ISSN-0039-2502

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 61, Number 4, Autumn 2019

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Beautiful bursts
(See page 3 for details)

Journal of the Association of Lunar & Planetary Observers
The Strolling Astronomer

Volume 61, No.4, Autumn 2019
This issue published in September 2019 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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Inside the ALPO

Papers & Presentations

ALPO Resources

Our Advertisers

Inside the ALPO
Member, section and activity news

Point of View

Why We Observe

By Akkana Peck, astronomy web site designer, author, etc.

(Editor's note: Akkana is a prolific author of books and software on various topics. All are urged to visit https://shallowsky.com/moon/ for a taste of the good stuff she has done. Her commentary is a tongue-in-cheek commentary instigated by nonobservers and not to be taken literally.)

What good is an observatory?

What good is reality, when you can display a picture of anything at all on your computer screen, in 24-bit color?

What good is the outdoors, with the wind on your face and the chill biting your fingers, when you could be indoors, sitting in a cushioned chair in a climate-controlled fluorescent-lit room?

Why spend effort trying to locate an observatory in a dark site, or waste money maintaining a large telescope instead of a small one? After all, M42, M31, M13, and the double handful of other bright objects, are pretty -- everybody says so -- and once you've seen one fuzzy patch, you don't really need to spend time trying to notice differences between various different fuzzy patches, do you? Sure, some of the fainter fuzzy patches are farther away, but why should that be exciting to someone looking at it? If you just want to look at things that are far away, you can always download images from the Hubble web site.

Why waste your time learning to use a telescope, learning to find your way around the skies, making friends with the constellations, learning patterns in the sky which you'll greet with warm recognition every clear night for the rest of your life? Wouldn't it be easier to punch in a couple of coordinates and wait for the telescope to slew automatically without your having to work or think or learn?

Why waste time learning observing skills, getting good at seeing details in almost invisibly faint objects, when a camera, or, better yet, a computer controlled CCD array, can capture light much better? Isn't the human eye obsolete as a research tool, anyway?

What good is it to anyone that there are people intimately familiar with the constellations, who spend their nights scanning the skies looking for comets and other new objects? Surely any new comet would eventually show up on some computer-monitored CCD survey, so why should we get excited about the guys shivering out there with their binoculars, or glorify them by naming objects after them? Isn't a name like "C/1996 B2" just as good as "Comet Hyakutake"?

What use is the look on someone's face when they see Saturn through a telescope for the first time, or the shout of a child saying "Hey, Mom, Dad, come look at this!"? They've all seen photos of Saturn before, bigger and better than they see it through a small telescope -- why waste their time showing them a live image, and why do they always seem to get so excited about it?

Inside the ALPO
Member, section and activity news

News of General Interest

Our Cover: Those Beautiful Perseids

This issue of your Journal features a beautiful composite image created by Heather Wendelboe of Cheyenne, Wyoming, and which clearly shows the Perseid radiant.

Her comments: "Composite of multiple images. In the original image, the constellation of Persus is visible. I did correctly align all the meteors I captured to the radiant. The camera was facing north. The two stars parallel to the roof are the outside of the dipper part of the Little Dipper, so you can trace up to see where the North Star is — hanging out right above my Trans Am shaker scoop.

"The location was Centennial, Wyoming. The date was August 10-11, 2019. I shot the cars at the Nici Self Historical Museum. However, I shot the meteor shower about two blocks from there. The NICI museum staff was nice enough to let us on the property after hours to do the car shoot, but we couldn't stay there all night, so I had to change locations for the meteor shower shoot. I used the *PhotoPills* app for Android to make sure I had the camera oriented in exactly the same direction with exactly the same field of view of the sky so that the appearance of the sky would be the same as if I had shot it at the same location as the cars.

"I used a Nikon D750 camera with an Irix Blackstone 15mm f/2.4 lens. Exposures for the sky were f/2.8 and 15 seconds, ISO 3200 before moonset and ISO 6400 after moonset. I used a *Vello ShutterBoss* intervalometer to shoot continuously from about 8 p.m. to 4 a.m. local time; the frame I selected for the sky was from 1:13 a.m. It was very cloudy most of the night, so less than 20

Wanted: Jupiter Observing Section Coordinator

An exciting new opportunity is now available for Jupiter observers in the ALPO! The ALPO is now seeking a new coordinator for the Jupiter Observing Section. Qualifications for this voluntary staff position are that you:

- Are an ALPO member, either dues-paying or with a lifetime membership as a recipient of the Peggy Haas Service Award.
- Have a good working knowledge of this gas giant planet as an observer.
- Are reasonably well-read about Jupiter and the significance of observed features as they relate to the physical nature of the planet.
- Have the time, energy and desire to make this commitment.

Current Acting Jupiter Coordinator Richard Schmude will continue on as an assistant coordinator and will continue to write the apparition reports that appear in the Journal. The new section coordinator will provide support to keep the basic functions of the section operating smoothly. These include:

- Archiving new observations.
- Answering correspondence from observers.
- Preparing relatively brief quarterly reports for the Journal about the Jupiter section and any recent observational phenomena seen on Jupiter.

While this is volunteer position with no pay, the rewards are intangible and most desirable. You would be in charge of the ALPO's largest network of observers in one of the most active observing sections in the ALPO. You would be in direct contact with many fellow observers and learn about changes with Jupiter first-hand that you can communicate to your broader audience of fellow ALPO members with each issue of the ALPO Journal!

So, please consider this opportunity and if interested, contact Richard Schmude at *schmude@gordonstate.edu*. Richard will guide you on your responsibilities for this position of coordinator and can answer any questions that you may have.

Serving the ALPO in a voluntary capacity such as this may seem like a lot of work, but it can also be the highlight of one's lifelong pursuit in amateur astronomy. In doing good work for the ALPO Jupiter Observing Section, you would be making a positive difference for the ALPO and the rest of the astronomical community! Please consider this opportunity. Thank you!

Inside the ALPO
Member, section and activity news

meteors were captured, even with that wide field of view.

"I processed the raw images in Adobe Lightroom, and assembled the composite image in Adobe Photoshop. The image is titled "The Grand Illusion," part of my ongoing "Wild West Automotive Astroscapes" series."

The photo credit should go to "BOLO Photo (Heather M. Wendelboe)".

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 & 'Observers Notebook' Podcasts

Tim Robertson, program coordinator
cometman@cometman.net

ALPO Lunar & Planetary Training Program

The ALPO Training Program currently has 3 active students at various stages of the program.

The ALPO training program is a two-step program, and there is no time requirement for completing the steps. But I have seen that those students who are motivated usually complete the program in a short amount of time. That motivation comes from the desire to improve their observing skills and contribute to the pages of the Journal of the ALPO.

The ALPO Lunar & Planetary Training Program is open to all members of the ALPO, 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.

The course of instruction for our program is two-tiered.

- The first tier is the "Basic Level" and includes reading the ALPO's *Novice Observers Handbook* and mastering the fundamentals of observing. These fundamentals include performing simple calculations and understanding observing techniques.
- When the student has successfully demonstrated these skills, he or she can then advance to the "Novice Level" for further training where one can specialize in one or more areas of study. This includes obtaining and reading handbooks for specific lunar and planetary subjects. The novice then continues to learn and refine upon observing techniques specific to his or her area of study and is assigned to a tutor to monitor the novice's progress in the Novice Level of the program.

When the novice has mastered this final phase of the program, that person can then be certified to "Observer Status" for that particular field.

'Observers Notebook' Podcasts

The Observers Notebook podcast is going strong. I have recorded over 80 podcasts with various members of the ALPO, mostly section coordinators to highlight the programs within each section. The length of the podcast averages around 30 minutes in length.

Inside the ALPO
Member, section and activity news

The longest podcast thus far is over 1 hour and 30 minutes. But we can record longer, there is no time limit- the hosting service that I am using has unlimited space available for podcasts.

The most recent podcasts now online and available include interviews with Ms. Pranvera Hyseni in Kosovo, Serbia, Grant Tandy of the "Hopservatory" in Bend Oregon, Dr Erin MacDonald as we discuss Science in Pop Culture, and John Barentine of the International Dark Sky Association.

Podcasts are released on the 1st and 15th of every month, and if you subscribe to it via iTunes it will automatically be downloaded to your device.

The podcast will also be used to 'get the word out' on any breaking astronomy news or events happening in the night sky. So let me know if you have any breaking news that you want out there.

I am also looking for member profile pieces where we get to know the members of the ALPO. Please contact me if any of you would be interested in discussing those subjects.

If you have a subject matter that you would like to hear on the podcast, please drop me a note. I would like to have a discussion on the use of color filters for planetary observing, and how you plan an evening observing session, if any of you would be interested in discussing those subjects, please let me know.

It takes a great amount of time and money to make and produce the podcast. Thus far it has been done with the help of service called Patreon, and we currently have five supporters – two of whom are NOT even members of the ALPO!

You can support the podcast by giving as little as $1 a month; for a $5 monthly donation, you receive early access to the podcast before it goes public; for a monthly donation $10, you receive a copy of the *Novice Observers Handbook*, and for $35 a month, you receive producer credits on the podcast and a one-year membership in the ALPO. You can help us out by going to the link below:

https://www.patreon.com/ObserversNotebook

Inside the ALPO
Member, section and activity news

Here are a few interesting statistics you might be interested in as well:

- Number of downloads as of August 1, 2019: over 24,000
- Number of Subscribers (all formats): over 220+
- Average of number daily downloads (last 3 months): 70
- iTunes rating: 5 Stars!
- Locations of most downloads: USA, UK, Canada, Australia, Germany, and France.
- The top three most downloaded podcasts so far are all about Comets with Carl Hergenrother!

You can hear the podcast on iTunes, Stitcher, iHeart Radio, Amazon Echo, and Google Play just search for *Observers Notebook*. You can also listen to it at the link below:

https://soundcloud.com/observersnotebook

The *Observers Notebook* is also on Facebook – just search for "Observers Notebook" in the search field on top.

Thanks for listening!

For more information about the ALPO Lunar & Planetary Training Program or the *Observers Notebook*" podcasts, contact Tim Robertson at:
• (e-mail) cometman@cometman.net
•(regular mail) Tim Robertson
195 Tierra Rejada Rd #148
Simi Valley CA, 93065

Call for JALPO Papers

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

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 contact information can be found in the *ALPO Resources* section of this Journal.

ALPO Observing Section Reports

Eclipse Section

Mike Reynolds, section coordinator
dr.mike@ootwastro.com

January 2019 Total Lunar Eclipse

We are still accepting reports on the 20-21 January 2019 total lunar eclipse.

Please continue to send your reports via either email or regular mail to the contact information in the *ALPO Resources* section of this Journal.

Visit the ALPO Eclipse Section online at www.alpo-astronomy.org/eclipseblog

Mercury / Venus Transit Section

Mike Reynolds, section coordinator
m.d.reynolds@fscj.edu

Transit of Mercury 11 November 2019

This November we will have the opportunity to observe a transit of Mercury. This is fairly-well placed for most North and South American Observers. The path of Mercury across the face of the sun is nearly dead-center.

See the full page chart by Fred Espanek on the next page for transit details. Afterwards send your reports to both Mike D. Reynolds, 12740 Shellcracker Road, Jacksonville, FL 32226 USA; dr.mike@ootwastro.com

Keith Spring, 2173 John Hart Circle, Orange Park, FL 32073; star.man13@hotmail.com

Transit of Mercury 13 November 2032

The next transit of Mercury will occur 13 years after this November's event. So if you are calendaring future transits, please include the next transit of Venus on 10-11 December 2117.

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

Meteors Section

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

The 2019 Perseid meteor shower was badly compromised by a nearly Full Moon. Maximum activity was predicted for August 13 and it appears this prediction was right on the mark. The ascending portion of the Perseid shower was well-observed as during that time, the waxing Moon set during the evening hours. This allowed dark sky views of the morning activity when the Perseid radiant was located highest in a dark sky.

After August 10 though, the only available dark sky was between moonset and the start of dawn. This window of opportunity shrank until it disappeared completely by August 14. On the morning of maximum activity, this window was approximately 45 minutes long. I was able to count 37 Perseids in that span. Combining my observations with others yielded a zenith hourly rate (ZHR) of 75 at that time, which was the highest recorded this year. The ZHR figure normalizes all parameters as if all observers viewed under the same

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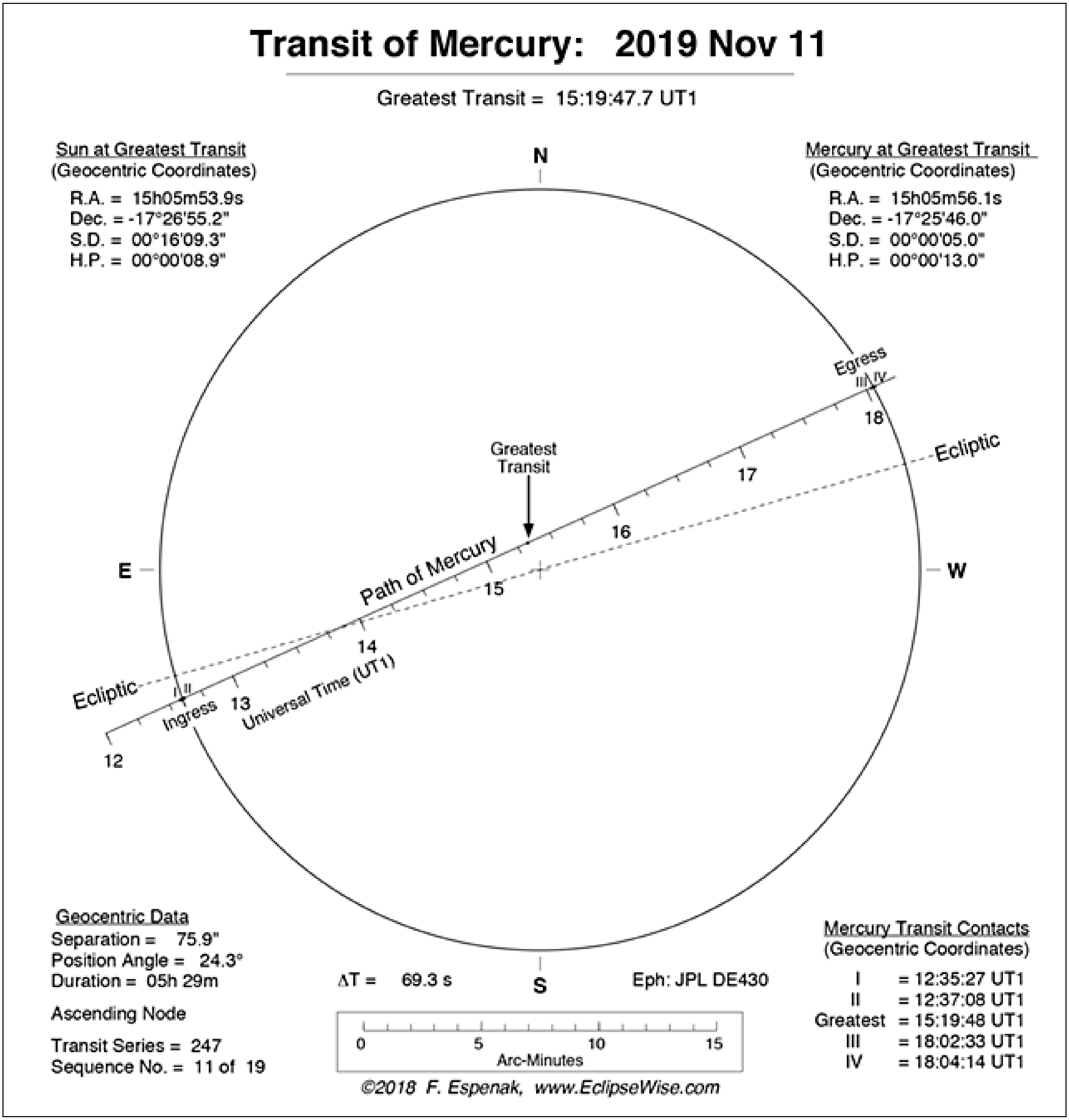
Inside the ALPO
Member, section and activity news



conditions. It allows a direct comparison

Inside the ALPO
Member, section and activity news

of the Perseid rates at that time. ZHR's are nearly always far above what one actually sees because it corrects all sky conditions to perfect (limiting magnitude of +6.50) and places the radiant at the zenith.

