; a site for collective work of the section or for posting only selected observations for review? The ALPO-Japan website has been useful for others to submit observations for posting also. (Note that ALPO-Japan is not formally associated with our organization and no records can be found describing any previous relationship.)

In response to the question of defining the use and development of either uploading directly observations to the ALPO Galleries web page from ALPO members or posting observations by coordinators, Mike Reynolds suggested that perhaps Larry Owens might help with producing a protocol document directing other section coordinators in utilizing the ALPO Galleries web pages for their own section's use. This might promote the use of the ALPO Galleries web pages and also direct and encourage coordinators that have not used this resource, to do so.

The ASO web page for lunar and planetary images has been terminated in the face of continued security issues on their server. Ken said that the ALPO should express our thanks for the ASO's past support of this web archive and for removing the ALPO's association with this website.

Issue Eight: Annual Meeting Sites for 2017, 2018, and 2019

(Introduced by Mike Reynolds and Matt Will)

Mike Reynolds and Matt Will talked about possible future sites for ALPO annual meetings for the next three years. After having met with the Astronomical League for 7 of the last 9 years, it might be well to expand our horizons in meeting with other groups. One suggested possibility at last year's meeting was to have our annual meeting for 2017 sometime after the August total solar eclipse. At that meeting, ALPO Board member Richard Schmude suggested that the Georgia Regional Astronomers Meeting (GRAM) scheduled in the fall of that year, and sited for the University of Georgia at Athens might be an ideal location for the ALPO to meet. GRAM is a regional consortium of Georgia universities, amateur astronomy clubs, museums, science centers, etc., that among other things holds an annual astronomy meeting in Georgia, usually in October. The meetings seem to be a mix of professional and amateur presentations about a wide range of astronomical topics. It was proposed that this would be a good venue and a good time of the year for the ALPO to meet, considering that by that time, speakers would be ready to do presentations about the recent 2017 total solar eclipse occurring that previous August. While this 2017 meeting was tentatively scheduled on the GRAM website, Julius Benton informed the Board that his astronomical contacts at the University of Georgia were unaware of the 2017 meeting was scheduled to take place there. This prompted Mike Reynolds to offer Jacksonville as an alternative site for the annual meeting, staying with the plan to meet in the fall. A motion was made by John Westfall to have the annual meeting in the fall of 2017, meeting with GRAM if that is still possible or meeting in Jacksonville if meeting with GRAM is not viable. The motion was seconded by Matt Will and carried with 5 votes in the affirmative. Mike Reynolds agreed to follow up with Richard Schmude and GRAM concerning the 2017 meeting and Julius Benton would follow up with the University of Georgia about confirming that the meeting would happen there in 2017.

Mike Reynolds and Matt Will have been in touch with Executive Director Randy Atwood of the Royal Astronomical Society of Canada, concerning their scheduling of upcoming annual General Assembly Meetings for future years. The 2018 General Assembly Meeting is scheduled to be held in late June or early July, and is "tentatively" sited for Calgary, Alberta. This is a change from the previously scheduled site of Toronto. 2018 might be a great time to meet with the RASC. We had met in Calgary with the RASC in 2007 and had a wonderful time! Randy Atwood gave Mike and Matt an enthusiastic invitation to join them at a future date. We should give the RASC serious consideration. No final decision was made; however, the Board was generally favorable to a meeting with the RASC in 2018.

Some interesting choices were discussed for 2019. Several organizations came to mind for possible joint meetings. The Society of Astronomical Sciences (SAS) has shown an interest in the past to meet with us. Lately, the SAS has been more flexible about meeting at sites other than Big Bear Lake, a traditional location for SAS meetings. The SAS meets with the American Association of Variable Star Observers (AAVSO) on even-numbered years. Since the SAS tends to meet on the West Coast, it might give our West Coast ALPO members an opportunity to travel a short distance to attend a possible joint meeting with these two organizations. ALPO member Stephen Tzikas, who also sits on the board of directors of the Society of Amateur Radio Astronomers (SARA), entertained a proposal from Mike Reynolds for a joint meeting with them or possibly including the SAS as well. The meeting could be arranged at possibly the Pisgah

Astronomical Research Institute (PARI), located near Brevard, North Carolina. PARI has given the ALPO an open invitation to host an annual meeting for some time now, and if PARI is still amenable to hosting the ALPO, a joint meeting at this wonderful site would be ideal. Stephen thought that a joint meeting with SARA could be possible. However, SARA generally has two annual meetings at fixed venues that never deviate in location and altering this routine might not appeal to its board. Mike Reynolds will explore a joint meeting with SAS and SARA and contact PARI about its interest for hosting us in 2019. If not, at least a West Coast meeting with SAS might still be viable for 2019.

Issue Nine: Acting Staff for Consideration to Permanent Appointment

(Introduced by Mike Reynolds)

Over the course of a year, there are several acting staff member appointments made by the ALPO Executive Director. Future permanent status for these positions can occur by a vote of the ALPO Board. The purpose of the period of acting status is to ensure that appointed staff are getting on in their positions and that they are not having problems administering programs. The current acting staff is listed below:

Kim Hay, who was an acting assistant coordinator for the Solar Section, resigned from her staff position last spring. Kim started out as an acting assistant coordinator in March 2004 and was lead coordinator for this section from August 2005 through September 2015. The ALPO Board thanks Kim for her service and leadership of the Solar Section over many years.

Rik Hill, previously assigned as a scientific advisor to the section, and a past founding recorder for this section dating back to 1982, was reassigned as an acting assistant coordinator in July 2015, and in September 2015 became acting lead coordinator for the Solar Section. On a recommendation from our executive director, the Board waived the usual two-year probation requirement for acting staff and assigned Rik permanent status as lead coordinator for the Solar Section. Mike Reynolds made a motion to promote Rik Hill to permanent status as coordinator for the Solar Section. Ken Poshedly seconded the motion and the Board cast five votes for the motion in the affirmative. Other staff will be up for consideration for permanent status by the time of next year's Board meeting.

Ken Poshedly also made a general comment concerning the structure of ALPO section staff. Assistant staff should assist the lead coordinator with various tasks that make the section work. The Solar Section is a good example with assistant coordinators supporting the section with specific assignments. The restructuring of the Solar Section has made it a stronger section. Other sections should consider reevaluating their human resources to improve their productivity.

Issue Ten: Board Vacancies

(Introduced by Mike Reynolds)

There was a brief discussion concerning vacancies brought on by the passing of two former Board members, our founder Walter H. Haas and longtime Board member Donald C. Parker. Mike Reynolds opened this discussion on a need for demographic diversity on the Board as a way of expanding our horizons with others that may be interested in astronomy, but may not relate well to the people involved with it. John Westfall pointed out that ALPO has an age demographic problem as well, as the ALPO tends to be composed more of older adults. Matt Will said we seem to attract older adults since many reenter the hobby of amateur astronomy having more time for it after the children are raised, and their career is secure. Matt expressed the need for Board members who could offer the ALPO a broader spectrum of talents and skills, particularly in the area of organizational mechanics where our legal and managerial obligations need to be addressed on a consistent basis. John commented that there is no need to fill these vacancies for now. The ALPO by-laws allow for a maximum of nine Board members. The current number of Board members at seven, an odd number, will ensure that ties in voting will not occur. Julius Benton made a motion to keep the ALPO Board at the same size as it is now and to look into diversity for future expansion of the Board. The motion was seconded by Ken Poshedly and all Board members present voted yes, 5 to 0.

Issue Eleven: ALPO Lunar Orbiter Images

(Introduced by John Westfall)

John Westfall gave an update concerning the state of the Lunar Orbiter images held by John on behalf of the ALPO. The status and description of this collection is given in last year's meeting minutes. The hard copies have no research value, as these images are readily obtainable online. They may be of value as a collectable item and may be of some artistic or historic value. John had said that was no change is the disposition of the collection. John was still looking for a buyer or institution to receive these images. Ken Poshedly said that he could inquire to the Fernbank Science Center in Atlanta, Georgia, which might be interested in this collection. (Since the meeting, Fernbank Science Center has expressed an interest in the collection). While the ALPO would be happy to donate this collection to any educational institution, shipping and insurance would need to be paid for by the receiving party.

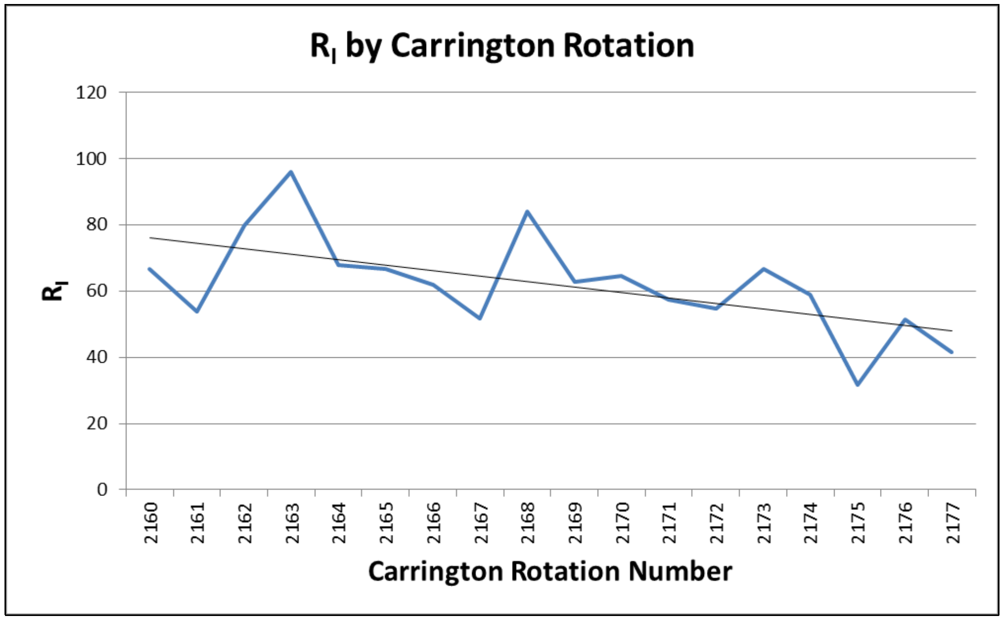
Adjournment

With no further business to conduct, John Westfall made a motion to adjourn, with Mike Reynolds seconding and all Board members present voting in the affirmative at 11:01 a.m. EDT.

Feature Story: ALPO Solar Section

A Report on Carrington Rotations 2174 thru 2177

By Richard (Rik) Hill,
Acting Coordinator &
Scientific Advisor,
ALPO Solar Section
rhill@lpl.arizona.edu



Overview

Solar activity continued its long slide towards a minimum predicted for 2020-21. The rotational sunspot number never rose to 70 during this reporting period as evidenced in plot.1. At the time of this writing (CR 2076), we have already experienced a number of days with a count of 11, which is the lowest possible number above zero, since the formula for determining the Wolf number is 10g+s (or 10 times the number of sunspot groups plus the number of spots). For individual observer sunspot counts, a "personal factor" is usually applied by the tabulator, reckoned from many days of observing by that observer.

The average daily sunspot number for this reporting period (Oct. 15, 2015 - Feb. 17, 2016) was 61.2 — a drop from the 65.8 of the previous reporting period with a high of 108 (on 02/04 & 05) and a low of 12 (on 10/10)

As in the last two reports, the ALPO Solar Section will be referred to as "the Section" here. Carrington Rotations (2069-73) will be called CRs. Similarly, Active Regions will be called "ARs", using only the last four digits of the full number. "Groups" will apply to the visible light or "white light" collection of sunspots while "Region" or "Active Region" will apply to all phenomena associated with the particular sunspot group. Statistics used in this report are compiled by the WDC-SILSO* at the Royal Observatory of Belgium which is responsible for the International Sunspot Number used here. All times will be Coordinated Universal Time and dates are reckoned from that. Dates will be expressed numerically with month/day such as "9/6" or "10/23".

The terms "leader" and "follower" will be used here instead of east or west on the Sun. "W-L" may be used to indicate White Light observations while Hydrogen-Alpha may be "H-a" and Calcium K-line "CaK", abbreviations well-familiar to the experienced solar observer. An important point, "**naked eye**" here means the ability to see a feature on the Sun through a **proper and safe** solar filter with no other optical aid. You should never look at the Sun, however briefly, without proper filtration.

All areas on the disk will be expressed in the standard measurement of millionths of the disk, with a naked-eye spot generally being about 1,000 millionths for the average person. Spot classifications are the ones defined by Patrick McIntosh of NOAA (McIntosh 1981, 1989) and detailed in an article in JALPO (Vol.33, Hill 1989). This classification system is also detailed by the author on the Section website in an article on white light flare observation.

Observers contributing to this report and their modes of observing are summarized in Table "1. Contributors to This Report" on page 29 of this report. It will be used as a reference throughout this report rather than repeating this information on every image or mention.

Carrington Rotation 2174

Dates: 2016 02 18.1722 to 2016 03 16.4986

Avg. R_I = 59.0

High R_I = 111 (3/4)

Low R_I = 25 (2/25)

The RI maximum in this rotation was caused by a numerous (at least six) small A to C class groups with many umbral spots. Only two regions exceeded an area of 100 millionths, AR 2505 and AR 2506. Of the two. AR 2506 was better covered by the Section observers. The evolution of this region is well-shown in a montage by Ramakers (Fig. 1), observed first by Broxton and Leventhal in solar drawings on 2/23 a day before NOAA designated it. (Well done, guys!) Over the next few days, these two observers followed the region as it developed a leader with radially symmetrical penumbra and went from McIntosh A-class to C-class in both their estimations. The first images we have of this region were on 2/26 by Corban (H-a), Tyler (w-l) and Ramakers (w-l, H-a, CaK), in fact, the latter observer may have caught low-level flaring at 15:55 UT in an H-a image. At this time, the group was listed as Cao and producing one flare every two hours on average. The area was 30 millionths and the magnetic class only beta. There was a leader spot with rudimentary penumbra followed by a couple umbral spots and a few pores. The next day, the area and class were the same but flare production had dropped to only half of the previous value. Now the leader consisted of two small spots with penumbrae surrounded by umbral spots and pores, with a follower that was a single spot twice the size of either leader spot. Connecting the leaders and follower spots was a line of umbral spots arcing north of the group. On 2/28, the day of central meridian passage, the flare production was the same but the area had doubled. It was now a Dai class group but still magnetically beta. The leader was still the two spots but the penumbrae were losing their organization and all the umbral spots and pores were following the leaders. The follower was largely unchanged from the previous day and the clear line of umbrae and pores connecting the two was reduced to two umbral spots between the leader and follower to the south. Ramakers showed a fairly quiescent plage in CaK, surrounding the region. It was very interesting on the 29th that the leader spots had coalesced into one spot with a much more radially symmetrical penumbra shown in a Tyler image at

Table 1. Contributors to This Report

Observer	Location	Telescope (aperture, type)	Camera	Mode	Format
Michael Borman	Evansville, IN	102mm, RFR 90mm, RFR 102mm, RFR	Point Grey GS3	W-L H-a CaK	digital images
Richard Bosman	Enschede, Netherlands	110mm, RFR 355mm, SCT	Basler Ace 1280	H-a W-L	digital images
Tony Broxton	Cornwall, UK	127mm, SCT	N/A	W-L	drawings
Gabriel Corban	Bucharest, Romania	120mm, RFL-N	Point Grey GS3-U3	H-a W-L	digital images
Franky Dubois	West-Vlaanderen, Belgium	125mm, RFR	N/A	visual sunspot reports	—
Howard Eskildsen	Ocala, FL	80mm, RFR	DMK41AF02	W-L wedge CaK	digital images
Joe Gianninoto	Tucson, AZ	115mm, RFR 80mm, RFR	N/A	W-L H-a	drawings
Guilherme Grassmann	Curitiba, Brazil	60mm, RFR	Lumenera Skynyx 2.0	H-a	digital images
Richard Hill	Tucson, AZ	90mm, MCT 120mm, SCT	Skyris 445m	W-L	digital images
Bill Hrudey	Grand Cayman	200mm, RFL-N 60mm, RFR	ASI174MM	W-L H-a	digital images
David Jackson	Reynoldsburg, OH	124mm, SCT	N/A	W-L	digital images
Jamey Jenkins	Homer, IL	102mm, RFR 125mm, RFR	DMK41AF02	W-L CaK	digital images
Pete Lawrence	Selsey, UK	102.5mm, RFR	ZWO ASI174MM	H-a	digital images
Monty Leventhal	Sydney, Australia	250mm, SCT	N/A Canon-Rebel	W-L/H-a H-a	drawings digital images
Efrain Morales	Aguadilla, Puerto Rico	50mm, RFR	Point Grey Flea 3	H-a	digital images
German Morales C.	Bolivia	200mm, SCT	N/A	visual sunspot reports	—
Theo Ramakers	Oxford, GA	80mm, RFR 11" SCT 40mm, H-a PST 40mm, CaK PST	ZWO ASI174MM DMK41AU02AS DMK21AU03AS DMK21AU03AS	H-a W-L H-a Cak	digital images
Ryc Rienks	Baker City, OR	203mm, SCT 40mm, H-a PST	N/A	W-L H-a	drawings
Chris Schur	Payson, AZ	152mm, RFR 100mm, RFR	DMK51	CaK W-L (CaK-off-band continuum) H-a	digital images
Avani Soares	Canoas, Brazil	120mm, RFR	ZWO-ASI 224	W-L	digital images
Randy Tatum	Bon Air, VA	180mm, RFR	DFK31AU	W-L-pentaprism	digital images
David Teske	Starkville, MS	60mm, RFR	N/A Malincam	W-L, H-a W-L	digital images
David Tyler	Buckinghamshire, UK	178mm, RFR 90mm, RFR	ZWO	W-L H-a	digital images

NOTE: Telescope types: Refractor (RFR), Newtonian Reflector (RFN), Schmidt Cassegrain (SCT), Maksutov-Cassegrain (MCT), Cassegrain (Cass)

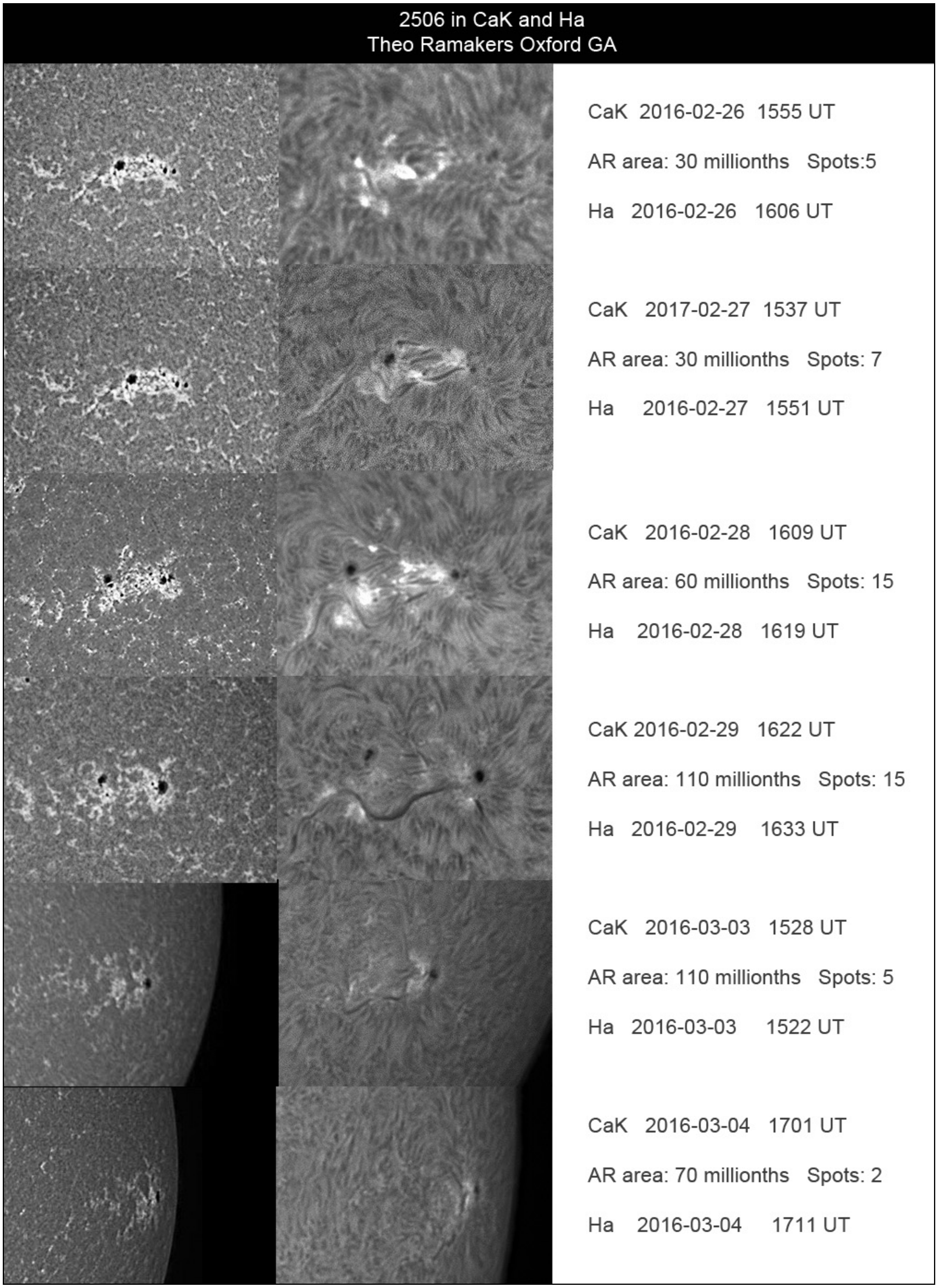


Figure 1. CaK and H-alpha views following the development of AR2506 by Ramakers on the dates and times listed on the image. Instrumental details can be found in Table 1.

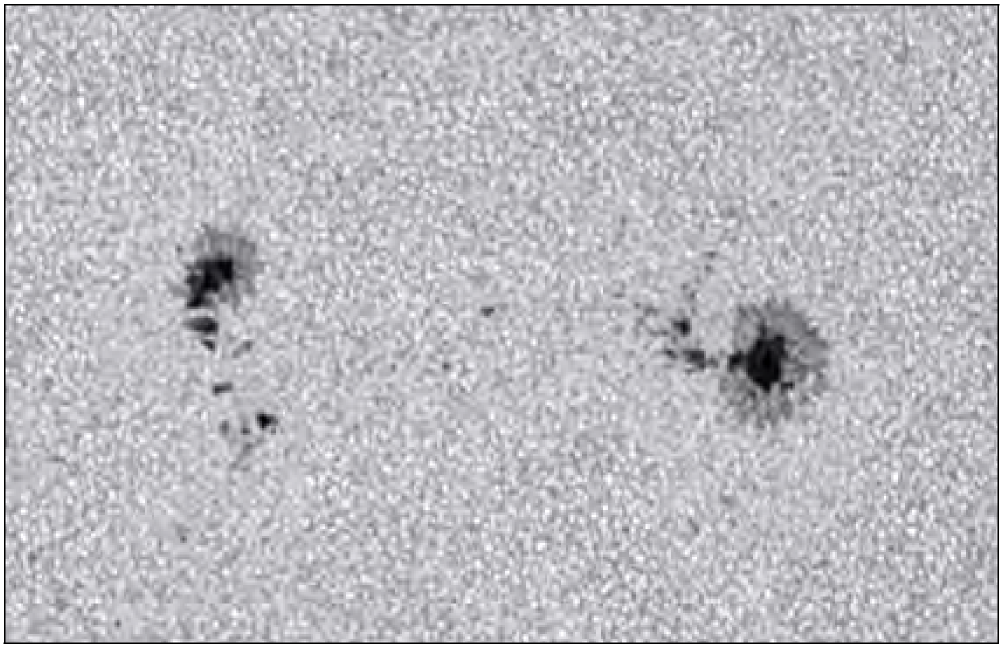


Figure 2. A nicely detailed white light image by Tyler with his 178mm RFR of AR2506 at 2016-02-29-10:33 UT. Details on equipment are in Table 1.

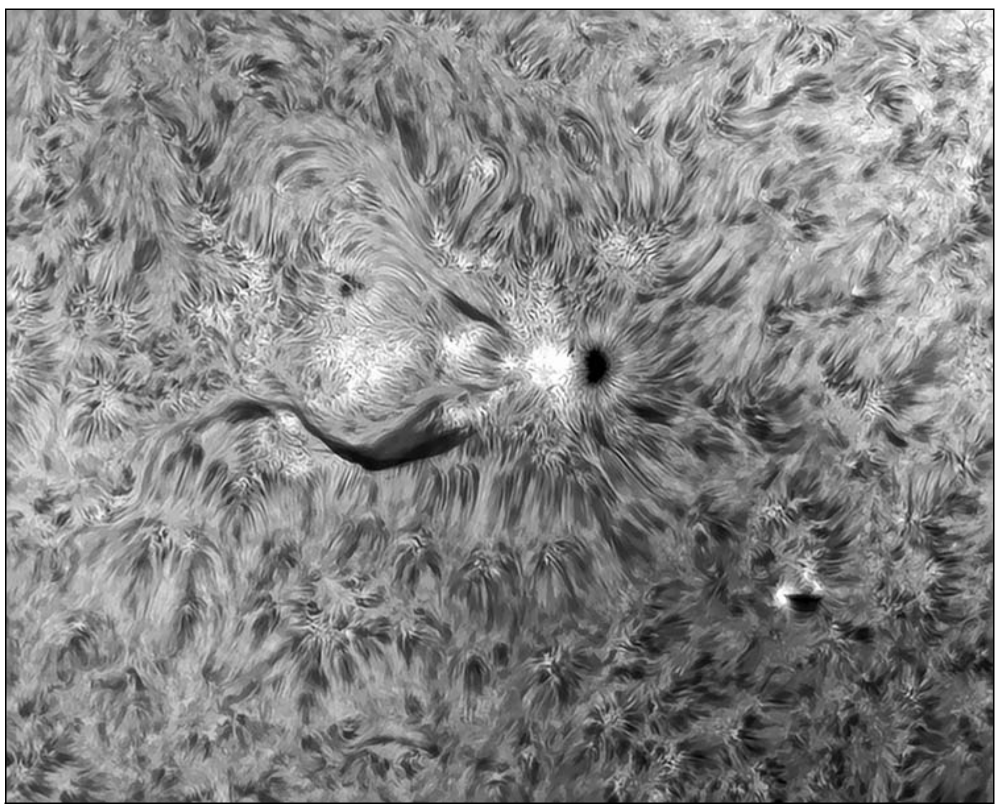
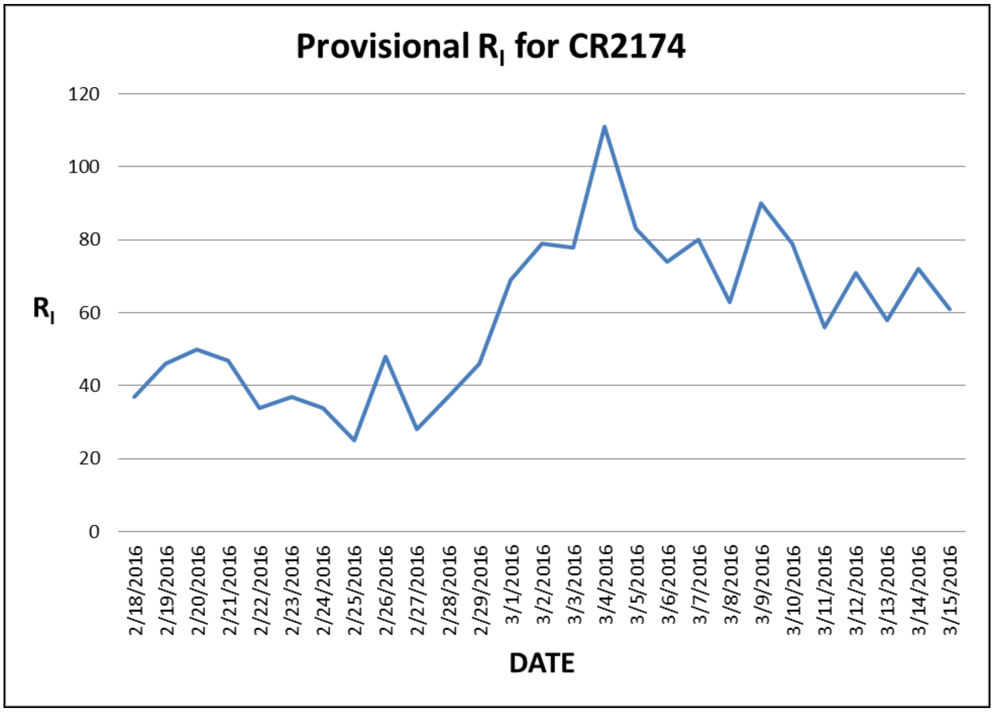


Figure 3. An exquisite H-alpha image of AR 2506 by Corban on 2016-03-01-11:28 UT. Further information can be found in Table 1.

10:33 UT (Fig. 2). This was followed by a couple of small umbral spots with a few penumbral bits. The follower was largely unchanged but the spots between the two were gone. The magnetic class was now beta-gamma though flares were down to about a dozen in a 48-hour period. The area of the region had grown to 110 millionths even with fewer spots an increase of 50 millionths, but still classed as Dai.

The month of March opened with this region having grown another 20 millionths with the same McIntosh Class, but the magnetic class had dropped to just beta and the flare list was only a half-dozen now. Leventhal showed in his combined w-l/H-a drawing, that the leader and follower were roughly equal in size and form now. A spectacular Corban H-a image at 11:27 UT (Fig. 3) showed the follower to be about half the size of the leader and in two parts divided by a thin light bridge. On 3/2, the leader spot, very round now, was followed by three roughly equal sized umbral spots in a bent line with a few pores scattered about shown well in images by Tyler and Corban and a sketch by Leventhal. Clearly dissolution was taking place. The area fell back to 110 millionths with an unchanged magnetic class and less than a half-dozen flares in the previous 48 hours. This continued on the 3rd with the sunspot group class now Hsx and the area 70 millionths. Magnetic class was reduced to alpha and only four flares were noted. A Tyler H-a image at 10:04 UT showed a small hot plage immediately following the leader spot. In his w-l image at 10:14 UT, the leader was seen to have an east-west elongated umbra divided into three unequal pieces (the center piece being the smallest) by two, very thin light bridges. This was all in a nice symmetrical penumbra with one detached piece following closely. Bright facular spots could be seen in the area that was the H-a plage. There were a few scattered tiny umbral spots and pores following all this. As this region was leaving the disk Ramakers got a good H-a image of it on 3/4. The only big changes were the loss of all the follower spots, and the plage was now reduced to just a few bright points. In CaK, the plage was a bit more extensive but not like a few days earlier. The area was now 60 millionths with a class of Cso though it looked more like the Hsx class of a couple days earlier.



Carrington Rotation 2175

Dates: 2016 03 16.4986 to 2016 04 12.7896
Avg. R_I = 31.8
High R_I = 87 (3/16, first day of the rotation)
Low R_I = 12 (4/2 & 4/3)

After attaining a high on the opening day of this rotation, activity rapidly dropped and spent most of the rotation with daily counts at or below 42. The high was due to two larger groups, one of which was well-observed by the Section, AR 2524. This region came onto the disk on the opening day of the rotation but no observations were submitted. It was first shown well in a w-l Tyler image at 10:11 UT (Fig. 4) the next day. Corban also took a remarkable image of it on 3/17 at H-a 11:34 UT. At this point it was listed as an Eao sunspot group rather than the Hsx that was officially listed the day before. (NOAA must not have seen the follower spot.) The leader consisted of a single round spot with a large umbra and radially symmetrical penumbra, consistent with an Hsx spot. This was followed by what was obviously a large complex spot with multiple umbrae in a complex non-symmetrical penumbra with penumbral bits, umbral spots and pores around. Flare production was a promising 12 in 48 hours from this magnetic class beta region.

On 3/18, Corban had another very dramatic image of this region in H-a (Fig.5). The leader appeared to be a single round spot with symmetrical penumbra and a follower that was similar size and shape with a bright plage between them and closer to the follower.

This was confirmed in a w-l drawing by Broxton and a combined w-l and H-a by Leventhal. The group was now classed as Eao at 230 millionths area and the magnetic class was beta. There was no data on the 19th but on 3/20, Jenkins in a whole-disk w-l image showed the situation to be little changed, two fairly equal sized round spots. Tyler in a w-l image on 3/21 at 1027 UT, showed the leader to be round with a full penumbra while the follower umbra was now triangular, with one corner broken off, all in a penumbra that was still radially symmetrical. About 10 minutes earlier, Corban got a nice H-a image that showed the two spots looking fairly quiescent with plages between them. The plage closest to the follower was brighter and probably the site for any flaring. Two hours later, Corban showed further breakdown in his w-l image of the region at 12:52 UT. Ramakers CaK and H-a images at 14:32 and 14:38 UT respectively, confirmed the earlier appearance. The class was now Eso with an area of 240 millionths and a magnetic class that was still beta with 10 flares over the previous two days. It was the only action on the disk at this time.

The follower breakup and dissolution continued on 3/22 as seen by Tyler and Ramakers. A Tyler image at 14:36 UT showed a very thin light bridge bisecting the follower spot. Pieces were breaking off on several sides of the umbra and the penumbra was becoming less organized. The two plages were still seen in H-a and CaK image by both observers but the brighter one was now the one closest to the leader spot. The area and classes remained the same but flare production had increase slightly. AR 2524 straddled the central meridian at 21:10 UT as observed in a Leventhal drawing. The area decreased to 210 millionths on the 23rd but all classes were the same. The following plage was breaking down rapidly as seen in several Ramakers H-a images. Late on this day, Leventhal, in a combined w-l/H-a drawing noted that several pieces had broken off the follower. There were no observations for 3/24 but on 3/25, Broxton (w-l drawing) showed the leader unchanged while the follower was smaller with a small penumbra. Leventhal (w-l/H-a drawing) showed the penumbra gone at 21:30 UT. The area had dropped to 100 millionths with a group class of Eso and a

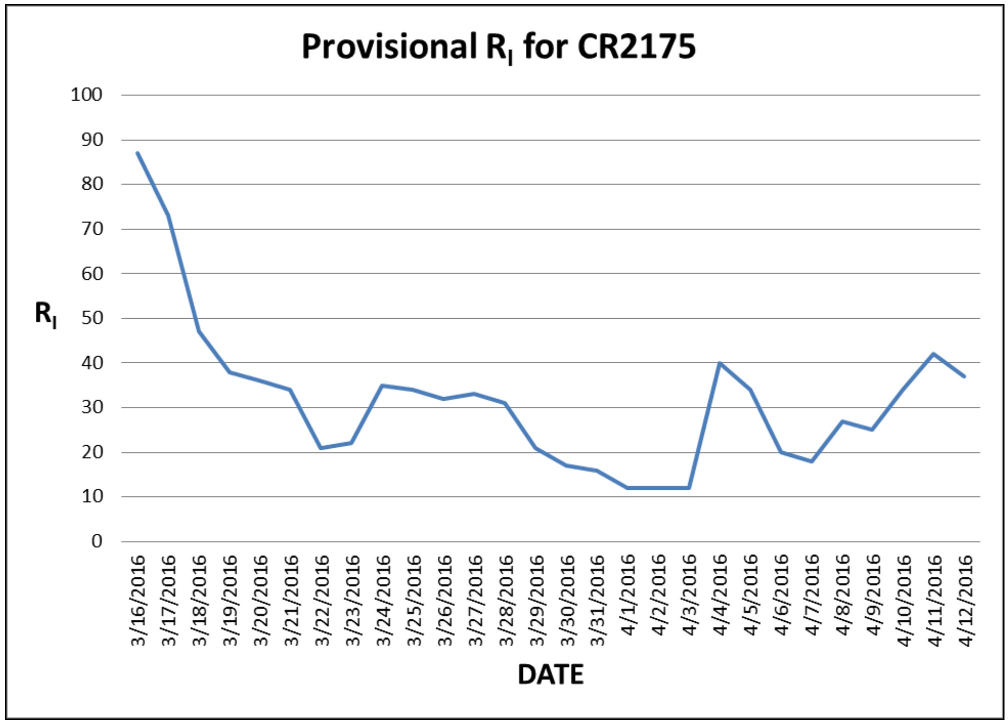


Figure 4. A remarkable image by Tyler of the full appearance of AR 2524 on 2016-03-17-10:11 UT using his 178mm refractor detailed in Table 1. Note the 3-dimensional appearance of the penumbra in the leading spot.