These results for 2019 are similar to those recorded for 2017 and 2018 so it appears that the Perseids produced a normal display for this shower.

Earlier in the year, the eta Aquariids were the only major springtime shower in 2019 which was not affected Moonlight. I made a major effort to enlist the observations of the most experienced observers in the southern hemisphere to give us a good look at the 2019 return.

The reason for this is that observers located south of the equator have a longer night this time of year and can observe this radiant at a higher elevation before dawn interferes. This should give us a better idea of the true activity with fewer corrections compared to data from the northern hemisphere.

Visual hourly rates remained less than 10 until May 2nd, when rates ramped up nicely and reached a peak on the nights of May 5 and 6 with visual hourly rates reaching 38 and 39 per hour as seen under the dark skies of Queensland, Australia.

Calculations of the zenith hourly rates for these two nights show a distinct peak on May 5th, reaching as high as 76 per hour. Visual rates remained above 10 through May 10th. The last ETA meteor was reported on May 15th. The shower was predicted to last until May 24th but lunar conditions made it difficult to continue past May 15th.

I want to thank our fellow observers located south of the equator for their help in this endeavor and I look forward to working with them again in the not too distant future.

A reminder here that your section coordinator has taken advantage of podcasts to verbally spread the news of upcoming major meteoric events. Tim Robertson does a great job asking interesting questions while I try my best not to bore the listener! Give these podcasts a try at:

https://soundcloud.com/observersnotebook

Be sure to also check out the other interesting podcasts offered by the many sections of ALPO!

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

Section News

This report includes meteorite highlights and new meteorite approvals from April 16, 2019 to August 15, 2019 from the Meteoritical Society's Nomenclature Committee.

The ALPO Meteorites Section received several inquiries about suspected meteorites, most of which are terrestrial and do not require further analysis. As always, ALPO members who collect meteorites are encouraged to report unusual features in their meteorite samples that might be of interest to researchers for specialized analysis.

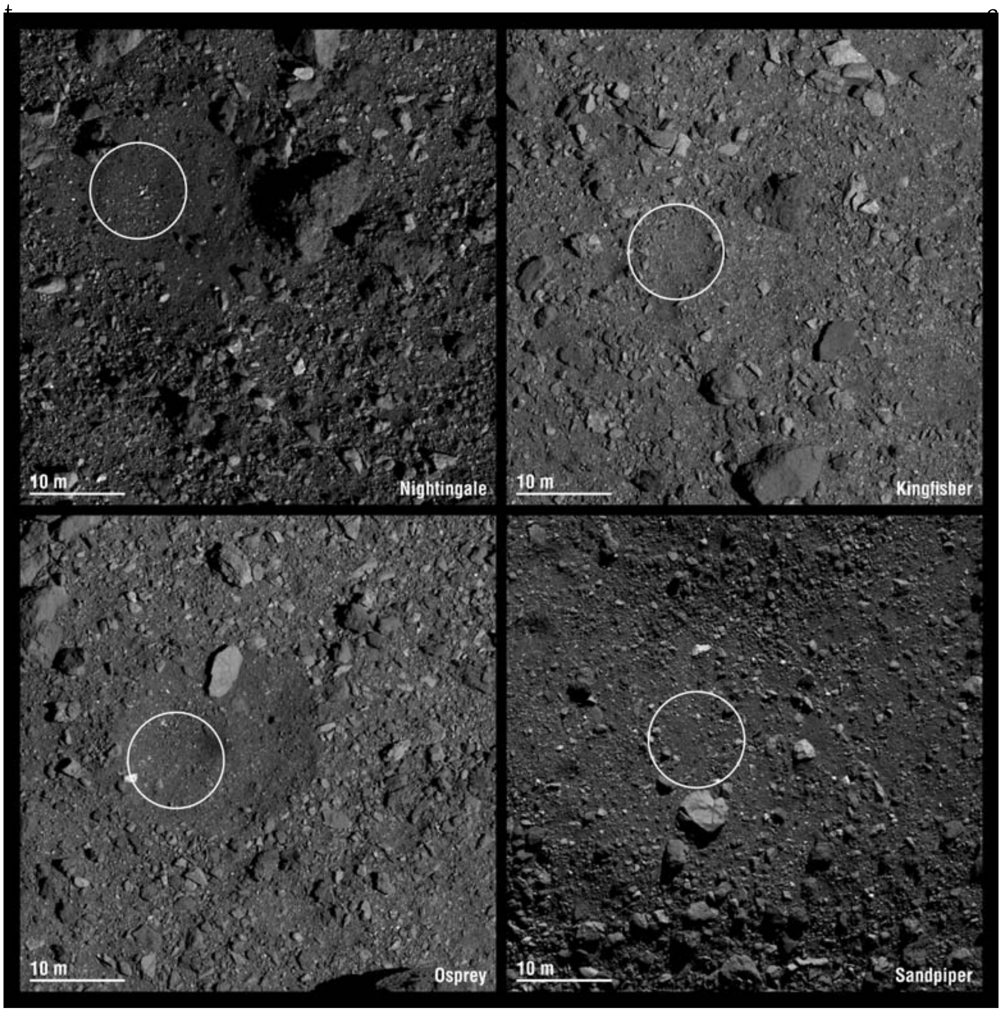
Meteorite News

Noteworthy meteorites approved or updated during this period include three witnessed falls that span the globe: Mauerkirchen L6 (Austria), Aguas Zarcas CM2 (Costa Rica), Ksar El Goraane H5 (Morocco), and one probable fall, Mhabes el Hamra H4/5 (Mauritania).

The most important meteorite recovered was the Aguas Zarcas CM2 chondrite that fell in Costa Rica on April 23, 2019. Many stones were recovered before heavy rains occurred, preserving important material for research, especially organic compounds. This is

The Aguas Zarcas CM2 chondrite meteorite. See text for details.

Inside the ALPO
Member, section and activity news



The final four candidate sample collection sites on asteroid Bennu are designated Nightingale, Kingfisher, Osprey and Sandpiper. Each circle has a 16.4 ft (5 m) radius. Credit: NASA/Goddard/University of Arizona.

he closest meteorite analog to asteroid Bennu, target of the OSIRIS-REx asteroid sample return mission.

The *Meteoritical Bulletin Database* (*https://www.lpi.usra.edu/meteor/*) records officially recognized, classified meteorites of the world's inventory. As of April 15, 2019, it contains a total of 61,744 meteorites. There were 1,009 new meteorites approved, reclassified or discredited, most from desert regions. Newly approved meteorites include 829 ordinary chondrites (303 H, 435 L, 90 LL, one chondrite-ung), 74 arbonaceous chondrites (3 C-ung, 4 CK, 38 CM, 8 CO, 3 CR, 18 CV), five R chondrites, four EH, six irons, one acapulcoite, one acap/lodranite, one lodranite, five mesosiderites, 11 ureilites, 26 HEDs, 16 lunar, five Martian, and 18 discredited (primarily duplicates or renumbered designations).

For more information and official details on particular meteorites, go to *https://www.lpi.usra.edu/meteor/metbull.php*

Three Antarctic meteorites share the smallest recovery mass of only 0.1g each: MacKay Glacier 14019, Grove Mountains 090338, Grove Mountains 090429. The largest meteorite reported was the 405 kg Tassédet 004 H melt breccia chondrite from Niger.

Visit the ALPO Meteorites Section online at *www.alpo-astronomy.org/meteorite/* for a very detailed explanation of all facets of meteorite studies.

Comets Section

Report by Carl Hergenrother, section coordinator
carl.hergenrother @ alpo-astronomy.org

Most of 2019 has been lacking with respect to easy-to-observe visual comets. The last three months of the year will be a welcome change as two long-period comets are expected to be brighter than 9th magnitude.

The first visual comet, C/2018 W2 (Africano), reached perihelion on September 5 at 1.45 au and passed within 0.49 au of Earth on September 27. As October begins, Comet Africano should still be near its maximum brightness between magnitude 7.5 and 8.0. October sees the comet starting a rapid fade to 10th magnitude by late October, 12th magnitude by late November, and 14th magnitude by late December. Since it is a dynamically old long-period comet, its post-perihelion fading may not be as precipitous as predicted here.

Northern hemisphere observers will find C/Africano well-placed in the evening sky at the start of October. Its southern motion makes it a difficult object for northern observers by November. It is well-placed for southern hemisphere observers the entire quarter as it traverses Pisces (Oct 1-3), Aquarius (Oct 3-14), Pisces Australis (Oct 14-27), and Grus (Oct 27-Mar 7).

Inside the ALPO
Member, section and activity news

The second visual comet is C/2017 T2 (PANSTARRS). This dynamically new long-period comet has been brightening slowly since its discovery back in early October of 2017. Perihelion doesn't occur until 2020 May 4 at 1.62 au. Closest approach to Earth (at 1.66 au) occurs only a few weeks after perihelion. This comet is intrinsically bright. As a point of comparison, it is intrinsically ~2 magnitudes brighter than C/2018 W2. The greater geocentric range results in a peak brightness of 8th magnitude for C/2017 T2 which is similar to C/2018 W2. But its greater intrinsic brightness results in the comet being brighter than 10th magnitude for ~9 months (from 2019 December to 2020 August).

C/PANSTARRS starts October at ~12th magnitude and brightens to magnitude 9.4 by New Year's Eve. It will be located at northern declinations, thereby making it well-placed for northern hemisphere observers as it moves through Taurus (Oct 1-6), Auriga (Oct 6-Dec 3), Perseus (Dec 3-20), and Camelopardalis (Dec 20-30).

Ephemerides for Comet C/2017 T2 (PANSTARRS) and Comet C/2018 W2 (Africano)

Date	R.A.	Decl.	r (au)	d (au)	Elong (deg)	m1	Const	Max El 40N	Max El 40S
C/2017 T2 (PANSTARRS)									
2019 Oct 01	05 36.9	+27 31	3.15	2.78	102	11.9	Tau	76	21
2019 Oct 11	05 39.4	+29 38	3.06	2.55	111	11.6	Aur	80	20
2019 Oct 21	05 39.6	+32 08	2.96	2.32	121	11.3	Aur	82	18
2019 Oct 31	05 36.5	+35 03	2.87	2.12	130	11.0	Aur	85	15
2019 Nov 10	05 29.3	+38 23	2.77	1.93	140	10.6	Aur	88	12
2019 Nov 20	05 17.0	+42 05	2.68	1.78	149	10.3	Aur	88	8
2019 Nov 30	04 58.5	+45 56	2.59	1.66	154	10.0	Aur	84	4
2019 Dec 10	04 33.7	+49 35	2.49	1.58	152	9.8	Per	80	0
2019 Dec 20	04 03.7	+52 39	2.40	1.53	144	9.5	Per	77	0
2019 Dec 30	03 31.7	+54 52	2.31	1.52	133	9.4	Cam	75	0
C/2018 W2 (Africano)									
2019 Oct 01	23 28.9	+03 23	1.50	0.51	165	7.8	Psc	51	49
2019 Oct 11	22 32.8	-20 13	1.54	0.67	134	8.6	Aqr	28	72
2019 Oct 21	22 00.3	-32 02	1.59	0.92	112	9.5	PsA	17	83
2019 Oct 31	21 43.3	-37 51	1.65	1.20	97	10.4	Gru	12	75
2019 Nov 10	21 35.8	-41 01	1.72	1.48	85	11.2	Gru	9	64
2019 Nov 20	21 34.4	-42 54	1.80	1.76	76	11.9	Gru	7	54
2019 Nov 30	21 37.0	-44 07	1.88	2.02	67	12.6	Gru	4	45
2019 Dec 10	21 42.6	-44 58	1.96	2.27	59	13.2	Gru	2	37
2019 Dec 20	21 50.2	-45 36	2.05	2.49	52	13.8	Gru	0	31
2019 Dec 30	21 59.4	-46 07	2.15	2.69	47	14.3	Gru	0	26

Image Caption: Sketch of comet C/2018 W2 (Africano) by Michel Deconinck with a Takahashi Mewlon 250.

As always, the Comet Section is happy to receive all comet observations, whether images, drawings, magnitude estimates, and even spectra. Please send your observations via email to *carl.hergenrother@alpo-astronomy.org*

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*

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

Solar Section

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

Solar activity fell to an extremely low level still heading for a minimum predicted for some time in 2022-23 according to the Space Weather Prediction Center at NOAA.