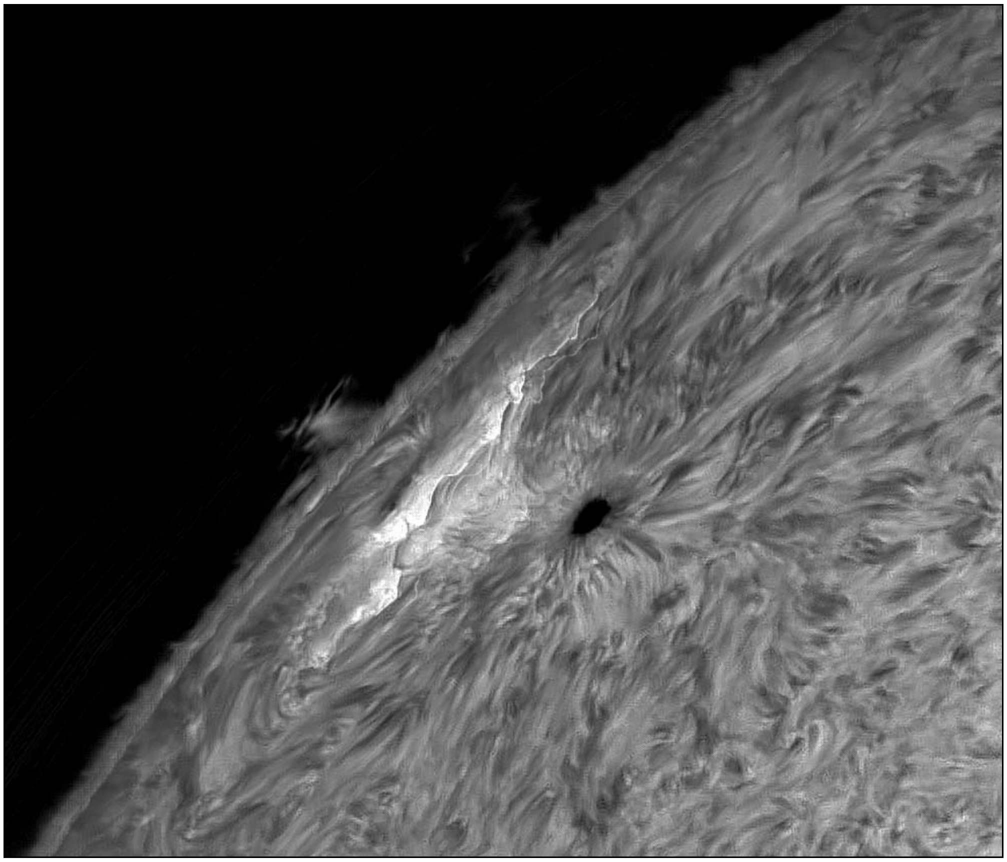


Figure 5. A phenomenal image of AR 2524 on 2016-03-17-11:35 UT by Corban. Note the curtain of material obscuring the plage near the follower spots. Information on his equipment is found in Table 1.

magnetic class of beta with 10 flares. This group class seems rather generous and would better as Dso or Cso. Jenkins, in a whole disk w-l image on the 26th, showed the follower gone altogether. Now the class was Hsx with an area of 80 millionths and a magnetic class of alpha. Leventhal confirmed this in a drawing later this day. Ramakers got a final image of this singular Hsx spot on the limb on 3/28 at 15:36 UT.

Carrington Rotation 2176

Dates: 2016 04 12.7896 to 2016 05 10.0368

Avg. R_I ***= 51.4***

High R_I ***= 90 (4/28)***

Low R_I ***= 22 (4/23)***

While peak activity in terms of RI appears to have occurred in the second half of this rotation, that was mostly due to numerous groups with less than 100 millionths area and lots of individual spots. The region that was most heavily observed was AR 2529 though AR 2542 played a pretty close second.

Ramakers was the first to observe this region in H-a, CaK and w-l, on the limb on 4/7 in a previous rotation. It was listed as an Hkx group only because it was on the limb and its true extent could not be seen yet, with an area of 330 millionths and a magnetic class of alpha. Even with this latter class it produced, on average, one flare per hour! Starting on 4/8 we have a six-day Ramakers H-a/Cak montage covering the disk passage and evolution of this region (Fig. 6). On the 8th, both in Ramakers H-a and CaK, there was a large sunspot followed by a bright plage. This was confirmed in a w-l image by Hrudey in his four-day w-l montage (Fig. 7). On 4/9 Tyler, in a w-l image at 11:07 UT, and Eskildsen, in a w-l image at 13:26 UT and CaK image at 13:19 UT (Fig. 8), showed the leader to be a large spot in penumbra followed by a cluster of umbrae with rudimentary penumbrae on the sides away from the middle of the cluster. The follower collection of spots were wreathed in and followed by much faculae in w-l and a plage in CaK. About the time of the Eskildsen image, Ramakers was showing low-level flaring taking place in this follower cluster. The official classification was Dhi, with an area of 350 millionths while Leventhal gave it a class of Chi. He, too, was noting minor flaring at 22:05 UT. The magnetic class was beta with a flare per hour on average. On 4/10, w-l images by Tyler (09:12 UT), Ramakers (21:59 UT) and Hrudey, showed the leader spot was more or less the same, but the follower had inverted itself so that the penumbral material was on the inside of the cluster while the umbrae were following. In the Tyler image, in middle of the group was an island of detached penumbra. It was gone by the time of the Ramakers image. These islands of penumbrae are usually this short-lived. A Corban H-a image the previous day showed the leader spot in a whirlpool of filaments. By this day, however, there were filaments arching away from the spot radially to about two spot diameters out. The area of the group now had jumped to 850 millionths and the class was Eki with a magnetic class of beta and 40 flares in the previous 48 hours. This would remain the same for the next two days. There was one observer reporting that this was a naked-eye spot, but that is unlikely. For most of us mere mortals, 900-1000 millionths for a SPOT is the threshold. This was 850 millionths for the whole spot GROUP.

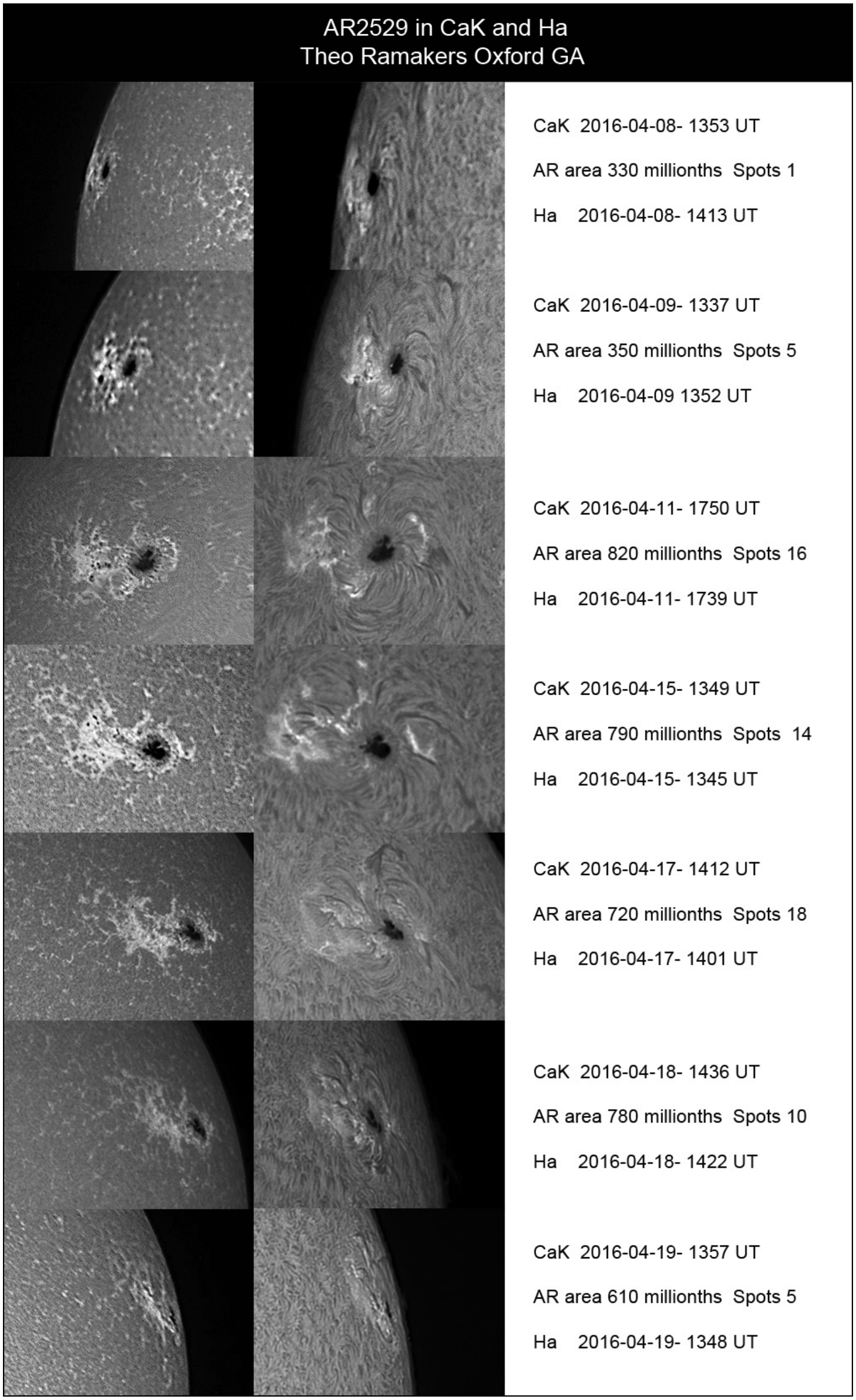


Figure 6. Another evolutionary montage in CaK and H-alpha by Ramakers this time on AR 2529 at the dates and times shown on the images. His equipment specifications can be found in Table 1.

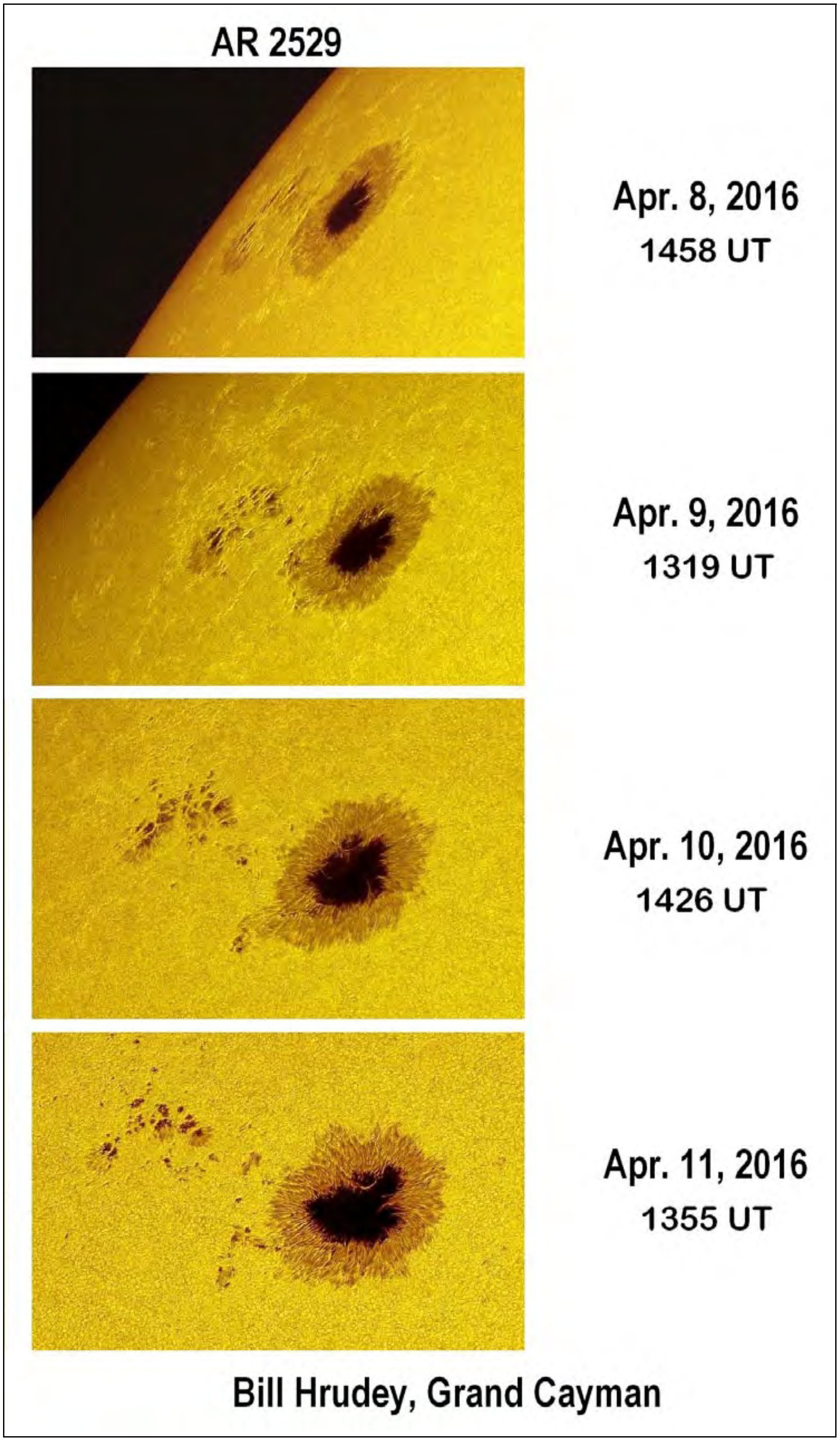
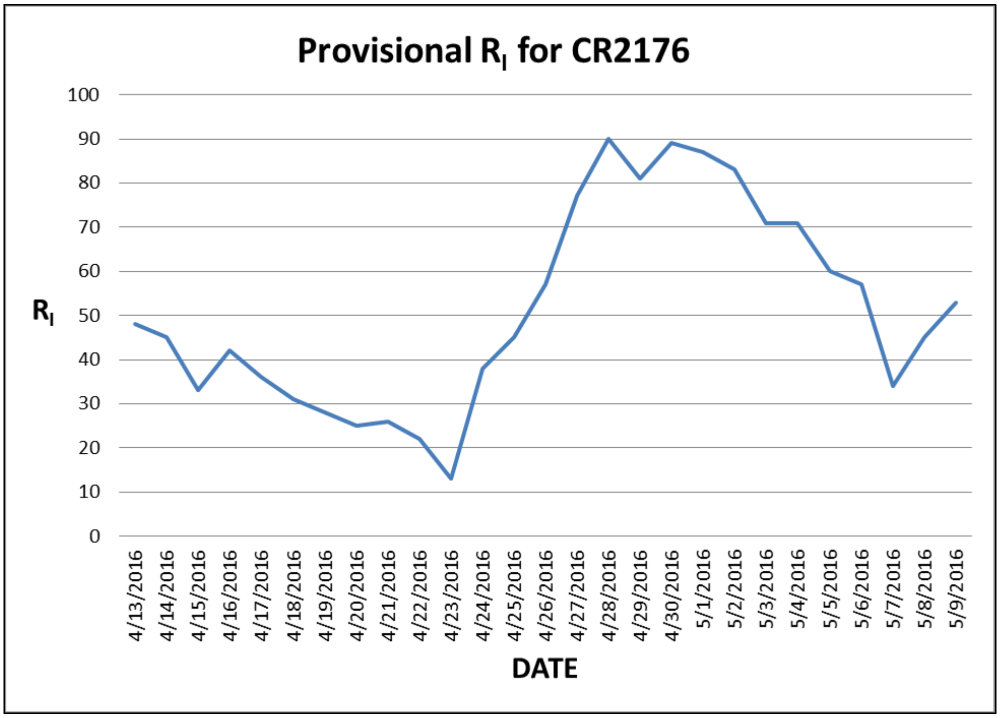


Figure 7. An excellent quality white-light evolutionary 4-day montage of AR 2529 by Hrudey using the 200mm solar Newtonian with equipment listed in Table 1.



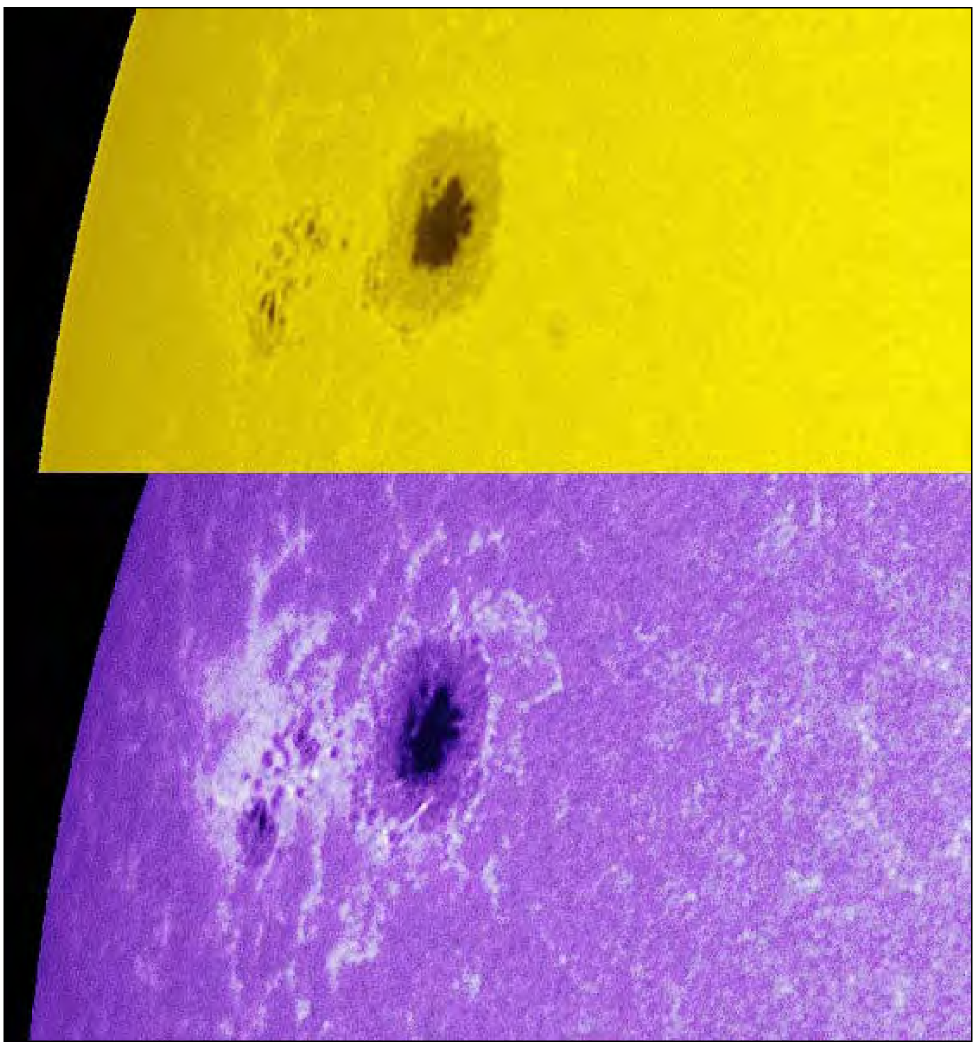


Figure 8. A two-pane image of AR 2529 by Eskildsen. The upper white-light image was taken at 2016-04-09-13:26 UT and the lower CaK image a few minutes earlier at 13:19 UT. Details about the equipment used is available in Table 1.

There was little change on the 11th except that the umbra in the leader took on the shape of a heart on its side as a light bridge began invading from the leading side. In H-a, several observers saw a bright north-south line preceding the whole region. This was probably a site for some of the flares. Maximum development was on this day. The next day, there was almost no change except that the light bridge in the leader's umbra was wider and deeper into the umbra. A w-l, six-day montage by Hill began on this date and served to show the late evolution as this group began its decline and headed for the limb (Fig. 9) Then on 4/13, we were treated to a spectacular sub-arc-second view of this group thanks to Tyler (Fig. 10). The light bridge is beautifully shown and had now almost cut off one corner of the umbra. The class was now Eho and the area had fallen to 780 millionths with only 30 flares in 48 hours. Grassman, in a CaK image, showed the large plage encompassing the follower spots was still there. The vertical bright line preceding the whole region was still there and still quite bright. On the 14th, the leader had some penumbra breaking off to the north but otherwise things were much the same. A w-l image by Hill shows this as well as the scattering of umbral spots and pores following the leader. Tatum, on 4/15 in a w-l image, showed the separated penumbral bits to have developed some small umbrae adding to the scattering of spots that followed. This was all showing disruption of the main umbra, a clear indication of decline. The area had fallen to 740 millionths but the class was still Eki and the magnetic class was now beta-gamma, though flare production had fallen to around 25 in 48 hours. H-a

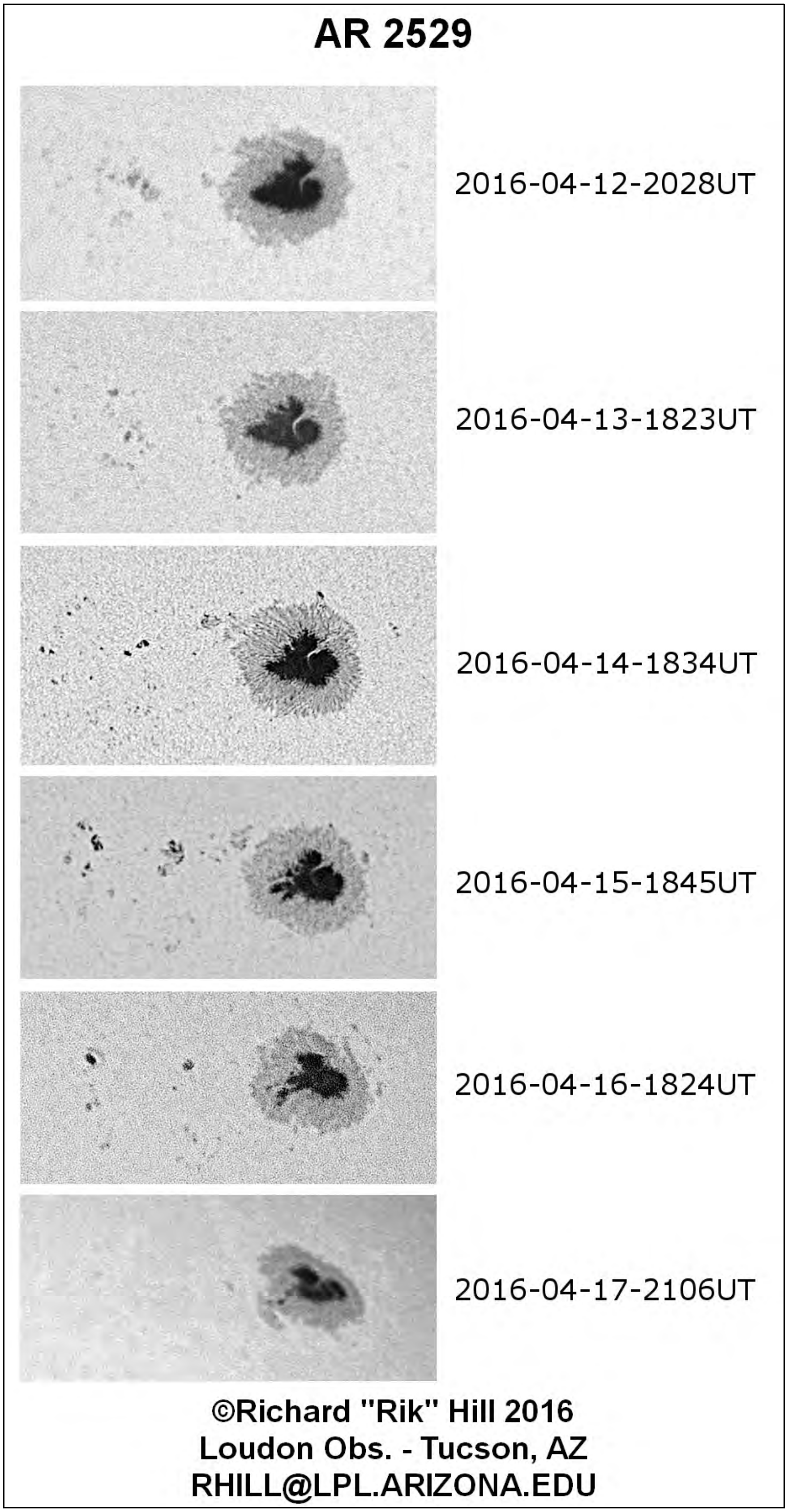


Figure 9. A white-light evolutionary montage by Hill on the dates and times shown. Done with a Questar details are in Table 1.

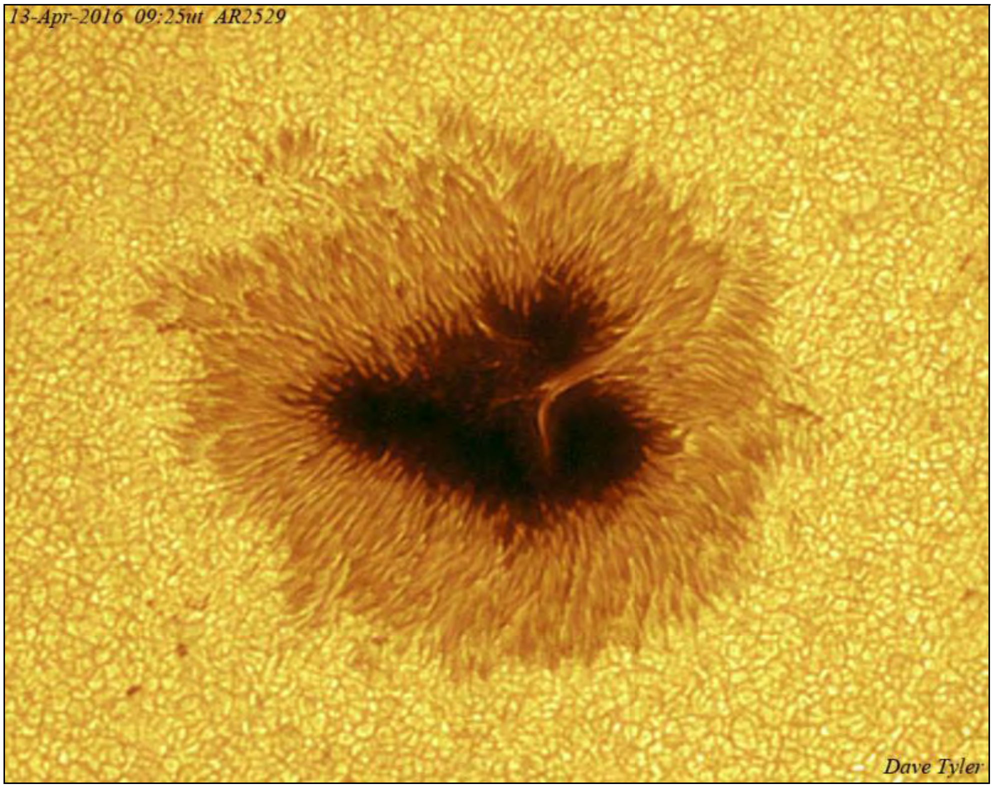
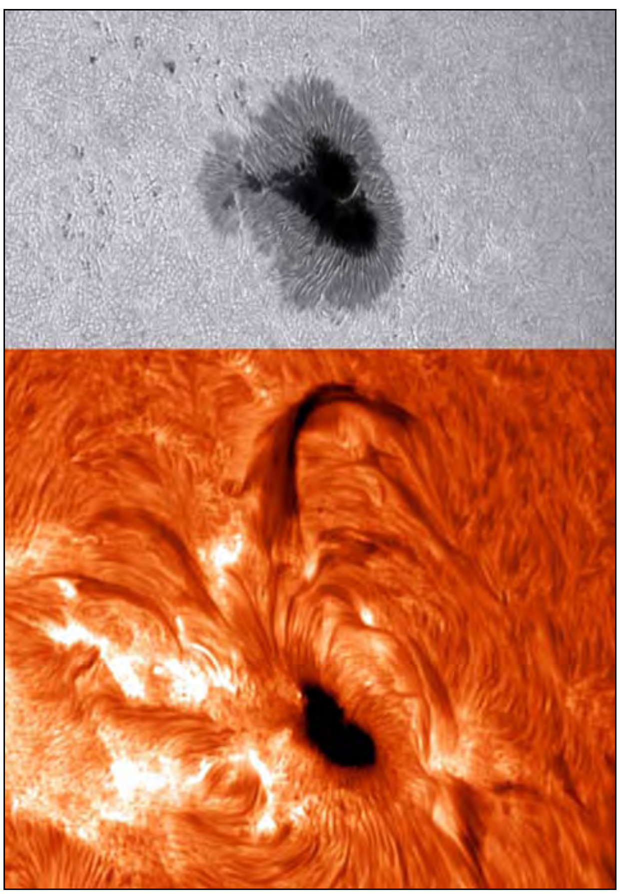


Figure 10. A spectacular image of AR 2529 on 2016-04-13-09:25 by Tyler using equipment listed in Table 1. Note the details in the light bridge on the right half of the umbra.



observations by several observers on the 16th showed the main spot at the focus of a spiral of 4-6 filaments. The following plage was breaking down and was much smaller now in both CaK and H-a.

The leader had taken on an east-west teardrop shape on 4/17 as pieces of the umbra were separating and taking bits of penumbra with them. A montage of two Tyler images, w-l (10:01 UT) and H-a (11:42 UT), show this and the fantastic filament structure (Fig. 11). As AR 2529 neared the limb on 4/18, there was only the main spot that was the former leader, and a very few tiny umbral spots around and following. The main umbra was now crossed by at least three light bridges, one particularly bright as shown in Ramakers and Tatum w-l images. The last view of this once-great region was by Ramakers in an H-a image on 4/20 at 15:42 UT when it was on the limb (Fig. 12). It would have been nice to see a disk occulted prominence image as I'm sure there were some nice loops and prominences.

Figure 11. A two pane white-light (10:01 UT) and H-alpha (11:42 UT) view of AR 2529 by Tyler on 2016-04-17 showing the dramatic appearance in H-alpha of what was an unremarkable white-light spot group. Details of equipment used can be found in Table 1.

Carrington Rotation 2177

Dates: 2016 05 10.0368 to 2016 06 06.2479

Avg. R_I = 41.4

High R_I = 90 (5/14)

Low R_I = 0 (6/3)

This rotation opened with promise but rapidly sunk to the lowest levels of activity in the reporting period. AR 2546 was the region that most observers worked on for this rotation. It was first seen very near the limb by Leventhal in one of his combined w-l/H-a images of 5/13 at 2220 UT. It was not seen by Gianninoto at 15h UT nor captured in an H-a image by Borman at 19h UT, so this was another nice catch by Leventhal. He estimated the class at Hsx which is very close to the official Hhx assigned to it on 5/14 by NOAA. On that day the area was listed as 250 millionths with a magnetic class of alpha and was already producing about one flare every 2 hours. There were four smaller regions on the Sun that were capturing everyone's attention, but on 5/15 at 11:31 UT, Ramakers took a great H-a image of this region showing nice long filaments radiating out from the large spot with a plage following. Grassmann, in CaK at 12:03 UT the same day, captured the

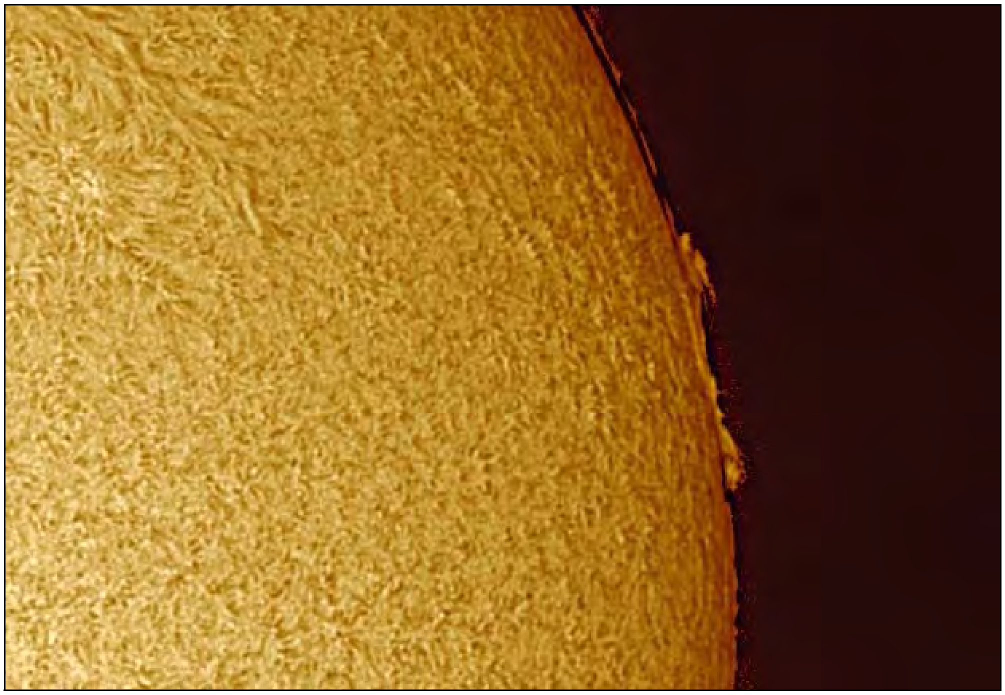
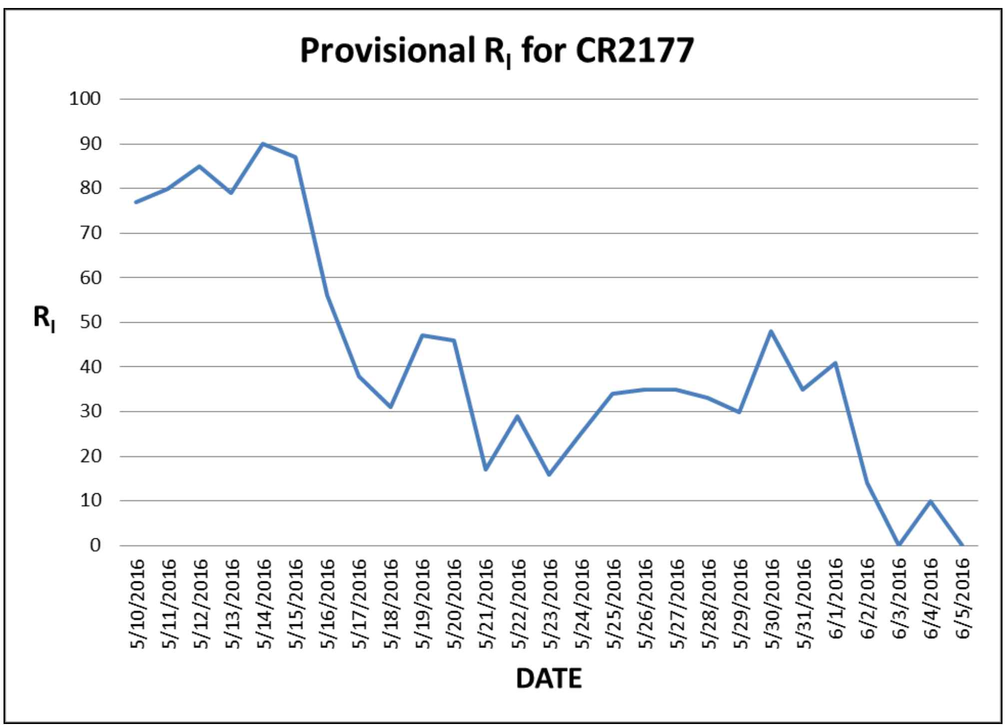


Figure 12. A Ramakers H-alpha view of AR 2529 as it was passing around the limb on 2016-04-20-15:42 UT. Equipment details can be found in Table 1.



following plage in more detail as it surrounded the penumbra of the main spot. By 5/16, the area had jumped to 410 millionths with the same classes. Images by Ramakers and Corban (w-l, H-a and CaK) captured a single large spot with radially symmetrical penumbra followed by a north-south oriented crescent-shaped plage, the obvious site for flares. Flare production levels remained the same. On the 17th, Corban took a remarkable H-a image (Fig. 13) of this region showing great detail in the following crescent. It was now listed as Cho with an increased area of 540 millionths. The magnetic class was beta-gamma. The only observation on 5/18 was from Leventhal. He classed the group as Cki (versus Cko officially) with two umbrae in a single penumbra. The next day, a Corban w-l image hinted at this split. But the highlight of this day was a splendid H-a image by Lawrence. (Fig. 14) It showed how the former bright crescent was now a chevron pointing away from the main spot. There were beautiful filaments radiating away from this spot in nearly every direction, a very impressive sight. The group was still Cho, but the area had fallen to 440 millionths and magnetic class was beta. Flare production was now below 20 in 48 hours.