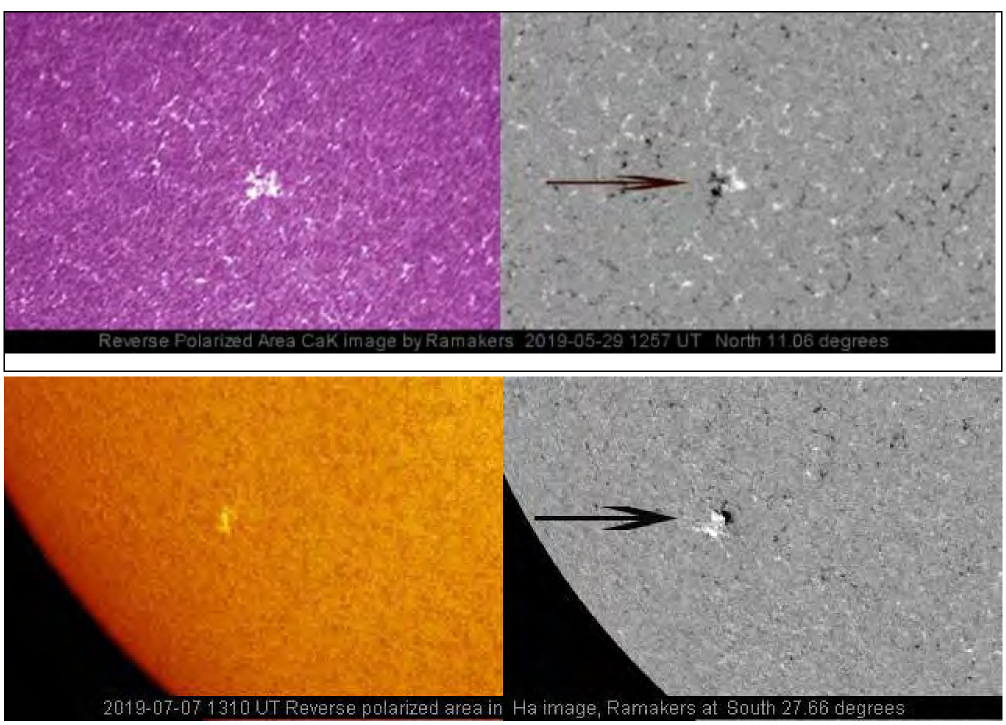
As of the writing of this report for 2019, 65% of the days have been spotless, slightly more than the 61% for all of last year. During Carrington Rotations (CR) 2217-18 we had a run of 36 days with no spots — the longest such since the last solar minimum. And according to Assistant Coordinator Theo Ramakers, we have just passed the 500th spotless day since the last solar maximum.

The ALPO Solar Section staffing and operations are very stable with a good core of active observers. From CR 2216-18, we received 906 images and observing reports into the archive from about half our observers.

Inside the ALPO
Member, section and activity news

Theo Ramakers, continues to successfully monitor the sun for reverse polarized areas heralding Cycle 25 comparing the NASA-SDO magnetograms with H-a and CaK images of the same regions from our observers in the archive.

Sketch of comet C/2018 W2 (Africano) by Michel Deconinck with a Takahashi Mewlon 250.



Two solar images by Theo Ramakers. See images for details.

He has put together a PDF gallery of these regions at:

http://www.alpo-astronomy.org/solarblog/wp-content/uploads/2019/04/2019-04-xx-RevPolarized.pdf

One that was particularly impressive was from May 29 with another on July 7.

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

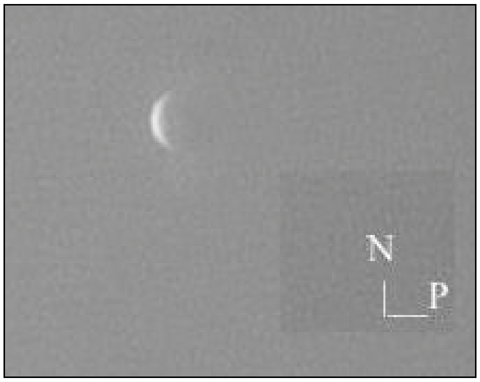
Report by Frank J. Melillo, section coordinator
frankj12@aol.com

While summer winds down as you read this, Mercury ended the favorable morning apparition in August. I had plans to observe and image in full daylight, but Howard Eskilden of Ocala, Florida, had a great start; he imaged Mercury on the morning of August 5 and when the planet displayed a crescent phase at 25% illumination with a disk diameter of 8.6 arc-seconds. See his photo as part of this report.

This is quite an accomplishment for him. Even though it is difficult to make out any details, Mercury shows phases like the Moon and Venus. If you observe Mercury daily, the phase changes quickly from day to day.

Currently (early August), the evening apparition is poor as seen from the northern hemisphere. But if you really want to catch Mercury, I suggest waiting to observe it on October 29 and 30. On those two evenings after sunset, Venus will slide 2½ degrees north of Mercury.

Inside the ALPO
Member, section and activity news



Mercury as imaged by Howard Eskildsen of Ocala, Florida, on August 5, 2019 at 11:20 UT. Equipment: 6-inch, f/8 refractor with Explore Scientific objective lens, 2x barlow, W-25 red filter and a DMK 41AU02.AS CCD. Planet was 8.6 arc-seconds, 119.9° phase. Seeing 5/10, Transparency 2-3/6, variable clouds. North is at top and “P” indicates proceeding to the west.

You can use Venus as guide to find Mercury in the deep twilight. Plus, the nearby thin crescent Moon will join the group and be especially visible on October 30. Using a pair of binoculars will help with viewing. But better days are coming!

Mercury will disappear in the evening and will go through Inferior Conjunction with the Sun on November 11. And that will be special! Mercury will slide exactly between the Earth and the Sun and we will see the transit! It will be visible from roughly the same part of the globe as the May 9, 2016 event. Therefore, you can see the same kind of transit twice within 3½ years! Information about the transit is published elsewhere in this Journal. Just keep in mind that this will be the last one until 2049 in case you want to see the transit again from the same area!

After the transit, the show is not over — Mercury will display the best morning apparition of the year. By November 24, it will be visible at magnitude -0.2 with a nearby crescent Moon 8 degrees to the upper right. There will be a nice view with the naked eye about 45 minutes before sunrise.

Mercury will reach its Greatest Elongation at 20.1 degrees of the Sun on November 29, and it will shine even brighter at -0.5 magnitude. Mercury will continue to be visible well into mid-December as it slowly descends towards the Sun and reach Superior Conjunction on January 10, 2020.

Please be sure to send your observations to the Mercury section so we can have nice coverage of these apparitions and especially the November 11 transit.

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

Venus Section

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

Venus reached Superior Conjunction with the Sun back on August 14, 2019, ending the 2018-19 Western (Morning) Apparition. Venus will become visible in the western sky just before sunset during the months leading into the fall season of 2019, becoming more favorably placed for viewing as winter approaches, reaching Greatest Elongation East of 46.1° on March 24, 2020.

Venus will be passing through its waning phases (a progression from a nearly fully illuminated disk to various crescent phases). Thus, observers will be witnessing the leading hemisphere of the planet as it increases its apparent diameter at the time of sunset on Earth.

Venus is predicted to reach theoretical dichotomy (half phase) on March 27 and then subsequently attain its greatest illuminated extent by April 28, 2020 at visual magnitude -4.6.

Venus will reach Inferior Conjunction with the Sun on June 3, 2020, thereby ending the Eastern (Evening) Apparition.

The accompanying table of Geocentric Phenomena in Universal Time (UT) are presented for the convenience of

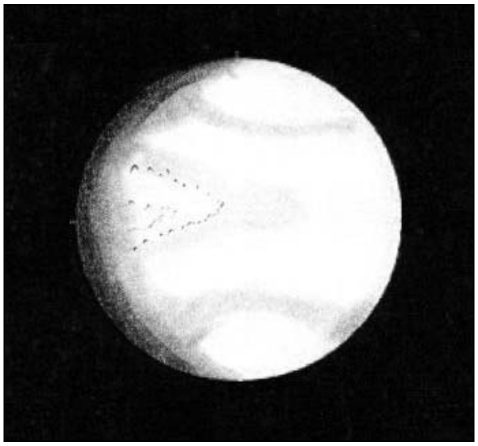
Mercury Needs You!!

More correctly, the ALPO Mercury Observing Section needs you.

Your reports — no matter how sparse they may be — are indeed valuable for scientific research.

Our professional-amateur collaboration activities are getting stronger and we need you to keep the movement going!

Inside the ALPO
Member, section and activity news



A full-disk drawing of Venus by Detlev Niechoy of Göttingen, Germany. Observation was done using a blue filter at 11:57 UT on May 12, 2019, on his 20.8 cm (8.0-in.) SCT under fair seeing conditions. The drawing depicts a shaded and slightly irregular terminator with faint banded and amorphous dusky markings, including an irregular bright area (outlined by dotted lines) on the disk as well as both cusp caps and cusp bands. The apparent diameter of Venus is 11.2", phase k=0.904 (90.4% illuminated), and visual magnitude -3.7. South is at the top of drawing.

observers for the 2019-20 Eastern (Evening) Apparition.

As of the date of this report (mid-July), observers have been carefully planning their observational programs for 2019-20 to determine when observational circumstances will permit the execution of visual drawings in integrated light and with color filters, as well as digital imaging at UV and near IR wavelengths.

Readers of this Journal should be familiar with our on-going collaboration with professional astronomers as exemplified by our sharing of visual observations and digital images at various wavelengths during ESA's previous *Venus Express* (VEX) mission that ran for about nine years from 2006 until the mission ended in 2015. It remains as one of the most successful Pro-Am efforts to date involving ALPO Venus observers around the globe. Such observations will remain important for further study and will continue to be analyzed for several years to come as a result of this endeavor.

For reference, the VEX website is *http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856.*

A follow-on collaborative Pro-Am effort continues in 2019 in support of Japan's (JAXA) *Akatsuki* mission that began full-scale observations starting back in April of 2016. The website for the *Akatsuki* mission has is currently active so interested and adequately equipped ALPO observers can still register and start submitting images if they have not already done so. More information will continue to be provided on the progress of the mission in forthcoming reports in this Journal.

It is extremely important that all observers participating in the programs of the ALPO Venus Section always first contribute their observations to the ALPO Venus Section at the same time submittals are sent to the Akatsuki mission.

This will enable full coordination and teamwork between the ALPO Venus Section and the Akatsuki team in collection and analysis of all observations whether they are submitted to the Akatsuki team or not. If there are any questions, please do not hesitate to contact the ALPO Venus Section for guidance and assistance.

Those still wishing to register to participate in the coordinated observing effort between the ALPO and Japan's (JAXA) *Akatsuki* mission should utilize the following link:

https://akatsuki.matsue-ct.jp/

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 drawings of the planet at visual wavelengths. Regular imaging of Venus in both UV, near-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 (e.g., dusky 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 form will help observers know what should be reported in addition to supporting information such as telescope aperture and type, UT date and time,

Geocentric Phenomena of the 2019-20 Eastern (Evening) Apparition of Venus in Universal Time (UT)

Superior Conjunction	2019 Aug 14^{d} 00^{h} UT (angular diameter = 9.7″)
Greatest Elongation East	2020 Mar 24^{d} 00^{h} UT (46.1°)
Theoretical Dichotomy	2020 Mar 27.04^{d} UT (Venus is predicted to be exactly half phase)
Greatest Illuminated Extent	2020 Apr 28^{d} 00^{h} UT (-4.6m_{v})
Inferior Conjunction	2020 Jun 03^{d} 00^{h} UT(angular diameter = 58.3″)

Inside the ALPO
Member, section and activity news

magnifications and filters used, seeing and transparency conditions, etc. The ALPO Venus observing form is located online at:

http://alpo-astronomy.org/gallery3/var/albums/Publications-Section/Observing-Section-Publications/Venus/VenusReportForm.pdf?m=1521162039

Under favorable circumstances during future apparitions, 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 planet as a cooperative simultaneous observing endeavor with visual observers. Also, observers should undertake imaging of the planet at near-IR wavelengths (e.g., 1000nm) the time of inferior conjunction, 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.

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 David Teske, acting program coordinator
drteske@yahoo.com

As I write this report in late July, the 50th anniversary of the first Moon landing has taken place. I hope that you were able to watch some of the many television and movie specials commemorating this event. I know that back at this time, the Apollo landings inspired future stargazers including myself.

ALPO Lunar Section Staff Update

We are proud to announce that David Teske of Louisville, Mississippi, has been named acting coordinator of the ALPO Lunar Topographical Studies program of the Lunar Section following the retirement of Wayne Bailey. Wayne will remain involved as assistant coordinator.

Following is a self-profile submitted by David:

Greetings! I consider myself a life-long amateur astronomer. Back in the days of Apollo, I was just a youngster then, but I can remember the missions way back then. It was around this time on likely a cold winter night in Duluth, Minnesota, that I was shown a nice conjunction of Venus and the crescent Moon. Maybe that was the astronauts in their spacecraft I probably thought. My first use of a telescope was from a neighboring friend of my father. That was back in the Comet Kohoutek days. Shortly thereafter, I had my very own telescopes. My first "real" telescope was a 4.25-inch f/10 reflector telescope from Edmund Scientific. I wonder how many other members of the ALPO cut their teeth on telescopes like these. With that telescope, I began observing all things in the sky. With a Tuthill Solar Screen, I used it to begin daily drawing and counting of sunspots that continues to this day some 8,700 observations later. Be careful what projects that you start!

In college I was fortunate enough to give public lectures at the planetarium and gave countless programs mostly to school children, especially through the heyday of Halley's Comet. Alas, much like Comet Kohoutek, it wasn't much of a show in northern latitudes. Through work at the planetarium and nature centers, I refined my major in college to be a science teacher. Through many twists and turns, I had a most interesting time in the education field. From sixth grade science to AP biology, physics and chemistry, I taught almost every science that they could toss at me and received local and national awards for those efforts.

All along the way, I kept up and grew an interest in astronomy. I have done much outreach, showing the public various sights through the telescopes at local nature centers, observatories, and schools. The celestial object that always grabs perhaps the most attention is our Moon. How many times have I heard the question, "Can you see the flag?" But it is that very Moon that keeps drawing me to it. There is such a wealth of details to see with any telescope. Over the years I have acquired many reference books about the Moon, have developed a routine of sketching and imaging the Moon, and sharing what I have researched in the ALPO Lunar Observer newsletter. As I take over as the acting coordinator of Lunar Topographic Studies program from the very capable hands of Wayne Bailey, I look forward to continuing the excellent work that is a tradition of our observers.

Inside the ALPO
Member, section and activity news

The ALPO Lunar Topographic Studies Section (ALPO LTSS) received a total of 120 observations from 18 observers during the April-June quarter.

Twenty five contributed articles were published in addition to numerous commentaries on images selected.

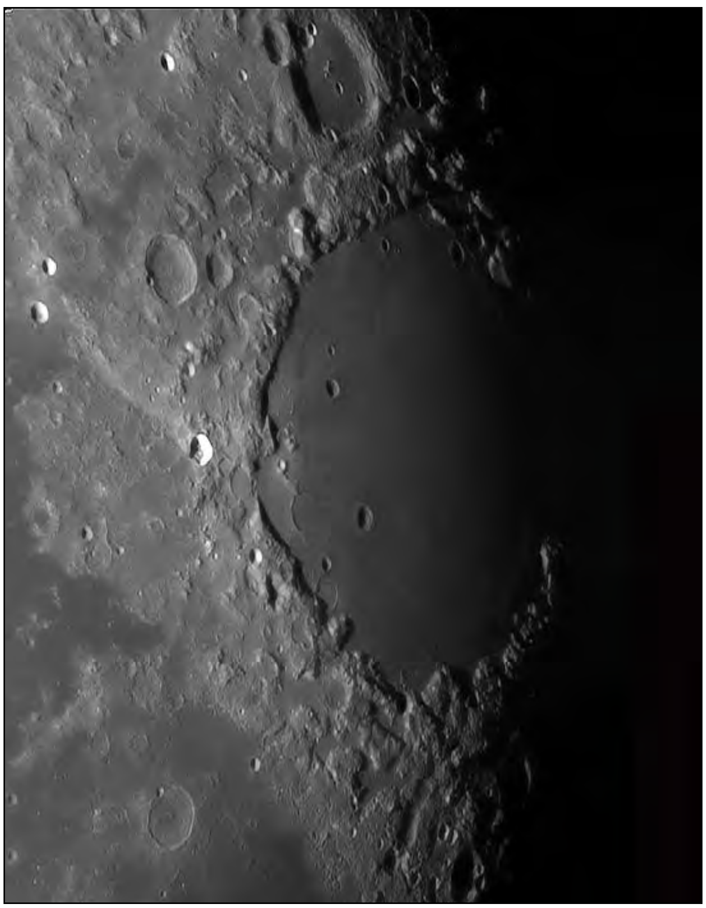
The *Focus-On* series continued under Jerry Hubbell, with an article on the Apollo 12 landing site regions.

The next *Focus-On* topics will include craters of the ALPO Selected Areas Program.

Electronic submissions can now be submitted through the ALPO website, (lunar@alpo-astronomy.org). The former method of submitting them directly to the coordinators will still work, but please don't submit through both the website and directly. See the most recent issue of *The Lunar Observer* (http://moon.scopesandscapes.com/tlo.pdf) for instructions on its use. Hard copy submissions should continue to be mailed to me at the address listed in the ALPO resources section of the Journal.

The lunar image gallery/archive is also now active. At the time of this writing, all images received after December 2017 are in the gallery. Images will continue to be inserted, working back through the years. Also, all issues of the *The Lunar Observer*, including those from its beginning in 1997 as an American Lunar Society publication to becoming the newsletter of this ALPO program in June 2004, are now available on the website.

Below is an example of the excellent work submitted by members of the ALPO Lunar Section. The image below is of Mare Crisium as imaged by Howard Erikson. He took this image with a 6-inch f/8 refractor telescope on 19 July 2019 with seeing 6/10. Many such images and commentary adorn *The Lunar Observer*. All who are interested in lunar phenomena are invited to submit images, drawings, and comments about our nearest neighbor in the cosmos.



Mare Crisium as imaged by Howard Eskildsen in Ocala, Florida, USA, on July 19, 2019 at 09:28 UT. Seeing 6/10, Transparency 3-4/6. Equipment: 6-inch, f/8 refractor with Explore Scientific objective lens, 2x barlow, W-8 yellow filter and a DMK 41AU02.AS CCD.

Visit the following online web site for more info, including current and archived issues of *The Lunar Observer*: moon.scopesandscapes.com.

Lunar Meteoritic Impacts

Brian Cudnik,
program coordinator
cudnik@sbcglobal.net

One report of an impact candidate was received in July from the ROCG ELT (Remote Observatory of Campos dos Goytazes, and the Exoss Lunar Team) group in Brazil (Carlos Henrrique Barreto and Tiago Augusto Torres Moreira). This is a report of an impact flash they observed on June 8. They had sent the analysis and the videos and still images which I have on file. The flash was recorded (image below) at 22:00:37 UT and appears to be a genuine event.

The ROCG group has offered to collaborate with us in the search for lunar meteors. I am currently exploring this option and the details therewith. At the same time, my institution (Prairie View A&M University) has submitted a proposal for the systematic monitoring of the Moon for lunar meteoroid impacts, making use of our recently completed observatory. The proposal was submitted in mid-June 2019 and we should find out about funding late this year.

Aside from this event, no other reports have been received as of this writing (in mid-August). We did have at least one individual, Lawrence Garrett of the International Occultation Timing Assn, try to observe the Moon for several nights recently for Perseid impacts. He is using an 8-inch Cassegrain and an Eagle Run Video camera. So far he has not spotted anything conclusive via video over two nights.

Inside the ALPO
Member, section and activity news

Please visit the ALPO Lunar Meteoritic Impact Search site online at http://alpo-astronomy.org/lunarupload/lunimpacts.htm

Lunar Transient Phenomena

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

No new LTP reports have been received since the last JALPO section report this past spring-summer. However, please note the following reports:

- On 2019 Apr 17, 03:49 UT, Maurice Collins (New Zealand) took an image of the Aristarchus area of the Moon which seemed to show a pseudo-peak inside the crater Herodotus with a hint of a shadow. However, it is felt that this is probably a speck of dirt on the camera.
- On 2019 May 15, 01:50-02:13 UT, Jay Albert (Florida, USA) was able to confirm a tiny spot of light on the shadowed floor of Gassendi, originally seen by Peter Grego on 2011 Oct 07, 22:30-22:40 UT, as normal appearance of the floor of the crater at this colongitude.
- AEA observers from Argentina, took some high resolution images of the 21 July partial lunar eclipse and were surprised to see some shadow on the edges of individual features close to the unbra – we suspect, however, that this may be an image processing issue with the stacking software as the umbra slowly moves across the lunar surface.
- K.C. Paul (Hong Kong) took a high-resolution image of Petavius on 2019 Jul 18, 17:15 UT, which seems to show a second rille north of the main one; this is being investigated as it's close to the limit of resolution and doesn't show up in the LRI laser altimeter data.

UAI observer Maurizio Cecchini (Italy) has published a paper in the July-Sept edition of *Astronomia*, the bi-monthly magazine of the Italian Amateur Astronomers Union (Unione Astrofili Italiani). The paper describes a dome found adjacent to a peak in the Montes Teneriffe. The UAI utilized the *Lunar Observing Schedule* website to help request additional observations.

The *Lunar Observing Schedule* can be found online at:

http://users.aber.ac.uk/atc/lunar_schedule.htm

Lunar observers are encouraged to image, or at least visually observe, the Moon at specific narrow selenographic colongitude and sub-solar latitude observing windows that match those of many past LTP observations. This has proved very successful in eliminating some past LTP reports as normal appearances of the lunar surface.

We welcome new participants in our program, whether they are experienced visual observers, or high-resolution lunar imagers. This helps us to solve some past historical lunar observational puzzles.

LTP observational alerts are given on this Twitter page: https://twitter.com/lunarnaut

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

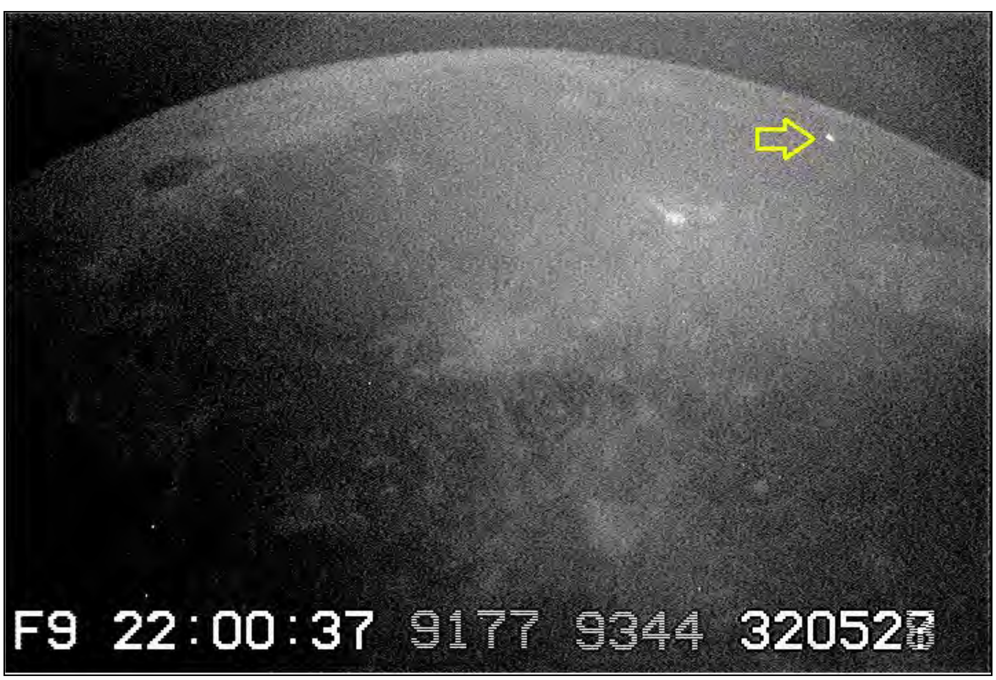


Image of June 8, 2019 lunar meteoritic impact as imaged by the ROCG ELT; see text on page 15 for details. Image contrast increased here for clarity.

Lunar Domes

Report by Raffaello Lena, program coordinator
raffaello.lena@alpo-astronomy.org

We have received a total of 150 new images, including some by Tom Astron, Francesco Badalotti, Kenneth Cantu, Ryan Cornell, Howard Eskildsen, Marcelo Mojica Gundlach, Guy Heinen, Richard Hill, Raffaello Lena, Rod Lyon, K.C. Pau, Jim Phillips, Frank Schenck, Schultz Tonkli and Kacper Wierzchos.

M. M. Gundlach imaged the Piccolomini dome. And K. Wierzchos on January 18,

Inside the ALPO
Member, section and activity news

2019, at 23:35 UT, noticed a dome-shaped structure near Grimaldi C when observing with a 4-inch, f/9 refractor at 225x. Wierzchos was able to image it with an iPhone on May 17, 2019, at 00:39 UT. The structure is virtually invisible in LROC WAC and NAC imagery. We encourage more high-resolution imagery of this area so we can have more data to identify the shape of this suspect feature. Please check your past imagery.

F. Badalotti has imaged the Gruithuisen domes. T. Astron has imaged the domes Cauchy omega and tau and some domes near Messier. S. Tonkli has submitted images of the domes field in Milichius-T. Mayer and the Encke dome. R. Lyon has imaged the Hortensius domes and the small bisected dome in Gassendi named Gassendi 1.

K.C. Pau has also imaged the small bisected dome termed Gassendi 1, the Hansteen 1 e 2 domes, Wollaston domes, Palmieri 1 dome, domes in Arago region and a possible magmatic intrusion near Ukert.

R. Lena has imaged several domes, including the dome near Kepler, domes in Reiner region and near Hortensius, Kies, Reinhold, Arago and Fracastorius. J. Phillips imaged the Marius hills and Mersenius P dome.

G. Heinen has submitted many images of the domes near Yerkes, in the Arago region, Valentine domes termed V1-3, Kepler dome, Manilius domes, Sinus Iridum domes near Promontorium Laplace, including also domes in T. Mayer-Hortensius-Milichius region, domes in the wide Cauchy region, domes in Kies pi termed K1-K3, domes in Capuanus. He has also noticed a bulge which could be a dome located at coordinates 7.51° S and 34.97° W near Wichmann A. More images will be useful for a full investigation of this feature.

G. Heinen has noticed and imaged three further volcanic constructs located in the Milichius region, now termed M24-M26. Based on the first data M24 is located at coordinates 32.55° W and 19.17° N, with a diameter of 19 km and an average slope angle of 0.6°. M25 is located at coordinates 30.73° W and 16.70° N, with a diameter of 2.5 km and an average slope angle of 8.6° which likely is another lunar cone. M26 is located at coordinates 28.07° W and 3.28° N, with a diameter of 14 km and an average slope angle of 1.0°. The identification of further suspected domes in the wide Milichius-T. Mayer region is ongoing and future updates will be done.

R. Lena, G. Heinen and K.C. Pau have recently imaged a small volcanic cone located to the SE of Arago crater which is now termed A11 with a diameter determined to 2.3 km. Its height amounts to 120 m and the average slope angle corresponds to 5.9°. A11 lies at coordinates 22.04° E and 5.41° N. It is reported as a dome in the USGS geologic map I-510 and has formed in basalts of relatively high TiO_2 abundance. Based on the measurements and the steep slope, it is likely that A11 is a lunar cone.

F. Schenck has imaged the Messier domes, under investigation, two domes near Laplace, Arago domes and two domes near Delisle. He has also submitted images of the craters Herodotus and Aristarchus. The very prominent dome Herodotus 1 is easily visible and the images display less prominent domes, near crater Wollaston.

R. Hill has imaged the domes in the Marius shield, the dome near Yangel termed Ya1, and the domes of Mersenius P and Palmieri 1.

H. Eskildsen has submitted many images including Valentine domes, Gardner megadome, Arago domes, the dome near Yerkes, Gruithuisen highland domes, domes in Milichius and the bisected domes in Birt. Further images made by Eskildsen display a lunar cone near Lassel D, the Hyginus domes, Menelaus domes, Archytas G dome, Herodotus 1 dome, Hansteen alpha which is another highland dome, Fracastorius dome, Piccolomini dome, Meton dome, Cauchy and Vitruvius domes, Mairan domes, Marius hills and Rümker volcanic complex.

R. Hill and H. Eskildsen have imaged a possible dome south of Mason located at coordinates of 41.0° N and 29.7° E. Based on preliminary analysis, this dome is 145±15 m high and the diameter amounts to 7.0±0.3 km, yielding an average slope angle of 2.3°±0.2°. Further investigation is ongoing.

Finally, the investigation of further domes in Marius hills is in progress. Last work has been published in JALPO 61-3 (Summer 2019).

The surname of one of the contributors to the Marius Shield (Part 2) report was misspelled in Table 1, on page 46, and in the Figure 10 caption on page 55. The correct spelling is G. Heinen (Luxembourg).

Interested observers can publish their future images using the email address *lunar-domes@alpo-astronomy.org*. Further images received are shared in our Facebook group Lunar Dome Atlas Project: *https://www.facebook.com/groups/814815478531774/*

Interested observers can participate to the lunar domes program by sending their observations to both Raffaello Lena (coordinator, atl *raffaello.lena@alpo-astronomy.org*) and Jim Phillips (assistant coordinator, at *thefamily90@gmail.com*).

Inside the ALPO
Member, section and activity news

Mars Section

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

> See also the following items related to this observing section later in this Journal:
>
> - A summary of 59 J-filter and 63 H-filter brightness measurements of Mars made between late 2015 and mid-2017.
> - A report on using IR blocking filters for Mars observations.

Mars went through conjunction with the Sun on September 2, 2019, ushering in a new apparition. This is a good, perihelic apparition, but we'll not be able to see much on the planet for the next few months. Expect a "pre-apparition report" to be published in this Journal soon. Now — before to the apparition — is a good time for observers to be thinking about equipment upgrades for the coming apparition. With a view to that, a short article about the filters to use on Mars is in this Journal.