On 5/20, this region was on the central meridian and very nearly dead-center of the disk. In a Grassmann H-a image, the bright region was now just a line extending from the following edge of the main spot to the south. The area had increased to 520, but all classes and flaring was the same. Over the next couple days the morphology of this group remained largely unchanged but the area increased slightly to 550 millionths. Even so, flare production dropped below 20 in 48 hours. Starting on 5/22, we have a three-day panel of w-l and H-a images by Tyler that serve to note the end of this region. It had, on the 23rd, dropped to 460 millionths and the class was a more realistic Hhx, indicative of a decaying sunspot group where the remaining large spot gets more round and simply decreased in area. During this three-day period, CaK image by Corban, Jenkins, Ramakers and Schur showed the plage following the large spot to be decreasing in area and intensity. Three observers (Borman, Grassmann and Ramakers) got good CaK images of this

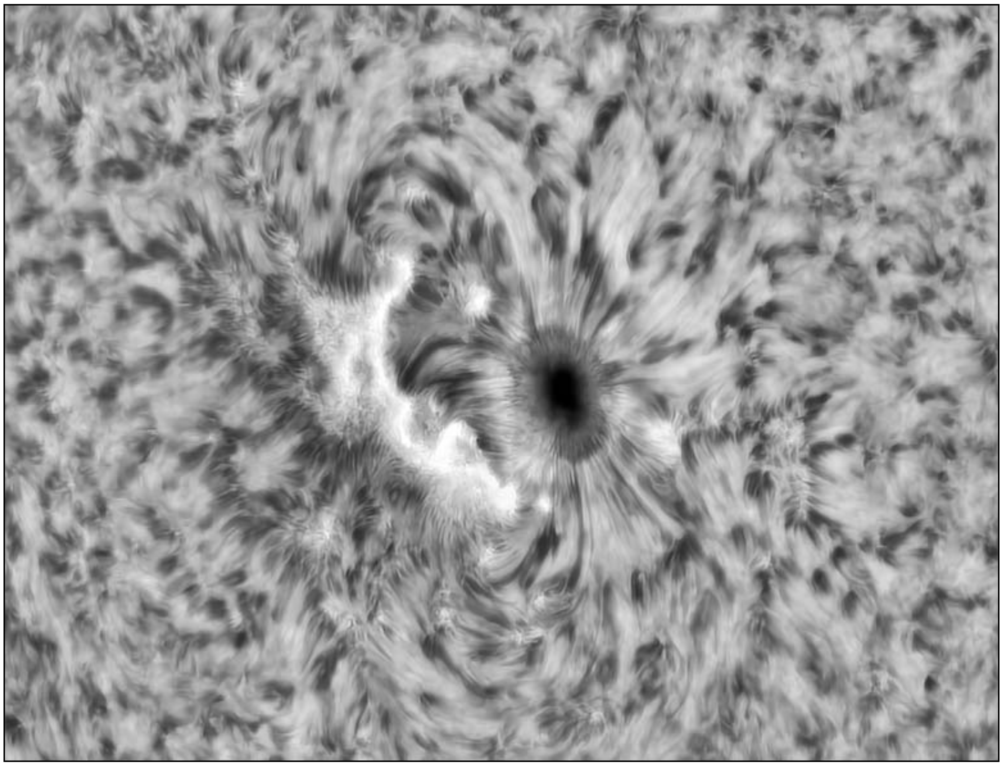


Figure 13. A breathtaking H-alpha image of AR 2546 by Corban showing remarkable following plage in great detail at 2016-05-17-18:16 UT. His equipment is listed in Table 1.

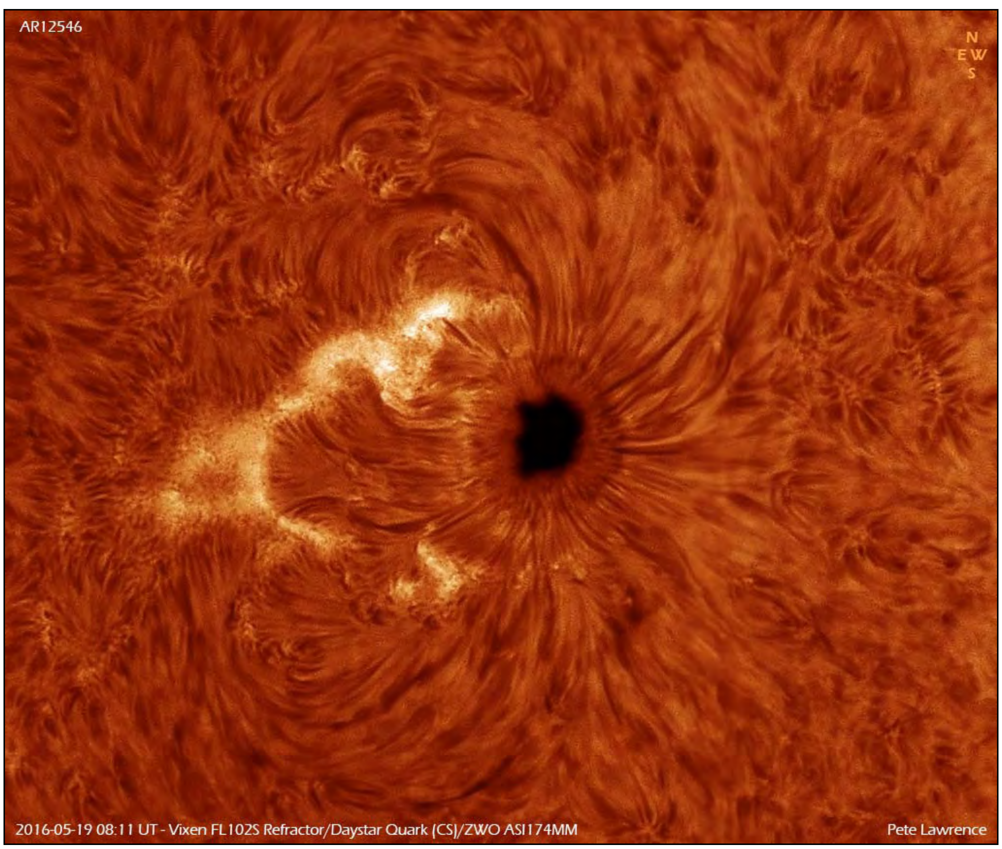


Figure 14. A beautifully detailed H-alpha image by Lawrence of AR 2546 taken on 2016-05-19-08:11 UT using equipment listed in Table 1.

region on 5/22-24 (Fig. 16) showing the slow decay of this region in that light as it approached the limb. Gianninoto got the last look at this region on the limb in one of his w-l/H-a drawings at 1420 UT. By 22:30 UT, Leventhal saw nothing at this location.

Conclusion

It is abundantly clear that solar activity has decreased from previous reporting periods, hinting that we may be heading into an early and possibly protracted minimum if some solar astronomers' predictions are borne out (Livingston & Penn 2008). The quality of the observations being submitted is far and away better than anything we saw in previous years. All observers are to be commended for such high quality, diligent work!

So what's to do as things wind down? Take heart, there is much to observe. Projects that include observing the evolution of granulation, pores and the development of smaller sunspot groups are still of value and the monitoring of plage formation, whether or not it results in the formation of sunspots, is always useful. The search for polar faculae and plages during a quiet Sun is another project of interest, as well as watching for the first activity of the next cycle happening at higher latitudes (around +/- 40° or higher).

So don't give up through the solar minimum, just look forward to the coming of the next Cycle!

References:

Hill, R.E., (1989), Journal of the Assn of Lunar & Planetary Observers, Vol. 33, p. 10.

Livingston, W., Penn, M.; (2008) "Sunspots may vanish by 2015." *https://wattsupwiththat.files.wordpress.com/2008/06/livingston-penn_sunspots2.pdf*

McIntosh, Patrick S., (1989) "The Classification of Sunspot Groups" Solar Physics, Vol. 125, Feb. 1990, p. 251-267. *http://link.springer.com/article/10.1007/BF00158405*

McIntosh, Patrick S., (1981) The Physics Of Sunspots, Sacramento Peak National Observatory, Sunspot, NM; L.E. Cram and J.H.Thomas (eds.), p. 7. *http://adsabs.harvard.edu/abs/1981phss.conf.....C*

Further references used in the preparation of this report:

Solar Map of Active Regions *https://www.raben.com/maps/date*

SILSO World Data Center *http://sidc.be/silso/home*

SILSO Sunspot Number *http://www.sidc.be/silso/datafiles*

The Mass Time-of-Flight spectrometer (MTOF) and the solar wind Proton Monitor (PM) Data by Carrington Rotation *http://umtof.umd.edu/pm/crn/*

NOAA Solar Indices Data *http://www.ngdc.noaa.gov/nndc/struts/results?t=102827&s=1&d=8,4,9*

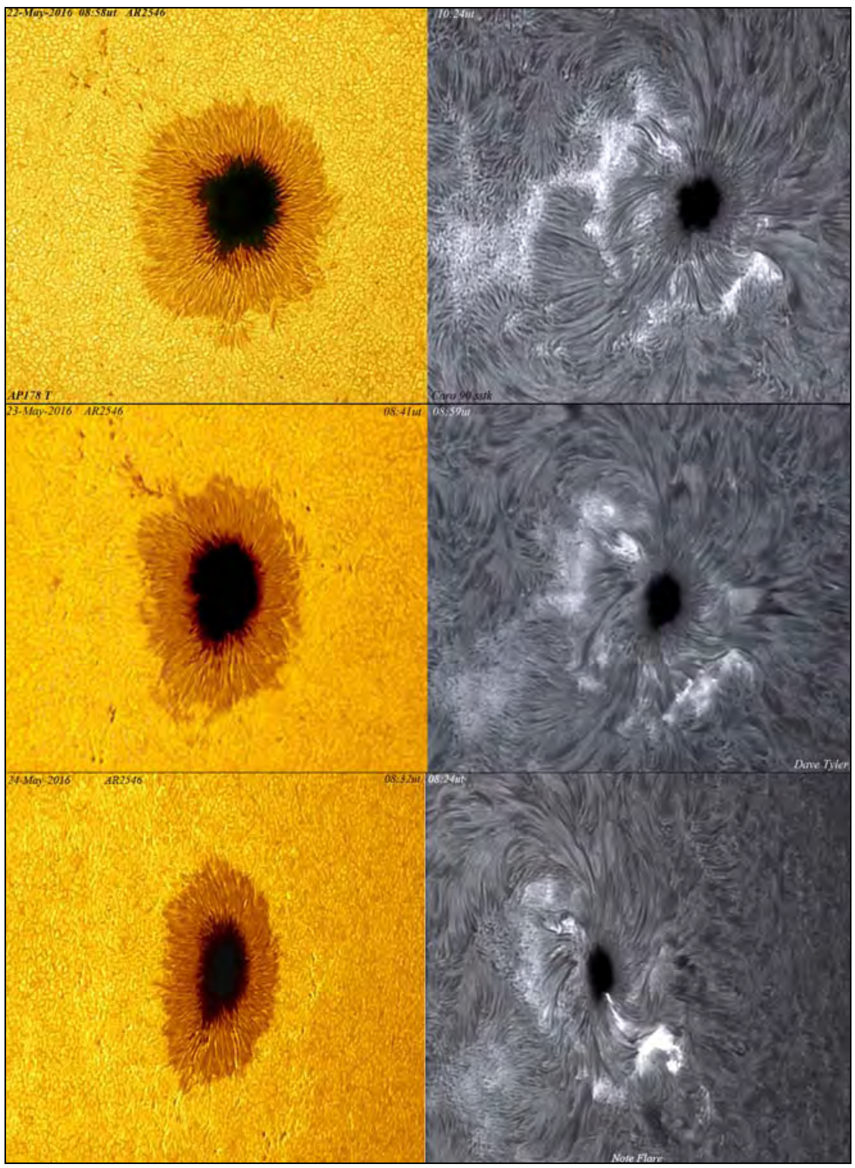


Figure 15. A 3-day evolutionary sequence in white-light and H-alpha of AR 2546 by Tyler. From top to bottom, left to right the dates and times are: 2016-05-22-08:58 and 10:24 UT, 2016-05-23-08:41 and 08:59 UT, and bottom is 2016-05-24-08:32 and 08:24 UT. Equipment details are listed in Table 1.

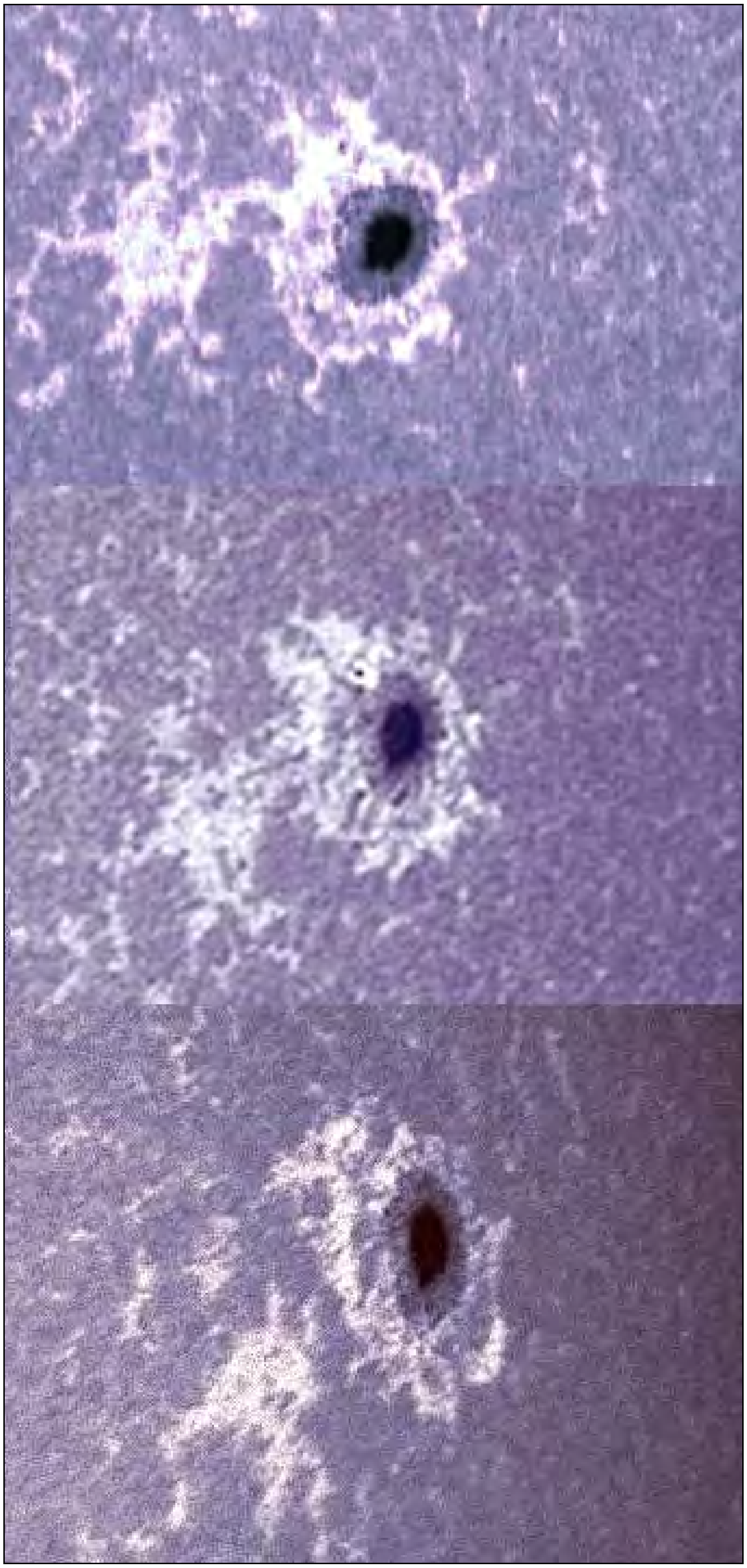


Figure 16. Three days of AR 2546 in CaK. At top, we see the view on 2016-05-22-19:16 UT by Borman; in the middle, 2016-05-23-13:28 UT by Grassmann; and at bottom, 2016-05-24-09:24 by Ramakers. Details of their equipment can be found in Table 1.

Feature Story:

Galilean Satellite Eclipse Timings: The 2004-05, 2005-06 and 2006-07 Apparitions

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Assistant Coordinator, ALPO Jupiter Section, Program Coordinator, Galilean Satellite Eclipses
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Abstract

During the three Jupiter apparitions, 2004/05-2006/07, seven observers made 155 visual timings of the eclipses of Jupiter's three Galilean satellites — Io, Europa and Ganymede. (The fourth Galilean satellite, Callisto, was not eclipsed during this period.) We compare the means of times of observed eclipse disappearances and reappearances with the predictions of the IMCCE (Institut de Méchanique Céleste et de Calcul des Éphémérides) for the three apparitions, both singly and combined. In addition, the three apparitions' timings are grouped together to investigate the possible effect of telescope aperture on observed eclipse times.

Table 1. Circumstances of the 2004/05-2006/2007 Jupiter Apparitions

Quantity	Apparition		
	2004/05	**2005/06**	**2006/07**
Initial solar conjunction	2004 SEP 21, 23h	2005 OCT 22, 13h	2006 NOV 21, 23h
First maximum phase angle	2005 JAN 08, 04h (10.39°)	2006 FEB 07, 12h (10.46°)	2007 MAR 10, 22h (10.71°)
Opposition to the Sun*	2005 APR 03, 15h (δ = -4.0°)	2006 MAY 04, 14h (δ = -14.8°)	2007 JUN 05, 23h (δ = -21.9°)
Closest approach to Earth†	2005 APR 04, 14h (D = 44.2")	2006 MAY 06, 00h (D = 44.6")	2007 JUN 07, 12h (D = 45.8")
Second maximum phase angle	2005 JUL 01, 20h (10.74°)	2006 AUG 02, 03h (10.82°)	2007 SEP 03, 08h (10.99°)
Final solar conjunction	2005 OCT 22, 13h	2006 NOV 21, 23h	2007 DEC 23, 06h
Observing Season			
First eclipse timing§	2004 DEC 21 (+91d)	2005 DEC 17 (+56d)	2007 FEB 20 (+91d)
Last eclipse timing§	2005 AUG 15 (-68d)	2006 AUG 08 (-105d)	2007 OCT 21 (-63d)
Duration	237d	234d	243d
Solar Elongation Range	073°W-053°E	044°W-085°E	079°W-050°E

* δ = Jupiter's declination at opposition.
† D = Jupiter's equatorial diameter in arc-seconds.
§ In parentheses are the number of days after initial solar conjunction (+) or before final solar conjunction (-).

Sources: Meeus 1995; *Astronomical Almanac*, 2004, 2005, 2006 and 2007 issues; JPL *HORIZONS* website. Dates and times throughout this report are in Universal Time (UT).

All Readers

Your comments, questions, etc., about this report are appreciated. Please send them to: *ken.poshedly@alpo-astronomy.org* for publication in the next Journal.

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Introduction

The Jupiter apparitions covered here were the 28th, 29th and 30th observed by the ALPO Jupiter Section's Galilean Satellite Timing Program, consisting of visual timings of the eclipses by Jupiter of the four Galilean satellites Io, Europa, Ganymede and Callisto. Our observers timed the "last speck" visible when the satellites entered Jupiter's shadow (disappearance) and the "first speck" visible when they emerged from eclipse (reappearance). Each satellite's mean disappearance and reappearance timings were then averaged to determine if its position corresponded to its ephemeris. (Our 1998/99 Apparition report described in detail our method of reduction, which also cited the reports for the previous apparitions. [Westfall 2009: 40, 42, 48; see also Westfall 2012, 2015 and 2016.])

Beginning with the 2001/02 Apparition, we have compared our timings with the Institut de Méchanique Céleste et de Calcul des Éphémérides (IMCCE) predictions of planetary satellite phenomena, currently available through 2016.

Table 1 lists the pertinent dates and other circumstances for the three apparitions studied.

Jupiter's declination became increasingly southerly throughout the period covered, thus becoming less favorable for observers in the Earth's northern hemisphere.

Observations and Observers

The 155 timings received for 2004/05-2006/07 brought our 30-apparition total to 10,738 visual timings, but reflect a decided drop in number per apparition from the 255 received for the 2000/01-2003/04 Apparitions. Table 2 gives descriptive statistics for the observations made during the three apparitions covered in this report.

The pattern of more observations made following opposition than before, and of more reappearance timings than disappearance timings, has held throughout the history of our program. This time bias is understandable, but the statistical significance of our results would be improved were the observations more evenly distributed.

It is gratifying to see that five of our seven observers have continued with our program for ten or more apparitions, and three have also contributed well over 100 timings each. The international basis of our program continues, with two observers residing outside the United States.

The contributors all used moderate-size telescopes in the aperture range 6.3-35.6 cm (2.5-14 in.). The mean aperture, weighted by number of observations, was 24.7 cm (9.7 in.), while the median aperture was 24.4 cm (9.6 in.), which are higher average apertures than used in most previous apparitions. Most of the observers used more than one telescope during the observing period. Indeed, one contributor, Dietmar Buettner, timed the reappearance of Io on 2007 Aug 14 twice; noting the event first with a 10-cm (4.0 in.) refractor, but 19 seconds later with his 6.3-cm refractor (2.5 in.).

Table 2. Number of Eclipse Timings, 2004/05-2006/7 Apparitions

Quantity	Apparition			
	2004/05	2005/06	2006/07	2004-07
Number of Timings	34	41	80	155
Timings before Opposition	13 (38%)	17 (41%)	31 (39%)	61 [39%]
Timings after Opposition	21 (62%)	24 (59%)	49 (61%)	94 [61%]
Disappearance Timings	15 (44%)	21 (51%)	34 (42%)	70 [45%]
Reappearance Timings	19 (56%)	20 (49%)	46 (58%)	85 [55%]

Table 3. Participating Observers, 2004/05-2006/07 Apparitions

Observer and Telescope				Apparition				ALPO Timing Program Total	
I.D. No.	Name	Nationality	Tel. Aper. (cm)	2004-05	2005-06	2006-07	2004-2007 (Total)	Number of Appar.	Number of Timings
1a	Abbott, A. P.	Canada	15	3	-	-	3	10	31
1b			31.8	-	1	1	2 (5)		
2a	Buettner, D	Germany	6.3	-	-	2	2	15	97
2b			10	-	3	6	9 (11)		
3a	Cudnik, B.	USA (TX)	20.3	6	-	-	6	3	46
3b			25.4	7	-	-	7		
3c			31.75	1	-	-	1 (14)		
4	Haas, W.H.	USA (NM)	20	-	3	-	3	19	148
5a	Hays, R.H., Jr.	USA (IL)	13	-	1	2	3	20	256
5b			15	8	14	12	34 (37)		
6	Sandel, J.	USA (SC)	25.4	-	-	27	27	1	27
7a	Westfall, J.	USA (CA)	9.0	-	1	2	3	29	457
7b			35.6	9	18	28	55 (58)		
Timings per Observer				8.5	8.2	16.0	22.1		

Timings Analysis: Satellite Positions

The individual eclipse timings made by our participants in 2004/05-2006/07 are listed in Table 8 at the end of this report. Table 4, below, summarizes the eclipse timings made in this period, with the means, standard errors of the means, and medians of the differences ("residuals") between our timings and the IMCCE ephemeris.

Since we are combining the results of three different apparitions, we need to investigate whether the timings of the three apparitions differ significantly from each other. A nonparametric ANOVA

Table 4. Timings Residuals, 2004/05-2006/07 Apparitions

Satellite and Event	Apparition			
	2004/05	2005/06	2006/07	2004/05-2006/07
Io				
1D: No. of Timings	9	9 (8)	18	36 (35)
1D: Mean	+83.2±2.9s	+77.8±5.0s	+79.2±1.5s	[+80.1±1.3s]
1D: Median	+81.0s	+76.5s	+80.0s	[+80.0s]
1R: No. of Timings	9	12 (11)	23 (22)	44 (42)
1R: Mean	-82.7±4.7s	-86.5±7.0s	-98.0±4.1s	[-89.1±3.8s]
1R: Median	-84.0s	-91.0s	-105.5s	[-91.0s]
(1D+1R)/2: Means	+0.3±2.8s	-4.4±4.3s	-9.4±2.2s**	[-4.5±2.3s]
(1D+1R)/2: Medians	-1.5s	-7.5s	-12.8s	[-7.5s]
Europa				
2D: No. of Timings	2	5	6 (5)	13 (12)
2D: Mean	+109.5±14.5s	+89.8±8.4s	+109.0±5.9s	[+102.8±5.3s]
2D: Median	+109.5s	+91.0s	+106.0s	[+106.0s]
2R: No. of Timings	7	3	13 (12)	23 (22)
2R: Mean	-102.6±4.8s	-90.3±18.5s	-107.4±4.2s	[-100.1±4.2s]
2R: Median	-107.0s	-112.0s	-111.5s	[-111.5s]
(2D+2R)/2: Means	+3.5±7.6s	-0.3±9.6s	+0.8±3.6s	[+1.3±0.9s]
(2D+2R)/2: Medians	+1.2s	-10.5s	-2.8s	[-2.8s]
Ganymede				
3D: No. of Timings	4	7	10	21
3D: Mean	+320.2±44.0s	+436.4±17.1s	+385.6±22.2s	[+380.7±27.5s]
3D: Median	+329.5s	+443.0s	+364.5s	[+364.5s]
3R: No. of Timings	3	5	9 (8)	17 (16)
3R: Mean	-372.0±10.2s	-478.6±15.8s	-356.2±5.8s	[-402.3±31.4s]
3R: Median	-360.0s	-470.0s	-359.5s	[-360.0s]
(3D+3R)/2: Means	-25.9±22.6s	-21.1±11.6s	+14.7±11.5s	[-10.8±10.5]
(3D+3R)/2: Medians	-15.2s	-13.5s	+2.5s	[-13.5s]

Satellites are designated: 1 = Io, 2 = Europa, and 3 = Ganymede; D = disappearance, R = reappearance. Numbers of timings in parentheses are the numbers used in the analysis after those with unusually large residuals (most often due to poor observing conditions) were omitted. In the right-hand column, values in brackets are the means or medians of the three apparitions weighted equally, those without brackets are totals; ** shows a mean observed-predicted difference that is significant at the 1-percent level.

Table 5. Analysis of Variance Test for Inter-Apparition Timing Differences, 2004/05-2006/07 Apparitions

Event Type	Apparitions Compared		
	2004/05 vs. 2005/06	2004/05 vs. 2006/07	2005/06 vs. 2006/07
Io disappearances	ns	ns	ns
Io reappearances	ns	*	ns
Europa disappearances	ns	ns	ns
Europa reappearances	ns	ns	ns
Ganymede disappearances	ns	ns	ns
Ganymede reappearances	ns	ns	**

Table 6. Comparison of Mean Residuals, Mallama *et al*. 2010 and ALPO, 2004/05-2006/07 Apparitions

Satellite and Program	Apparition			
	2004/05	2005/06	2006/07	2004/05-2006-07
J1: Mallama *et al.* 2010	-9.2±0.6	-13.0±0.4	-16.5±---	-12.9±1.7
ALPO	+0.3±2.8	-4.4±4.3	-9.4±2.2	-4.5±2.3
J2: Mallama *et al.* 2010	-5.2±1.3	-6.2±2.1	-11.0±1.4	-5.2±1.5
ALPO	+3.5±7.6	-0.3±9.6	+0.8±3.6	+1.3±0.9
J3: Mallama *et al.* 2010	+4.5±2.1	+11.4±1.8	+26.6±2.5	+14.2±5.3
ALPO	-25.9±22.6	-21.1±11.6	+14.7±11.5	-10.8±10.5

Residuals are in seconds. Satellites are designated as follows: J1 = Io, J2 = Europa and J3 = Ganymede. In the right-hand column, values are the means of the three apparitions weighted equally.

(analysis of variance) was used to test for any such differences, with the results shown in Table 5, where "ns" indicates no significant difference, "*" a difference significant at the 5-percent level and "**" a difference significant at the 1-percent level.

Because significant differences were found in only 2 of the 18 comparisons, we feel justified in combining the results of the three apparitions in our analysis.

In our analysis, a *positive* residual means that an event was timed to be later than predicted in the IMCCE ephemeris, while a *negative* residual indicates that the event was recorded as earlier than forecast. Disappearances occur later than the predictions, and reappearances earlier; a pattern that is expected because the ephemeris predicts the time of the midpoint of an event that actually occurs over a period of several minutes. In Table 4 we estimated the observed mid-time residuals of the events by taking the mean of the means of the timings of disappearance and reappearance (e.g., "(1D + 1R)/2"). In order to reduce the effect of any remaining unusually late or early timings, we also calculated and averaged the medians of the residuals. As it turns out, the results for the medians differed significantly from those for the means only for the median of Europa's medians.

As shown in Table 4, the three satellites' eclipse times usually did not vary significantly from those predicted by the IMCCE. The only exception among the 12 mean positions given in Table 4 was Io during the 2006/07 Apparition, when it appeared that Io was significantly ahead of its predicted position by approximately 9.4±2.2 seconds, or 163±38 km.

Table 7. Aperture vs. Residual Regression Results, 2004/05-2006/07 Apparitions Combined

Event Type	Number of Timings	A (Y-intercept, sec)	B (slope; sec/ cm)	Standard Error (s)	Significance of B
1D	35	+3.7±3.1	-71.7±54.0	±9.2	ns
1R	42	-16.9±6.7	+273.9±107.9	±21.9	*
2D	12	-5.9±14.1	+160.7±296.5	±16.6	ns
2R	22	+7.0±10.4	-143.9±195.8	±18.1	ns
3D	21	-16.7±45.1	+361.0±914.9	±70.3	ns
3R	16	+18.5±13.9	-361.5±244.6	±24.0	ns

Event types: 1 = Io, 2 = Europa, 3 = Ganymede; D = disappearance, R = reappearance. Significance: ns = not significant, * = significant at 5-percent level.

The independent CCD-photometric Galilean satellite eclipse-timing program coordinated by Anthony Mallama observed 110 eclipses during the 2004/05-2006/07 Jupiter apparitions (Mallama *et al*. 2010). We have compared their results with the IMCCE ephemeris and have calculated residuals for each type of eclipse event, then averaging their disappearance and reappearance residuals for each satellite, as done above for the ALPO visual observations.

The Mallama *et al*. program's disappearance and reappearance residuals were based on mid-disappearance and mid-reappearance, rather the "last speck" and "first speck" times of the ALPO program. However, the means of the CCD disappearance and reappearance mean residuals should be comparable to ours, and the mean residuals of both programs are listed in Table 6.

The standard errors for the individual apparitions are uniformly much smaller for the Mallama program than those for our results. Also, when multiple CCD

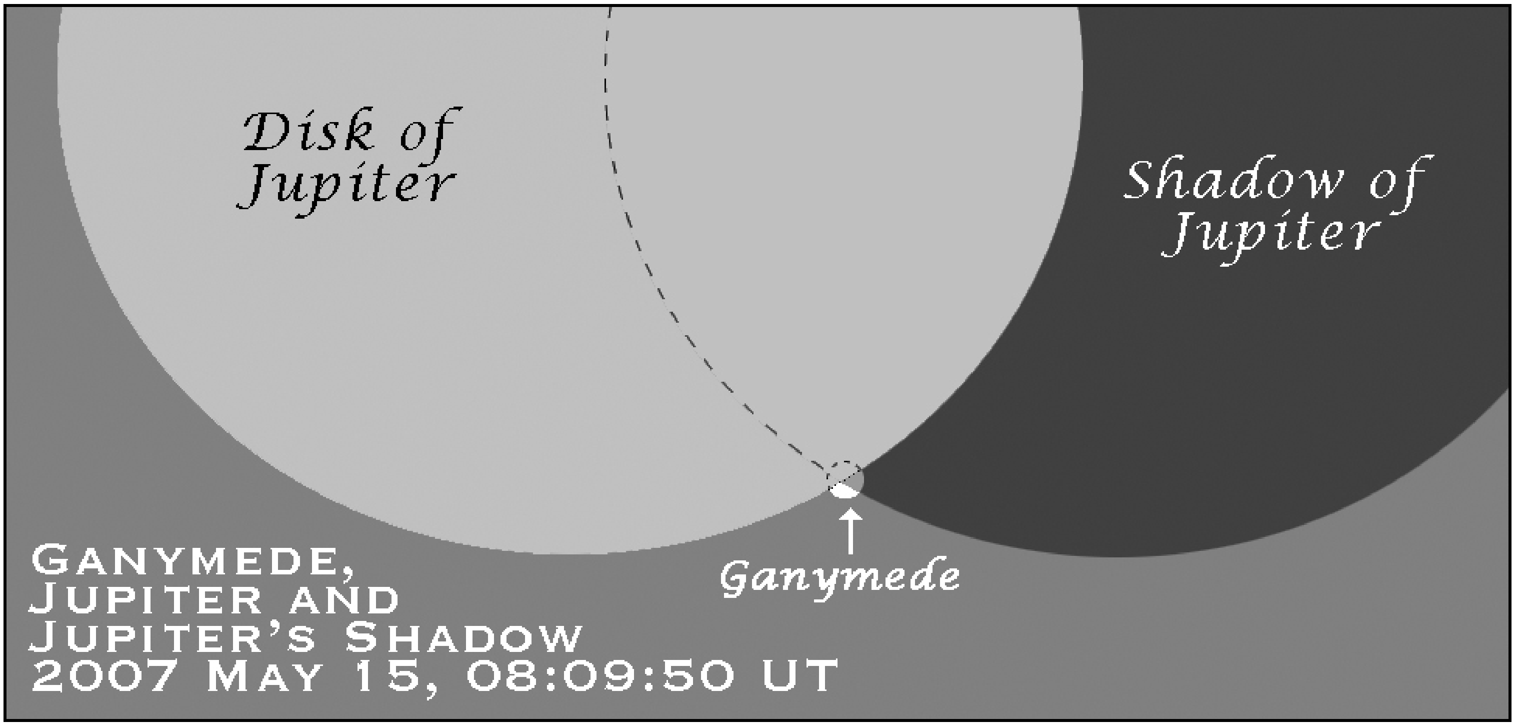

Fig 1. See text.

timings were made for the same event, they often agreed with each other to within a second. Thus we have high confidence in the CCD results and conclude that their residuals consistently reflect real differences between the satellites' positions and the IMCCE ephemeris. The ALPO results for Io and Europa, however, tended to agree more closely with the same ephemeris. For Ganymede both sets of observations showed large differences from the IMCCE ephemeris, but as we have noted, the ALPO timings for Ganymede events had large uncertainties.

Timings Analysis: Aperture Effect

In the majority of types of satellite events, for most of the previous apparitions analyzed, telescope aperture had a statistically significant effect on our observers' timings. Larger instruments have tended to show disappearances later, and reappearances earlier, than smaller telescopes. Using the procedure described in (Westfall 2015), we combined the timings from all three apparitions, giving the aperture-residual regression results in Table 7.

In only one of the six cases did telescope aperture have a significant effect on the timing residuals, the reappearances of Io; it is probably no coincidence that we had more timings for this type of event than for any other. We can conclude that observers with larger telescopes tended to time Io's reappearances earlier than did those with smaller instruments.

A Surprise Reappearance

Using his 25-cm (10-in.) Newtonian at 300 power, Jeffery Sandel reported an eclipse reappearance of Ganymede on 2007 May 15 at 08:09:50 UT. On the face of it, his was not an unusual observation. However, that particular reappearance was *not* predicted by either the IMCCE or the *Astronomical Almanac for the Year 2007*. Both ephemerides predicted that Ganymede would disappear into eclipse at 05:59 UT and not be seen again until 10:10, when it would emerge from behind Jupiter's limb. In Mr. Sandel's words, "reappearance of III @ extreme SPR. disk very distinctly seen and became rather bright for ~ 1 min. @ most then disappeared behind limb!!"