Be sure to check the Mars image gallery on the ALPO website:

First, go to http://www.alpo-astronomy.org, then click on the "ALPO Section Galleries" link at the upper right corner of the screen. Next click on the "Mars images and observations" icon, then click on the Mars image folder for the desired year.

Please consider contributing your images, drawings and descriptions to this archive – not only for the coming apparition, but also for the just-finished 2018 apparition. To contribute, send your observations directly to mars@alpo-astronomy.org.

Also, don't forget to either join or sign in to the Yahoo Mars Observers discussion group at https://groups.yahoo.com/neo/groups/marsobservers/info. This group has more than 1,450 members. There, you can post your observations in the photos section and discuss anything you please about the Red Planet.

Minor Planets Section

Frederick Pilcher, section coordinator
pilcher35@gmail.com

> Republication of a paper that was originally published in *The Minor Planet Bulletin* on "Visual Observation of Minor Planets" appears later in this Journal.

Some of the highlights published in *The Minor Planet Bulletin*, Volume 46, No. 3, 2019 July-September, are presented. These represent the recent achievements of the ALPO Minor Planets Section.

Brian Skiff and several colleagues publish lightcurves of 72 asteroids from the Lowell Observatory Near-Earth Asteroid Photometric Survey. Many of these 72 asteroids are main belt, not near-Earth, asteroids.

The Minor Planet Bulletin announces a position opening for Associate Producer that will probably promote in two years into Producer. Required skills are Proficiency with Microsoft Ward 2013/2010, pdf computer documents, and email. Production status is tracked using excel. The applicant should also have sufficient expertise with asteroid astronomy to do some error checking, recommending editorial corrections, and strong skill with written English. Any ALPO member who would like to apply please send an application to Richard Binzel, publisher of the Minor Planet Bulletin, email address rpb@mit.edu.

Lorenzo Franco publishes a spin-shape model for 1117 Reginita. He finds a sidereal rotation period 2.946472 hours with the usual two ambiguous rotational pole positions at celestial longitude and latitude 0 degrees and +43 degrees; 174 degrees and +47 degrees, respectively.

A satellite of an asteroid may be detected photometrically if a brief dip is observed

Table of Minor Planets Detailed in This Report

Minor Planet	Type	Author(s)	Primary Rotation Period (h)	Orbital Revolution Period (h	Status
Asteroids with Occulting Satellites					
1453 Fennia	Hungaria	L. Franco et al.	4.4120	23.10	secure
1717 Arlon	Main Belt	L. Franco et al.	5.1448	18.24	secure
381677 2009 BJ81	Near-Earth	B. Warner, R. Stephens	325	27.08	tentative
2016 AZ8	Near-Earth	B. Warner, R. Stephens	16.807	13.548	tentative
Asteroids with Non-Occulting Satellites					
152931 2000 EA107	Near-Earth	R. Stephens, B. Warner	4.1387	16.079	tentative
454177 2013 GJ35	Near-Earth	B. Warner, R. Stephens	49.75	2.8169	tentative
Probably Solid Rock Asteroid (Very Fast Rotation Periods)					
2019 EA2	Near-Earth	A. Carbognani, L. Buzzi	0.02882		—

Inside the ALPO
Member, section and activity news

in the rotational lightcurve as the secondary either transits or is occulted by the primary. Their combined light is reduced during these satellite events. Dual period software can separate the two lightcurves with separate periods from the observed combined lightcurve. Asteroids with this reported behavior are listed in the first portion of table in this report.

If the satellite's orbital plane is not close to the line of sight, satellite events are not observed. It may be possible to detect the presence of the satellite if primary and secondary have different rotation periods and amplitudes, and their combined lightcurve can be separated with dual period software. Two asteroids reported to have different primary and secondary rotation periods, but no observed transit/ occultation events, are listed in the second portion of table in this report.

One very small Earth approacher, diameter in the range 10 to 40 meters, was found to have a very short rotation period, faster than the centrifugal limit and therefore indicative of being a solid rock (monolith) rather than the usual rubble pile. It is listed in the third portion of table in this report.

In addition to asteroids specifically identified in the table, lightcurves with derived rotation periods are published for 228 other asteroids as listed below:

31, 41, 58, 89, 131, 153, 224, 291, 359, 384, 422, 433, 449, 464, 488, 491, 711, 735, 841, 858, 917, 1019, 1032, 1036, 1038, 1095, 1184, 1187, 1229, 1266, 1269, 1361, 1394, 1435, 1491, 1504, 1547, 1577, 1585, 1600, 1603, 1608, 1609, 1614, 1620, 1627, 1667, 1720, 1789, 1802, 1804, 1856, 1883, 1884, 1938, 2048, 2053, 2120, 2162, 2199, 2206, 2207, 2246, 2253, 2267, 2305, 2363, 2373, 2384, 2399, 2408, 2496, 2536, 2642, 2670, 2678, 2727, 2893, 3040, 3072, 3099, 3157, 3248, 3255, 3317, 3329, 3330, 3361, 3394, 3398, 3569, 3677, 3767, 3769, 3788, 3877, 3901, 3923, 4148, 4181, 4221, 4286, 4317, 4404, 4435, 4536, 4626, 4692, 5144, 5189, 5321, 5332, 5547, 5703, 5889, 5976, 6053, 6178, 6246, 6258, 6638, 6801, 7230, 7336, 7358, 7145, 7430, 7497, 7520, 7761, 7834, 7954, 8073, 8567, 8647, 9068, 9671, 10046, 10358, 10565, 10715, 11200, 11650, 11852, 11855, 12593, 12700, 13063, 14874, 15438, 16198, 16529, 16724, 16880, 16908, 16960, 17109, 17989, 18348, 18736, 18895, 20446, 26355, 26377, 26582, 26858, 27331, 32910, 33143, 33818, 33903, 35380, 37652, 44266, 46629, 50149, 52402, 53430, 57735, 59490, 68347, 68348, 69971, 73308, 76978, 85818, 88254, 89959, 90403, 95260, 100088, 101496, 110767, 136849, 137032, 137052, 137170, 138852, 138937, 141052, 142348, 144901, 162361, 162820, 163051, 163899, 164400, 189700, 208565, 237442, 238063, 247405, 250139, 307321, 307505, 318411, 410088, 445068, 2005 FC3, 2006 SK134, 2008 US4, 2010 JV34, 2014 QR295, 2018 WR1, 2018 XV, 2019 AP3, 2019 CH.

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, 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 uninitiated 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/MPB/mpb.php

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 section staff members Richard Schmude, Craig MacDougal and John McAnally

See also the following items related to this observing section elsewhere in this Journal:

- The boxed notification for a new Jupiter Section coordinator on page 3.
- A summary of Galilean satellite eclipse timing observations covering 2012-2013. This Journal will publish the remaining Eclipse Timing Program reports completed by the late John Westfall.

First, a search is now in progress for a new coordinator for this section. While I held this job for many years, I stepped down several years ago to assistant coordinator, but continue to prepare the Jupiter apparition reports. In my place, former assistant coordinator Ed Grafton stepped up to full coordinator. But with Ed's desire to drop back due to health reasons a few years later, I've been full coordinator once more.

Therefore, we really need a new full coordinator to prepare these short, quarterly section reports and perform only a few other duties. I will continue to prepare the Jupiter apparition reports. An expanded job description is provided on page 3 of this Journal.

Second, due to lack of interest as well as no need for visual timings of Jupiter features that can be better recorded with various devices, the ALPO Jupiter

Inside the ALPO
Member, section and activity news

Central Meridian Transit Timings program is hereby retired; program coordinator John McAnally continues as Assistant Jupiter Coordinator with duties to be agreed upon and determined by Richard as Jupiter Section Coordinator

Third, Assistant Coordinator Craig MacDougal reports that there are currently 512 members in the ALPO Jupiter Yahoo e-mail group where they post images and discuss matters. During the last few months, several observers have reported "flakes" coming off the Great Red Spot and merging with the South Equatorial Belt.

This Section coordinator has just received copies of his updated Jupiter manual, "Observing Jupiter in the 21st Century" which will soon be available from the Astronomical League. Because there are several important updates in this revised version, all who observe or image Jupiter are strongly urged to obtain a copy.

Finally, this coordinator has not been able to collect near-infrared brightness measurements of Jupiter due to inclement weather at this location. He hopes to collect measurements as weather conditions improve.

Finally, after a fake e-mail with this coordinator's name as the sender was received by various ALPO members this past June, all contributors are advised to send all images ONLY to *Jupiter@alpo-astronomy.org* where they will be scanned for viruses before being forwarded on to me. Those received images will also be posted in the ALPO Jupiter Images and Observations gallery.

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

Excellent image of Saturn taken by Clyde Foster of Centurion, South Africa on July 9, 2019 at 22:47 UT. His RGB image was captured in good seeing using a 35.6cm (14.0 in.) SCT. His image shows the Seeliger Opposition Effect which is an apparent brightening of the rings for a short interval near opposition. This phenomenon is caused by the coherent back-scattering of sunlight by μ-sized icy particles in the rings when the phase angle between Sun-Saturn-Earth is <0.3°. The apparent diameter of Saturn's globe was 18.0" with a ring tilt of +24.3°. CMI = 36.0°, CMII = 34.8°, CMIII = 10.2°. NNNTeZ White Spots have merged together and are just barely noticeable and distributed across the globe within same saturnigraphic latitude of +65.0°. The apparent visual magnitude = +0.1. South is at the top of the image.

Saturn Section

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

See also the 2014-2015 Saturn apparition report later in this Journal.

Saturn's westward elongation increases steadily during the fall months with the planet remaining reasonably well-placed to view, draw and image for quite a few hours after sunset as the planet slowly

Table of Geocentric Phenomena for the 2019-20 Apparition of Saturn in Universal Time (UT)

Conjunction	2019 Jan 02^d UT
Opposition	2019 July 09^d
Conjunction	2020 Jan 13^d
Opposition Data for July 09, 2019	
Equatorial Diameter Globe	18.08″
Polar Diameter Globe	16.68″
Major Axis of Rings	41.05″
Minor Axis of Rings	18.24″
Visual Magnitude (m_v)	+0.2
B =	+26.18°
Declination	-22.80°
Constellation	Sagittarius

Inside the ALPO
Member, section and activity news

progresses toward conjunction with the Sun on January 13, 2020.

The accompanying Table of Geocentric Phenomena for the 2019-20 Apparition in Universal Time (UT) is included here for the convenience of observers.

The ALPO Saturn Section has received a multitude of excellent digital images of the planet at visual and infrared wavelengths, as well as disk drawings. Observers are continuing to report discrete atmospheric phenomena in Saturn's northern hemisphere, including interesting recurring small white spots in the EZn (northern half of the Equatorial Zone) interacting with the adjacent EB (equatorial band), plus a possible small white spot in the EZs (southern half of the Equatorial Zone, as well as a recurring group of white spots in the NNNTeZ (North North North Tmperate Zone) with what appeared to be closely associated white spots near the southern edge of the NPR (North Polar Region).

There are also several possible white spots that have been noted within the NEBZ (North Equatorial Belt Zone) that lies midway between the NEBn (North Equatorial Belt, northern component) and NEBs (North Equatorial Belt, southern component).

These observations seem to suggest that the aforementioned white spot activity at these saturnigraphic latitudes probably have persisted since the 2018-19 apparition that ended back on January 2, 2019. Somewhat elongated white streaks continue to be reported in the EB (Equatorial Belt). The aforementioned white spots have persisted and have shown up well in most images submitted using RGB, red, IR, and CH4 (methane) filters.

It will be extremely worthwhile to continue to monitor Saturn and capture images with the same multi-wavelength filters to determine if the longevity and changing morphology of these or similar features during the remainder of the current 2019-20 apparition. Observers should be watchful for any new atmospheric phenomena that might suddenly appear.

With the rings tilted by about +24° toward our line of sight from Earth in 2019-20, observers still have fairly good view of the northern hemisphere of the globe and north face of the rings during this apparition despite Saturn's southerly declination of -22° for Northern Hemisphere observers.

Pro-Am cooperation with the *Cassini* mission continued back during the past 2016-17 apparition as NASA's remarkable close-range surveillance of the planet for nearly 13 years that started back on April 1, 2004, concluding its amazing odyssey back on September 15, 2017 when it plunged into Saturn's atmosphere.

For quite a few years to come, planetary scientists will be carefully studying the vast database of images and data gleaned from the *Cassini* mission, including images provided during the mission by ALPO observers.

It should be emphasized, that ALPO Pro-Am efforts did not cease when the *Cassini* mission ended during September of 2017. Indeed, as in the immediately preceding 2018-19 apparition, and still ongoing during the 2019-20 observing season, our team of observers are regularly monitoring Saturn for atmospheric phenomena and we are actively sharing our results and images with the professional community. Thus, anyone worldwide who wants to join us in our observational endeavors is highly encouraged to submit systematic observations and digital images of the planet at various wavelengths throughout the current 2019-20 apparition.

Observers are also reminded that visual numerical relative intensity estimates (also known as visual photometry) remain an extremely important part of our visual observing program and are badly needed to ascertain recurring brightness variations in the belts and zones on Saturn as well as the major ring components.

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 (i.e., simultaneous observations).

The ALPO Saturn Section thanks all observers for their dedication and perseverance in regularly submitting so many excellent reports and images in recent years. 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

Remote Planets Section

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

Both Uranus and Neptune are well placed in the late evening sky during October. Neptune reached opposition in

Inside the ALPO
Member, section and activity news

September and Uranus will reach opposition in late October.

To find any of the remote planets for telescopic observations, I suggest that you first use a star chart which shows the position of the target, then use binoculars to find the target. [Note that skyandtelescope.com is a great source to find specific locations of sky objects.]

Next, locate the target in the finder scope of your telescope. Finally, use a low-power eyepiece and center it in the field-of-view. Note that you may need a dark site to locate Neptune in binoculars and in the finder scope.

Both planets have albedo features, which can be imaged with a near infrared filter. Uranus has a bright North Polar Region while Neptune may have irregular bright spots.

The writer has just submitted the 2018-2019 remote planets report. Unfortunately, in May when my computer was being upgraded, my Uranus/Neptune filter was eliminated. I have not been able to recover it as of July 19.

The writer has already collected some brightness measurements of Neptune. I hope that many more will follow.

Finally, my usual reminder that my book *Uranus, Neptune and Pluto and How to Observe Them* 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).

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

Errata

The dates of the ALPO Conference were misstated on page 5 of JALPO61-3. The correct dates were July 12 and 13.

The excellent lunar image by Maurice Collins on page 15 shows the very prominent crater Langrenus near the center and not Copernicus.

The first name of our ALPO Lunar Domes Survey Program coordinator was misspelled on page 44. The correct spelling is Raffaello.

The surname of one of the contributors to the Marius Shield (Part 2) report was misspelled in Table 1, on page 46, and in the Figure 10 caption on page 55. The correct spelling is G. Heinen (Luxembourg).

Feature Story:

ALPO Board Meeting Minutes, Barnesville, Georgia, Friday, July 12, 2019

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

ALPO Board Meeting - Barnesville, Georgia, Friday, July 12, 2019 - Final Draft

Call to Order

On Friday, July 12, 2019 at 6:45 p.m. EDT (Eastern Daylight Time), ALPO Executive Director and Board Chairman Richard W. Schmude, Jr. called the ALPO Board of Directors meeting to order in Conference Room 325 in the Russell Building on the campus of Gordon State College, located in Barnesville, Georgia. The ALPO Board meeting was held during the 2019 South East Region of Astronomical League meeting, where the ALPO participated in its paper presentation sessions held on July 12th and 13th.

ALPO Board members Richard W. Schmude, Jr. (Executive Director and Chairman), Matthew L. Will (Corporation Secretary and Treasurer) and Julius L. Benton, Jr. (Associate Executive Director) and Kenneth T. Poshedly (Journal Editor and Publisher) were present and in person at the Board meeting along with Board members Sanjay Limaye and Carl Hergenrother, participating via our AT&T teleconference line away from the meeting site. Board member Mike D. Reynolds could not attend or participate in this year's annual meeting due to prior commitments. Also in attendance were ALPO Lunar Topographic Studies Section Coordinator Wayne Bailey and his wife Betty, ALPO Mars Section Coordinator Roger Venable, and ALPO members Shawn Dilles, Mike Hood, David Teske, Howard Eskildsen, and several unidentified individuals.

ALPO Executive Director Richard Schmude and presenter David Whalen prepare the "Jupiter Basics" program PowerPoint slides at the 2019 ALPO conference at Gordon State College in Barnesville, Georgia, on July 12 and 13. *Photo by Howard Eskildsen.*

ISSUE ONE: Approval of the Board Meeting Minutes of 2018

(Introduced by Matthew Will)

The Board meeting minutes for our 2018 ALPO Board meeting were approved by all the Board members last fall.

ISSUE TWO: Future Annual Meeting Venues

(Introduced by Richard Schmude)

Richard Schmude presented to the ALPO Board, a number of options for next year's meeting. The Astronomical League plans to have an ALCON meeting hosted by TAAS (The Albuquerque Astronomical Society) in Albuquerque, New Mexico, in 2020. The meeting is to be held from Thursday, July 16th through Saturday, July 18th. Since we haven't met with the League since 2016, this might be a good opportunity to renew long-standing ties.

Richard also mention some organizations that might be willing to host us in the future as well.

The RASC (Royal Astronomical Society of Canada) has always been open to hosting us at its General Assembly meetings, that occur annually during the month of June. Next year's meeting location has not been publicized yet, but the RASC likes to plan meetings at least two years in advance when hosting other organizations. It is therefore likely that the RASC might consider hosting the ALPO at a General Assembly meeting in 2021 or beyond. Richard said that he has periodic contact with the RASC and will follow up and communicate the ALPO's interest in meeting with them in the not too distant future.

Some time ago, PARI, (Pisgah Astronomical Research Institute) had extended a standing invitation to meet at its complex in western North Carolina. PARI is located near Brevard, North Carolina, and about 50 miles south of Asheville. While remote, PARI could meet all of our needs for meeting space and accommodations.

SARA (Society of Amateur Radio Astronomers) has an annual conference that meets in June, usually at the Green Bank Radio Observatory in West Virginia. Past discussions about meeting with SARA included complications with the logistics for such a meeting. For example, being a remote radio receiving complex, cell phone usage is not permitted in or near the Green Bank site.

Some Astronomical League regions put on good annual meetings, such as the Mid-States Region and the North Central Region. Their meetings can occur generally around April or May. This timing may be too early for the ALPO to meet, but does offer a possibility for meeting at a well-organized affair.

Richard mentioned that meeting with the AAS (American Astronomical Society) was another possibility. Though the AAS has been an organization that promotes and supports professional astronomers, it has recently embraced the amateur astronomer with a special amateur membership and might be open to hosting an amateur organization at one of its annual meetings. The AAS has two annual meetings, one occurring in January and another during the summer. The summer meeting would be a better time for the ALPO to meet. The AAS is scheduled to meet in Madison, Wisconsin, from Saturday, May 30th to Wednesday, June 4th of next year. However, the AAS plans its meetings five years out, so meeting with them that soon may not be possible. Julius Benton commented that the registration costs for AAS meetings for professional astronomers have been quite expensive in the past, and may not be affordable for ALPO members. Ken Poshedly suggested that before a final decision is made concerning next year's annual meeting site, that the ALPO contact AAS about a possible 2020 meeting. Matt Will offered to contact the AAS and inquire about a possible meeting for 2020 or beyond. Until we here back from the AAS, a meeting time and location for the next annual conference will be open.

ISSUE THREE: Journal Status and the Appointment of a New Journal Editor

(Introduced by Richard Schmude and Ken Poshedly)

Current Journal Editor and Publisher Ken Poshedly wishes to retire from his position with the publication of the Fall 2019 issue of the Journal, but stay on as assistant editor until things are settled. Ken stated that after 18 years of his involvement in producing Journal issues, he wanted to step back from the rigorous effort of managing, editing, and composing the layout for the Journal. Ken had made his interest known to the Board last spring and to the membership in his Point-of-View article in the Summer 2019 issue of the Journal. Ken has advised the ALPO Board on a replacement for his position to assume responsibilities for managing the placement of and editing of the articles submitted to the Journal. At Ken's invitation, ALPO member Shawn Dilles has come forward to accept the position of Journal Editor and Publisher. Shawn has already been involved with quite extraordinary work for the Publications Section, by providing complete digital copies of past "hard copy-only" Journal issues, not previously available that date back to the ALPO's first issue in March 1947. Shawn has also been working with ALPO member Mike Mattei in the complete indexing of past volumes of the Journal and is currently working on a comprehensive index by title and author. Due to the complexities of the duties that Ken had assumed in producing the Journal over the years, Ken felt that the job of layout and final processing should be performed by a separate person that is already skilled in such production tasks and can perform that effort in a straightforward and knowledgeable manner. Ken has found a prospective professional that the ALPO can hire on a

Attendees at the 2019 ALPO conference at Gordon State College in Barnesville, Georgia, on July 12 and 13. *Photo by Frank Melillo.*

contractual basis. Cost for this service is still being negotiated, but should not exasperate ALPO finances according to ALPO Treasurer Matt Will. Matt suggested that this involvement with a contractor could be looked upon as a "pilot project" to see, over the next year, what technical issues might need to be resolved and what the actual cost will be, from an issue-to-issue basis.

Richard Schmude agreed with this approach and as Executive Director, appointed Shawn to fill Ken's role as an acting Editor and Publisher of the Journal, effective after the publication of issue Volume 61, Number 4 (Fall 2019). Ken has agreed to stay on to assist Shawn as an assistant editor for the Journal to help Shawn make the adjustments in his role as acting Journal Editor and Publisher. Shawn expressed his sincere wish to keep the Journal up to its high standards and continue in the publishing traditions of the ALPO. The ALPO Board is very grateful to Shawn for taking on this great responsibility and will certainly support him in every way it can to make this transition a success.

ISSUE FOUR: Status of Membership and Finances

(Introduced by Matthew Will)

Matt Will reports that membership numbers in the ALPO are up from last year. The ALPO had 337 members in May 2018. We now have 378 members, a net gain of 41 members. The recent interest in the major Mars apparition of 2018, greater exposure the ALPO has had from the ALPO podcasts, and a more interactive website over the last few years have probably encouraged other amateurs to join our ranks.

Board member Carl Hergenrother suggested that membership numbers could be increased even more with a more dynamic front page for the ALPO website, that could be changed daily, where a new observation could be showcased or some bit of news about Solar System astronomy or the ALPO could be highlighted. Carl is also a board member of the AMS (American Meteor Society) and said that when the AMS took this approach of constantly varying their front webpage, it increased interest and membership in AMS. This along with daily blasts on Twitter and Facebook, members and non-members alike check in with the website everyday. Carl also said that we need a PayPal donate button on the front page.

Ken commented that the Online Section already does quite a bit of work accommodating many section and program coordinators with numerous postings on a daily basis. A more dynamic front webpage would be beneficial and could be done, but work on the website has been prioritized to meet the needs of our coordinators and their sections or programs. Having more support in managing the volume of work that comes with the website could help and would alleviate shortcomings that we have. On the matter of a PayPal donate button on the frontpage, Matt looked into this matter a few years back, and found that it would require some cooperation from the Online Section with record keeping, accounting, and reporting when payments come in. Matt will review the PayPal option again this fall to see if anything has changed with PayPal's practices and if some kind of a work-around can be done to make this a less burdensome issue with staff in the Online Section.

Finances are relatively stable, with the ALPO business account floating a relatively high balance of $7,500.00 as of July 1st. The deficit of $924 in our budget analysis for the first five months of 2019 was expected since the ALPO had annual expenses that were paid in their entirety in the early part of the year and were not prorated over the rest of the year. Also, the ALPO received many more renewals than normal in late 2018 in anticipation of the dues increase in 2019 that would have normally been collected in early 2019; therefore, presenting less income than would normally occur over the first half of 2019.

ALPO Solar Section Assistant Coordinator Theo Ramakers during one of his two solar presentations. *Photo by Matt Will.*

The ALPO Endowment has enjoyed considerable growth over the last five years. With the acquisition of capital from the liquidated John Westfall Charitable Trust, the ALPO Endowment is now at a value of $241,481.29 as of July 1st. The purpose of the Endowment is to hopefully help finance a central headquarters operation for the ALPO in the future. The ALPO Endowment funds are now being reinvested as U.S. Treasury Bills, a process that began last December. We have converted four retired certificates of deposit that were earning interest of 0.35 to 0.40% to 52-week U.S. Treasury Bills earning interest of between 2.35 to 2.72%. The last certificate of deposit comes due in July. The ALPO is taking advantage of a better return without making a longtime commitment in investing our Endowment in this manner.

The ALPO Board has a separate treasury committee to oversee the work of the treasurer and to act if needed to resolve any issues beyond the treasurer's control. The treasury committee is composed of three independent Board members that are not corporate officers in the ALPO. Mike Reynolds, Ken Poshedly and Richard Schmude have agreed to sit on this committee for the next two years.

ISSUE FIVE: Changes in the Management of the ALPO Endowment

(Introduced by Matthew Will)

The ALPO Treasurer had submitted a paper to the ALPO Board last February entitled A Plan for Future Management of the ALPO Endowment concerning some fundamental changes to promote growth and stability for the Endowment. The paper reviewed the operations of 7 different astronomical organizations, three of which have active management of trust funds in place, similar to our endowment. Of the three, the approach used by the Astronomical League seems to be the best model for the ALPO. The treasurer proposed in that paper to the ALPO Board a number of steps be taken to enact a fully operational trust fund.

First, our Bylaws and our Standing Rules need to recognize the Endowment as a trust fund and implement procedures for its management. The revisions in the Bylaws would establish policy and direction for the trust fund and revisions in the Standing Rules would provide specifics for its management. The main issue among these revisions would be the establishment of a "board of trustees" that would control management of the Endowment as a trust fund and report to the treasurer and the ALPO Board at appropriate intervals.

As a side issue, the treasurer pointed out that the Bylaws and the Standing Rules also needed to be updated, as there is language in reference to outdated specifics. Outdated passages and updated content were highlighted in Treasurer's Interim Report submitted to the Board last June.

If the changes in the Bylaws and Standing Rules pass, the treasurer would start recruiting trustees for ALPO Endowment Board of Trustees. It would be ideal to have persons that have some knowledge of money management, but mainly they should be able to participate in the decision-making of investing funds. A chairperson would be elected from this group to coordinate decision-making. Later on, with approval from the ALPO Board, this chairperson could be involved in the selection of a financial advisor to help with investing the Endowment.

Finally, on a longer term track, the treasurer will look at ways of reforming current bookkeeping and recordkeeping practices so that external audits for the purposes of applying for possible grants in the future can be performed gracefully.

The ALPO Treasurer thought that it would be essential to have these reforms and directives in place to keep the Endowment on track and expressed at this meeting so that the ALPO Board could implement the first of these proposals as soon as possible.

Executive Director Richard Schmude expressed the need to more closely read through the changes to the Bylaws and Standing Rules before voting. Understanding the Board's need for further study, Matt Will offered to reconvene a discussion on these changes to the Bylaws and the Standing Rules in about a month later through a conference call, to discuss and either vote or modify the changes still further for a future vote. The Board agreed with this approach.

ISSUE SIX: The Jupiter Section Coordinator's Position and its Future

(Introduced by Richard Schmude and Ken Poshedly)

Ken Poshedly discussed the past and current situation with the Jupiter Section. ALPO member and observer Ed Grafton had agreed to become the lead coordinator of the section in November 2013. Ed was to provide quarterly section reports for the Journal and receive correspondence while Richard Schmude would continue writing apparition reports for the Journal. Unfortunately, Ed had to bow out as Jupiter Section Coordinator due to health issues and the duties of coordinator in 2018 reverted back to Richard. Richard agreed that the work plan for the Jupiter Section should include a coordinator that handles the duties that Ed maintained, where Richard could again just focus on producing the apparition reports as before. Richard said that the Jupiter apparition reports can take an extrordinary amount of time, up to 200 man-hours to produce. This makes the work very difficult to manage when quarterly section reports and correspondence with other observers are also being managed by the same person.

Obviously, a return to the old arrangement where there was a division of duties among two or more volunteer staff members would be less stressful and more productive situation. In searching for someone to fill the position of coordinator, Ken suggested that a blast email should be sent to all ALPO member that have expressed an interest in Jupiter observing in the past, that would be an invitation to consider leading the Jupiter Section. Matt Will agreed to take the lead on this and will send that email to all interested Jupiter observers that are already ALPO members.

ISSUE SEVEN: ALPO Youth Section Status

A proposal was made last December to the ALPO Board by ALPO Solar Section Assistant Coordinator Pam Shevak for revamping the ALPO Youth Section using social media. Ken Poshedly suggested discussion be deferred on this topic until a later time. No objections were raised by the Board.

ISSUE EIGHT: ALPO Observer and Service Awards

(Introduced by Matthew Will)

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 founder and director emeritus and was established in 1985. The selection of this award is conducted by a committee convened by its committee chairman, Timothy J. Robertson. The Walter H. Haas Observers Award recipient was selected from that committee that was composed of ALPO members, some of whom are on staff and all are experienced observers that are familiar with the ALPO observing community. 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 Julius L. Benton, Jr.