What appears to have happened is that the satellite almost literally fell between the cracks. When the center of Ganymede's apparent disk emerged from Jupiter's shadow, it was hidden by the planet. However, as shown in Figure 1, the satellite's southern hemisphere managed briefly to appear, sandwiched between Jupiter's shadow and its limb! [Figure 1]

Conclusion

The analysis of our program's timings made during the three Jupiter apparitions, 2004/05-2006/07, showed that the times of eclipses by Jupiter of Io, Europa and Ganymede did not differ significantly from the IMCCE ephemeris (the only exception being Io, and then

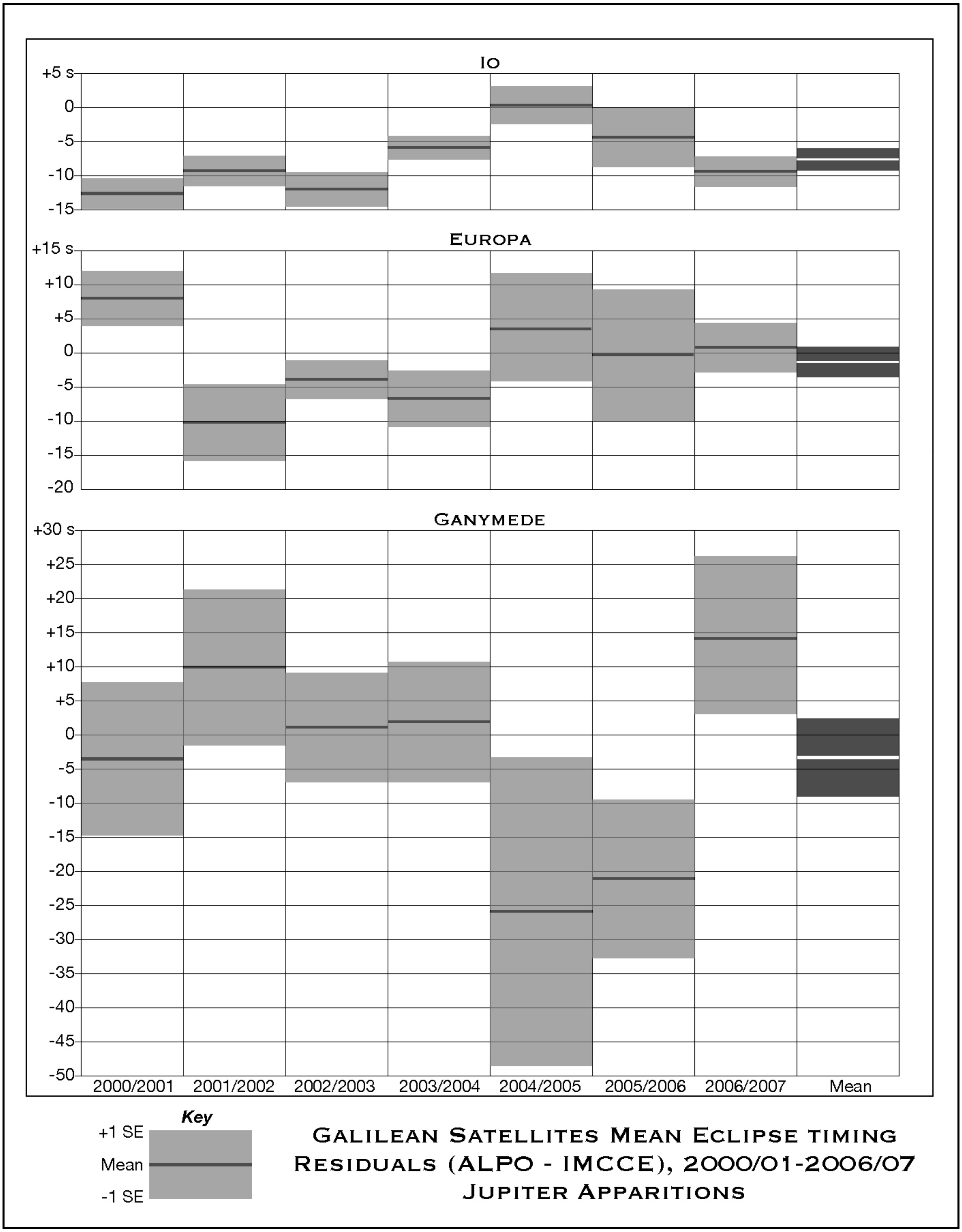

Fig. 2. See text.

only during the 2006/07 Apparition). Figure 2 plots the longer-term trend of the residuals of the three satellites, 2000/2001-2006/2007. [Figure 2] Our mean residuals for Io, Europa and Ganymede tended not to disagree significantly from the IMCCE ephemeris, but to disagree significantly with the independent CCD timings made by Anthony Mallama and his associates, whose mean results also frequently disagreed significantly from the IMCCE ephemeris (Mallama *et al*. 2010).

We thank the observers who contributed timings during 2004/05-2006/07, and hope that they continue with our program. We also invite others who are interested in this visual observing program, which requires only modest-sized telescopes, to contact the program coordinator (John Westfall at johnwestfall@comcast.net, 5061 Carbondale Way, Antioch, CA 94531 USA). He will be happy to furnish interested observers with a copy of observing instructions, a timing report form, and a copy of Galilean satellite eclipse predictions for the coming apparition.

References

Lieske, Jay H. (1981). “Catalog of Eclipses of Jupiter’s Galilean Satellites, 1610-2000.” *Astronomy and Astrophysics Supplement Series*, *44* (May): 209-216. *http://adsabs.harvard.edu/abs/1981A&AS...44..209L* [The full catalog is available on microfiche.]

Mallama, Anthony; Stockdale, Chris; Krobusek, Bruce A. and Nelson, Peter (2010). “Assessment of the Resonant Perturbation Errors in Galilean Satellite Ephemerides using Precisely Measured Eclipse Times.” *Icarus*, 210: 346-357. *http://adsabs.harvard.edu/abs/2010Icar..210..346M*

Meeus, Jean (1995). *Astronomical Tables of the Sun, Moon and Planets.* Richmond, VA: Willmann-Bell. *http://www.amazon.com/Astronomical-Tables-Sun-Moon-Planets/dp/094339645X*

United States Naval Observatory (2002). *The Astronomical Almanac for the Year 2004*. Washington: U.S. Government Printing Office.

________ (2003). *The Astronomical Almanac for the Year 2005*. Washington: U.S. Government Printing Office. h*ttps://www.amazon.com/Astronomical-Almanac-2005-NauticalAlmanacOff/dp/B000Q9VJVE/ref=sr_1_8?ie=UTF8&qid=1467852236&sr=8-8&keywords=astronomical+almanac+2005*

________ (2004). *The Astronomical Almanac for the Year 2006*. Washington: U.S. Government Printing Office. *https://www.amazon.com/Astronomical-Almanac-Year-Companion-Online/dp/0118873334/ref=sr_1_1?ie=UTF8&qid=1467852137&sr=8-1&keywords=astronomical+almanac+2006*

________ (2005). *The Astronomical Almanac for the Year 2007*. Washington: U.S. Government Printing Office. *https://bookstore.gpo.gov/products/sku/008-054-00207-2*

Westfall, John E. (2009). “Galilean Satellite Eclipse Timings During the 1998/99 Apparition.” *Journal of the Assn of Lunar & Planetary Observers*, 51 (3): 38-48. *http://www.alpo-astronomy.org/djalpo/51-3/JALPO51-3%20-%20Free.pdf*

________. (2012). “Galilean Satellite Eclipse Timings During the 1999/2000 Apparition.” *Journal of the Assn of Lunar & Planetary Observers*, 54 (4): 45-54.*http://www.alpo-astronomy.org/djalpo/* [Password: occultation]

________. (2015). "Galilean Satellite Eclipse Timings: The 2000/01 Apparition." *Journal of the Assn. of Lunar & Planetary Observers*, 57 (4): 37-47.

________ (2016). “Galilean Satellite Eclipse Timings: The 2001-2004 Apparitions.” *Journal of the Assn. of Lunar & Planetary Observers*, 58 (2): 50-60.

Table 8. Galilean Satellite Eclipse Timings, 2004/05-2006/07 Apparitions

UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif
Io Disappearances						Io Reappearances – Continued						Europa Reappearances – Cont.					
41221	17	-15	3a	000	+79	60716	20	-20	7b	101	-107	70614	6	-27	5b	101	-79
41228	18	-15	3a	000	+78				5b	200	-85	70621	11	-27	7b	100	-111
50214	17	-16	3b	000	+92	60801	19	-20	5b	000	-102	70624	14	-27	2b	002	-113
50309	10	-16	5b	000	+93	60808	19	-20	7b	200	-86	70709	22	-27	5b	000	-112
			7b	000	+95	70610	2	-18	7b	000	-51	70716	25	-27	6	000	-127
50316	8	-16	5b	000	+81	70617	5	-17	7b	100	-107				7b	100	-114
			7b	100	+88	70619	6	-17	6	010	-101	70723	28	-27	7b	100	-121
50323	5	-16	3b	000	+73				7b	200	+45	70810	32	-26	6	122	-93
50325	4	-16	7b	201	+70	70626	9	-17	6	000	-118	70817	33	-26	7b	100	-108
51217	11	-19	5b	100	+69				5b	000	-116	70911	31	-26	6	000	-120
60109	15	-19	7b	200	+77				7a	000	-72	70918	30	-25	7b	100	-109
60125	17	-20	5b	100	+70	70628	10	-17	6	000	-117	Ganymede Disappearances					
60208	19	-20	7b	000	+85	70705	12	-17	6	100	-122	50217	39	-42	5b	100	+426
60224	19	-20	7b	000	+109	70712	15	-17	6	100	-111	50325	10	-43	7b	201	+284
60404	12	-20	5b	000	+76				5b	000	-106	50619	22	-47	3b	010	+196
60415	8	-20	2b	020	+79				7b	102	-105				5b	200	+375
60422	5	-20	5b	100	+57	70719	17	-17	7b	200	-99	60423	9	-59	1b	100	+384
60427	3	-20	7b	200	*+29*	70722	18	-17	2b	100	-92				5b	000	+501
70220	17	-19	7b	100	+80	70728	19	-16	5b	000	-94	60430	4	-59	7b	100	+363
70308	19	-19	5b	100	+69	70804	20	-16	7a	000	-52	60529	3	-59	5b	001	+430
70324	20	-18	7b	110	+65	70814	21	-16	2b	010	-106				4	110	+465
70326	20	-18	2a	220	+73				2a	010	-87	60605	8	-59	7b	200	+469
70331	19	-18	7b	011	+80	70820	21	-16	7b	101	-110	60711	25	-59	4	110	+443
70416	18	-18	7b	100	+78				6	111	-106	70515	20	-53	7b	220	+357
			5b	000	+80	70905	20	-16	6	100	-108				5b	110	+372
70423	16	-18	7b	000	+83				5b	000	-100				6	000	+511
70425	16	-18	6	010	+81	71021	14	-15	7b	200	-75	70522	13	-51	6	122	+460
70502	14	-18	6	111	+83	Europa Disappearances									7b	000	+464
70504	13	-18	2b	202	+86	50225	23	-21	1a	001	+89	70802	20	-49	5b	001	+331
70509	12	-18	7b	100	+86	50315	13	-21	3b	000	+130				6	011	+421
70511	11	-18	6	121	+86	60219	30	-27	5b	100	+95	70809	23	-48	7b	100	+337
70516	9	-18	7b	201	+86	60323	25	-27	5b	000	+109	70914	23	-46	5a	100	+289
70520	7	-18	2b	202	+76	60330	21	-27	5b	000	+91				6	122	+314
70525	5	-18	7b	000	+70	60424	7	-27	7b	100	+77	Ganymede Reappearances					
			6	000	+84	60501	2	-27	7b	100	+77	50507	31	-45	7b	100	-397
70527	4	-18	6	001	+80	70331	31	-28	7b	011	+94	50612	46	-47	3b	000	-359
Io Reappearances						70425	25	-27	7b	200	+96	50619	47	-48	7b	100	-360
50424	9	-17	3b	100	-69				6	010	+106	60529	21	-59	5b	100	-465
50426	10	-17	7b	201	-75	70520	11	-27	6	000	+124	60605	27	-60	7b	200	-425
50503	12	-17	1a	000	-84	70527	7	-27	7b	200	*+15*	60626	40	-59	2b	000	-528
50510	14	-17	7b	100	-100				6	100	+125	60711	44	-60	7b	100	-505
50519	16	-17	3a	000	-104	Europa Reappearances									4	110	-470
50526	18	-17	7b	200	-69	50416	9	-21	3a	000	-89	70402	23	-55	5b	100	-359

Table 8. Galilean Satellite Eclipse Timings, 2004/05-2006/07 Apparitions (Continued)

UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif
50611	19	-17	3c	000	-61				1a	011	-81	70515	-0	-53	6	000	*
50704	19	-18	3a	000	-94	50511	23	-22	5b	100	-99	70620	13	-51	5a	000	-347
50720	17	-18	5b	200	-88	50518	25	-22	3a	000	-118	70627	21	-51	1b	212	-319
60513	4	-20	7b	201	+54	50612	31	-23	3b	000	-107				6	101	-239
60524	8	-20	5a	001	-100	50714	29	-23	5b	100	-108	70718	39	-50	2b	001	-368
60531	10	-20	7b	202	-91	50815	21	-24	5b	200	-116	70802	46	-49	7b	101	-376
60607	13	-20	7b	200	-101	60512	5	-28	7b	201	-45				5a	000	-366
60614	16	-20	7a	010	-17	60613	23	-28	5b	000	-112				6	222	-355
60623	17	-20	7b	102	-95	60715	31	-28	5b	000	-114	70907	49	-47	6	021	-360
60624	18	-20	2b	200	-86	70607	1	-27	6	110	-44						
60707	19	-20	7b	200	-81	70614	6	-27	7b	000	-82						

Column headings: UT = Universal Time, expressed as ymmdd, where y is the last digit of the year; LD = distance of satellite from Jupiter's limb in arc seconds; Lat = jovigraphic latitude of satellite on Jupiter's shadow cone in degrees; ObN = observer number as in Table 3; STB = observing conditions, where S = seeing, T = transparency and B = field brightness, all expressed in terms of 0 = condition not perceptible, 1 = condition perceptible but does not affect accuracy and 2 = condition perceptible and does affect accuracy; and Dif = (observed – calculated) eclipse time in seconds. Timings in italics were excluded during regression analysis due to unusually large residuals. *Note:* * = unusual observation described in text.

Feature Story: ALPO Observations of Saturn During the 2012 - 2013 Apparition

By Julius L. Benton, Jr.,
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This paper includes a gallery of Saturn images submitted by a number of observers.

Please note that when a visual observer records or suspects a specific feature on Saturn, it is important to secure future observations quickly if we wish to obtain the period of rotation. For this purpose we encourage observers to use these facts: In System I (EZ plus NEB or SEB), 7 rotations are accomplished in close to 3 Earth-days, while in System II (rest of planet), 9 rotations require close to 4 such days.

A complete set of Saturn Observing Forms are available for downloading at http://www.alpo-astronomy.org/publications/ALPO Section Publications/SaturnReportForms - All.pdf

See the ALPO Resources Section, ALPO Observing Section Publications of this Journal for hardcopy availability.

Abstract

The ALPO Saturn Section received 425 visual observations and digital images for the 2012-13 apparition for the period from December 16, 2012 through September 28, 2013. Observations were contributed by 37 observers located in Australia, Africa, Brazil, China, Colombia, France, Germany, Greece, Italy, Japan, New Zealand, Philippines, Puerto Rico, South Africa, United Kingdom, and United States. Instruments employed to carry out the observations ranged in aperture from 9.0 cm (3.5 in) up to 183.0 cm (72.0 in). Imaging of multiple diffuse bright areas still occurred within Saturn's North Tropical Zone (NTrZ) between Saturnigraphic latitude +35° and +45° presumably in the aftermath of the brilliant complex storm feature of 2010-11. Bright spots were also imaged throughout the 2012-13 apparition in the North Temperate Zone (NTeZ) and the North North Temperate Zone (NNTeZ). A recurring dark condensation for much of the observing season was seen toward the northernmost edge of the

Table 1. Geocentric Phenomena in Universal Time (UT) for Saturn During the 2012-2013 Apparition

Conjunction		2012	Oct	25^d
Opposition		2013	Apr	28^d
Conjunction			Nov	06^d
Opposition Data				
Visual Magnitude		+0.1		
Constellation		Libra		
B		+18.2°		
B'		+18.3°		
Globe	Equatorial Diameter	18.7″		
	Polar Diameter	16.7″		
Rings	Major Axis	42.5″		
	Minor Axis	13.3″		

All Readers

Your comments, questions, etc., about this report are appreciated. Please send them to: ken.poshedly@alpo-astronomy.org for publication in the next Journal.

Online Features

Left-click your mouse on:

- The author's e-mail address in blue text to contact the author of this article.
- The references in blue text to jump to source material or information about that source material (Internet connection must be ON).

Observing Scales

Standard ALPO Scale of Intensity:
0.0 = Completely black
10.0 = Very brightest features
Intermediate values are assigned along the scale to account for observed intensity of features
Ring B has been adopted (for most apparitions) as the standard on the numerical sequence. The outer third is the brightest part of Ring B, and it has been assigned a constant intensity of 8.0 in integrated light (no filter). All other features on the globe and in the rings are estimated using this standard of reference.

ALPO Scale of Seeing Conditions:
0 = Worst
10 = Perfect

Scale of Transparency Conditions:
Magnitude of the faintest star visible near Saturn when allowing for daylight and twilight

IAU directions are used in all instances (so that Saturn rotates from west to east).

Table 2: Contributing Observers, 2012-2013 Apparition of Saturn

	Observer	Location	No. of Observations	Telescopes Used
1.	Abel, Paul G.	Leichester, UK	8 1 1	20.3 cm (8.0 in.) NEW 40.6 cm (16.0 in.) NEW 50.8 cm (20.0 in.) DALL
2.	Akutsu, Tomio	Cebu City, Philippines	10	35.6 cm (14.0 in.) SCT
3.	Arditti, David	Middlesex, UK	1	35.6 cm (14.0 in.) SCT
4.	Ashcraft, Clif	Perrineville, NJ	23	28.0 cm (11.0 in.) SCT
5.	Barry, Trevor	Broken Hill, Australia	49	40.6 cm (16.0 in.) NEW
6.	Benton, Julius L.	Wilmington Island, GA	50	15.2 cm (6.0 in.) REF
7.	Borges, Fabricio	Cariaccia, Brazil	2	20.3 cm (8.0 in.) NEW
8.	Chang, Daniel	Hong Kong, China	7	18.0 cm (7.1 in.) REF
9.	Collins, Maurice	Palmerston North, NZ	11	11.0 cm (4.3 in.) REF
10.	Combs, Brian	Buena Vista, GA	6	35.6 cm (14.0 in.) SCT
11.	da Silva, Vlamir	San Paolo, Brazil	16	20.3 cm (8.0 in.) SCT
12.	Delcroix, Marc	Tournefeuille, France	4 1	31.8 cm (12.5 in.) NEW 106.0 cm (41.7 in.) CAS
13.	Foster, Andrew	Gamba, Gabon, Africa	1	28.0 cm (11.0 in.) SCT
14.	Go, Christopher	Cebu City, Philippines	18	35.6 cm (14.0 in.) SCT
15.	Hansen, Torsten	Berlin, Germany	1	35.6 cm (14.0 in.) SCT
16.	Hergenrother, Carl	Tucson, AZ	7	183.0 cm (72.0 in.) GRE
17.	Hill, Rik	Tucson, AZ	1 2	9.0 cm (3.5 in.) MAK 20.3 cm (8.0 in.) MAK
18.	Hood, Mike	Kathleen, GA	10	35.6 cm (14.0 in.) SCT
19.	Ikemura, Toshihiko	Osaka, Japan	4	38.0 cm (15.0 in.) NEW
20.	Jaeschke, Wayne	West Chester, PA	6	35.6 cm (14.0 in.) SCT
21.	Kardasis, Manos	Athens, Greece	22	28.0 cm (11.0 in.) SCT
22.	Llewellyn, Dan	Decatur, GA	1	35.6 cm (14.0 in.) SCT
23.	Maxson, Paul	Phoenix, AZ	20 64	25.4 cm. (10.0 in.) SCT 35.6 cm. (14.0 in.) SCT
24.	Melillo, Frank J.	Holtsville, NY	5	25.4 cm (10.0 in.) SCT
25.	Melka, Jim	St. Louis, MO	5	45.0 cm (17.7 in.) NEW
26.	Morales, Efrain	Aquadilla, Puerto Rico	1	30.5 cm (12.0 in.) SCT
27.	Niechoy, Detlev	Göttingen, Germany	9	20.3 cm (8.0 in.) SCT
29.	Peach, Damian	Norfolk, UK	14	35.6 cm (14.0 in.) SCT
30.	Phillips, Jim	Charleston, SC	1 3	25.4 cm (10.0 in.) MAK 50.8 cm (20.0 in.) NEW
31.	Phillips, Michael A.	Swift Creek, NC	3	35.6 cm (14.0 in.) NEW
32.	Rosolina, Michael	Friars Hill, WV	2	35.6 cm (14.0 in.) SCT
33.	Sweetman, Michael E.	Tucson, AZ	11	10.2 cm (4.0 in.) REF
34.	Triana, Charles	Bogota, Colombia	3	20.3 cm (8.0 in.) SCT
35.	Walker, Gary	Macon, GA	3	25.4 cm (10.0 in.) REF
36.	Wesley, Anthony	Murrumbateman, Australia	16	36.8 cm (14.5 in.) NEW
37.	Zannelli, Carmelo	Palermo, Italy	1	35.6 cm (14.0 in.) SCT
	TOTAL OBSERVATIONS		**425**	
	TOTAL OBSERVERS		**37**	

Instrumentation Abbreviations:
NEW = Newtonian, SCT = Schmidt-Cassegrain, MAK= Maksutov-Cassegrain, REF = Refractor, GRE = Gregorian,
CAS = Cassegrain

North Temperate Belt (NTeB) along the southern edge of the NTeZ, plus a lesser prominent dark spot in the North North Temperate Belt (NNTeB) in May. Occasional small bright areas appeared within the EZn (Equatorial Zone, northern half) since mid-February, particularly obvious at IR wavelengths. Of continuing interest have been amateur images of the remarkable hexagonal feature at Saturn's North Pole at different wavelengths. Views of the major ring components, including Cassini's and Encke's divisions, were much improved this apparition due to the more favorable ring tilt toward Earth, and ALPO observers continued involvement in our cooperative Pro-Am imaging campaign at various wavelengths, including routine active participation by visual observers, as we monitor activity on Saturn's globe and submit results to Cassini scientists. The inclination of Saturn's ring system toward Earth, ***B,*** *attained a maximum value of +19.3° on February 12, 2013, and therefore, more of the planet's Northern Hemisphere and North face of the rings were seen to advantage during 2012-13. A summary of visual observations and digital images of Saturn contributed during the apparition are discussed, including the results of continuing efforts to image the curious bi-colored aspect and azimuthal brightness asymmetries of the rings. Accompanying the report are references, drawings, photographs, digital images, graphs, and tables.*

Introduction

This report is based on an analysis of 425 visual observations, descriptive notes and digital images contributed to the ALPO Saturn Section by 37 observers from December 16, 2012 through September 28, 2013, referred to hereinafter as the 2012-13 "observing season" or apparition of Saturn. Examples of submitted drawings and images are included with this report, integrated as much as practicable with topics discussed in the text, with times and dates all given in Universal Time (UT).

Table 1 provides geocentric data in Universal Time (UT) for the 2012-13 apparition. The numerical value of **B**, or the Saturnicentric latitude of the Earth referred to the ring plane (+ when north), ranged between the extremes of +19.3°

Figure 1

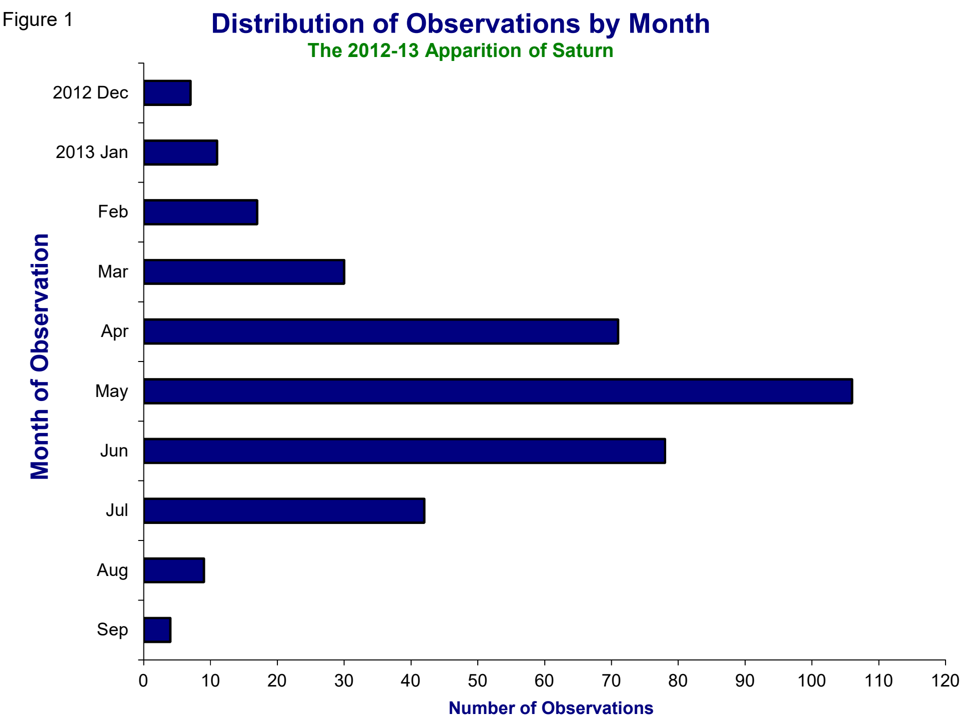
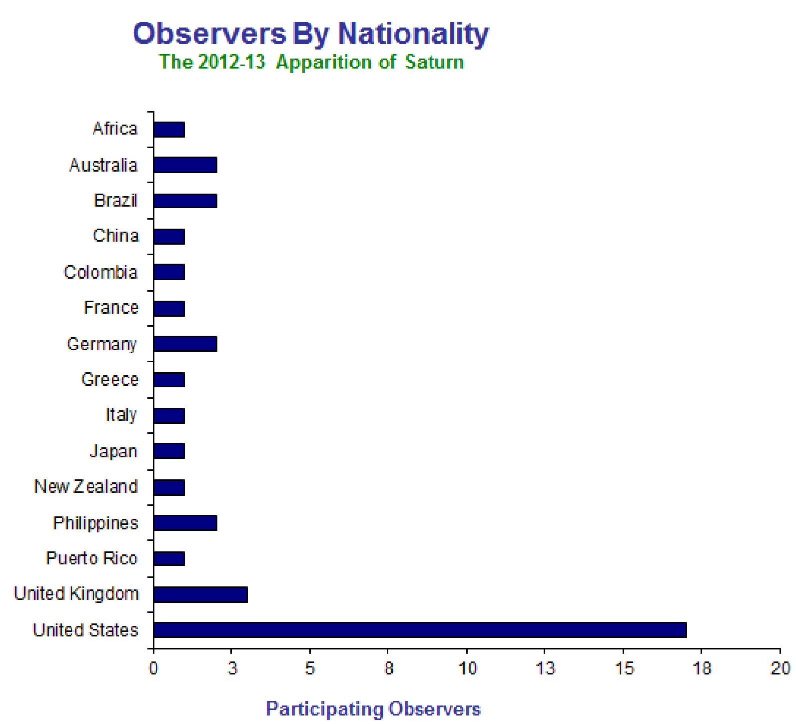


Figure 2



(February 12, 2013) and +17.2° (June 01, 2013). The value of **B'**, the saturnicentric latitude of the Sun, varied from +16.8° (December 16, 2012) to +19.9° (September 28, 2013).

Table 2 lists the 37 individuals who submitted 425 reports to the ALPO Saturn Section this apparition, along with their observing sites, number of observations, telescope aperture, and type of instrument. *Figure 1* is a histogram showing the distribution of observations by month, where it can be seen that 34.1% were made prior to opposition, 1.9% at opposition (April 28, 2013), and 64.0% thereafter. Although there's often a tendency for observers to view Saturn preferentially at or near opposition when the planet is well-placed high in the evening sky, coverage favored a wider span of time around opposition during the 2012-13 apparition (86.4% of all observations took place from early March through late July 2013). To accomplish the best overall coverage, observers are always encouraged to start viewing and imaging Saturn as soon as the planet becomes visible in the eastern sky before sunrise following conjunction with the Sun. Our goal is to carry out consistent observational surveillance of the planet for as much of its mean synodic period of 378^d as possible. (This period refers to the elapsed time from one conjunction of Saturn with the Sun to the next, which is slightly longer than a terrestrial year.)

Figure 2 and *Figure 3* show the ALPO Saturn Section observer base and the international distribution of all observations submitted during the apparition. The United States accounted for 45.9% of the participating observers and 52.7% of the submitted observations. With 54.1% of all observers residing Australia, Africa, Brazil, China, Colombia, France, Germany, Greece, Italy, Japan, New Zealand, Philippines, Puerto Rico, and the United Kingdom, whose total contributions represented 47.3% of the observations, international cooperation remained strong this observing season.

Figure 4 graphs the number of observations this apparition by instrument type. Slightly more than two-fifths (43.8%) of all observations were completed with telescopes of classical design (refractors, cassegrains, Newtonians, and Gregorians), while the remaining 56.2% were made with catadioptrics (Schmidt-Cassegrains, Maksutov-Cassegrains, and Dall-Kirkhams).

Figure 3

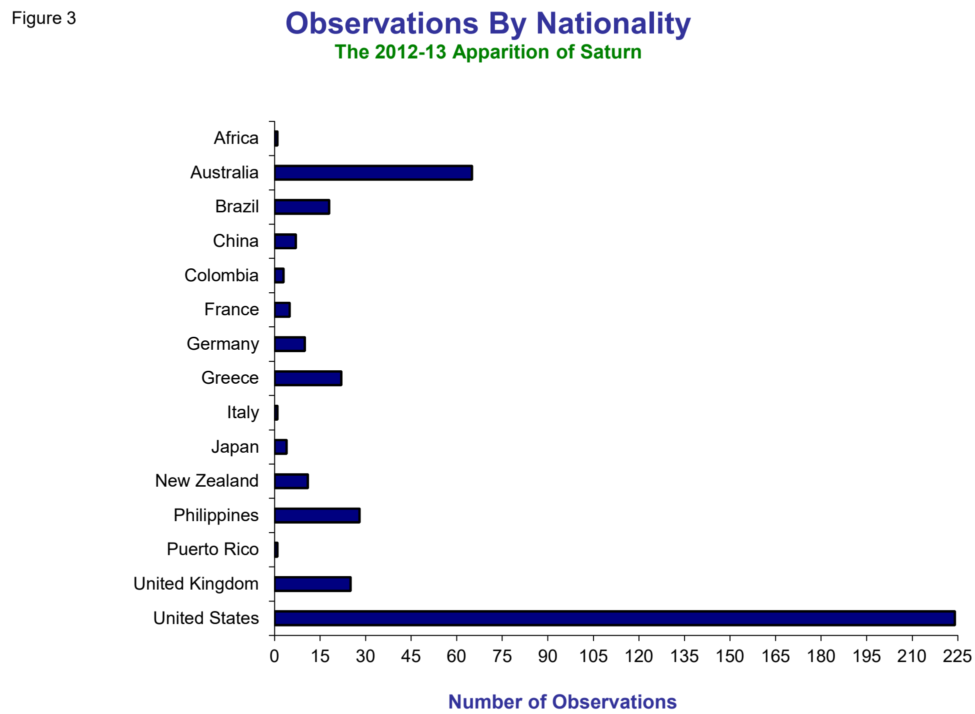


Figure 4

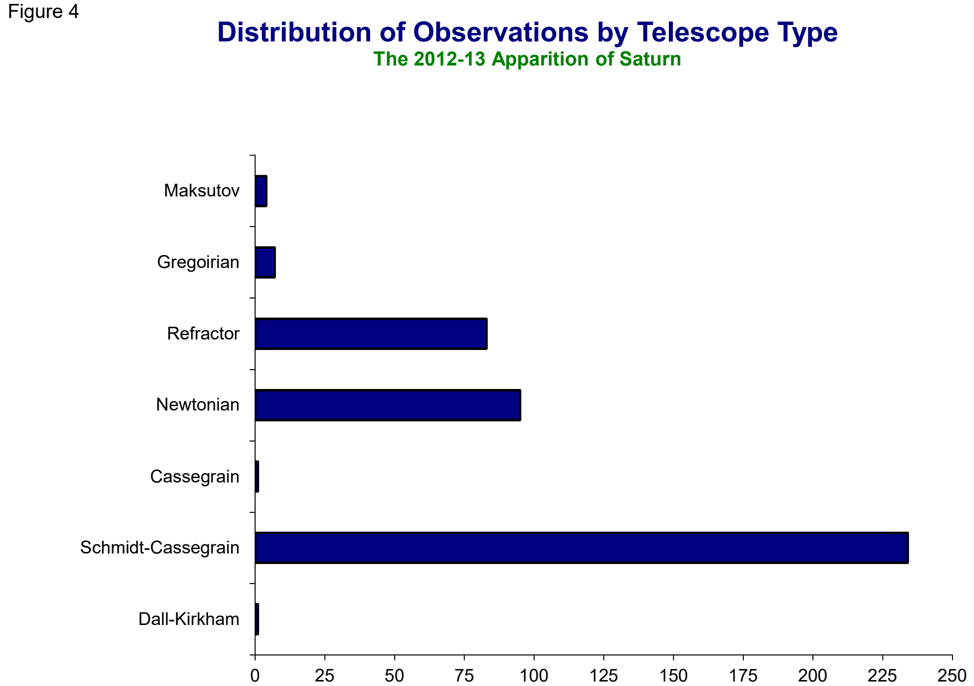


Table 3: Visual Numerical Relative Intensity Estimates and Colors for the 2012-13 Apparition of Saturn

Globe/Ring Feature	# Estimates	2012-13 Mean Intensity & Standard Error	Intensity Difference Since 2011-12	Mean Derived Color
Zones				
EZn	12	7.96 ± 0.20	+0.20	Bright Yellowish-White
NTrZ	3	6.33 ± 0.98	-0.02	Light Yellowish-White
NTeZ	2	5.00 ± 0.00	-1.20	Yellowish-Gray
NPR	2	4.50 ± 1.06	+2.00	Gray
NPC	12	2.00 ± 0.08	-----	Dark Gray
Belts				
Globe S of Rings	13	5.83 ± 0.15	+0.20	Light Yellowish-Gray
NEBw (whole)	11	4.05 ± 0.10	+0.02	Dull Yellowish-Brown
NEBs	9	2.72 ± 0.16	-0.50	Dark Grayish-Brown
NEBn	10	4.00 ± 0.23	+1.30	Grayish-Brown
NTeB	1	4.00 ± 0.23	-0.40	Grayish-Brown
Globe N of Rings	12	5.85 ± 0.24	+0.40	Light Yellowish-Gray
Rings:				
A (whole)	13	4.65 ± 0.28	-0.70	Dull Grayish-White
A0 or B10	2	0.00 ± 0.00	0.00	Black
B (outer 1/3)	13	8.00 ± 0.00 **STD**	0.00	Brilliant White
B (inner 2/3)	13	6.65 ± 0.15	+0.45	Yellowish-White
Ring C (ansae)	3	2.33 ± 0.24	+1.20	Very Dark Gray
Crape Band	10	3.45 ± 0.23	+0.45	Dull Gray
Sh G on R	2	0.00 ± 0.00	0.00	Black shadow
Sh R on G	2	0.00 ± 0.00	-----	Black Shadow

Notes:
For nomenclature see text and Figure 5. A letter with a digit (e.g. A0 or B10) refers to a location in the ring specified in terms of units of tenths of the distance from the inner edge to the outer edge. Visual numerical relative intensity estimates (visual surface photometry) are based upon the ALPO Intensity Scale, where 0.0 denotes complete black (shadow) and 10.0 refers to the most brilliant condition (very brightest Solar System objects). The adopted scale for Saturn uses a reference standard of 8.0 for the outer third of Ring B, which appears to remain stable in intensity for most ring inclinations. All other features on the Globe or in the rings are compared systematically using this scale, described in the Saturn Handbook, which is issued by the ALPO Saturn Section. The "Intensity Difference Since 2011-12" is in the same sense of the 2011-12 value subtracted from the 2012-13 value, "+" denoting an increase (brightening) and "–" indicating a decrease (darkening). When the apparent change is less than about 3 times the standard error, it is probably not statistically significant.

Telescopes with apertures ranging from 9.0 cm (3.5 in.) through 183.0 cm (72.0 in.) were used for recording observations this apparition. Readers are reminded, however, that there are numerous historical examples where smaller instruments of good quality have been successfully utilized for quite a few of our Saturn observing programs.