Julius Benton has demonstrated leadership in observation of Solar System bodies in a number of respects. In both the Saturn and Venus Observing Sections of the ALPO, Julius has developed a number of programs and techniques both visual and technical for the amateur observer to use that have proved fruitful in providing valuable observational data and insights into the inner workings of both planets.

Julius has been a tireless advocate for the acceptance of amateur observations in the use of professional research. Many recent NASA and ESA (European Space

(Left) ALPO Membership Secretary Matt Will presents Julius Benton with the Walter Haas Observer's Award; *photo by Ken Poshedly*. (Right) ALPO Journal editor & publisher Ken Poshedly presents Shawn Dilles with the Peggy Haas Service Award; *photo by Howard Eskildsen*.

Agency) space probe programs have used ALPO observations of Venus and Saturn to enhance their decisions on mission planning.

Julius has also been a mentoring influence to ALPO staff through his leadership as an ALPO Executive Director in three previous terms since July 2000 and an active ALPO Board member since August 1995. Julius has accepted a fourth term as Executive Director and we should all be grateful for that!

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, the Peggy Haas Service Award is Shawn Dilles.

Shawn Dilles became a member of the ALPO in September 2017. Though he hasn't been a member for very long, he has already done something that none of us could have ever have gotten around to or done as well as he did, that is, digitizing all ALPO Journal issues going back to the beginning, 1947 so they are available to all from our website.

Shawn sensed that the ALPO was an organization with a great mission and a great history when he joined. He was also aware that the ALPO's flagship operation, our quarterly Journal, was only partially digitized through a public website called Astrophysics Data Systems operated by the Smithsonian Astrophysical Observatory and funded by NASA. Technical and policy limitations did not permit this operation to scan the complete collections of Journal earlier than 1983. Shawn found a way to take on the scanning of older paper bound issues that would make these issues available in an easier to use format and available not only on the ADS website, but on the ALPO website as well. Working with ADS, Shawn painstakingly scanned issues page-by-page in a method that was acceptable to ADS and presentable to our readers on the ALPO website.

Shawn may be done with this scanning project, which would be a great accomplishment in and of itself, but now Shawn is creating a comprehensive index by author and title that will make this complete library of Journal issues an even more valuable resource for researchers of the future.

Shawn has given the ALPO and its Journal a sense of immortality in performing this most valuable function. This is why Shawn greatly deserves this year's Peggy Haas Service Award.

ISSUE NINE: Changes in the ALPO Lunar and Topographic Studies Program

(Introduced by Richard Schmude)

ALPO Lunar Topographic Studies Program Coordinator Wayne Bailey informed the ALPO Board a few months ago of his desire to retire from leading that program by the time of the 2019 ALPO Board meeting. Wayne recommended that longtime ALPO member and lunar observer David Teske be appointed to lead this program. At the meeting, David expressed his desire to lead the section and to take over the editorship of the program's newsletter, The Lunar Observer. Wayne Bailey expressed his desire to stay on an an assistant coordinator for the Lunar Topographic Studies Program to help David make the transition and continue on with the process of uploading lunar images and observations to the ALPO website. Executive Director Richard Schmude agreed to appoint David as the acting coordinator of the program and the Board agreed to reassign Wayne as an assistant coordinator for as long as Wayne needs to get these processes done.

ALPO Lunar Topographical Studies Program Coordinator David Teske. *Photo by Matt Will.*

ISSUE TEN: Lunar Nomenclature, Status Report - Naming of Craters or Lunar Features for Walter H. Haas, Donald C. Parker, Anton Rukl, and Winifred S. Cameron

(Introduced by Matthew Will)

Two years ago, a discussion was led by former Board member, the late John Westfall, regarding the naming of lunar features for ALPO members. The governing organization that sanctions the naming of such features for any astronomical body is the International Astronomical Union. The reader is referred to a fuller discussion of this topic in the past Board meeting minutes of 2017 and 2018. There has been no movement on this issue lately and one of the persons involved with this was not in attendance to discuss the topic in full. Therefore, discussion will be deferred on the progress of this matter until a later time.

ISSUE ELEVEN: Central Headquarters or Office Concept and Archiving

(Introduced by Matthew Will)

Julius Benton asked for a status report concerning the state of planning for an eventual central office for the ALPO. Matt Will said that time spent on this matter has mainly gone to studies and proposals to the ALPO Board for better management and preservation of the ALPO Endowment. From time to time, some effort has been channeled toward composing a business plan for when the ALPO can afford to operate such an operation. Matt has discussed in past reports to the Board various financing models that could work for the ALPO to maintain a central office. The main purpose for the central office would be chiefly for storage of archived hard copy observations of historical importance. The proposed central office could house a research library, as a number of ALPO members have research libraries and materials that they would like to donate to the ALPO. The offices could be a distribution center for astronomical equipment as some members in the past have offered to donate used equipment to help disadvantaged observers in other countries. Finally, just having a brick-and-mortar point of contact can be helpful to accommodate any inquiries that require a physical presence or contact. Matt will continue to inform the Board of future developments.

ISSUE TWELVE: Election of Corporate Officers

In accordance with a long-standing agreement among the Board members, the rotation for the positions of executive director and associate executive director continues. Julius Benton

will become our new executive director for the next two years and Carl Hergenrother will be the

new associate executive director. Matthew Will shall continue as both secretary and treasurer.

Matt Will made a motion to affirm the approval of these proposed officers serving for the next two years and Ken Poshedly seconded the motion. The motion passed 5 to 0 with ALPO Board members Benton, Hergenrother, Poshedly, Schmude and Will voting in the affirmative.

With no new business to conduct at the ALPO Board meeting, Matt Will made a motion to adjourn, and Ken Poshedly seconded. The motion passed with the Board members present voting unanimously in the affirmative with the Board meeting adjourning at 8:05pm EDT on Friday, July 12, 2019.

EXECUTIVE SESSION OF THE ALPO BOARD

On July 12, 2019, at 8:07pm the ALPO Board reconvened to go into executive session. The purpose of the executive session was to discuss some matters that were sensitive or confidential in nature. One matter that was not sensitive or confidential was the status of acting volunteer staff. See the Table of ALPO Acting Staff Appointments

The usual probationary period for review before the Board decides whether or not to grant permanent status, is two years. Acting ALPO staff are eligible for permanent status contingent on a vote by the ALPO Board.

After a discussion and review of the table, the ALPO Board decided to promote Jim Phillips to permanent status and to keep the remaining acting staff, acting until a decision is made at next year's Board meeting.

The executive session adjourned at 8:25pm, Friday, July 12, 2019.

Table of ALPO Acting Staff Appointments

Staff Member	Section	Title	Appointment Date
Jim Phillips*	Lunar Domes Survey Program	Acting Asst Coordinator	Feb 2018
Keith Spring	Eclipse Section	Acting Asst Coordinator	Sept 2018
Keith Spring	Mercury and Venus Transits Section	Acting Asst Coordinator	Sept 2018
Richard Schmude	Jupiter Section	Acting Coordinator	June 2018**

NOTE:
*Raffaello Lena was promoted to full Coordinator for this Lunar Program in February 2019, but Jim Phillips was kept in acting status.
**Richard Schmude was previously Coordinator of this section from February 2001 to November 2013.

Book Review

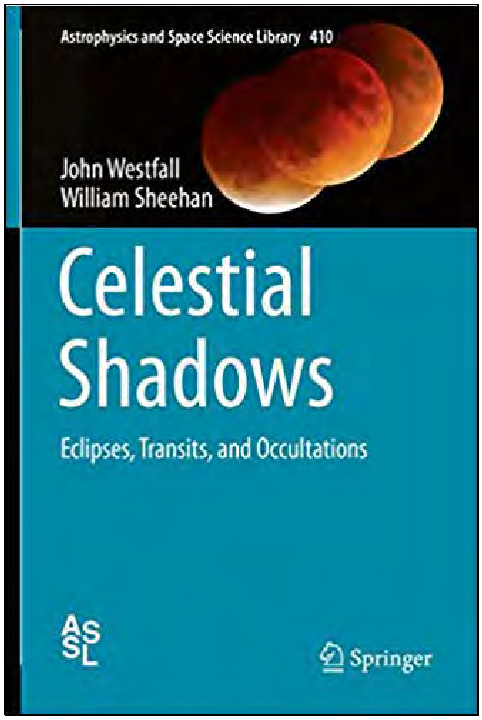
Celestial Shadows: Eclipses, Transits and Occultations

Book Review by Anthony Mallama
Book Authors: John Westfall & William Sheehan
Publisher and year: Springer, 2014
ISBN-13: 978-1493915347 or ISBN-10: 1493915347
Retail prices: Hardback $179.00, Paperback $149.99
Pages: 713

The recent passing of John Edward Westfall (JALPO, 2018, vol. 60, no. 4, pp. 20-24) prompted me to review the book *Celestial Shadows*, which he published with co-author William Sheehan in 2014. I had read and commented on an early draft of the book, and John was kind enough to send me a copy after it was printed. Had I not read the draft or received a gratis copy I would still hold this book to be the best and most comprehensive reference ever written on the science and the history of eclipses, transits, and occultations. Westfall and Sheehan cover practically every aspect of astronomical 'shadow' phenomena in a little over 700 pages. Readers at all levels will find a wealth of interesting, informative, and useful information in this volume.

A large portion of the book is devoted to the three main topics, which are solar eclipses, lunar eclipses, and transits of Venus. These phenomena are explained clearly and the text is augmented with hundreds of excellent illustrations.

Did you know that Earth's shadow inferred from lunar eclipse observations is about 2% larger than our planet's diameter? Westfall and Sheehan discuss this phenomenon, and cite observations and theories by more than a dozen astronomers in the process. The details of solar eclipses are treated in similar thoroughness with many past and future events being highlighted. Observers who witnessed the spectacular Great American eclipse of 2017 August 21 will enjoy reading about that event and



others in the Saros 145 cycle because their circumstances are described in depth as special examples. The next Great American eclipse of 2024 April 8 is also forecast in good detail.

Transits of Venus are memorable phenomena as those who witnessed the events of 2004 or 2012 can attest. These are rare occurrences and the next will not happen until 2117. Astronomers from the time of Edmond Halley, hundreds of years ago, reckoned that accurate timings of the transits would provide a definitive distance scale for the solar system. Captain James Cook sailed his famous ship *Endeavour* from England to Tahiti for the transit of 1769. The observations of these events were not quite as successful as had been hoped for, though, because the Venusian atmosphere rendered the timings imprecise. Nevertheless, the various other expeditions make for fascinating reading.

Rounding out *Celestial Shadows* are many other topics related to shadow phenomena. These include occultations of stars by the Moon, eclipses of planetary satellites, asteroids occulting stars, eclipsing binary stars, and transiting exo-planets. Each of these phenomena is providing or has provided vital information about celestial bodies in our solar system and beyond. The range of astronomical events and topics described in the book is so vast that they cannot be summarized adequately in a review such as this.

The general reader will find *Celestial Shadows* to be very accessible, because it is not too technical. The material centers on people and on history beginning thousands of years ago. One early story is that of the Chinese court astronomers Hi and Ho. The pair supposedly failed to predict a solar eclipse and, consequently, they were beheaded by their emperor. Indeed, the index lists more than 500 individuals, some living and some dead. Besides the Chinese emperor there are 3 other emperors, 9 kings, 3 czars, and 2 U.S presidents listed there. The index also includes 18 ancient scientists and philosophers, as well as 4 astronomers from the Cassini family alone, and 3 more from the famous Struve clan. Rounding out the cast of characters are writers, musicians and poets such as Herman Melville, John Philip Sousa and John Milton. Portions of the historical accounts are placed within the context of at least three different European wars. Finally, a great many organizations including the International Occultation Timing Association and our own ALPO are included.

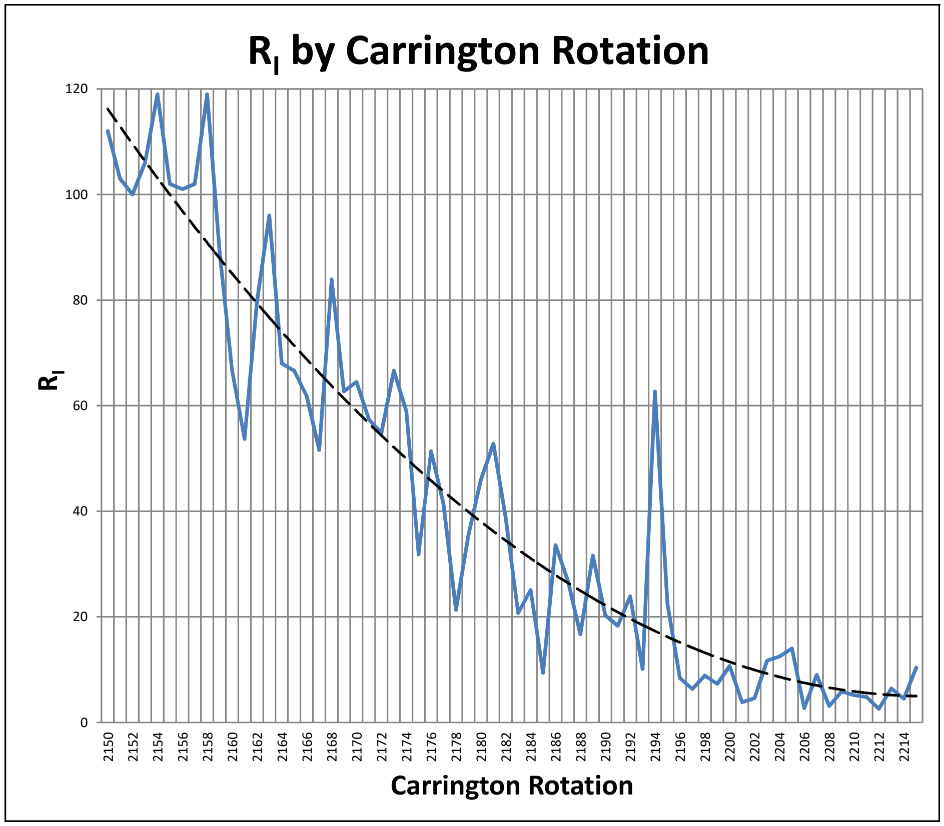
If there is one unfortunate aspect of this book it is the price which approaches two hundred U.S. dollars in the hardback format. However, soft cover and electronic versions are available for less. Perhaps used book sellers can provide more affordable copies as well and the book is likely available in technical libraries. In any case, *Celestial Shadows* is a terrific book that will be appreciated by every amateur or professional astronomer who lays eyes on it.