The ALPO Saturn Section is extremely grateful for all of the descriptive reports, digital images, visual drawings, and supporting data submitted by the observers listed in *Table 2* for the 2012-13 apparition. Without such dedicated observers, this report would not have been possible. Those who want to join us in our numerous Saturn observing programs using visual methods (e.g., drawings, intensity, latitude estimates, and CM transit timings), as well as employing digital imagers, are

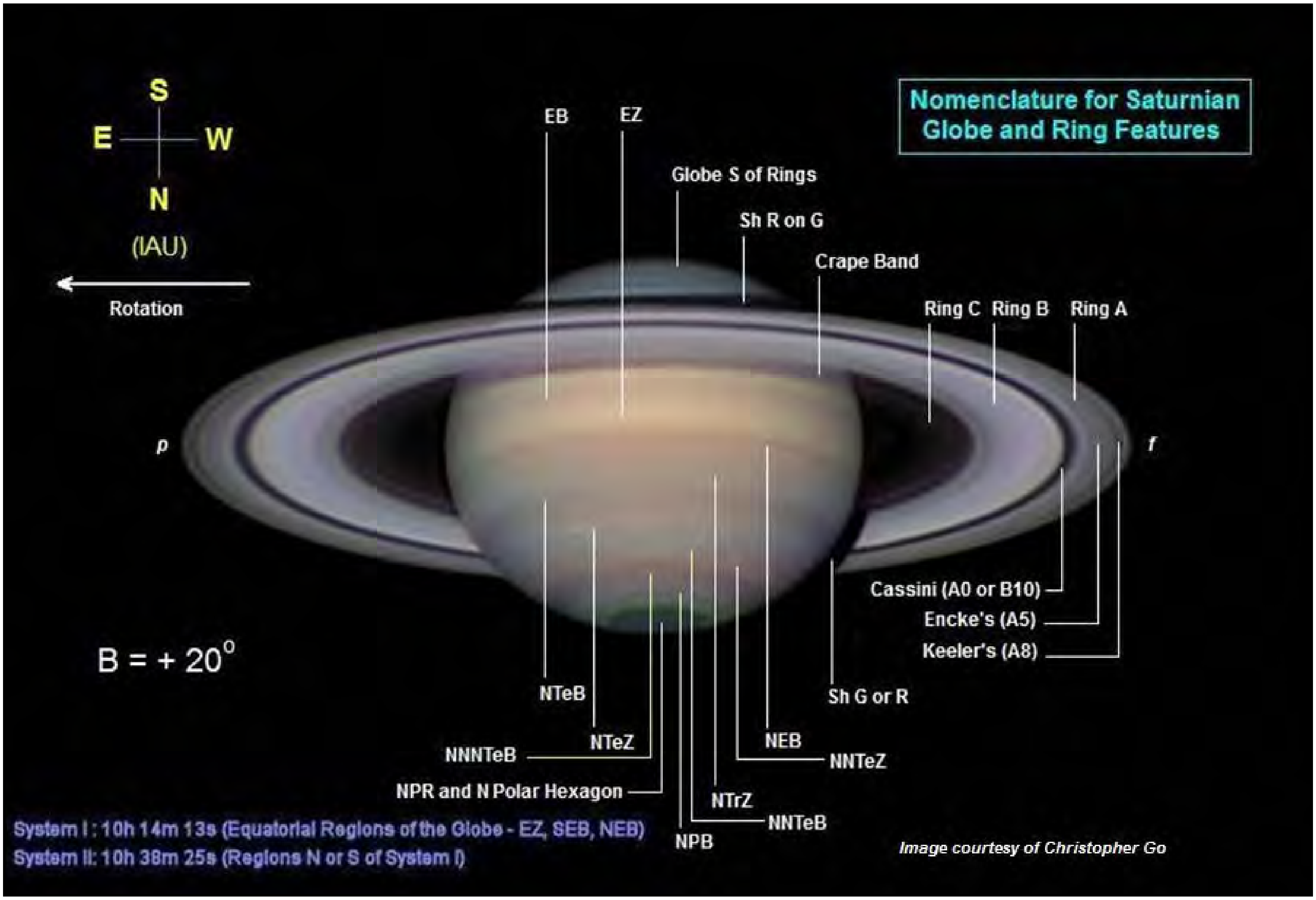


Figure 5. Saturn nomenclature, where A = Ring A, B = Band or Ring B or saturnicentric latitude of Earth, C = Ring C or Cap, E = Equatorial, f = following (celestial east), G = Globe, n = north component, N = North, p = preceding (celestial west), P = Polar, R = Ring(s) or Region, s = south component, S = South, Te = Temperate, Tr = Tropical, Z = Zone. The ring Ansae (not labeled) are the easternmost and westernmost protrusions of the Ring System. Note that "Gap" is also called "Division" or "Complex." South is at the top in this inverted view, similar to the orientation seen through an inverting telescope in Earth's Northern Hemisphere.

encouraged to do so in upcoming observing seasons as we strive to maintain the international flavor of our work. All methods of recording observations are crucial to the success of our programs, whether there is a preference for sketching Saturn at the eyepiece or simply writing descriptive reports, making visual numerical relative intensity or latitude estimates, or pursuing routine digital imaging. It should be noted that, in recent years, too few experienced observers are making routine visual numerical relative intensity estimates. These are desperately needed for maintaining data for a continuing comparative analysis of belt, zone, and ring component brightness fluctuations over many apparitions. The Saturn Section, therefore, urgently appeals to observers to set aside a few minutes while at the telescope to record intensity estimates (visual photometry) in integrated light and with standard color filters. The ALPO Saturn Section is always pleased to receive observations from novices, and the author will be delighted to offer assistance as one becomes acquainted with our programs.

The 425 observations contributed to the ALPO Saturn Section during 2012-13 were utilized to prepare this report. Drawings, digital images, tables, and graphs are included so readers can refer to them as they study the content of this report. For drawings or images utilized as examples of the more notable features or phenomena occurring within Saturn's belts and zones, contributors are identified in the text along with dates and times of those specific observations for easy reference back to the relevant tables that list instrumentation employed, seeing, transparency, CM data, and so forth. In addition, captions associated with illustrations provide useful information.

The numerical value of **B** (the Saturnicentric latitude of the Earth referred to the ring plane) attained a maximum value of +19.3° during the 2012-13 apparition. Consequently, opportunities for studying the belts and zones of the planet's northern hemisphere have steadily improved each observing season with the Earth situated north of the rings as they progressively increase their tilt toward our line of sight with maximum tilt of +27° coming in 2017 (the time of summer solstice in Saturn's northern hemisphere). Features of the southern hemisphere were mostly hidden from view by the rings as they cross in front of the globe.

Minor fluctuations in intensity of Saturn's atmospheric features (see *Table 3*) may simply be due to the varying inclination of the planet's rotational axis relative to the Earth and Sun, although photometric work in past years has shown that tiny oscillations of roughly 0.10 in the visual magnitude of Saturn likely happens over the span of a decade or so. Transient and longer-lasting atmospheric features seen or imaged in various belts and zones on the globe may also play a role in what appear to be subtle brightness variations. Regular photoelectric photometry of Saturn, in conjunction with carefully-executed visual numerical relative intensity estimates, is strongly encouraged.

The intensity scale routinely employed by Saturn observers is the standard *ALPO Standard Numerical Relative Intensity Scale*, where 0.0 denotes a total black condition (e.g., complete black shadow) and 10.0 is the maximum brightness of a feature or phenomenon (e.g., an unusually bright EZ or dazzling white spot). This numerical scale is normalized by setting the outer third of Ring B at a "standard" intensity of 8.0. The arithmetic sign of an intensity change is determined by subtracting a feature's 2010-11 intensity from its 2011-12 value. Suspected variances of 0.10 mean intensity points are usually insignificant, while reported changes in intensity that do not equal or exceed roughly three times the standard error are probably not important.

It has always been important to evaluate contributed digital images of Saturn captured with different apertures using systematic filter techniques. So our goal is to understand the level of detail seen and how it compares with visual impressions of the globe and rings. Moreover, it remains worthwhile to establish any correlation with spacecraft imaging and results from professional observatories. In addition to routine visual studies, such as drawings and visual numerical relative intensity estimates, we encourage Saturn observers to systematically image the planet every possible clear night. This allows documentation of individual features on the globe and in the rings, their motion and morphology (including changes in intensity and hue), to facilitate comparisons with images taken by professional ground-based observatories and spacecraft monitoring Saturn at close range. Furthermore, comparing images taken over several apparitions for a given hemisphere of the planet's globe provides information on long-term seasonal changes suspected by observers using visual numerical relative intensity estimates. Images and systematic visual observations by amateurs are being relied upon for providing initial alerts of interesting large-scale features on Saturn that professionals may not already know about but can subsequently examine with considerably larger and more specialized instrumentation.

Particles in Saturn's atmosphere reflect different wavelengths of light in very distinct ways, which causes some belts and zones to appear especially prominent, while others look very dark, so imaging the planet with a series of color filters may help shed light on the dynamics, structure, and composition of its atmosphere. In the UV and IR regions of the electromagnetic spectrum, it is possible to determine additional properties as well as the sizes of aerosols present in different atmospheric layers not otherwise accessible at visual wavelengths, as well as useful data about the cloud-covered satellite Titan. UV wavelengths shorter than 320nm are effectively blocked by the Earth's stratospheric ozone (O_3), while CO_2 and H_2O-vapor molecules absorb in the IR region beyond 727nm. The human eye is insensitive to UV light short of 320nm and can detect only about 1.0% at 690nm and 0.01% at 750nm in the IR (beyond 750nm visual sensitivity is essentially zero). Although most of the reflected light from Saturn reaching terrestrial observers is in the form of visible light, some UV and IR wavelengths that lie on either side and in close proximity to the visual region penetrate to the Earth's surface, and imaging Saturn in these near-IR and near-UV bands has provided some remarkable results in the past. The effects of absorption and scattering of light by the planet's atmospheric gases and clouds at various heights and with different thicknesses are often evident. Indeed, such images sometimes show differential light absorption by particles with dissimilar hues intermixed with Saturn's white NH_3 clouds.

In the forthcoming paragraphs, our discussion of features on Saturn's globe will proceed in the usual south-to-north order (traditional astronomical inverted and reversed view). For clarity, the relative positions of major belts and zones can be identified by referring to the nomenclature diagram shown in *Figure 5*. If no reference is made to a global feature in this report, the area was not reported by observers during the 2012-13 apparition. It has been customary in past Saturn apparition reports to compare the brightness and morphology of atmospheric features between observing seasons, and this practice continues as much as possible so readers are aware of very subtle, but nonetheless recognizable, variations that may be occurring seasonally on the planet.

Saturn's Globe: The Southern Hemisphere

Saturn's southern hemisphere was mostly hidden from our view during the 2012-13 apparition except for a small portion southward of where the rings crossed the globe. The overall visual numerical relative intensity assigned to this light yellowish-gray region suggested that it was only marginally lighter by +0.20 in mean intensity since 2011-12 and devoid of any recognizable activity by visual observers and those who imaged imaging Saturn. Careful examination of some of the best images submitted during the observing season revealed perhaps the diffuse northernmost edge of the gull gray South Polar Region (SPR) or perhaps the gray South Polar Belt (SPB), but visual observers did not describe these regions during the apparition [refer to Illustration No. 031].

Equatorial Zone – Southern Half (EZs). Just northward of the where the rings crossed the globe of Saturn, higher resolution images revealed a portion of the southern half of the Equatorial Zone (EZs) that appeared yellowish-white, and visual observers also gave descriptive impressions of the same feature but offered no visual numerical relative intensity estimates during 2012-13. Discrete activity in the form of small white spots of varying dimensions during 2012-13 were imaged by several observers within the EZs. The first bright spot in the EZs was imaged at RGB and IR (742nm) wavelengths by Trevor Barry on March 9th between 16:37UT and 17:17UT as it rotated across the CM [refer to Illustration No. 001]. On April 24th, he imaged another bright feature near the CM at 14:28UT in red light, which appeared fainter and more compact morphologically than the spot captured on March 9th [refer to Illustration No. 002]. Another image of a brighter and slightly elongated white spot was captured at red, RGB, and IR (742nm) wavelengths by Trevor Barry on April 25th between 14:29UT and 14:51UT located east of the CM [refer to Illustration No. 003]; this may have been the recurring spot originally imaged back on March 9th. On April 26th between 13:44UT and 13:59UT, he tracked across the CM what was presumably the same tiny white spot imaged two days before on April 24th best seen at red

General Caption Note for Illustrations 1-44*. B = saturnicentric latitude of the Earth; B' = saturnicentric latitude of the Sun; CMI, CMII and CMIII = central meridians in longitude Systems I, II and III; IL = integrated light; S = Seeing on the Standard ALPO Scale (from 0 = worst to 10 = perfect); Tr = Transparency (the limiting naked-eye stellar magnitude). Telescope types as in Table 2; feature abbreviations are as in Figure 5. In all figures, south is at the top and IAU east is to the left.*

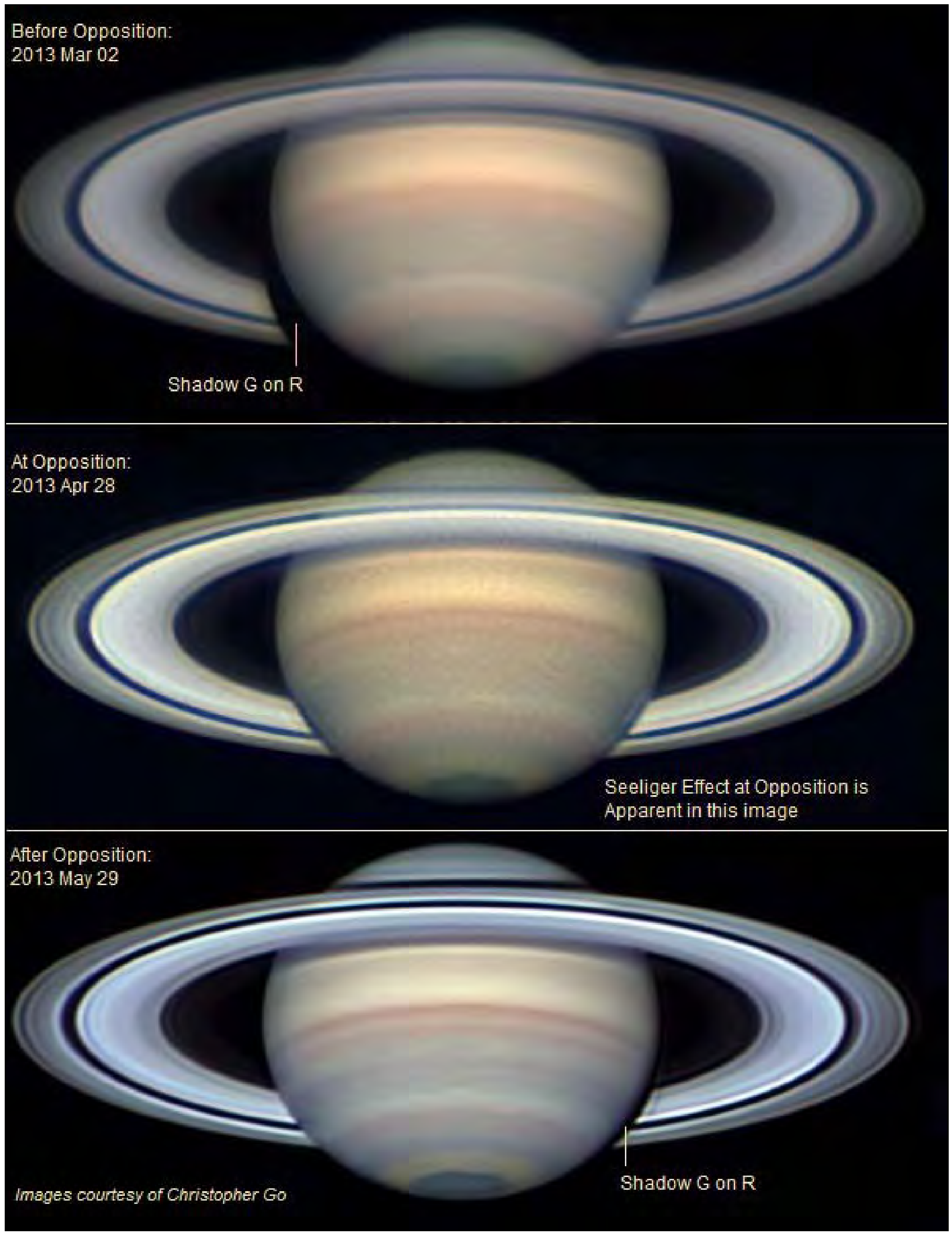


Figure 6. Three images digital images furnished by Christopher Go on March 2, 20133, 2012 at 19:54UT (before opposition), April 28, 2013 at 15:08UT (at opposition), and May 29, 2012 at12:21UT (after opposition).

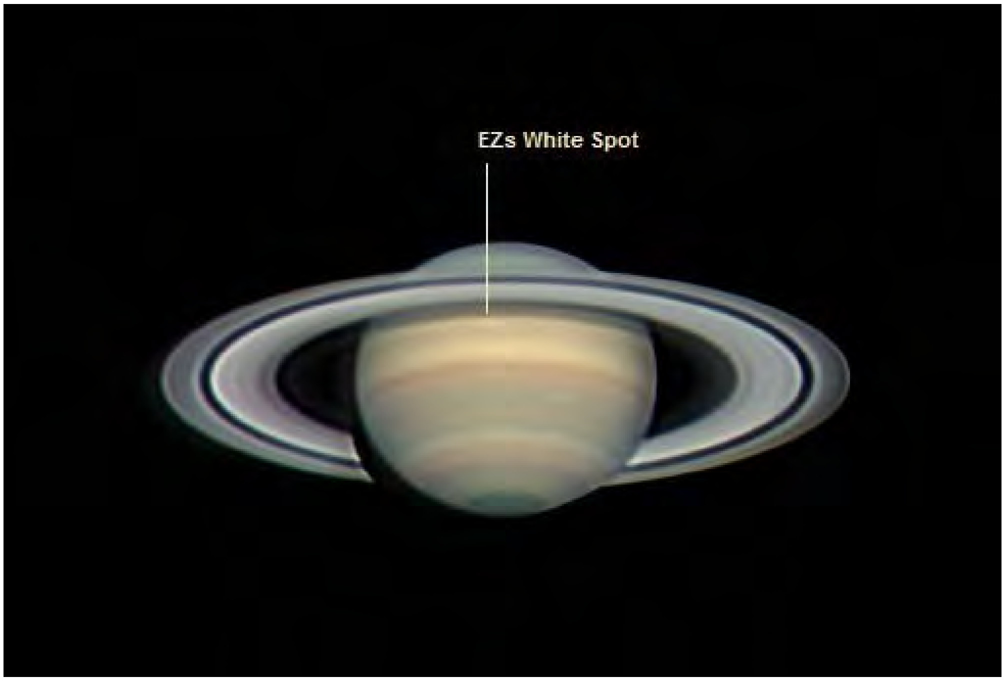


Illustration 001. 2013 March 09 16:58UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 7.0, Tr = not specified. CMI = 37.9°, CMII = 233.7°, CMIII = 119.1°, B = +19.18°, B´ = +18.33°. EZs White Spot is seen in this sharp image having just passed the CM.

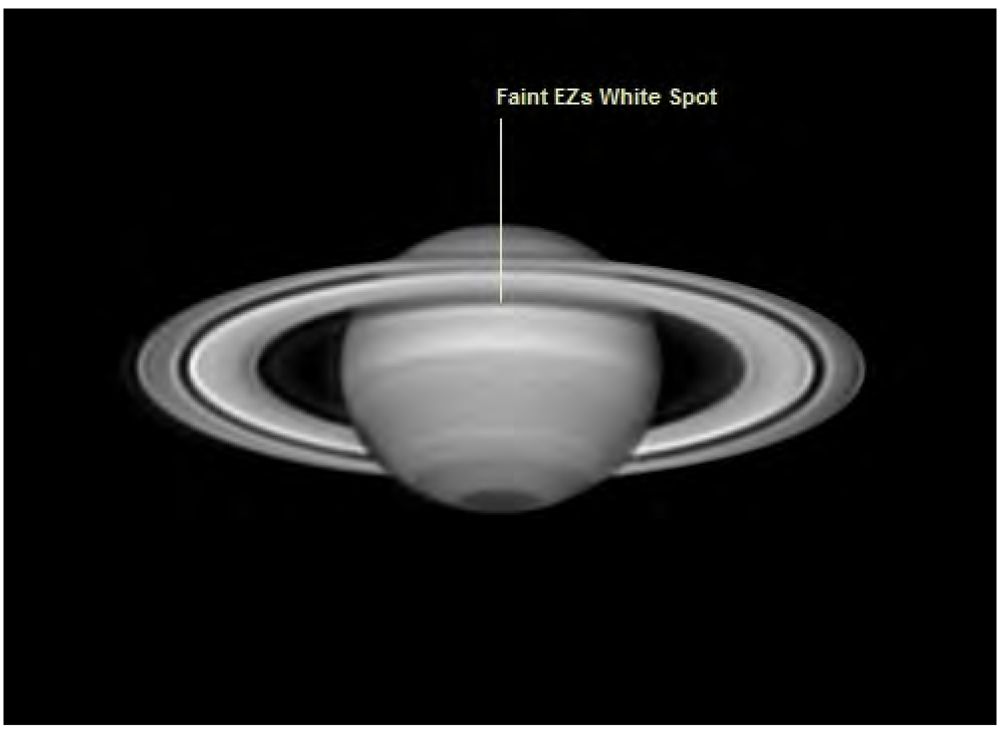


Illustration 002. 2013 April 24 14:28UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with Red filter. S = 6.0, Tr = not specified. CMI = 272.2°, CMII = 65.5°, CMIII = 255.5°, B = +18.23°, B´ = +18.78°. EZs White Spot near the CM is more apparent at red wavelengths in this image and seemingly fainter and more compact morphologically than the spot captured on March 9th.

wavelengths [refer to Illustrations No. 004]. After late April, there were no other images submitted showing the EZs white spots, which may indicate they were relatively short-lived transient features.

Saturn's Globe: The Northern Hemisphere

Equatorial Band (EB). Visual numerical relative intensity estimates of the dusky Equatorial Band (EB) were lacking during 2012-13, but it was depicted on several drawings in integrated light and quite obvious on several digital images submitted during the observing season [refer to Illustration No. 005].

Equatorial Zone – Northern Half (EZn). With the numerical value of **B** ranging between the extremes of +17.2° and +19.3° this apparition, it was the northern half of the Equatorial Zone (EZn) that could be seen and imaged to greatest advantage. Based on intensity estimates and digital imaging, the bright yellowish-white Equatorial Zone (EZn) was slightly brighter by +0.2 mean intensity points since 2011-12 and easily the brightest zone on Saturn's globe in 2012-13. On February 6th, between 04:50UT and 04:58UT, Manos Kardasis submitted RGB, near-IR (685nm), and CH_4 (884-900nm) images of a several white spots spread out longitudinally within the EZn near the CM (especially prominent in the near-IR image). His images were the first indications of discrete activity in the EZn received during the 2012-13 apparition [refer to Illustration No. 006]. A subsequent image of the same or similar features in the EZn was contributed by Vlamir da Silva on April 6th at 04:55UT [refer to Illustration No. 007]. An April 24th, Trevor Barry submitted an image at 14:45UT of white "mottled" features (best seen at 685nm (near-IR) within the EZn aligned for a short distance along the northern edge of the Equatorial Band (EB), with apparent dynamic atmospheric interaction between the EB and adjacent EZn white spots [refer to Illustration No.

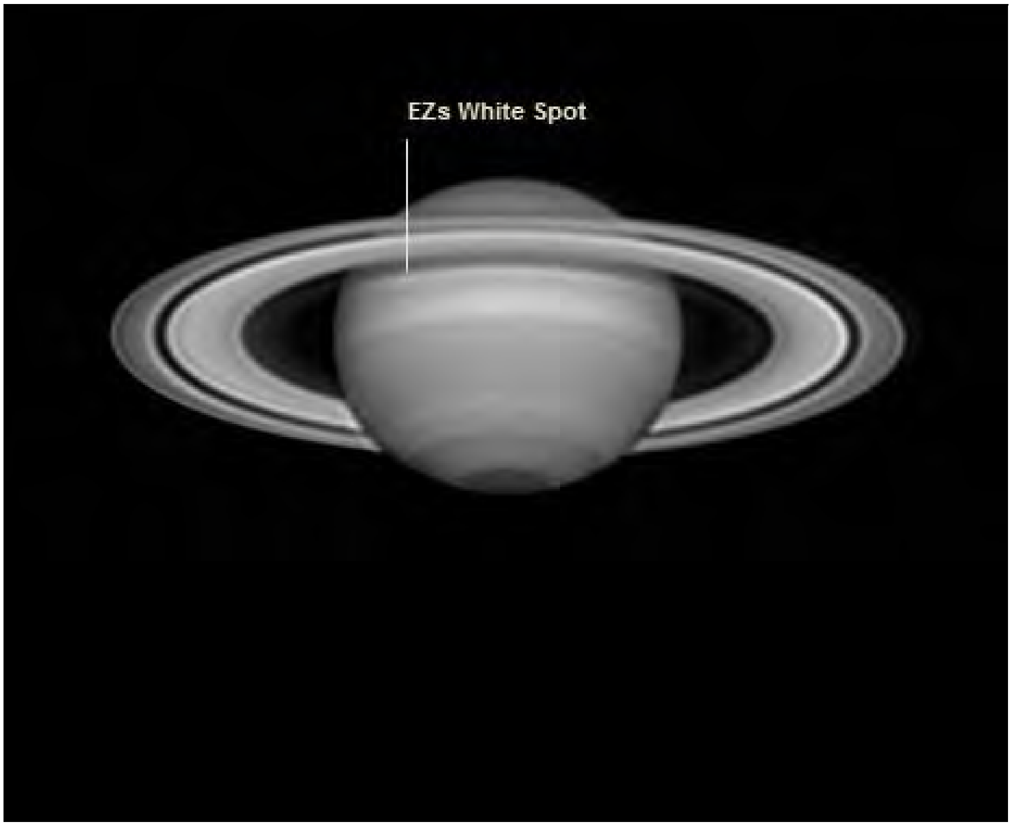


Illustration 003. 2013 April 25 14:29UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with Red filter. S = 6.5, Tr = not specified. CMI = 37.1°, CMII = 158.1°, CMIII = 346.9°, B = +18.21°, B´ = +18.78°. EZs White Spot approaching preceding (*p*) limb that is more apparent at red wavelengths; possibly the same recurring spot first imaged back on March 9th.

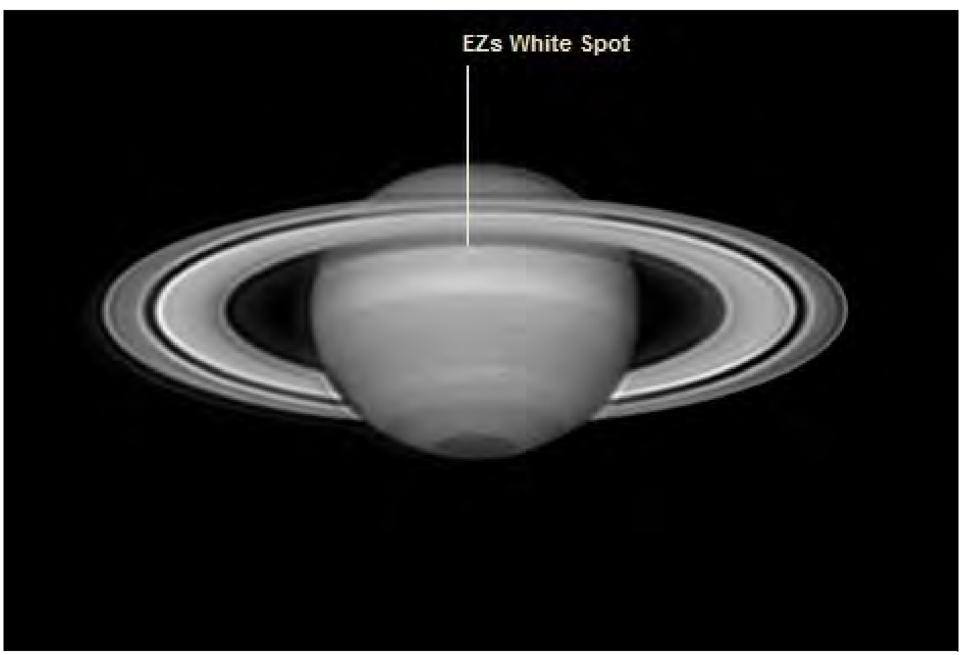


Illustration 004. 2013 April 26 13:44UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with Red filter. S = 8.5, Tr = not specified. CMI = 135.1°, CMII = 224.8°, CMIII = 52.4°, B = +18.18°, B´ = +18.80°. EZs White Spot is at CM at red wavelengths in excellent seeing; likely the same tiny white spot imaged two days before on April 24th.

008]. The features in these images were apparently short-lived. Despite a drawing submitted by Paul G. Abel on June 1st of three, small white spots approaching the CM at 23:22UT [refer to Illustration No. 009], there were no other specific reports received of white spot activity in the EZn during the observing season by visual observers. Visual observers did offer comment that the EZn usually appeared slightly more prominent in 2012-13 than in 2011-12.

North Equatorial Belt (NEB). The rather broad and dull yellowish-brown NEB (considered as a whole feature and abbreviated as "NEBw") was frequently reported by visual observers and imaged regularly throughout the 2012-13 apparition. Visual observers reported the NEBw as a singular belt just as frequently as it was described as being differentiated into the NEBs and NEBn components with the NEBZ lying in between during most of the observing season. The NEBw usually displayed a steady lighter-to-darker southward gradation in intensity across its broad width, consistent also with its form on most digital images. Accompanying descriptive reports and visual numerical relative intensity estimates revealed that the dark grayish-brown NEBs was -1.28 mean intensity points darker than the grayish-brown NEBn, with a faintly perceptible yellowish-gray NEBZ separating them. The better-defined NEBs was also much narrower in width than the seemingly more latitudinally diffuse NEBn. Although visual observers usually reported the NEBZ when the NEB was separated into components, there were no visual numerical relative intensity estimates submitted in 2012-13. Several wispy festoons were reported within the NEBZ on April 2nd by Paul G. Abel at 00:56UT as well as a somewhat diffuse dark area along the N edge of the NEBn on the same date [refer to Illustration No. 010]. Dusky features situated toward the south edge of the NEBw were occasionally reported by a few visual observers. For instance, consider a drawing in good seeing by Paul G. Abel at 23:31UT on May 22nd depicting three dark "barges" along the southern edge of the NEBw, as well as similar features in a drawing by the same observer on June 1st at 23:22UT [refer to Illustrations No. 011 and 009].

North Tropical Zone (NTrZ). Visual numerical relative intensity estimates, although minimal in number, suggested that the light yellowish-white NTrZ as virtually unchanged in overall intensity during 2012-13 compared with the immediately preceding apparition (negligible mean numerical relative intensity factor of only -0.02). The NTrZ was quite apparent on most images captured in good seeing conditions throughout the observing season and reported often in descriptive reports by visual observers. The first image of any discrete NTrZ white spot phenomena this apparition was received from Damian Peach on December 27, 2012 at 3:44UT depicting faint small "mottlings" and a faint compact spot headed toward the CM as the planet rotated [refer to Illustration No. 012]. A little more than two months later, on March 7, 2013 at 18:13UT, Anthony Wesley captured a compact and somewhat more distinct NTrZ white spot about to transit the CM in good seeing [refer to Illustration No. 013]. Several slightly diffuse white spots spread out within the NTrZ were imaged on March 23rd at 17:19UT by Anthony Wesley [refer to Illustration No. 014]. In addition, Trevor Barry's IR (742nm) image on March 24th at 16:31UT [refer to Illustration No. 015] shows a small compressed NTrZ white spot slightly past the CM that appeared similar to the feature imaged by Anthony Wesley back on March 7th. A slightly elongated NTrZ white spot is depicted on Paul G. Abel's sketch of Saturn on April 2nd at 00:56UT at the southern edge of NTrZ and perhaps superimposing itself over the northernmost edge of the NEBn [refer to Illustration No. 010]. Several elongated and diffuse NTrZ white spots are clearly visible longitudinally aligned across the globe in a beautifully detailed image of Saturn by Christopher Go on April 13th at 17:22UT [refer to Illustration No. 016]. No less that about six white spots distributed virtually from limb-to-limb along the NTrZ are shown in Damian Peach's remarkable image on April 21st at 22:48UT [refer to Illustration No. 018]. As the apparition progressed, the aforementioned observers and many others continued to report and capture images of multiple white spots in the NTrZ. For example, consider the collective excellent images by Dan Llewellyn on April 30th at 05:57UT, Daniel Chang on May 11th at 16:52UT, Wayne Jaeschke on May 21st

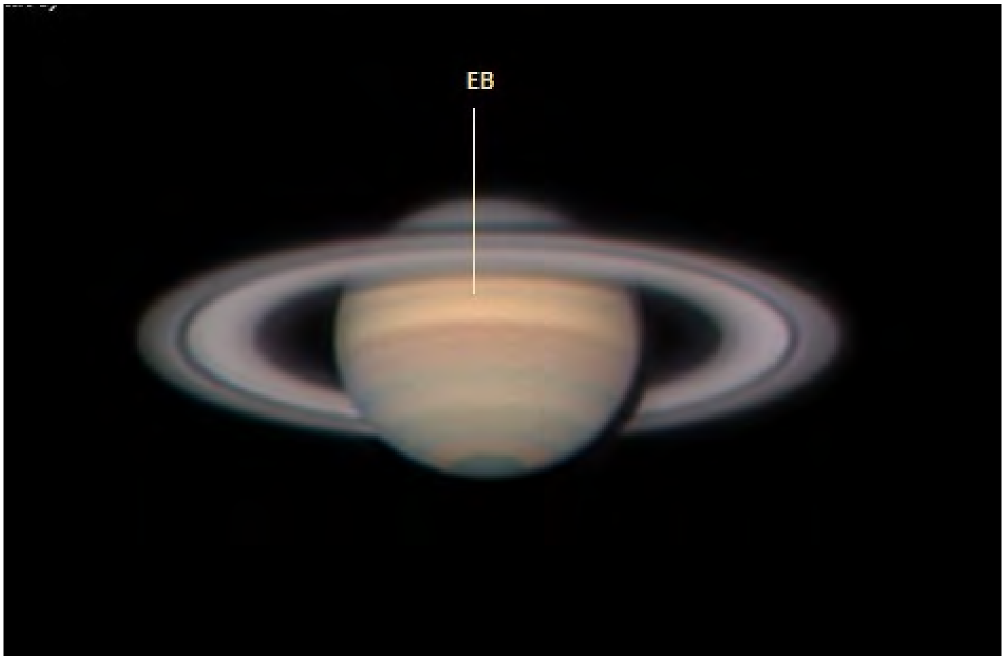


Illustration 005. 2013 August 01 08:44UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 4.5, Tr = not specified. CMI = 134.3°, CMII = 337.8°, CMIII = 48.6°, B = +17.46°, B´ = +19.69°. EB is apparent across the globe of Saturn in fair seeing conditions.

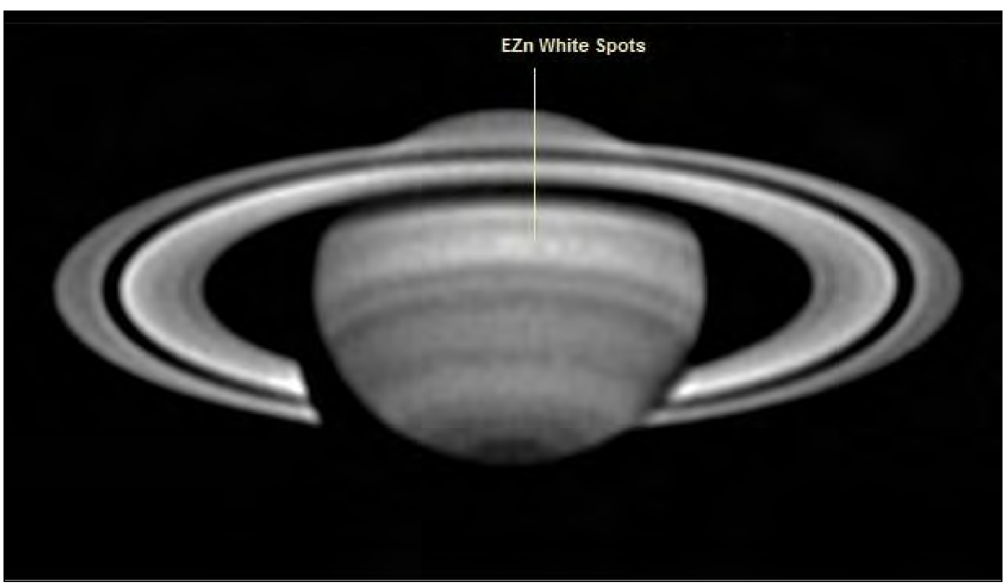


Illustration 006. 2013 February 06 04:50UT. IR (685nm) digital image by Manos Kardasis. 28.0 cm (11.0 in.) SCT. S and Tr not specified. CMI = 75.3°, CMII = 208.8°, CMIII = 132.2°, B = +19.35°, B´ = +18.03°. Several white spots are spread out longitudinally within the EZn near the CM (especially prominent in this near-IR image).

at 03:24UT, Tomio Akutsu on May 24th at 12:56UT, Jim Phillips on June 1st at 03:31UT, Michael Phillips on June 12th at 1:57UT, and finally on July 24th by Manos Kardasis at 19:19UT, all depicting the discrete NTrZ white spot activity prevalent at roughly saturnigraphic latitude +40° throughout 2012-13 [refer to Illustrations No. 019 thru 025]. Paul G. Abel's sketch on May 22nd at 23:32UT also shows what he suspected as a dusky feature within the NTrZ between the following (f) limb and the CM [refer to Illustration No. 011].

Illustration 007. 2013 April 06 04:55UT. Digital image by Vlamir da Silva. 20.3 cm (8.0 in.) SCT and RGB filters. S described as good (no numerical estimate), Tr not specified. CMI = 217.1°, CMII = 244.7°, CMIII = 96.9°, B = +18.67°, B´ = +18.60°. EZn white spots are stretched across CM.

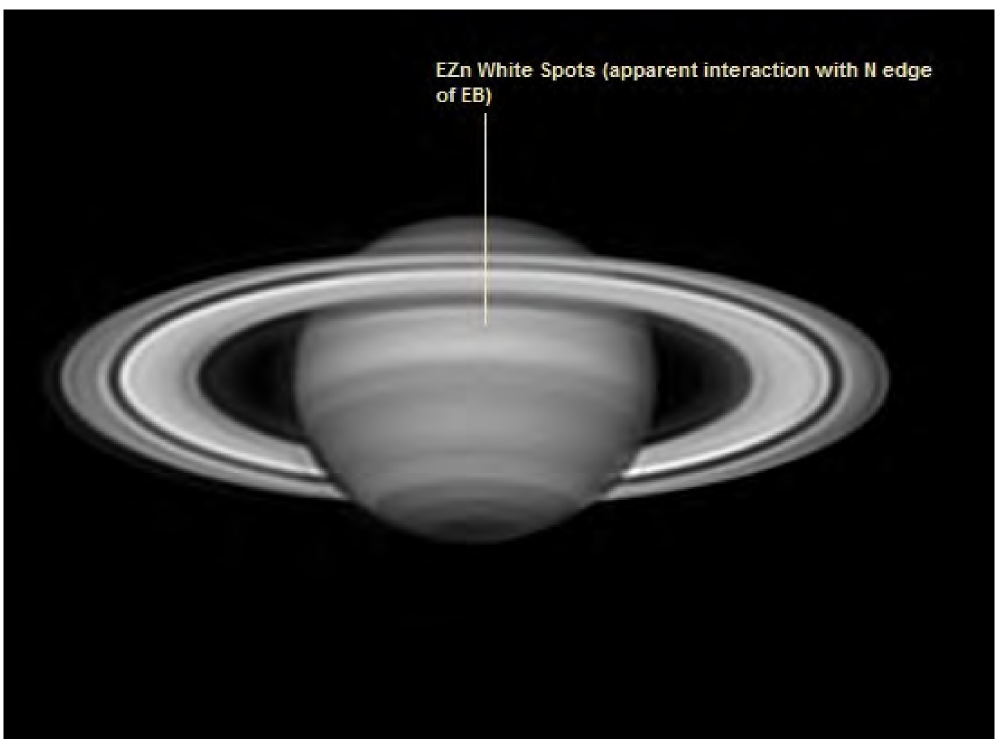


Illustration 008. 2013 April 24 14:45UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 742nmIR filter. S = 6.0, Tr not specified. CMI = 282.1°, CMII = 75.0°, CMIII = 265.0°, B = +18.23°, B´ = +18.78°. EZn white spots apparent at IR wavelengths showing interaction with N edge of EB.

In preparing this observational summary, it is tempting to attribute the white spot activity in the NTrZ, reported and imaged during 2012-13 and in several recent apparitions, as progressively fading remnants of the unprecedented massive NTrZ storm of 2010-11 that originated as columns of material suddenly emerged through the upper NH_3-ice cloud layer of Saturn's atmosphere. Because of the considerable latitudinal widening that occurred as the morphologically complex bright storm evolved with time and persisted in succeeding observing seasons, it was often difficult to clearly ascertain sharp northern and southern boundaries of the NTrZ occupying the region between saturnigraphic latitude +35° and +45° in the lingering wake of the 2010-11 storm.

North Temperate Belt (NTeB). The grayish-brown NTeB was reported only occasionally by visual observers during 2012-13, and if the solitary visual numerical relative intensity estimate provided is of any importance, the NTeB was perhaps slightly darker since 2011-12 (a difference of -0.4 mean intensity points). On February 5th at 18:11UT in good seeing, Trevor Barry imaged a rather compact dark spot in the NTeB about to cross the CM. Roughly three days later, on February 18th at 10:55UT, Brian Combs captured presumably the same dark spot within the NTeB between the CM and the preceding (*p*) limb of the globe. *Cassini* scientists also imaged the small NTeB dark spot on February 28th [refer to Illustration No. 026]. As the apparition progressed, observations of the NTeB dark spot continued; for instance, see the excellent detailed images of the feature by observers such as Christopher Go on March 2nd at 19:54UT, Anthony Wesley on March 18th at 17:24UT (spot on the CM), Trevor Barry on April 11th at 14:06UT, Carmelo Zannelli at 23:26UT on April 19th, and Christopher Go on May 23rd at 13:21UT [refer to Illustrations No. 027 thru 031]. In studying the images submitted during 2012-13, the long-lived dark NTeB spot was positioned toward the northernmost edge of the belt at an estimated saturnigraphic latitude +46° neighboring the southern edge of the NTeZ. Trevor Barry computed an approximate drift rate over a 15-week period of 3.4° per day based on data sampling between January 23rd and May 8th (105 days). With the possible exception of drawings by Paul G. Abel on April 16th at 23:36UT and on May 6th at 00:40UT, no visual observers called attention to this feature during the observing season conceivably due to its diminutive size [refer to Illustrations No. 032 and 033].

North Temperate Zone (NTeZ). Based on minimal visual numerical relative intensity estimates this apparition, the yellowish-gray NTeZ was presumed to be darker by -1.2 mean intensity points since 2011-12, dimmer visually than the NTrZ by a mean factor of -1.33. Again, this interpretation is based on very few intensity estimates, weakening confidence in the results. The NTeZ was quite apparent on the majority of digital images contributed during the observing season, and in seeming conflict with the aforementioned visual impressions, the NTeZ was a more prominent zone than the NTrZ on most images.

Bright spot activity was as common during 2012-13 in the NTeZ as was discrete phenomena in the NTrZ (discussed early). Damian Peach was the first to report white spot activity in his observation occurring on December 27, 2012 at 3:44UT, whereby he imaged a diffuse white spot in the NTeZ between the western limb of the globe and the CM (while simultaneously recording faint small white features and a fainter bright spot in the NTrZ) [refer to Illustration No. 012]. Almost a month later, on January 23rd at 18:48UT, Trevor Barry captured the NTeZ bright spot (west of the white spot in the image is the previously mentioned NTeB dark spot) [refer to Illustration No. 017]. Several white features across the globe in the NTeZ were documented by Anthony Wesley in his image of March 23rd at 17:19UT [refer to Illustration No. 014], as well as similarly on April 8th at 14:54UT by Trevor Barry accompanied by a near-simultaneous observation by Anthony Wesley on the same date at 16:19UT, all in good seeing conditions [refer to Illustrations No. 034 and 035]. Christopher Go's image of April 13th at 17:22UT shows clearly the NTeZ white spots across the globe [refer to Illustration No. 016]. Damian Peach detected the bright recurring NTeZ white spot in his digital photo on April 17th at 21:41UT [refer to Illustration No. 036], while the feature was also prominent in Carmelo Zannelli's image on April 19th at 23:26UT (which also shows the NTeB dark spot nearby) [refer to Illustration No. 030]. During the remainder of the 2012-13 apparition, observers continued to

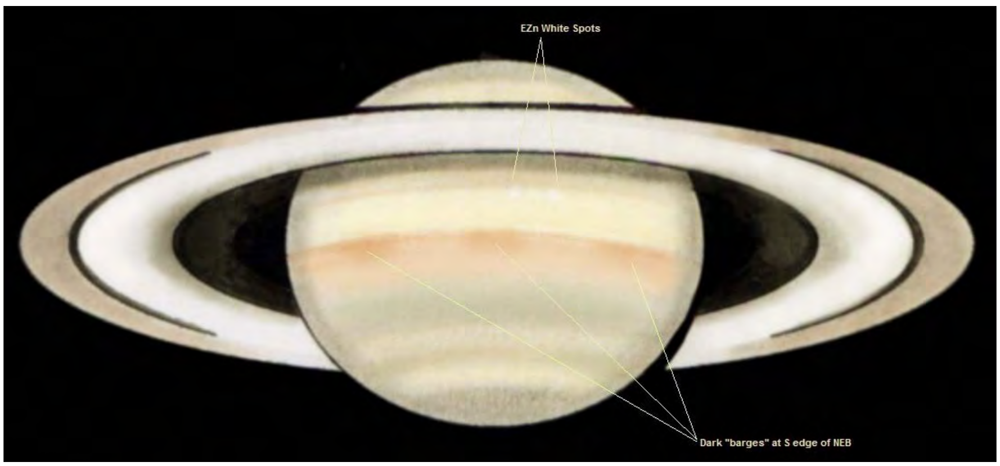


Illustration 009. 2013 June 01 23:22UT. Detailed sketch by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 6.0 (interpolated), Tr (described as good but not numerically rated). CMI = 270.5°, CMII = 264.4°, CMIII = 48.1°, B = +17.41°, B´ = +19.14°. Impressive colorized drawing showing three small white spots approaching the CM as well as dark "barges" at S edge of the NEB in good seeing.

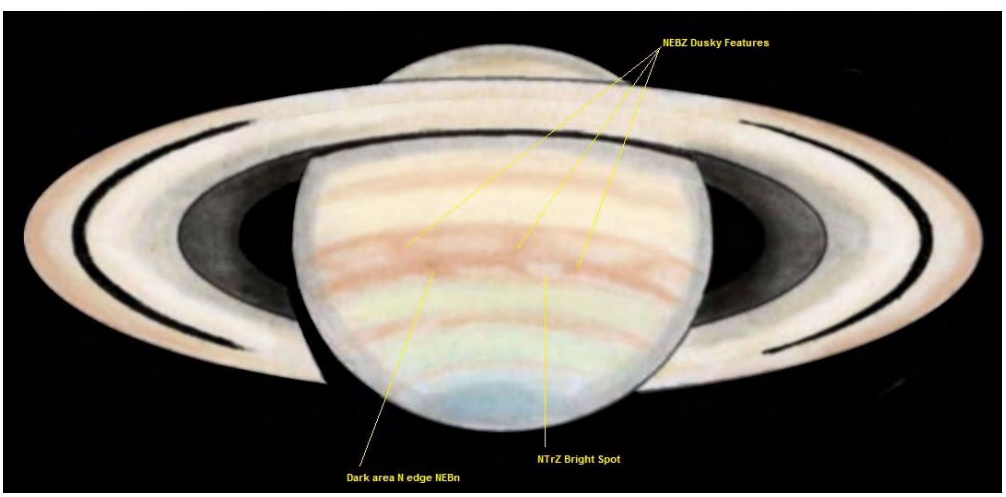


Illustration 010. 2013 April 02 00:56UT. Drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 5.0 (interpolated), Tr (described as good but not numerically rated). CMI = 299.4°, CMII = 101.5°, CMIII = 318.7°, B = +18.77°, B´ = +18.56°. Colorized drawing showing several wispy festoons in the NEBZ, a dark area at N edge of NEBn, and NTrZ white spot approaching CM.

record morphological development of the NTeZ white spot at about saturnigraphic latitude +48° as clearly illustrated in Christopher Go's excellent high-resolution images of May 21st at 13:28UT [refer to Illustration No. 037] and May 23rd at 13:21UT [refer to Illustration No. 031] both depicting how the feature had apparently lengthened and somewhat fragmented longitudinally since mid-April. Toshihiko Ikemura provided an image of the NTeZ white feature on May 24th at 12:02UT [refer to Illustration No. 038]. His was followed by a near-simultaneous observation by Tomio Akutsu on the same date at 12:56UT [refer to Illustration No. 022], the latter giving a similar impression of elongation and possible differentiation along the spot's length as noted by Christopher Go three days earlier on May 21st [refer to Illustration No. 037]. Segmentation of the NTeZ white spot is also apparent in Jim Phillips' image at 03:31UT on June 1st [refer to Illustration No. 023]. Such is also the case in the image by Damian Peach on July 8th at 20:37UT [refer to Illustration No. 039], as well as subsequent images in late July and early August by these and other observers. These data suggested that the NTeZ spot was fading and possibly dissipating as depicted in Damian Peach's image of July 19th at 20:31UT [refer to Illustration No. 040]. Visual observers did not submit reports of the NTeZ white spot activity in 2012-13.

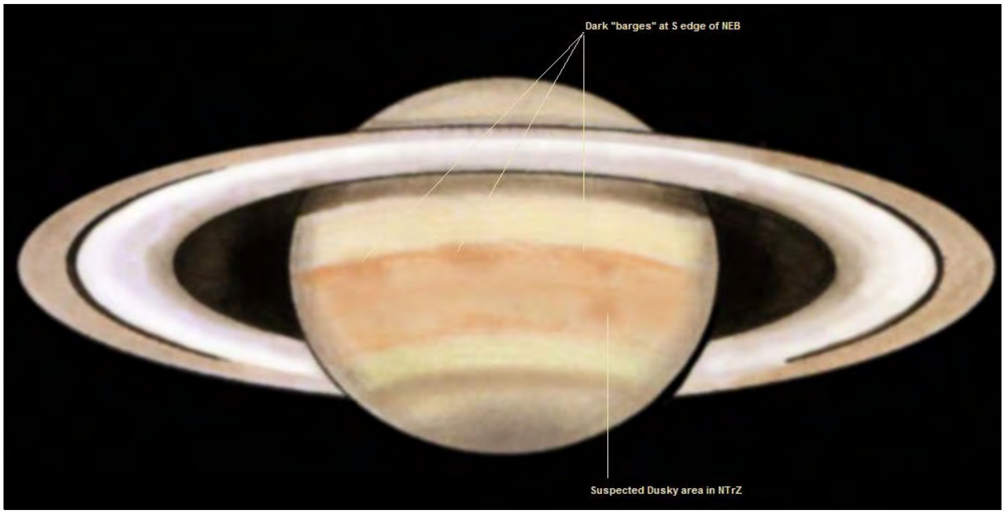


Illustration 011. 2013 May 22 23:31UT. Sketch by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 6.0 (interpolated),), Tr (described as good but not numerically rated). CMI = 112.6°, CMII = 69.3°, CMIII = 225.1°, B = +17.58°, B´ = +19.05°. Color drawing depicts three dark "barges" at S edge of NEB and a suspected dusky are in the NTrZ.

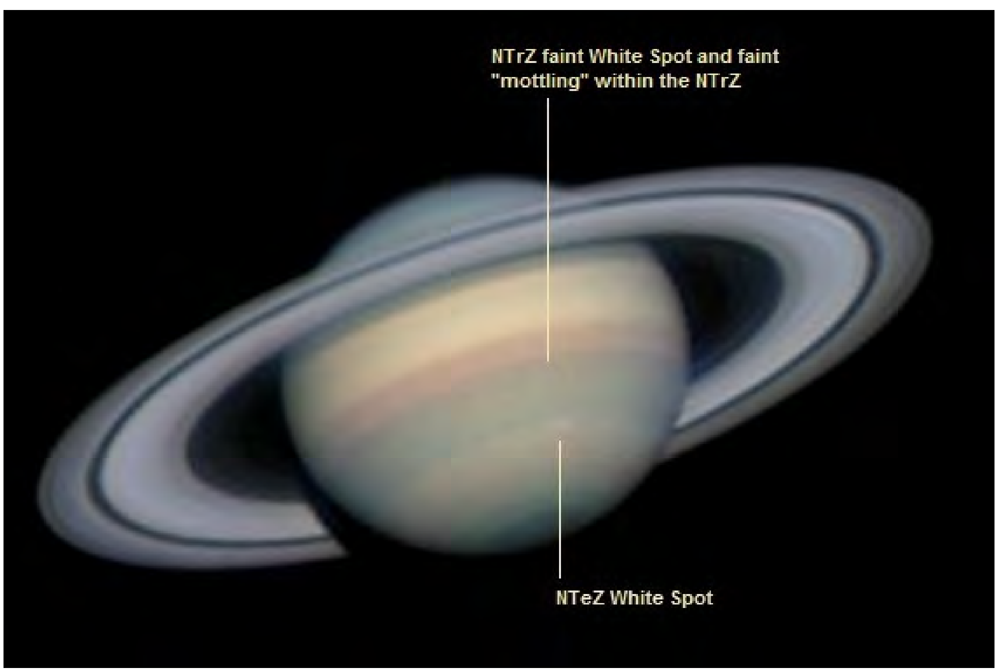


Illustration 012. 2012 December 27 03:44UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 339.4°, CMII = 358.8°, CMIII = 331.7°, B = +18.79°, B´ = +17.61°. Detailed images depicts NTrZ white spot and accompanying white "mottling" as well as a NTeZ white spot.

North North Temperate Belt (NNTeB). The dull gray NNTeB was difficult to detect even on the best images taken in good seeing conditions in 2012-13, but Vlamir da Silva imaged what appeared to be a dark spot in the NNTeB on May 5th at 03:09UT [refer to Illustration No. 041]. Visual observers did not report the NNTeB during the observing season.

North North Temperate Zone (NNTeZ). During 2012-13 the usually dull yellowish-gray NNTeZ was not reported visually but was depicted on the best images taken with moderate-to-larger apertures during the observing season. On July 8th at 20:37UT, Damian Peach imaged a tiny white spot in the NNTeZ on the CM in good seeing, while no other observers reported similar features in the zone [refer to Illustration No. 039]. Visual observers did not submit visual numerical intensity estimates of the NNTeZ nor were any white spots detected visually during the 2012-13 apparition.

North Polar Region (NPR). The gray NPR was frequently reported by visual observers, and it was evident on digital images contributed during the 2012-13 apparition. Since visual numerical

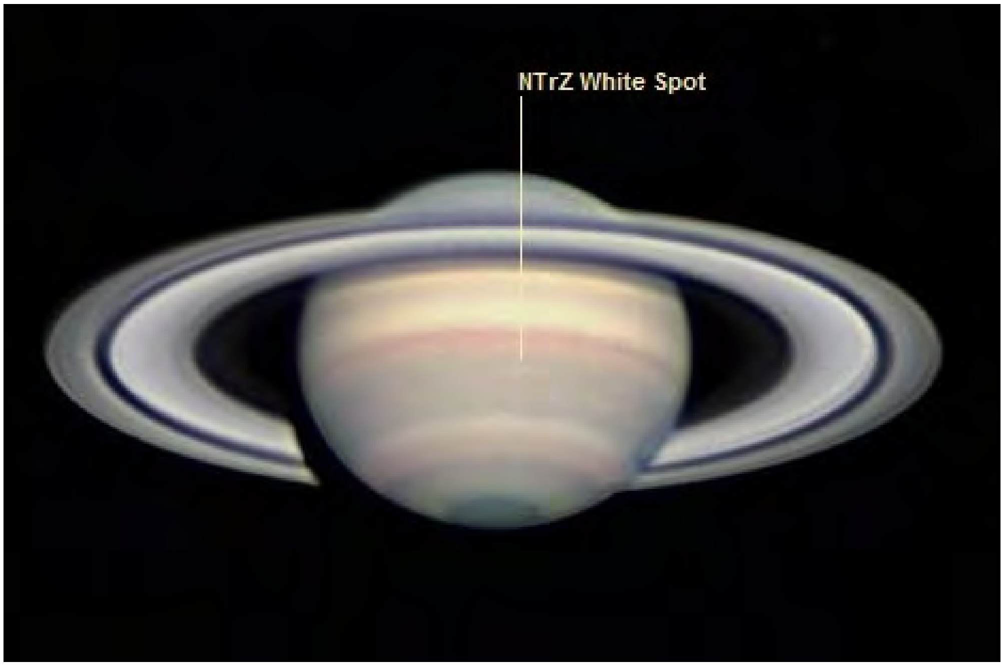


Illustration 013. 2013 March 07 18:13UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S and Tr not specified. CMI = 193.1°, CMII = 91.8°, CMIII = 339.5°, B = +19.20°, B′ = +18.32°. NTrZ white spot about to transit the CM in good seeing.

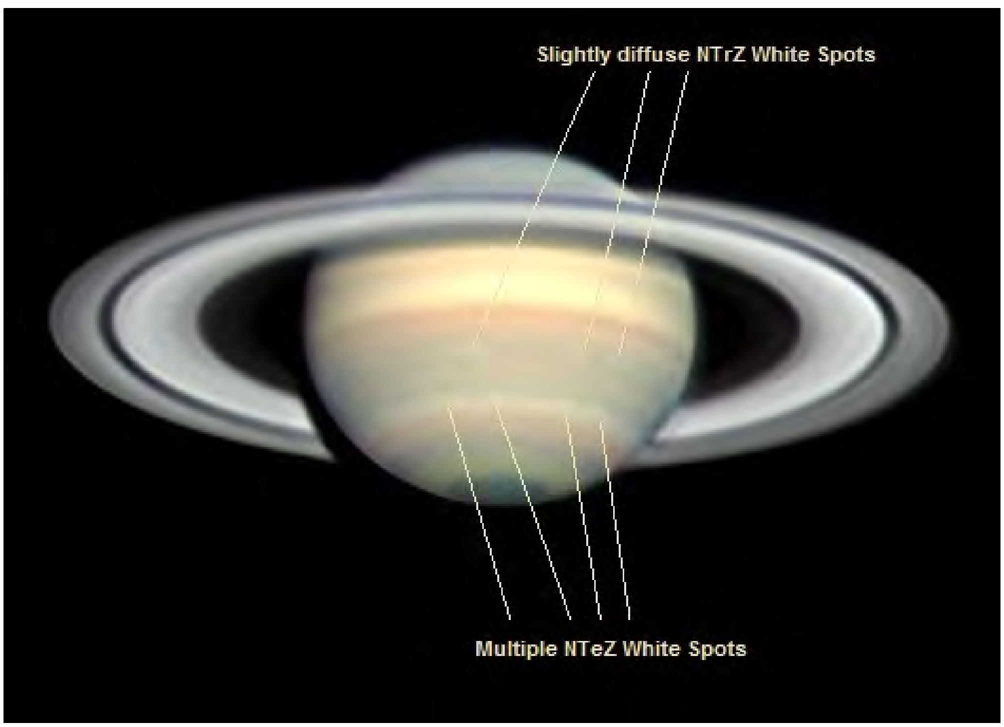


Illustration 014. 2013 March 23 17:19UT Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S and Tr not specified. CMI = 351.8°, CMII = 94.9°, CMIII = 323.4°, B = +18.95°, B′ = +18.47°. Several slightly diffuse white spots spread out within the NTrZ (remnants of the 2010-11 storm?) and multiple brighter white spots are depicted in the NTeZ.

relative intensity estimates were few in number, the impression of a brighter NPR by +2.00 in mean intensity since 2011-12 must be taken cautiously. The NPR was devoid of any recognizable activity by visual observers and those imaging Saturn during the observing season. Although visual observers did not report the NPB (North Polar Belt) in 2012-13, this narrow feature was usually recognizable on higher-definition images encircling the NPR as in Christopher Go's amazing image of May 29th at 12:04UT [refer to Illustration No. 042]. The always intriguing North Polar hexagon was easily recognizable on many of the best images this apparition [refer to Illustration No. 042] and it was actually apparent in a visual drawing made by Paul G. Abel on April 16th at 23:26UT [refer to Illustration No. 032].

Shadow of the Globe on the Rings (Sh G on R). The Sh G on R was visible to observers as a geometrically regular black shadow on either side of opposition during 2012-13. Any apparent variation of this shadow from a totally black intensity (0.0) during a given observing season is purely a consequence of bad seeing conditions or the presence of extraneous light. Digital images revealed this feature as completely black. Readers are reminded that the globe of Saturn casts a shadow on the ring system to the left or IAU East prior to opposition, to the right or IAU West after opposition, and on neither side precisely at opposition (no shadow). This is illustrated in *Figure 6* showing digital images furnished by Christopher Go on March 2, 2013 at 19:54UT (before opposition), April 28, 2013 at 15:08UT (at opposition), and May 29, 2013 at 12:21UT (after opposition).

Latitude Estimates of Features on the Globe. Observers did not submit latitude estimates of features on Saturn's globe during 2012-13. Readers are encouraged to try this simple visual technique developed by Walter Haas over 60 years ago to estimate latitudes. It merely involves determining as accurately as possible the fraction of the polar semidiameter of Saturn's globe subtended on the central meridian (CM) between the limb and the feature whose latitude is desired. As a control on the accuracy of this method, observers should include in their estimates the position on the CM of the projected ring edges and the shadow of the rings. The actual latitudes can then be calculated from the known values of B and B' and the dimensions of the rings, but this test cannot be effectively applied when B and B' are near their maximum attained numerical values. Experienced observers have used this visual convenient procedure for many years with very reliable results, especially since filar micrometers are virtually non-existent, and if available, they tend to be very expensive, not to mention sometimes tedious to use. A detailed description of the technique can be found in the author's book entitled Saturn and How To Observe It, published by Springer and available from booksellers worldwide.

Illustration 015. 2013 March 24 16:31UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 742nmIR filter. S = 6.0, Tr not specified. CMI = 282.1°, CMII = 75.0°, CMIII = 265.0°, B = +18.23°, B´ = +18.78°. Small compressed NTrZ white spot slightly past the CM that appeared similar to the feature imaged by Anthony Wesley back on March 7th.

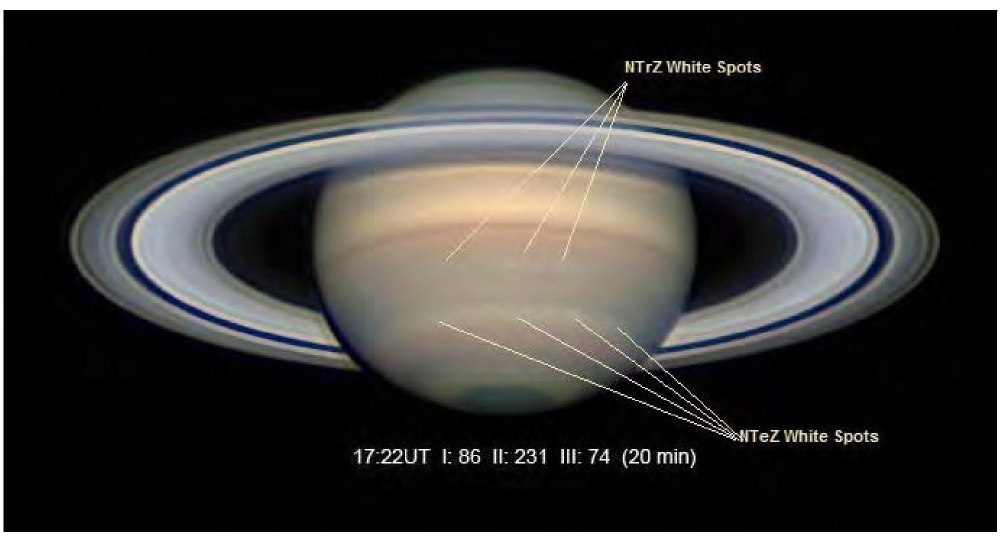


Illustration 016. 2013 April 13 17:22UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 7.5, Tr = 5.0. CMI = 85.9°, CMII = 230.6°, CMIII = 73.8°, B = +18.5°, B´ = +18.67°. Several elongated diffuse NTrZ and NTeZ white spots are clearly seen aligned across the globe in this beautifully detailed image.

Saturn's Ring System

The discussion in this section concerns visual studies of Saturn's ring system with the customary comparison of mean intensity data between apparitions, as well as interpretations of digital images of the rings contributed during 2012-13. With the ring tilt towards Earth in 2012-13 increasing to as much as +19.3°, the major ring components were increasingly easier for observers to see and image as the rings continued to progress toward their maximum inclination of +27° during the upcoming 2016-17 apparition.

Ring A. The majority of visual observers agreed that the dull greyish-white Ring A (taken as a whole) appeared slightly dimmer in 2012-13 than in 2011-12 according to visual numerical relative intensity estimates (difference of -0.7 mean intensity points). Visual observers usually described Ring A as being rather homogeneous rather than being subdivided into inner and outer halves, but digital images of Saturn in 2012-13 often showed inner and outer halves of Ring A, with the inner half slightly brighter than the outer half. Visual observers periodically reported the very dark gray Encke's division (A5) in 2012-13 when the rings were near their maximum tilt but offered no visual numerical relative intensity estimates, while many of the best images revealed A5 near the ansae. There were hints of the Keeler Gap (A8) on some images, but it was not described by visual observers [refer to Illustration No. 042].

Ring B. The outer third of Ring B is the traditional standard of reference for the ALPO Saturn Visual Numerical Relative Intensity Scale, with an assigned value of 8.0. Under circumstances of greater ring tilt during the 2012-13 apparition, visual observers reported that the outer third of Ring B appeared brilliant white with no variation in intensity, and compared with other ring components and atmospheric phenomena of Saturn's globe, it was always the brightest intrinsic feature. The inner two-thirds of Ring B during this apparition, described as yellowish-white and uniform in intensity, displayed a somewhat lighter intensity by a mean factor of +0.45 compared with the immediately preceding observing season. Digital images confirmed most visual impressions during 2012-13, with those of the highest resolution in good seeing revealing several "intensity minima" across the breadth of Ring B [refer to Illustration No. 042].

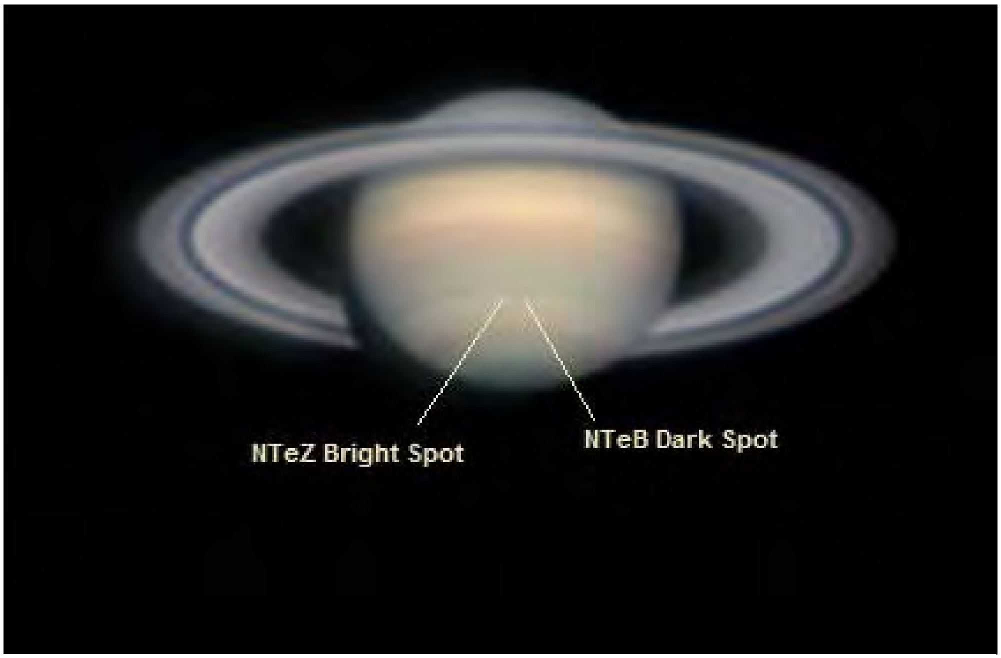


Illustration 017. 2013 January 23 18:48UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 4.5, Tr not specified. CMI = 265.8°, CMII = 112.8°, CMIII = 52,3°, B = +19.26°, B´ = +17.89°. NTeZ bright spot and nearby NTeB dark spot seen slightly toward the west from the NTeZ spot.

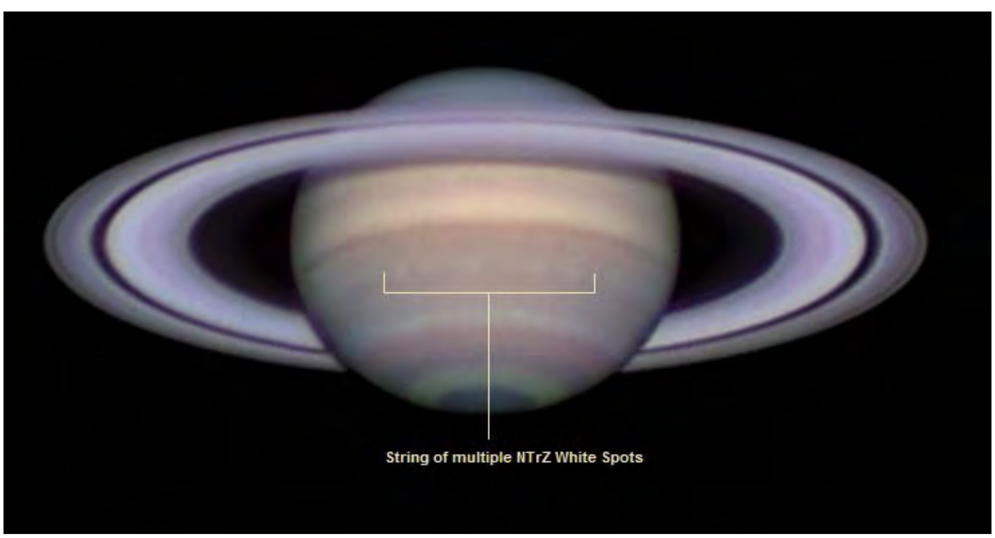


Illustration 018. 2013 April 21 22:48UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 192.2°, CMII = 71.2°, CMIII = 264.4°, B = +18.30°, B´ = +18.75°. String of multiple white spots are noticeable across the globe of Saturn.

Cassini's Division (A0 or B10). Cassini's Division (A0 or B10) was usually reported by visual observers in 2012-13, but only a couple of visual numerical relative intensity estimates were contributed. It was described as a black gap at both ansae and frequently traceable all the way around Saturn's ring system by visual observers (except, of course, where the globe blocked views of the rings). This was also true for most of the high-resolution images submitted [refer to Illustration No. 042]. While a black Cassini's Division was generally apparent on most digital images received during the 2012-13 observing season, any presumed deviation from a totally black intensity for Cassini's Division was a consequence of poor seeing, scattered light, or insufficient aperture. It is interesting to note that the globe can be seen through Cassini's Division (A0 or B10) in a number of the better images submitted this observing season [refer to Illustrations No. 018 and 035].

Ring C. The very dark gray Ring C was usually apparent at the ansae on most digital images during 2012-13 and depicted on drawings made by visual observers. A limited number of visual numerical relative intensity estimates this apparition suggested that Ring C at the ansae was lighter by +1.2 mean intensity points than it appeared in 2011-12. The Crape Band (merely Ring C in front of the globe of Saturn) was reported by visual observers and appeared dull gray in color, uniform in intensity, and not as dark as it appeared in 2011-12 (lighter by +0.45 intensity points) [refer to Illustration No. 033], and it was commonly visible on digital images [refer to Illustration No. 042].

Opposition Effect. The Seeliger "opposition effect" was reported by a handful of observers on opposition date

(April 28, 2013), which is a detectable brightening of Saturn's ring system within a very short interval on either side of opposition, typically when the phase angle between Sun, Saturn, and the Earth is ≤0.3°. This ring brightening is caused by coherent back scattering of sunlight by the m-sized icy particles that make up the rings, which do so far more efficiently than the particles of Saturn's atmosphere. Tomio Akutsu was among several observers whose images depicted this brightening of the rings during 2012-13, exemplified in his image at opposition on April 28th 15:04UT [refer to Illustration No. 043].

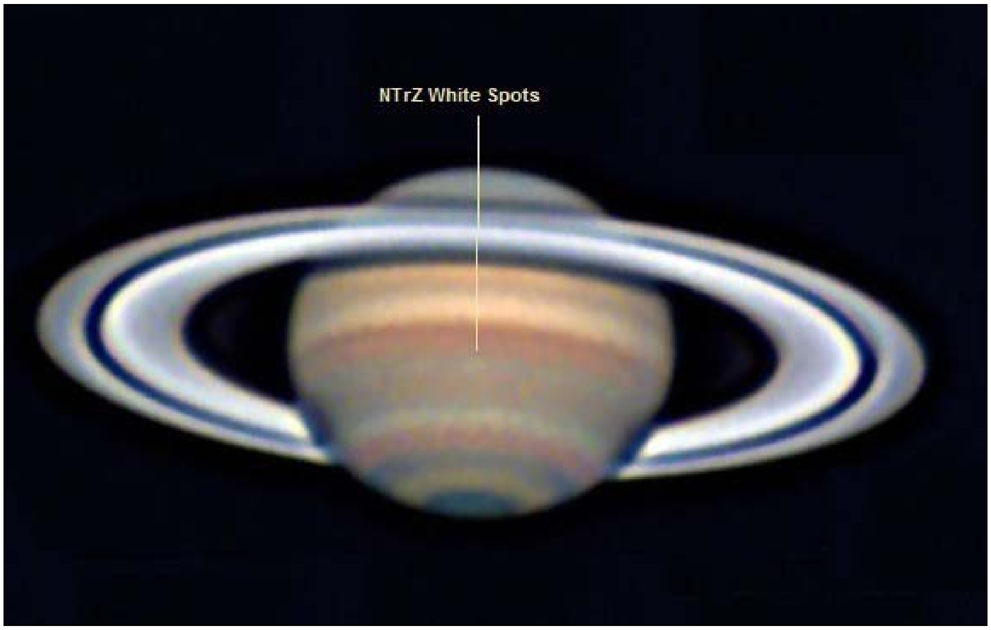


Illustration 019. 2013 April 30 05:57UT. Digital image by Dan Llewellyn. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 358.8°, CMII = 329.7°, CMIII = 152.9°, B = +18.09°, B´ = +18.83°. Several NTrZ white spots are shown across the globe.

Illustration 020. 2013 May 11 16:32UT. Digital image by Daniel Chang. 18.0 cm (7.1 in.) REF and RGB filters. S and Tr not specified. CMI = 299.1°, CMII = 260.5°, CMIII = 69.9°, B = +17.82°, B´ = +18.94°. NTrZ white spots are captured in this image with a smaller instrument.

Shadow of the Rings on the Globe (Sh R on G). This shadow in 2012-13 was usually described as a completely black feature where the rings crossed Saturn's globe. Those very few instances when the shadow appeared as grayish-black, a departure from an overall black (0.0) intensity, occurred for the same reason as previously noted in our discussion regarding the Sh G on R.

When **B** and **B'** are both positive, and the value of **B** is greater than that of **B'**, the ring shadow (Sh R on G) is to the north of the projected rings, which happened prior to April 25, 2013 [refer to Illustration No. 044]. When **B** and **B'** are both positive, and the value of **B** is less than of **B'**, the shadow of the rings on the globe (Sh R on G) is cast to their south, circumstances that occurred starting about April 25, 2013 through September 28, 2013 (the final observation received for the apparition) [refer to Illustration No. 042], and the Crape Band then is seen south of the projected Rings A and B. At times when the shadows of Ring A, Ring B, and Ring C projection are superimposed, it is often very challenging to distinguish between them in ordinary apertures and seeing conditions, and the shadow of Ring C is a further complication.

Terby White Spot (TWS). The TWS is an apparent brightening of the rings immediately adjacent to the Sh G on R. There were only a few times when this feature was noticed by visual observers during 2012-13. It is just an artificial contrast effect, not a real feature of Saturn's rings, but might be beneficial to try to find any correlation that might exist between the visual numerical relative

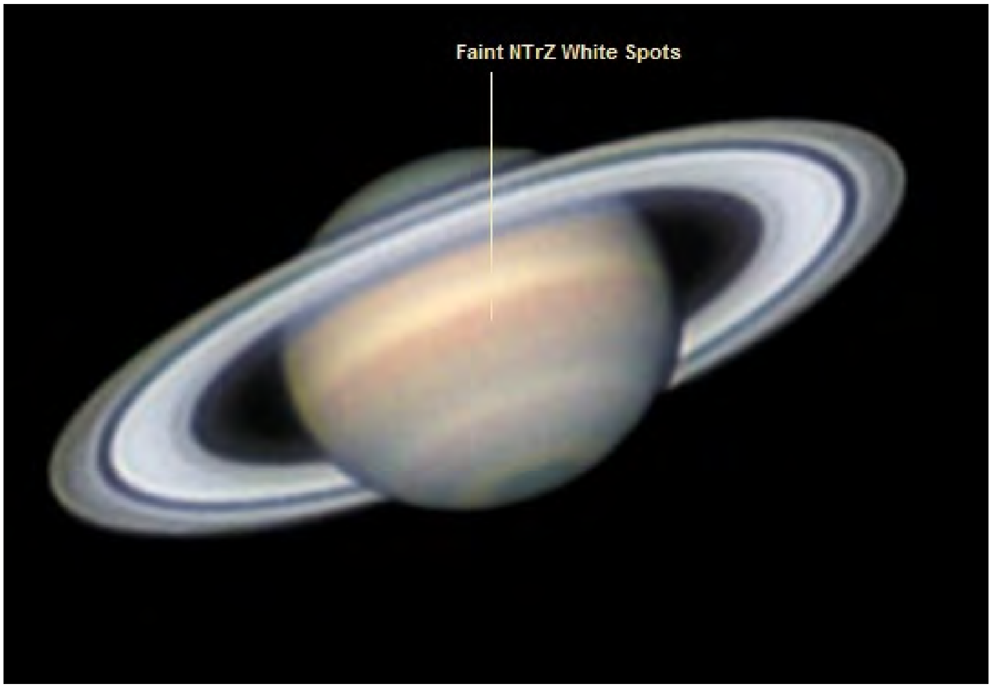


Illustration 021. 2013 May 21 03:24UT. Digital image by Wayne Jaeschke. 35.6 cm (14.0 in.) SCT with RGB filters. S and Tr not specified. CMI = 0.5°, CMII = 16.6°, CMIII = 174.6°, B = +17.62°, B´ = +19.03°. Faint diffuse white spots are visible in this image.

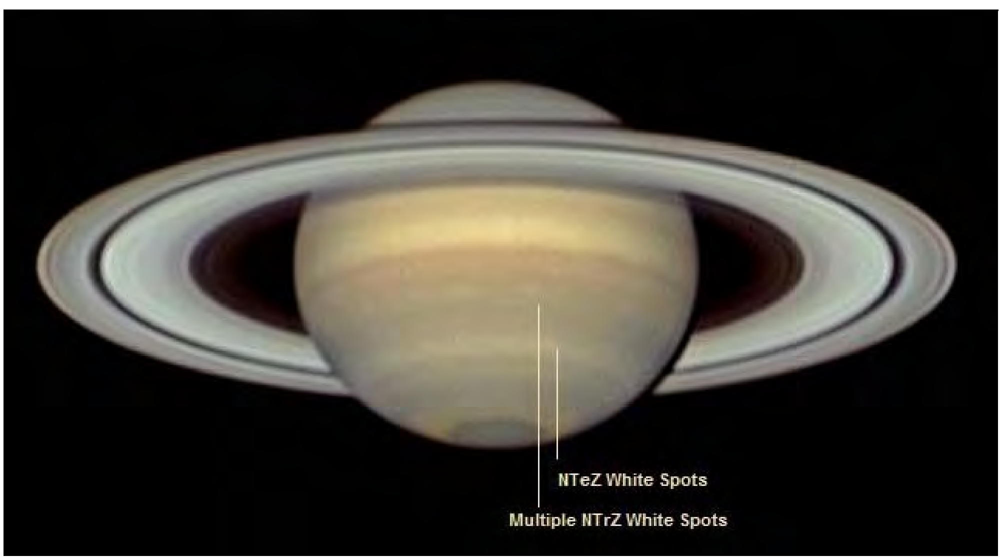


Illustration 022. 2013 May 24 12:56UT. Digital image by Tomio Akutsu. 35.6 cm (14.0-in.) SCT with RGB filters. S = 6.0, Tr = 5.0. CMI = 19.06°, CMII = 348.9°, CMIII = 255.3°, B = +17.55°, B´ = +19.06°. Multiple NTrZ white spots as well as NTeZ white spots are captured in this high-resolution image (notice near-simultaneous image by Toshihiko Ikemura on the same date).

intensity of the TWS and the varying tilt of the rings, including its brightness and visibility using variable-density polarizers, color filters, and digital images.

Bicolored Aspect of the Rings and Azimuthal Brightness Asymmetries. The bicolored aspect of the rings is an observed difference in coloration between the East and West ansae (IAU system) when systematically compared with alternating W47 (where W denotes the Wratten filter series), W38, or W80A (all blue filters) and W25 or W23A (red filters). There were no reports of this phenomenon in 2012-13, although in recent years observers have been systematically attempting to document the presence of the bicolored aspect of the rings using digital imagers. In the past, there have been rare instances when the phenomenon was allegedly photographed, and of particular importance would be images of the bicolored aspect at the same time it is sighted visually, especially when it occurs independent of similar effects on the globe of Saturn (which would be expected if atmospheric dispersion were a contributing factor). Such simultaneous visual observations cannot be stressed enough so that more objective confirmation of the bicolored aspect of the rings can occur.

Professional astronomers are well-acquainted with Earth-based sightings of azimuthal variations in the rings (initially confirmed by *Voyager* spacecraft), which probably is a consequence of light-scattering by denser-than-average clumps of particles orbiting in Ring A. ALPO Saturn observers are encouraged to try to image any azimuthal brightness asymmetries in Ring A, preferably at the same date that visual observers report it.

The Satellites of Saturn

Many of the planet's satellites show tiny fluctuations in visual magnitude as a result of their varying orbital positions relative to the planet and due to asymmetries in distribution of surface markings on a few. Despite close proximity sensing by spacecraft, the true nature and extent of all of the observed satellite brightness variations is not completely understood and merits further investigation.

Visual Magnitude Estimates and Photometry. ALPO Saturn Section observers in 2012-13 submitted no systematic visual estimates of Saturn's satellites employing recommended techniques by the ALPO Saturn Section.

Even though photometry has largely replaced visual magnitude estimates of Saturn's moons, visual observers should still try to establish the comparative brightness of a satellite relative to reference stars of calibrated brightness when the planet passes through a field of stars that have precisely known magnitudes. To do this, observers need to employ both a good star atlas that goes faint enough and an accompanying star catalogue that lists reliable magnitude values. A number of excellent computer star atlases exist that facilitate precise plots of Saturn's path against background stars for comparative magnitude estimates.

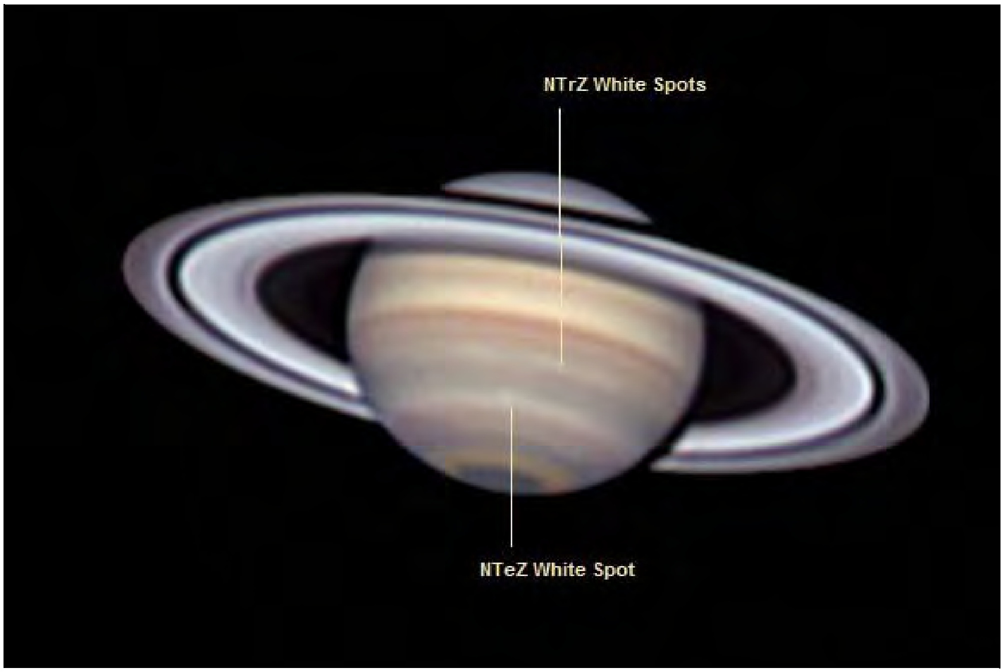


Illustration 023. 2013 June 01 03:31UT. Digital image by Jim Phillips. 50.8 cm (20.0 in.) NEW with RGB filters. S and Tr not specified. CMI = 292.2°, CMII = 312.8°, CMIII = 97.5°, B = +17.42°, B´ = +19.13°. Beautiful image depicting multiple white spots in the NTrZ and the NTeZ white spot just past the CM.

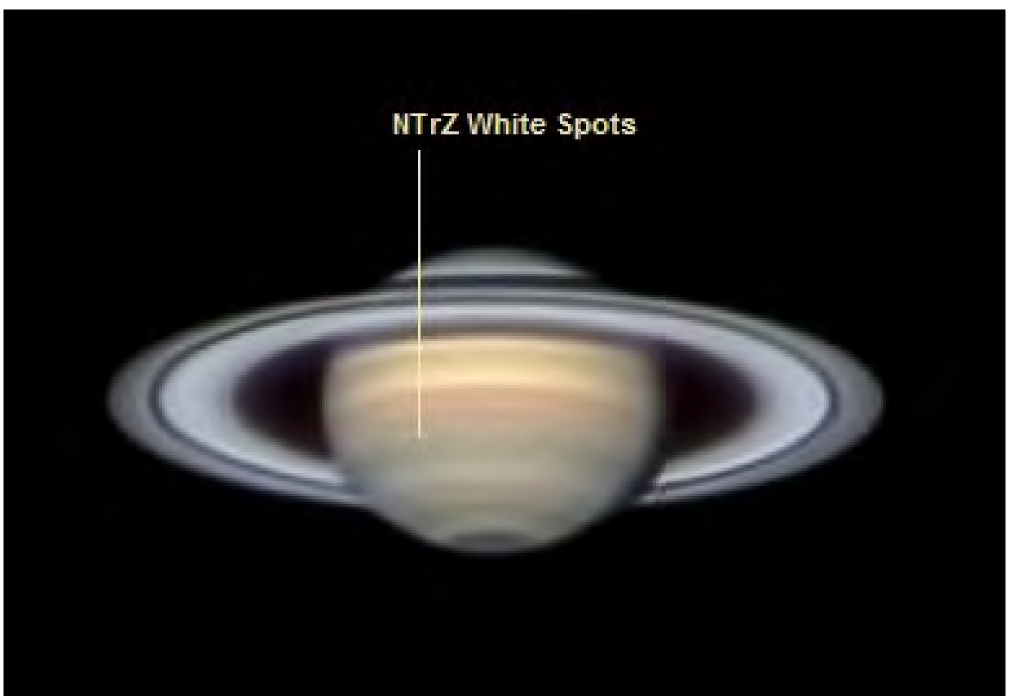


Illustration 024. 2013 June 12 01:57UT. Digital image by Michael A. Phillips. 35.6 cm (14.0 in.) NEW and RGB filters. S = 3.0, Tr = 4. CMI = 164.3°, CMII = 191.8°, CMIII = 323.3°, B = +17.28°, B´ = +19.23°. The NTrZ white spots are barely visible in this image between the CM and preceding (*p*) limb.

The methodology of visually estimating satellite magnitudes is simple. It starts with selection of at least two stars with well-established magnitudes and those that have about the same color and brightness as the satellite. One of the stars chosen should be slightly fainter and the other a little brighter than the satellite so that the difference in brightness between the stars is roughly 1.0 magnitude. This makes it easy to divide the brightness difference between the two comparison stars into equal magnitude steps of 0.1. To estimate the visual magnitude of the satellite, simply place it along the scale between the fainter and brighter comparison stars. In the absence of suitable reference stars, however, a last resort alternative is to use Saturn's brightest satellite, Titan, at visual magnitude 8.4. It is known to exhibit only subtle brightness fluctuations over time compared with the other bright satellites of Saturn that have measured amplitudes.

Some observers have begun using digital imagers with adequate sensitivity to capture the satellites of Saturn together with nearby comparison stars, thereby providing a permanent record to accompany visual magnitude estimates as described above. Images of the positions of satellites relative to Saturn on a given date and time are worthwhile for crosschecking against ephemeris predictions of their locations and identities. It is important to realize, however, that the brightness of satellites and comparison stars on digital images will not necessarily be exactly the same as visual impressions because the peak wavelength response of the CCD chip is typically different than that of the eye. Observers who have photoelectric photometers may also contribute measurements of Saturn's satellites, but they are notoriously difficult to measure owing to their faintness compared with the planet itself. Rather sophisticated techniques are required to correct for scattered light surrounding Saturn and its rings.

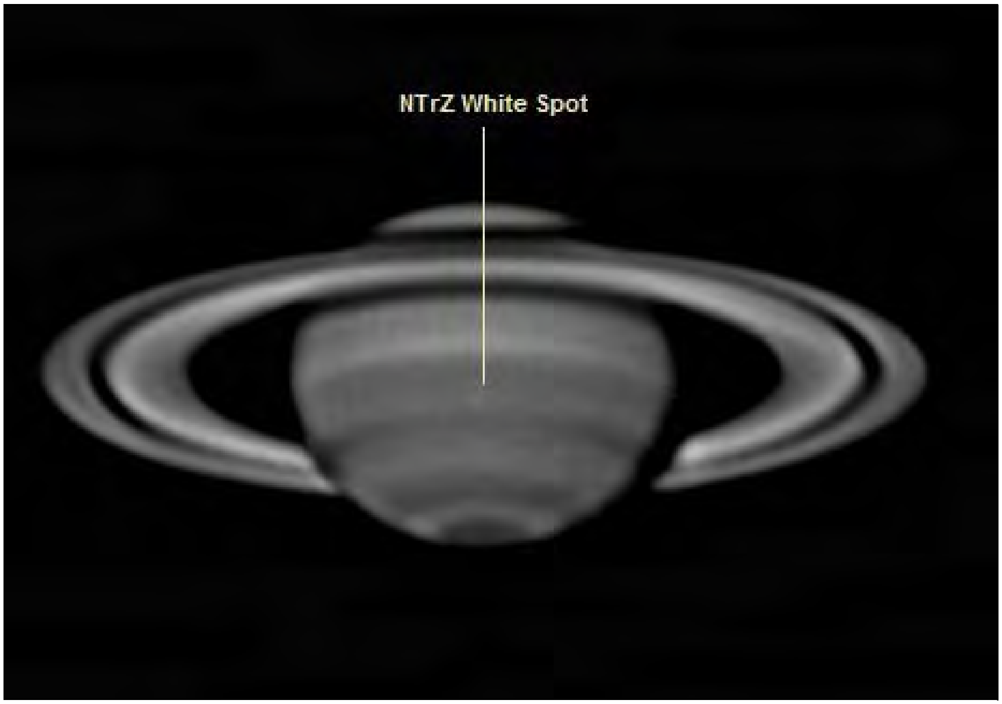


Illustration 025. 2013 July 24 19:19UT. Digital image by Manos Kardasis. 28.0 cm (11.0 in.) SCT with 610nmIR filter. S and Tr not specified. CMI = 233.1°, CMII = 320.7°, CMIII = 40.7°, B = +17.34°, B´ = +19.63°. In this 610nm IR image the NTrZ white spot is on the CM.

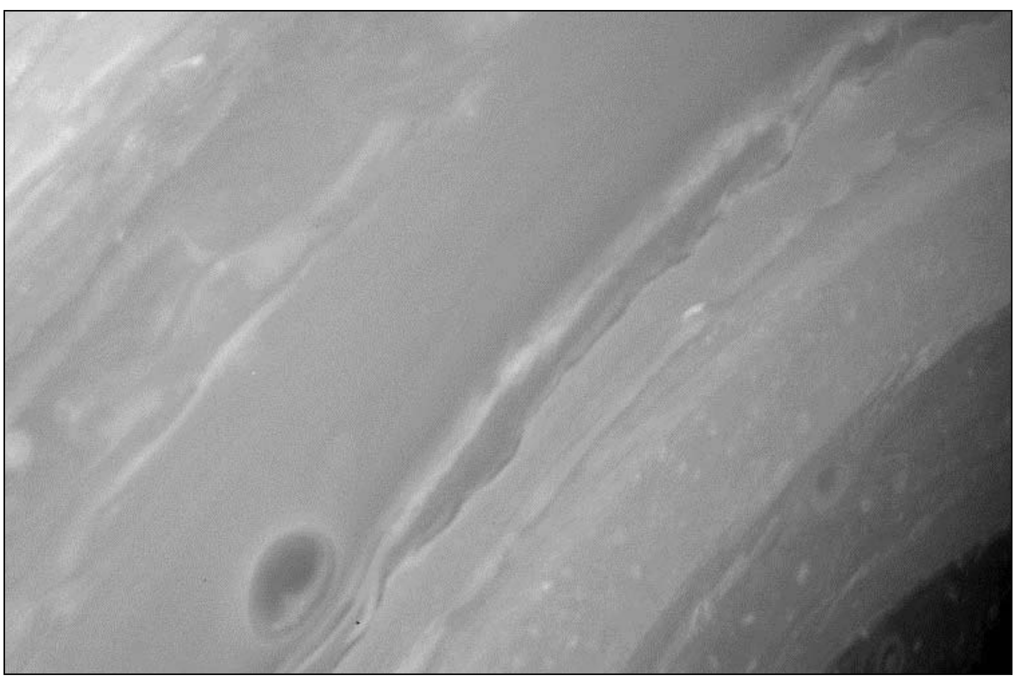


Illustration 026. 2013 February 28. *Cassini* high-resolution image of the small recurring NTeB dark spot imaged and followed by ALPO observers during 2012-13.

Spectroscopy of Titan. Since 1999, observers have been urged to attempt spectroscopy of Titan whenever possible as part of a cooperative professional-amateur project. Although Titan has been studied by the Hubble Space Telescope (HST), very large Earth-based instruments, and at close range the ongoing *Cassini-Huygens* mission, opportunities continue for amateurs to contribute systematic observations using appropriate instrumentation. Thanks to the *Cassini-Huygens* mission started in 2004 (and continuing until at least 2017), we now know that Titan is a very dynamic world with transient and long-term variations. From wavelengths of 300nm to 600nm, Titan's hue is dominated by a reddish methane (CH_4) atmospheric haze, and beyond 600nm, deeper CH_4 absorption bands appear in its spectrum. Between these CH_4 wavelengths are "portals" to Titan's lower atmosphere and surface, so regular monitoring in these regions with photometers or spectrophotometers is a useful complement to professional work. Long-term studies of Titan's brightness from one apparition to the next is meaningful in helping shed light on Titan's known seasonal variations. Observers with suitable equipment are being asked to participate in these professional-amateur projects, and further details can be found on the Saturn page of the ALPO website at *http://www.alpo-astronomy.org/* as well as directly from the ALPO Saturn Section.

Simultaneous Observations

Simultaneous observations or studies of Saturn by individuals working independently of one another at the same time and on the same date offer unparalleled chances of verification of ill-defined or traditionally controversial phenomena. The ALPO Saturn Section has organized a simultaneous observing team so that several individuals in reasonable proximity to each another can maximize the opportunities for viewing and imaging Saturn at the same time using similar equipment and methodology. Joint efforts like this significantly reinforce the level of confidence in the data submitted for each apparition. Some examples of such observations of Saturn during this apparition were cited earlier in this report. In forthcoming apparitions, such continued valuable work is strongly encouraged.

Illustration 027. 2013 March 02 19:54UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 6.5, Tr = 4.0. CMI = 350.4°, CMII = 48.3°, CMIII = 302.0°, B = +19.26°, B´ = +18.27°. The small NTeB dark spot is detected between the CM and the preceding (*p*) limb.

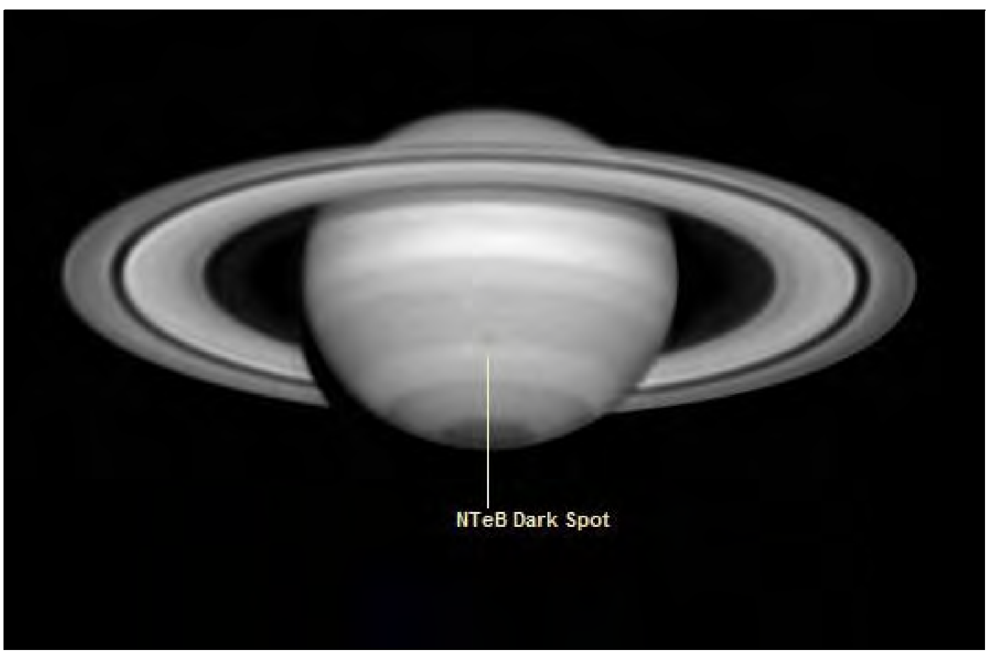


Illustration 028. 2013 March 18 17:24UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW using red filter. S and Tr not specified. CMI = 92.7°, CMII = 357.2°, CMIII = 231.7°, B = +19.04°, B´ = +18.42°. The small oval NTeB dark spot is prominent at red wavelengths in this superb image.

Pro-Am Opportunities

Our routine involvement in professional-amateur (Pro-Am) projects continued in 2012-13 with the standing invitation by Cassini scientists for amateurs to collect and submit as many images of discrete phenomena sighted or imaged on the globe of Saturn. Readers of this Journal may recall the collaborative efforts of amateurs and professionals in keeping track of the dynamic, brilliant NTrZ white storm raging on Saturn during the 2010-11 observing season. Moreover, dating back to the time Cassini started observing Saturn at close range a decade ago (in April 2004), digital images at wavelengths ranging from 400nm - 1m have been actively sought by the professional community from amateurs and remains as a project of high importance. In addition, more advanced observers should utilize classical broadband filters (e.g., Johnson system: B, V, R and I) with apertures upwards of 30.5 cm (12.0 in.) or larger, while also imaging through an 890-nm narrow band CH4 (methane) filter.

So, to maintain our vital Pro-Am effort, the *Cassini* team is steadfast in its desire for ALPO observers to continue to systematically patrol the planet every clear night for individual features, keeping track of their motions and morphology, and subsequently furnish input of interesting large-scale targets for on-board spacecraft imaging systems to begin close-up surveillance as the mission endures well into 2017. Note that visual observers with apertures ranging upwards from about 15.2 cm (6.0 in.) can play a very meaningful role by making routine visual numerical relative intensity estimates and recording suspected variations in belt and zone reflectivities (i.e., intensity) and color. The *Cassini* team combines ALPO Saturn Section images with data from the Hubble Space Telescope and from other professional ground-based observatories for immediate and future study.

As a means of facilitating regular Pro-Am observational cooperation, readers are asked to contact the ALPO Saturn

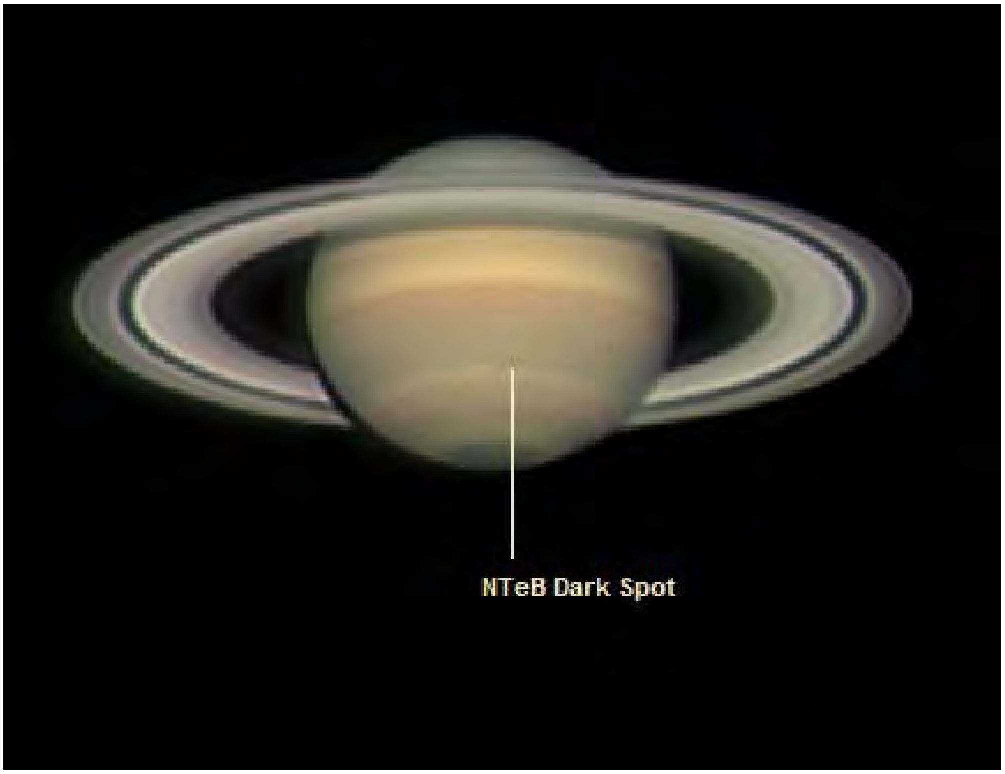


Illustration 029. 2013 April 11 14:06UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 6.5, Tr not specified. CMI = 265.8°, CMII = 112.8°, CMIII = 52.3°, B = +19.26°, B´ = +17.89°. The NTeB dark spot is easily seen nearing the CM in this image.

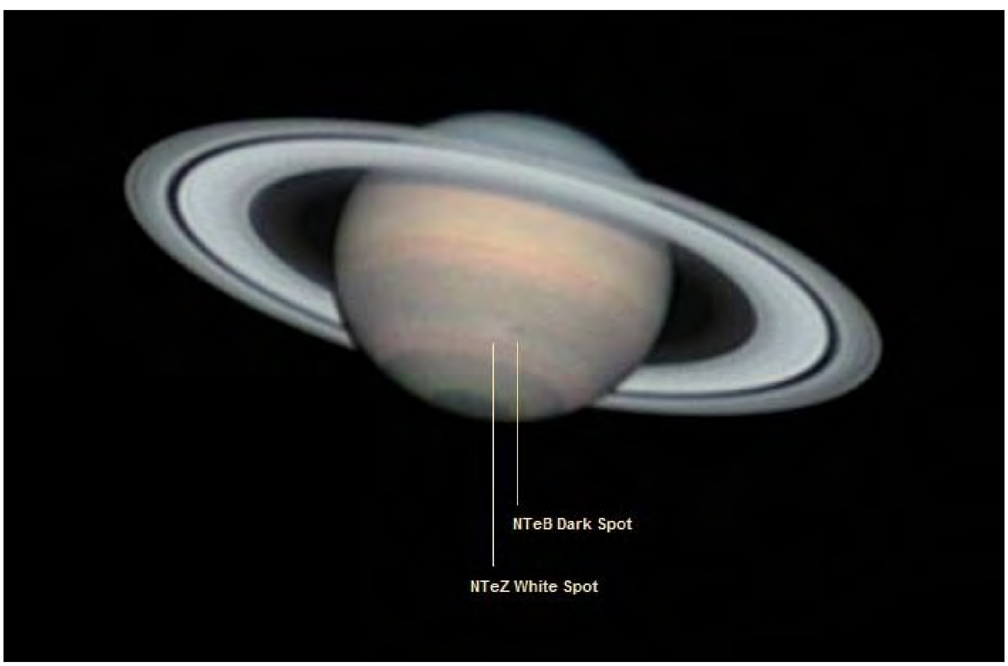


Illustration 030. 2013 April 19 23:26UT. Digital image by Carmelo Zannelli. 35.6 cm (14.0 in.) SCT with RGB filters. S = 5.5, Tr not specified. CMI = 325.7°, CMII = 268.4°, CMIII = 104.0°, B = +18.35°, B´ = +18.73°. Both the NTeZ white spot (on the CM) and nearby NTeB dark spot (approaching the CM) appear prominent in this excellent image.

Section with any questions as to how they can share their observational reports, drawings, and images of Saturn and its satellites with the professional community. The author is always happy to offer guidance to novices, as well as observers that are more experienced. A meaningful resource for learning how to observe and record data on Saturn is the *ALPO Lunar & Planetary Training Program*, and it is recommended that beginners take advantage of this valuable educational resource.

Conclusions

Based on a comparatively limited number of visual numerical relative intensity estimates submitted during 2012-13, the Equatorial Zone (EZn), North Equatorial Belt (NEB), and North Polar Region (NPR), each exhibited varying degrees of lighter overall relative intensity compared with the immediately preceding apparition. Features such as the North Tropical Zone (NTrZ), North Temperate Zone (NTeZ), North Temperate Belt (NTeB), all seemed slightly dimmer this apparition than in 2011-12. It should be noted, however, that viewing and estimating numerical relative intensities of features of Saturn's southern hemisphere during 2012-13 was severely limited because most of Saturn's southern hemisphere was hidden from our view where the rings crossed the globe. Nevertheless, immediately southward of the rings a few observers imaged the diffuse northernmost edge of the gull gray South Polar Region (SPR) or perhaps the gray South Polar Belt (SPB). The overall visual numerical relative intensity assigned to this light yellowish-gray region suggested that it was only marginally lighter by +0.20 in mean intensity since 2011-12 and devoid of any recognizable activity.

With regard to activity on Saturn's globe during 2012-13, lingering remnants of the massive North Tropical Zone (NTrZ) storm of 2010-11 possibly contributed to the appearance of several white spots seen and imaged in the region between Saturnigraphic latitude +35° and +45°. Multiple bright spots were also imaged throughout the observing season in the North Temperate Zone (NTeZ) and on at least one occasion in the North North Temperate Zone (NNTeZ). A recurring dark condensation for much of the observing season was imaged at the northernmost edge of the North Temperate Belt (NTeB) along the southern edge of the NTeZ, plus another possible dark spot in the North North Temperate Belt (NNTeB), plus rare accounts by one visual observer of festoon activity in the North Equatorial Belt Zone (NEBZ). Furthermore, small bright areas appeared within the EZn (Equatorial Zone, northern half) for much of the 2012-13 apparition, as well as similar bright spots in the EZs (Equatorial Zone, southern half). Observers also imaged the remarkable hexagonal feature at Saturn's North Pole on a routine basis at different wavelengths.

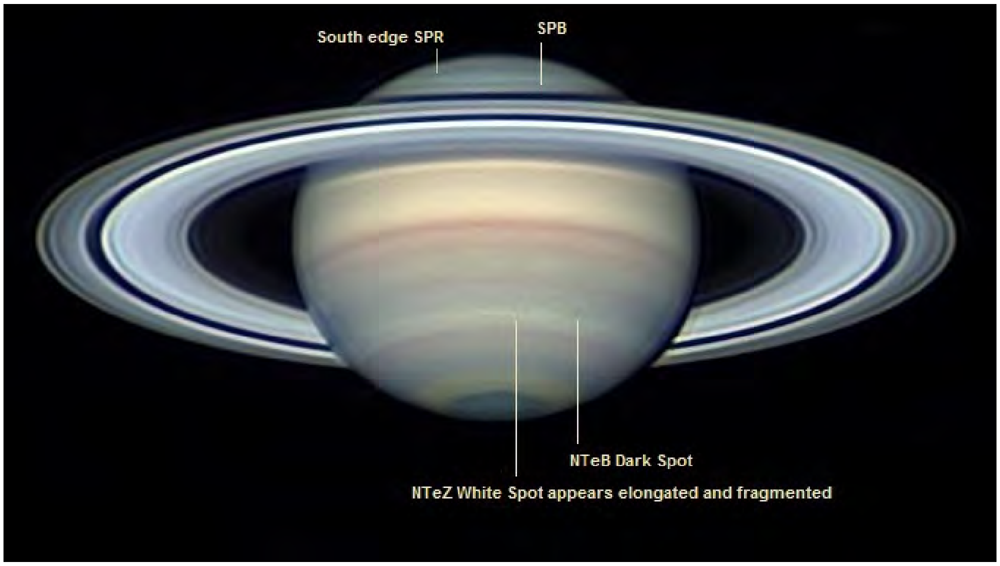


Illustration 031. 2013 May 23 13:21UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 7.5, Tr = 4.0. CMI = 239.2°, CMII = 177.3°, CMIII = 332.4°, B = +17.57°, B´ = +19.05°. This absolutely exquisite image depicts enormous detail in rings and on the globe. Notice how the NTeZ is elongated and segmented longitudinally; the NTeB dark spot is visible, and notice that the SPB and presumably the S edge of the SPR are apparent south of the rings.

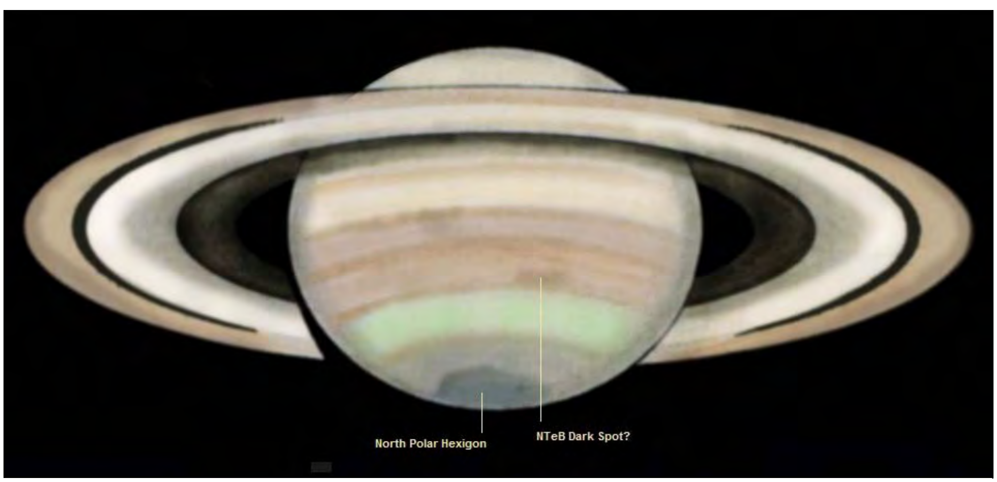


Illustration 032. 2013 April 16 23:26UT. Drawing by Paul G. Abel. 50.8 cm (20.0 in.) DALL in Integrated Light (no filter) at 356X. S = 5.0 (interpolated), Tr not specified. CMI = 312.6°, CMII = 352.2°, CMIII = 191.4°, B = +18.42°, B´ = +18.70°. Colorized drawing showing an elongated NTeB dark spot and the N polar hexagon.

ALPO observers worldwide continued their regular worldwide daily coverage of Saturn during 2012-13 on the lookout for discrete phenomena, with all relevant data passed on to the *Cassini* team as in previous apparitions. Therefore, Pro-Am cooperation was alive and well this apparition, continuing into upcoming years.

With respect to the Ring System, apart from routine visual observations and digital images showing Cassini's (A0 or B10), Encke's (A5), and possibly Keeler's (A8) divisions, several less conspicuous intensity minima at different locations within Ring B were recorded with digital imagers and vaguely suspected by visual observers. Although observers used standard methodology in looking for the bi-colored aspect of the rings during the 2012-13 apparition, there were no reports of the phenomenon by visual observers or indications of its presence on digital images submitted.

Digital imaging, which now occurs as routinely as visual studies of Saturn, frequently reveals minute details on the globe and in the rings often below the normal visual threshold. With a combination of both observational methods, opportunities substantially increase for detecting changes on Saturn during any given observing season. Because of their sensitivity, digital imagers help detect outbursts of activity that visual observers can ultimately try to study with their telescopes. This helps establish limits of visibility of such features in integrated light (no filter) and at various wavelengths.

With regard to Saturn's satellites, during the 2012-13 apparition observers did not submit magnitude estimates.

The author deeply appreciates the dedicated observational efforts by all those mentioned in this report in submitting drawings, digital images, descriptive reports, simultaneous observations, and visual numerical relative intensity estimates during the 2012-13 apparition. Regular systematic observational work enhances our programs. It bolsters Pro-Am collaboration and helps us ultimately better understand Saturn as a planet. Observers worldwide are encouraged to join us in our endeavors in future apparitions.

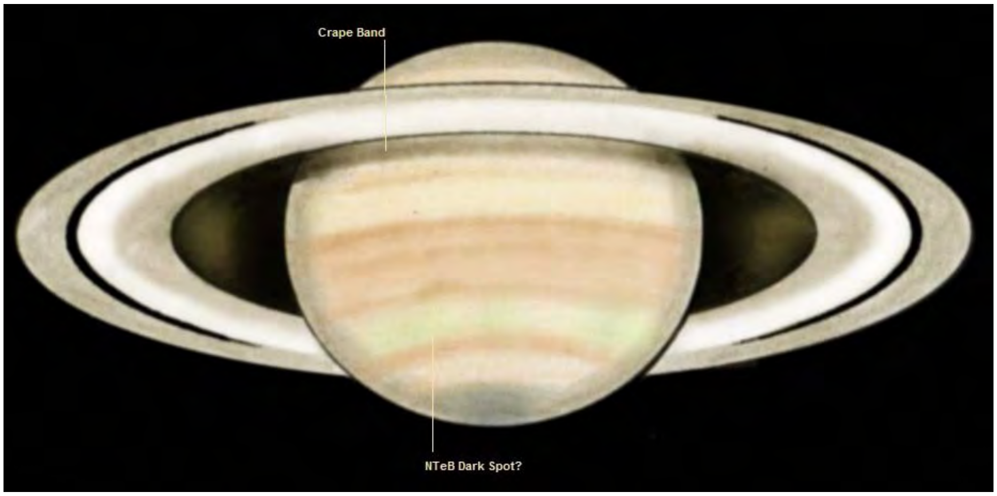


Illustration 033. 2013 May 06 00:40UT. Drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 5.0 (interpolated), Tr (described as excellent but not numerically rated). CMI = 199.1°, CMII = 343.4°, CMIII = 159.6°, B = +17.95°, B´ = +18.89°. Colorized drawing shows an elongated NTeB dark spot and the Crape Band.

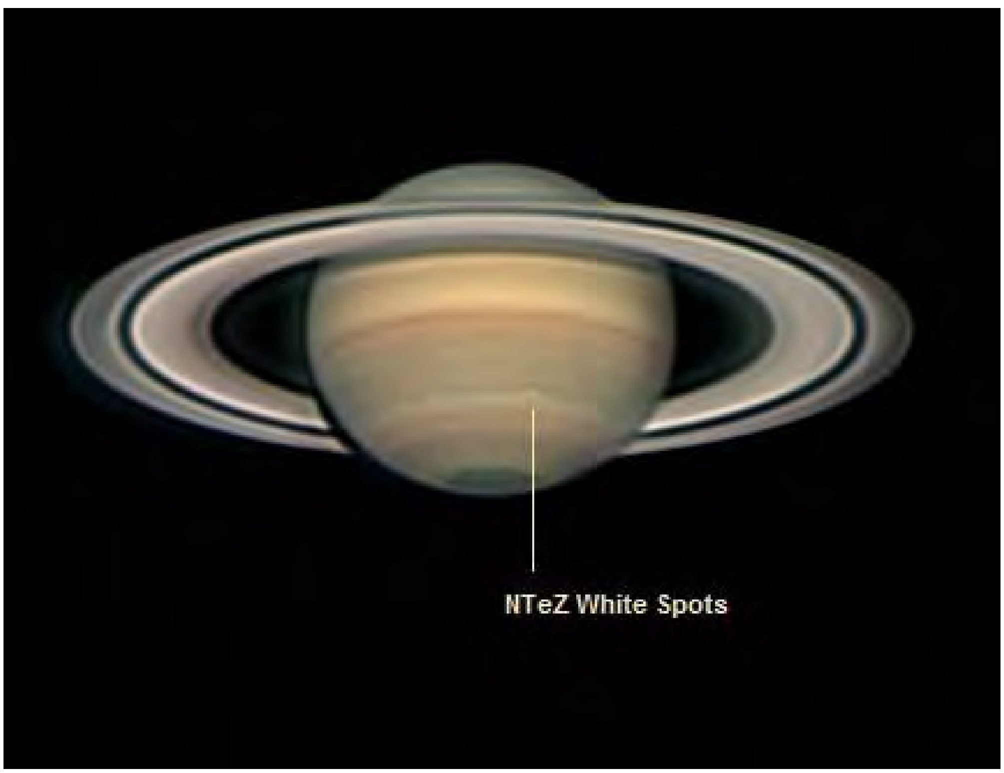


Illustration 034. 2013 April 08 14:54UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 6.5, Tr not specified. CMI = 97.2°, CMII = 46.7°, CMIII = 256.0°, B = +18.62°, B´ = +18.62°. NTeZ white spots (near-simultaneous with Anthony Wesley's image on the same date).

References

Alexander, A.F. O'D. (1962). *The Planet Saturn*. London: Faber and Faber. http://www.amazon.com/planet-Saturn-history-observation-discovery/dp/B0006AY82U

Benton, J.L., Jr. (2005). *Saturn and How to Observe It*. London: Springer-Verlag. http://www.amazon.com/Saturn-Observe-Astronomers-Observing-Guides/dp/1852338873/ref=sr_1_1/105-9507435-7968466?ie=UTF8&s=books&qid=1183915123&sr=1-1

________ (1996). *Visual Observations of the Planet Saturn: Theory and Methods (The Saturn Handbook)*. Savannah, GA: Review Publishing Company, 1996 (8th Revised Edition - now available also in pdf format) from the author.

___________ (2014). *ALPO Observations of Saturn During the 2010-2011 Apparition, JALPO, 56,* 2: 31-66.

___________ (2015). *ALPO Observations of Saturn During the 2011-2012 Apparition, JALPO, 57,* 2: 48-746.

Lissauer, Jack J, and de Pater, Imke, *Fundamental Planetary Science*. New York: Cambridge University Press, 2013. http://www.amazon.com/dp/052161855X/?tag=mh0b-20&hvadid=4162391626&ref=pd_sl_7lqawqcmqg_e

United States Naval Observatory, *The Astronomical Almanac*. Washington: U.S. Government Printing Office. (Annual Publication; the 2012 and 2013 editions, which were published in 2011 and 2012, respectively, were used for this report). http://bookstore.gpo.gov/search/apachesolr_search/The%20Astronomical%20Almanac

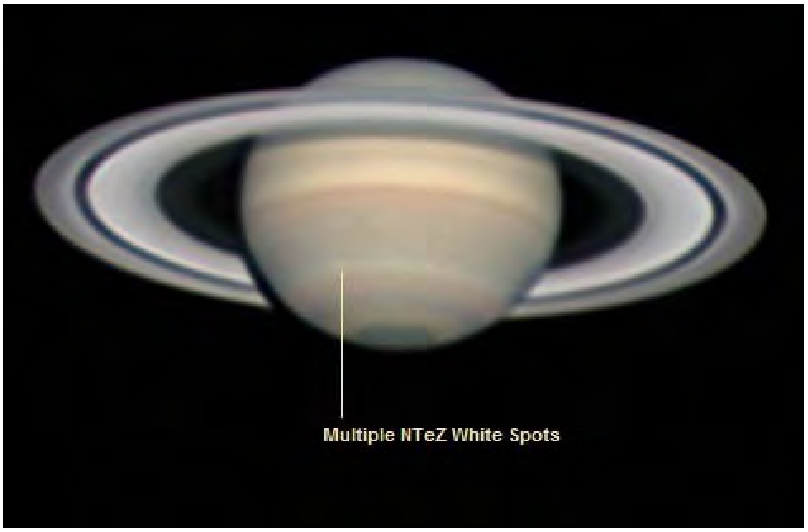


Illustration 035. 2013 April 08 16:19UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW and RGB filters. S and Tr not specified. CMI = 147.0°, CMII = 94.6°, CMIII = 303.8°, B = +18.62°, B´ = +18.63°. Multiple NTeZ white spots (compare with near-simultaneous image by Trevor Barry on the same date).

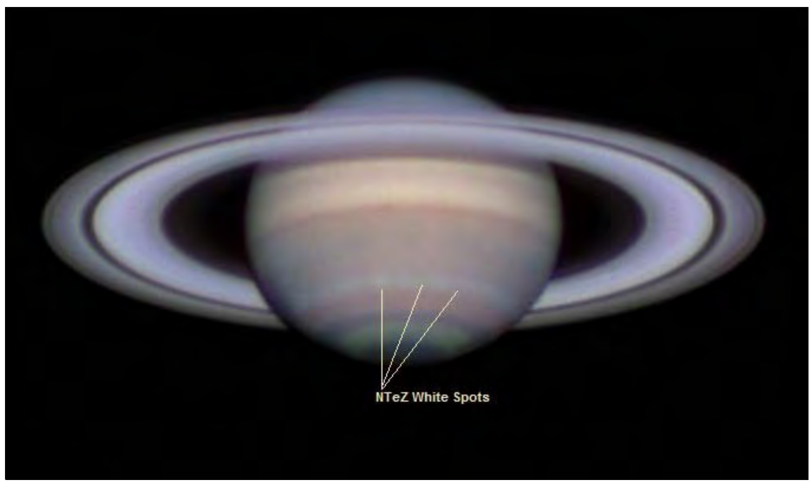


Illustration 036. 2013 April 17 21:41UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 15.4°, CMII = 25.1°, CMIII = 223.1°, B = +18.40°, B´ = +18.71°. Multiple NTeZ white spots are visible across the planet's globe.

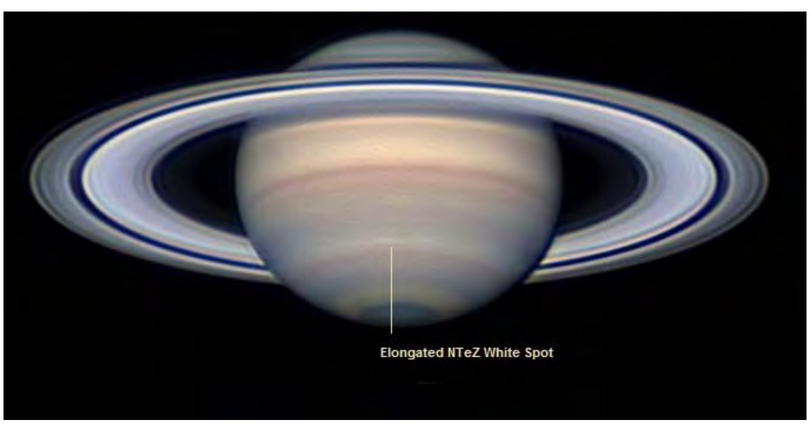
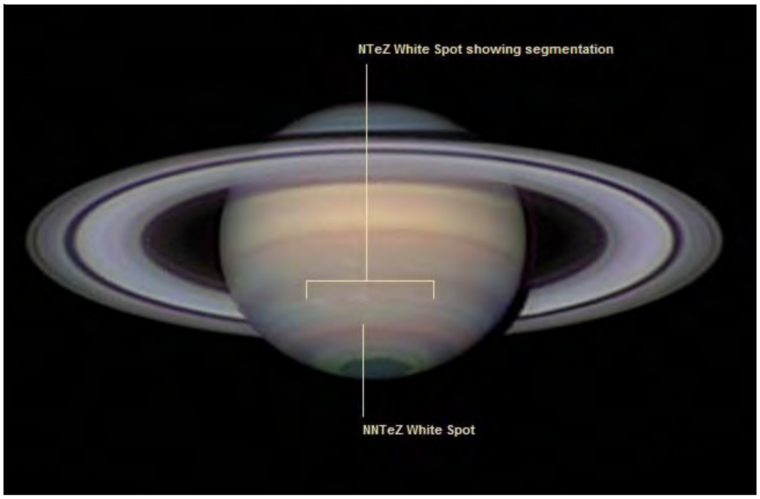


Illustration 037. 2013 May 21 13:28UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 7.5, Tr = 4.0. CMI = 354.7°, CMII = 357.2°, CMIII = 154.7°, B = +17.61°, B´ = +19.03°. This fine detailed image shows how the NTeZ is stretching out longitudinally perhaps into segments (compare with Christopher Go's image about two days later on May 23rd).

Illustration 038. 2013 May 24 12:02UT. Digital image by Toshihiko Ikemura. 38.0 cm (15.0 in.) NEW and RGB filters. S and Tr not specified. CMI = 304.2°, CMII = 308.7°, CMIII = 106.3°, B = +17.61°, B´ = +19.03°. NTeZ white spots are barely visible on this image (see near-simultaneous image by Tomio Akutsu on the same date).

Illustration 039. 2013 July 08 20:37UT Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 91.5°, CMII = 334.1°, CMIII = 73.4°, B = +17.20°, B´ = +19.48°. NTeZ white spots spread out longitudinally and showing a fading tendancy; a very small NNTeZ white spot is visible slightly past the CM.



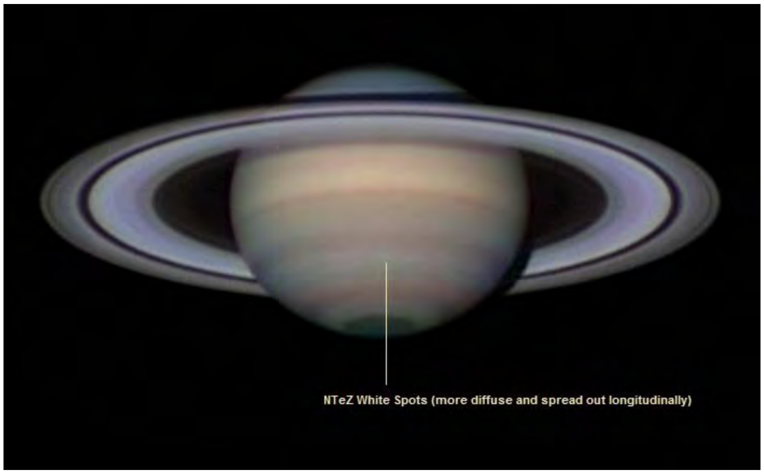


Illustration 040. 2013 July 19 20:31UT Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 14.3°, CMII = 261.8°, CMIII = 347.8°, B = +17.28°, B´ = +19.58°. NTeZ white spots are more diffuse and distributed longitudinally continuing the fading trend suspected earlier in July.

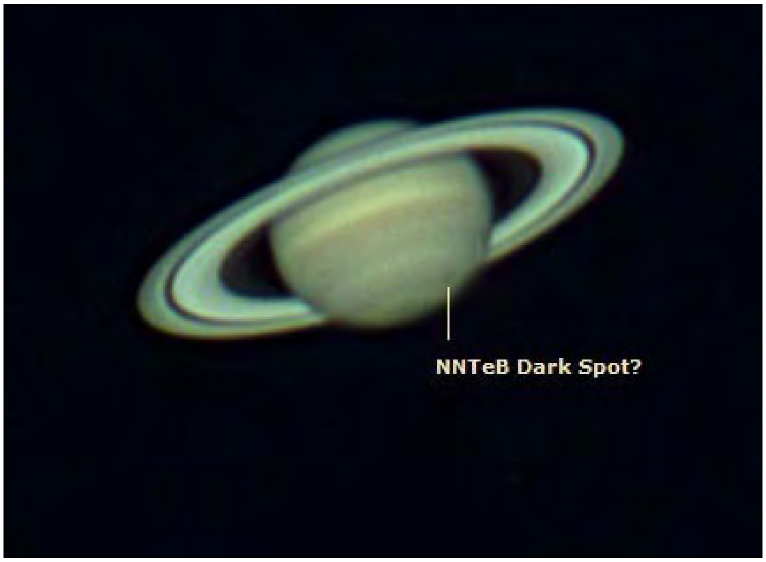


Illustration 041. 2013 May 05 03:09UT Digital image by Vlamir da Silva. 20.3 cm (8.0-in.) SCT with RGB filters. S (noted as good but not numerically rated) and Tr not specified. CMI = 162.1°, CMII = 335.4°, CMIII = 152.7°, B = +17.97°, B´ = +18.88°. NNTeB dark spot is possibly present in this image in good seeing.

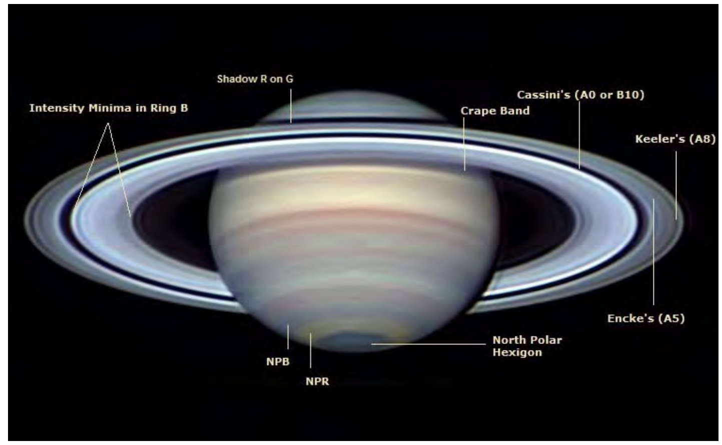


Illustration 042. 2013 May 29 12:04UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 8.5, Tr = 4.0. CMI = 220.0°, CMII = 326.1°, CMIII = 114.0°, B = +17.47°, B´ = +19.11°. Tremendously detailed image in excellent seeing showing many globe and ring features described in the text of the 2012-13 apparition report!

Illustration 043. 2013 April 18 15:04UT. Digital image by Tomio Akutsu. 35.6 cm (14.0-in.) SCT with RGB filters. S = 7.5, Tr = 5.0. CMI = 70.8°, CMII = 94.1°, CMIII = 279.2°, B = +18.13°, B´ = +18.82°. This image at opposition illustrates the Seeliger Effect quite adequately caused by coherent back-scattering of sunlight by the m-sized icy particles that make up the rings.

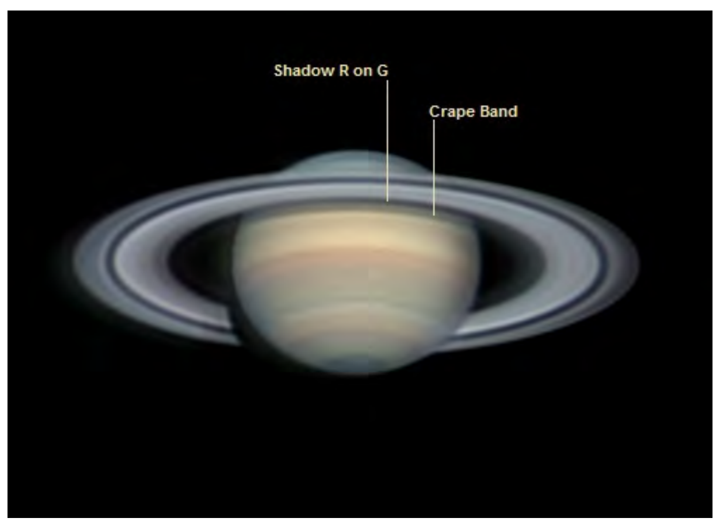


Illustration 044. 2013 February 05 19:04UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with RGB filters. S = 6.5, Tr not specified. CMI = 91.7°, CMII = 238.4°, CMIII = 162.2°, B = +19.35°, B´ = +18.02°. This image illustrates how the appearance of the Crape Band and Shadow of the Rings on the Globe can sometimes be confusing if observers don't pay close attention and know when either feature is visible during any given apparition.

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Lunar Selected Areas Program

http://moon.scopesandscapes.com/alpo-sap.html

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There is NO CHARGE for any of the ALPO monographs.

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- **Monograph No. 2**. *Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994. 52* pages. File size approx. 6.0 mb.

- **Monograph No. 3**. *H.P. Wilkins 300-inch Moon Map.* 3rd Edition (1951). Available as one comprehensive file (approx. 48 megabytes) or five section files (Part 1, 11.6 megabytes; Part 2, 11.7 megabytes; Part 3, 10.2 megabytes; Part 4, 7.8 megabytes; Part 5, 6.5 mb)

- **Monograph No. 4.** *Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.127* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere. File size approx. 2.6 mb.

- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of*

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Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878. By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Hard copy $10 for the United States, Canada, and Mexico; $15 elsewhere. File size approx. 2.6 mb.

- **Monograph No. *6.*** *Proceedings of the 47th Convention of the Association of Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.20* pages. Hard copy $3 for the United States, Canada, and Mexico; $4 elsewhere.File size approx. 2.6 mb.

- **Monograph No. 7.** *Proceedings of the 48th Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76* pages. Hard copy $12 for the United States, Canada, and Mexico; $16 elsewhere.File size approx. 2.6 mb.

- **Monograph No. 8**. *Proceedings of the 49th Convention of the Association of Lunar and Planetary Observers. Atlanta, Georgia, July 9-11,1998.122* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere.File size approx. 2.6 mb.

- **Monograph Number 9**. *Does Anything Ever Happen on the Moon?* By Walter H. Haas. Reprint of 1942 article. 54 pages.Hard copy $6 for the United States, Canada, and Mexico; $8 elsewhere.File size approx. 2.6 mb.

- **Monograph Number 10.** *Observing and Understanding Uranus, Neptune and Pluto*. By Richard W. Schmude, Jr. 31 pages. File size approx. 2.6 mb.

- **Monograph No. 11**. *The Charte des Gebirge des Mondes* (Chart of the Mountains of the Moon) by J. F. Julius Schmidt, this monograph edited by John Westfall. Nine files including an accompanying guidebook in German. Note files sizes:
  Schmidt0001.pdf, approx. 20.1 mb;
  Schmidt0204.pdf, approx. 32.6 mb;
  Schmidt0507.pdf, approx. 32.1 mb;
  Schmidt0810.pdf, approx. 31.1 mb;
  Schmidt1113.pdf, approx. 22.7 mb;
  Schmidt1416.pdf, approx. 28.2 mb;
  Schmidt1719.pdf, approx. 22.2 mb;
  Schmidt2022.pdf, approx. 21.1 mb;
  Schmidt2325.pdf, approx. 22.9 mb;
  SchmidtGuide.pdf,approx. 10.2 mb

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- **Lunar & Planetary Training Section:** *The Novice Observers Handbook* $15. An introductory text to the training program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. Available as pdf file via e-mail or send check or money order payable to Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065; e-mail cometman@cometman.net.

- **Lunar (Bailey):**
- (1) *The ALPO Lunar Selected Areas Program Handbook* (hardcopy, $17.50). Includes full set of observing forms. (2) *Observing forms*: Send a SASE for a hardcopy of forms. Both the Handbook and individual observing forms are available for download (as pdf files) at moon.scopesandscapes.com/alpo-sap.html. Use of observing forms will ensure that all requested information is included with observations, but are not required. Various lists and forms related to other Lunar section programs are also available at moon.scopesandscapes.com. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO lunar SAP section. Observers should make copies using high-quality paper.

- **Lunar**: *The Lunar Observer*, official newsletter of the ALPO Lunar Section, published monthly. Free at http://moon.scopesandscapes.com/tlo.pdf or send SASE to: Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080.

- **Lunar (Jamieson):** *Lunar Observer's Tool Kit*, price $50, is a computer program designed to aid lunar observers at all levels to plan, make, and record their observations. This popular program was first written in 1985 for the Commodore 64 and ported to DOS around 1990. Those familiar with the old DOS version will find most of the same tools in this new Windows version, plus many new ones. A complete list of these tools includes Dome Table View and Maintenance, Dome Observation Scheduling, Archiving Your Dome Observations, Lunar Feature Table View and Maintenance, Schedule General Lunar Observations, Lunar Heights and Depths, Solar Altitude and Azimuth, Lunar Ephemeris, Lunar Longitude and Latitude to Xi and Eta, Lunar Xi and Eta to Longitude and Latitude, Lunar Atlas Referencing, JALPO and Selenology Bibliography, Minimum System Requirements, Lunar and Planetary Links, and Lunar Observer's ToolKit Help and Library. Some of the program's options include predicting when a lunar feature will be illuminated in a certain way, what features from a collection of features will be under a given range of illumination, physical ephemeris information, mountain height computation, coordinate conversion, and browsing of the software's included database of over 6,000 lunar features. Contact
  harry@persoftware.com

- **Venus (Benton):** Introductory information for observing Venus, including observing forms, can be downloaded for free as pdf files at http://www.alpo-astronomy.org/venus. The *ALPO Venus Handbook* with observing forms included is available as the *ALPO Venus Kit* for $17.50 U.S., and may be obtained by sending a check or money order made payable to “Julius L. Benton” for delivery in approximately 7 to 10 days for U.S. mailings. The *ALPO*

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Venus Handbook may also be obtained for $10 as a pdf file by contacting the ALPO Venus Section. All foreign orders should include $5 additional for postage and handling; p/h is included in price for domestic orders. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO Venus section. Observers should make copies using high-quality paper.

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- **Minor Planets (Derald D. Nye):** *The Minor Planet Bulletin*. Published quarterly; free at *http://www.minorplanetobserver.com/mpb/default.htm*. Paper copies available only to libraries and special institutions at $24 per year via regular mail in the U.S., Mexico and Canada, and $34 per year elsewhere (airmail only). Send check or money order payable to "Minor Planet Bulletin", c/o Derald D. Nye, 10385 East Observatory Dr., Corona de Tucson, AZ 8564I-2309.

- **Jupiter:** *(1) Jupiter Observer's Handbook*, $15 from the Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. (2) *Jupiter*, the ALPO section newsletter, available from Craig MacDougal at *macdouc@verizon.net;* (3) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to *ALPO_Jupiter-subscribe@yahoogroups.com* (4) *Timing the Eclipses of Jupiter's Galilean Satellites* free at *http://www.alpo-astronomy.org/jupiter/GaliInstr.pdf*, report form online at *http://www.alpo-astronomy.org/jupiter/GaliForm.pdf*; send SASE to John Westfall for observing kit and report form via regular mail. (5) *Jupiter Observer's Startup Kit*, $3 from Richard Schmude, Jupiter Section Coordinator.

- **Saturn (Benton):** Introductory information for observing Saturn, including observing forms and ephemerides, can be downloaded for free as pdf files at *http://www.alpo-astronomy.org/saturn*; or if printed material is preferred, the *ALPO Saturn Kit* (introductory brochure and a set of observing forms) is available for $10 U.S. by sending a check or money order made payable to "Julius L. Benton" for delivery in approximately 7 to 10 days for U.S. mailings. The former *ALPO Saturn Handbook* was replaced in 2006 by *Saturn and How to Observe It* (by J. Benton); it can be obtained from book sellers such as *Amazon.com*. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO Saturn Section.

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THE ASSOCIATION
OF LUNAR & PLANETARY OBSERVERS (ALPO)

The Association of Lunar & Planetary Observers (ALPO) was founded by Walter H. Haas in 1947 and incorporated in 1990 as a medium for advancing and conducting astronomical work by both professional and amateur astronomers who share an interest in Solar System observations. We welcome and provide services for all individuals interested in lunar and planetary astronomy. For the novice observer, the ALPO is a place to learn and to enhance observational techniques. For the advanced amateur astronomer, it is a place where one's work will count and be used for future research purposes. For the professional astronomer, it is a resource where group studies or systematic observing patrols add to the advancement of astronomy.

Our Association is an international group of students that study the Sun, Moon, planets, asteroids, meteors, meteorites and comets. Our goals are to stimulate, coordinate, and generally promote the study of these bodies using methods and instruments that are available within the communities of both amateur and professional astronomers. We hold a conference each summer, usually in conjunction with other astronomical groups.

We have "sections" for the observation of all the types of bodies found in our Solar System. Section coordinators collect and study submitted observations, correspond with observers, encourage beginners, and contribute reports to our quarterly Journal at appropriate intervals. Each section coordinator can supply observing forms and other instructional material to assist in your telescopic work. You are encouraged to correspond with the coordinators in whose projects you are interested. Coordinators can be contacted either via e-mail (available on our website) or at their postal mail addresses listed in our Journal. Members and all interested persons are encouraged to visit our website at *http://www.alpo-astronomy.org*. Our activities are on a volunteer basis, and each member can do as much or as little as he or she wishes. Of course, the ALPO gains in stature and in importance in proportion to how much and also how well each member contributes through his or her participation.

Our work is coordinated by means of our quarterly periodical, the *Journal of the Assn. of Lunar & Planetary Observers*, also called *The Strolling Astronomer.* Membership dues include a subscription to our Journal. Two versions of our Journal are distributed — a hardcopy (paper) version and an online (digital) version in "portable document format" (pdf) at considerably reduced cost.

Subscription rates and terms are listed below (effective March 1, 2015).

We heartily invite you to join the ALPO and look forward to hearing from you.

- ..$US14 – 4 issues of the digital Journal only, all countries, e-mail address required
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Afterwards, e-mail the ALPO membership secretary at *matt.will@alpo-astronomy.org* with your name, address, the type of membership and amount paid.

If using the form below, please make payment by check or money order, payable (through a U.S. bank and encoded with U.S. standard banking numbers) to "ALPO" There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice. Send to: ALPO Membership Secretary, P.O. Box 13456, Springfield, Illinois 62791-3456 USA.

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Interest____

Interest Abbreviations
0 = Sun 1 = Mercury 2 = Venus 3 = Moon 4 = Mars 5 = Jupiter 6 = Saturn 7 = Uranus 8 = Neptune 9 = Pluto A = Asteroids C = Comets D = CCD Imaging E = Eclipses & Transits H = History I = Instruments M = Meteors & Meteorites P = Photography R = Radio Astronomy S = Computing & Astronomical Software T = Tutoring & Training Program (including Youth)

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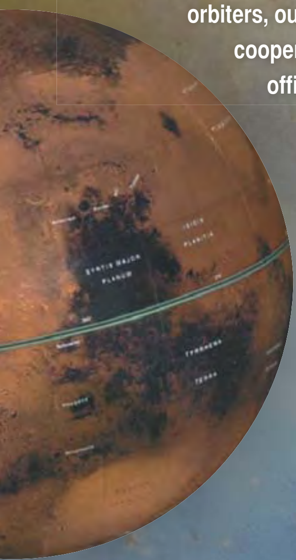

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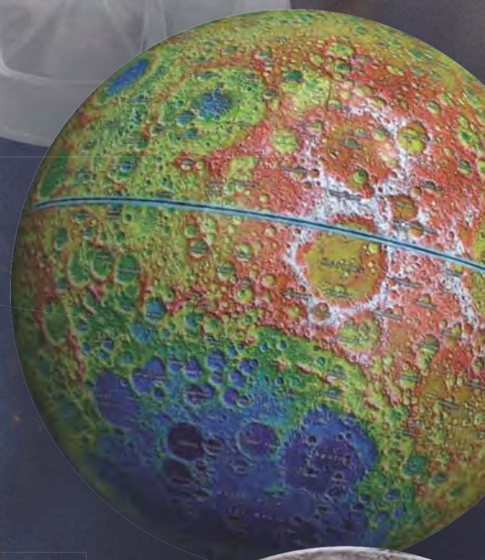

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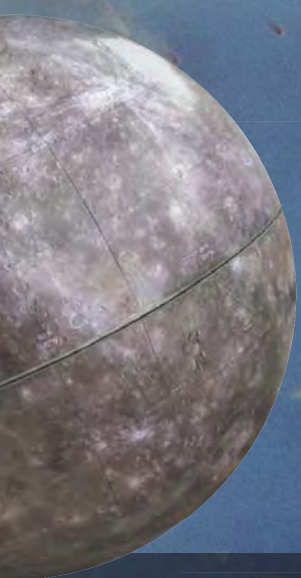

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