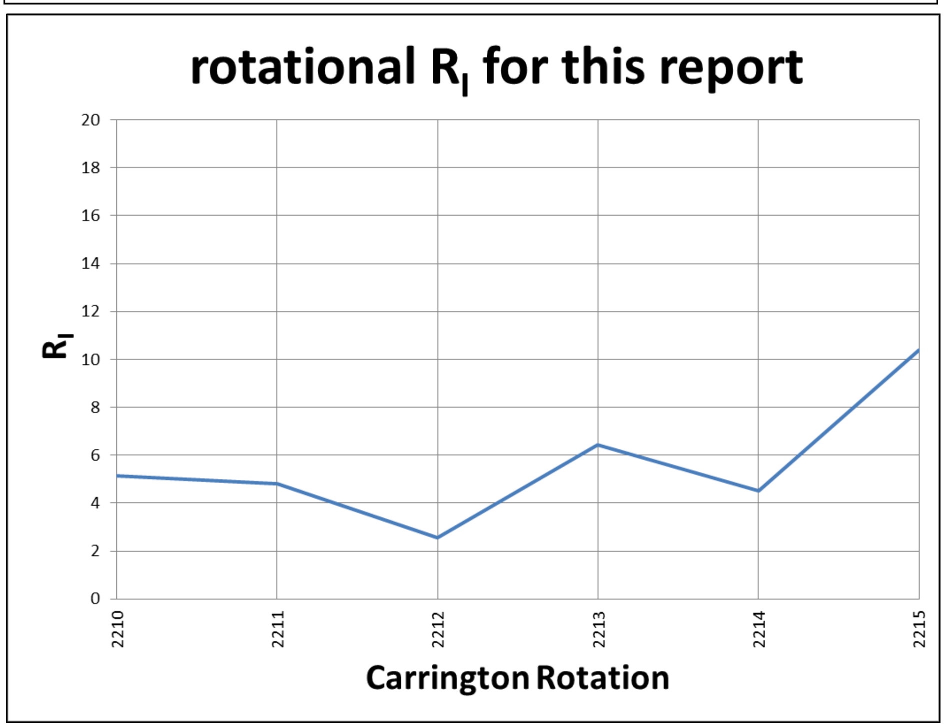
Papers & Presentations:

A Report on Carrington Rotations 2210 through 2215 (2018 10 26.8687 to 2019 04 08.7993)

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

To our hard-copy readers: This paper can be viewed in full-color in the online (pdf) version of this Journal.





Overview

The activity during this report interval remained very low as the first plot shows. It started at a low ebb but ended with a good show in CR 2215.

High R_I for period was 10.4 in CR2215 and the low was 2.56 in CR2212. (Avg. R_I was 5.65 mostly due to CR2215 or it would have been much lower as shown in the second plot. Of the 164 days that comprise this report, 101 were spotless or just over 61%. Peak activity day was on 3/21 with an daily R_I of 37 largely due to AR 2736. In fact, without this one region the 10.4 R_I for CR2215 would have been halved. This was the only region that evolved beyond D-class, being Eki for one day, and the only region that evolved beyond mag. class "beta".

Terms and Abbreviations Used In This Report

While this brief section is similar to the same in earlier reports it should be at least reviewed. As in previous reports, the ALPO Solar Section will be referred to as "the Section" and Carrington Rotations will be called "CRs". Active Regions are designated by the National Oceanic and Atmospheric Administration (NOAA) and will refer to all activity in all wavelengths for that region and will be abbreviated "AR" with only the last four digits of the full number

Table of Contributors

Observer	Location	Telescope (aperture, type)	Camera	Mode
Michael Borman	Evansville IN	102mm, RFR	Point Grey GS3	W-L
		90mm		H-a
		102mm, RFR		CaK
Richard Bosman	Enschede, Netherlands	110mm, RFR	Basler Ace 1280	H-a
		355mm, SCT		W-L
Raffaello Braga	Milano, Italy	112mm,RFR	PGR Chameleon mono 2.0	H-a
Tony Broxton	Cornwall, UK	127mm, SCT	N/A	W-L
Jeffery Carels	Bruges, Belgium	100mm, RFR	ZWO-ASI 120MM	W-L
Jean-Francois (Jeff) Coliac	France	30mm, Projection	N/A	W-L
Gabriel Corban	Bucharest, Romania	120mm, RFL-N	Point Grey GS3-U3	H-a
				W-L
Brennerad Damacenco	Sao Palo, Brazil	90mm, MCT	ASI224MC	W-L
Franky Dubois	West-Vlaanderen, Belgium	125mm, RFR	N/A	visual sunspot reports
Howard Eskildsen	Ocala, FL	80mm, RFR	DMK41AF02	W-L wedge
		80mm, RFR	DMK41AF02	CaK
Joe Gianninoto	Tucson, AZ	85mm, RFR	N/A	W-L
		60mm, RFR	N/A	H-a
Guilherme Grassmann	Curitiba, Brazil	60mm, RFR	Lumenera Skynyx 2.0	H-a
Richard Hill	Tucson, AZ	90mm, MCT	Skyris 445m	W-L
		120mm, SCT		
Bill Hrudey	Grand Cayman	200mm, RFL-N	ASI174MM	W-L
		60mm, RFR	ASI174MM	H-a
David Jackson	Reynoldsburg, OH	124mm, SCT	N/A	W-L
Jamey Jenkins	Homer, IL	102mm, RFR	DMK41AF02	W-L
		125mm, RFR		CaK
Pete Lawrence	Selsey, UK	102.5mm, RFR	ZWO ASI174MM	H-a
Monty Leventhal	Sydney, Australia	250mm, SCT	N/A	W-L/H-a
		250mm, SCT	Canon-Rebel	H-a
Tom Mangelsdorf	Wasilla, AK	120mm, RFR	N/A	W-L
Frank Mellilo	Holtsville, NY	200mm, SCT	DMK21AU03AS	H-a
Efrain Morales	Aguadilla, Puerto Rico	50mm, RFR	Point Grey Flea 3	H-a
German Morales C.	Bolivia	200mm, SCT	N/A	visual sunspot reports
John O'Neal	NC			Na-D
Theo Ramakers	Oxford GA	80mm, RFR	ZWO ASI174MM	H-a
		11 in. SCT	DMK41AU02AS	W-L
		40mm, H-a PST	DMK21AU03AS	H-a
		40mm, CaK PST	DMK21AU03AS	CaK
Ryc Rienks	Baker City OR	203mm, SCT	N/A	W-L
		40mm, H-a PST	N/A	H-a
Laura Schreiber	Wuertzburg, Germany	280mm, SCT	Basler IMX174	W-L
Chris Schur	Payson, AZ	152mm, RFR	DMK51	CaK
		152mm, RFR	DMK51	W-L (CaK-offband continuum)
		100mm, RFR	DMK51	H-a
Randy Shivak	Prescott, AZ	152mm, RFR	ZWO-ASI174	H-a
Avani Soares	Canoas, Brazil	120mm, RFR	ZWO-ASI 224	W-L
Randy Tatum	Bon Air, VA	180mm, RFR	DFK31AU	W-L-pentaprism
David Teske	Louisville MS	60mm, RFR	N/A	W-L/H-a
		100mm RFR	ZWO-ASI120MM	H-a
Vince Tramazzo	Tucson, AZ	94mm, RFR	N/A	W-L
		50mm, RFR		H-a

Table of Contributors (Continued)

James Kevin Ty	Manila, Philippines	TV101-RFR	ZWO-ASI 120MM	H-a
David Tyler	Buckinghamshire, UK	178mm, RFR	ZWO	W-L
		90mm, RFR		H-a
Christian Viladrich	Nattages, France	300mm, RFL-N	Basler 1920-155	W-L

NOTE:
RFR = Refractor (RFR), RFL-N = Newtonian Reflector, SCT = Schmidt Cassegrain, MCT = Maksutov-Cassegrain, Cass = Cassegrain.

being used. The term "groups" refers to the visible light or "white light" sunspots associated with an Active Region. Statistics compiled by the author have their origin in the finalized daily International Sunspot Number data published by the WDC-SILSO (World Data Center - Solar Index and Long Term Solar Observations) at the Royal Observatory of Belgium. All times used here are Coordinated Universal Time and dates are reckoned from that. Dates will be expressed numerically, with month/day such as "9/6" or "10/23". Carrington Rotation commencement dates are from the table listed on the Section web page on the ALPO website *http://alpo-astronomy.org/solarblog/wp-content/uploads/ephems/CNSun_2159_2306_A.pdf*

The terms "leader" and "follower" are used instead of "east" or "west" on the Sun to avoid misunderstandings. This follows the "right-hand rule" where, using your right hand, your thumb pointing up is the north pole and the rotation follows the curl of your fingers. Orientation of images shown here will be north up and celestial west to the right (northern hemisphere chauvinism). The cardinal directions (north, south, east, west) if used at all, will be abbreviated as N, S, E and W and Central Meridian of the visible disk will be CM.

The abbreviation to indicate white-light observations is "w-l", while hydrogen-alpha is "H-a" and calcium K-line is "CaK". "Naked-eye sunspots" means the ability to see these spots on the Sun without amplification but through proper and safe solar filtration. As a reminder, you should never look at the Sun, however briefly, without such filtration even at sunrise/set.

Areas of regions and groups are expressed in the standard units of millionths of the solar disk, with a naked-eye spot generally being about 900-1,000 millionths for the average observer. The McIntosh Sunspot Classification used here is the one defined by Patrick McIntosh of NOAA (McIntosh 1981, 1989) and detailed in an article in the JALPO Volume 33 (Hill 1989). This classification system is also detailed by the author on the Section website at *http://www.alpo-astronomy.org/solar/W-Lft.html i*n an article on white-light flare observation. This will be referred to as the McIntosh Class. The magnetic class of regions is assigned by NOAA and will be entered parenthetically after the McIntosh class or elsewhere referred to as "mag. class".

Lastly, due to the constraints of publishing, most of the images in this report have been cropped, reduced or otherwise edited. The reader is advised that all images in this report, and a hundred times more, can be viewed at full resolution in the ALPO Solar Archives. This can be accessed by going to the Solar Section web page and following the Archives link at the top of the right sidebar. You can also go to the Archives through this link: h*ttp://www.alpo-astronomy.org/gallery/main.php?g2_itemId=1699*

Section observers, their equipment and modes of observing are summarized in the *Table of Contributors* in this report. While not all individuals necessarily contributed to this specific report, they have contributed to previous reports and are ALPO Solar Section members. This should be used as a reference throughout this report.

References

Hill, R.E., (1989) "A Three-Dimensional Sunspot Classification System" *Journal of the Assn of Lunar & Planetary Observers*, Vol. 33, p. 10. *http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?1989JALPO..33...10H&data_type=PDF_HIGH&whole_paper=YES&type=PRINTER&filetype=.pdf*

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, pp. 251-267. *http://adsabs.harvard.edu/abs/1990SoPh..125..251M*

McIntosh, Patrick S., (1981) "The Physics Of Sunspots". Sacramento Peak National Observatory, Sunspot, NM; L.E. Cram and J.H.Thomas (eds.), p.7. *https://sourcelibraries.com/browse/the-physics-of-sunspots/*

Additional 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/

Carrington Rotation 2210

Dates: 2018 10 26.8687 to 2018 11 23.1743

Avg. R_I = 5.15
High R_I = 15 (11/12, 16, 17)
Low R_I = 0 (16 days)
Largest group = AR 2733
Formed on disk on 11/15 just past CM
Max. area = 60 (11/187 Cao beta)
Left disk on 11/20 (Axx, alpha)

All the activity for CR 2210 happened in the second half of the rotation. There three days of the high R_I of 15 and 16 days of zero sunspots. Only two regions were designated for this rotation and of them only one worth a mention, AR 2727.

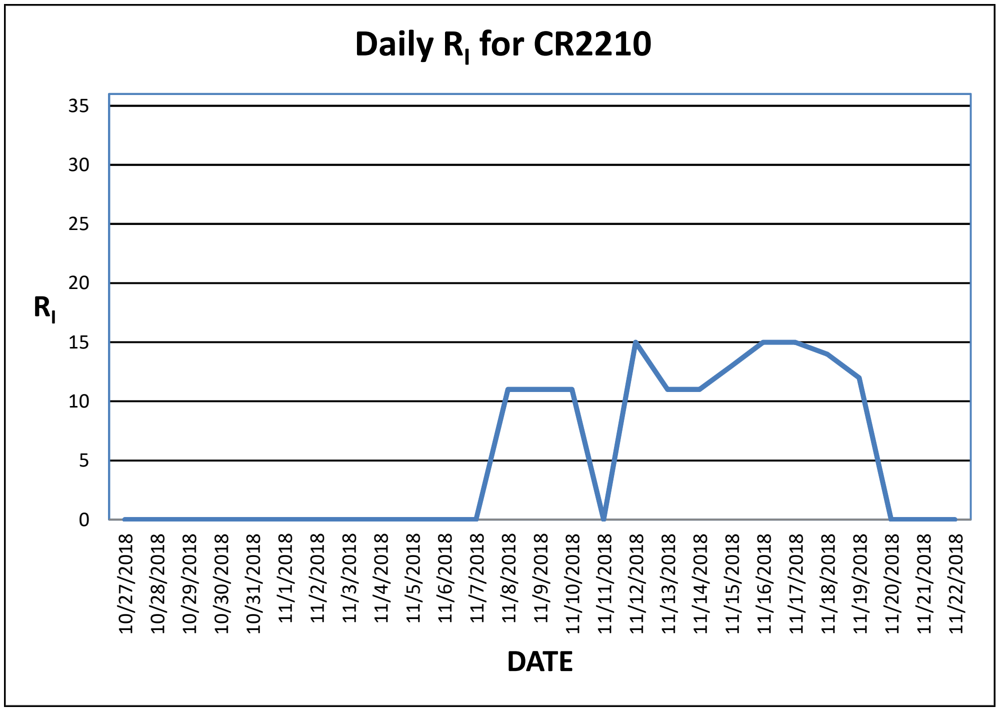
This region formed on the disk one day past CM passage and was first seen by Grassmann in CaK on 11/15 at 1742 UT. (Figure 1). It was trailing and even smaller region, AR 2726, just a half dozen or so umbral spots in a small plage. Good detail was shown in a Tyler w-l image on 11/17 with a total disruption of the photospheric granulation immediately about the group. (Figure 2) The plage the region sat in was well shown in a Braga CaK image at 12:24 UT on the same date (Figure 3) with a possible sub-flare caught in H-a by Melillo at 15:48 UT. (Figure 4) Maximum area and development was on the 18th and well shown in a w-l image by Ramakers at 13:58 UT. (Figure 5) At that time AR 2727 was a Cao (beta) group of 60 millionths area and about half way to the limb from the CM. Late on the 19th it had broken down to Axx of only 10 millionths area and went around the limb just a plage.

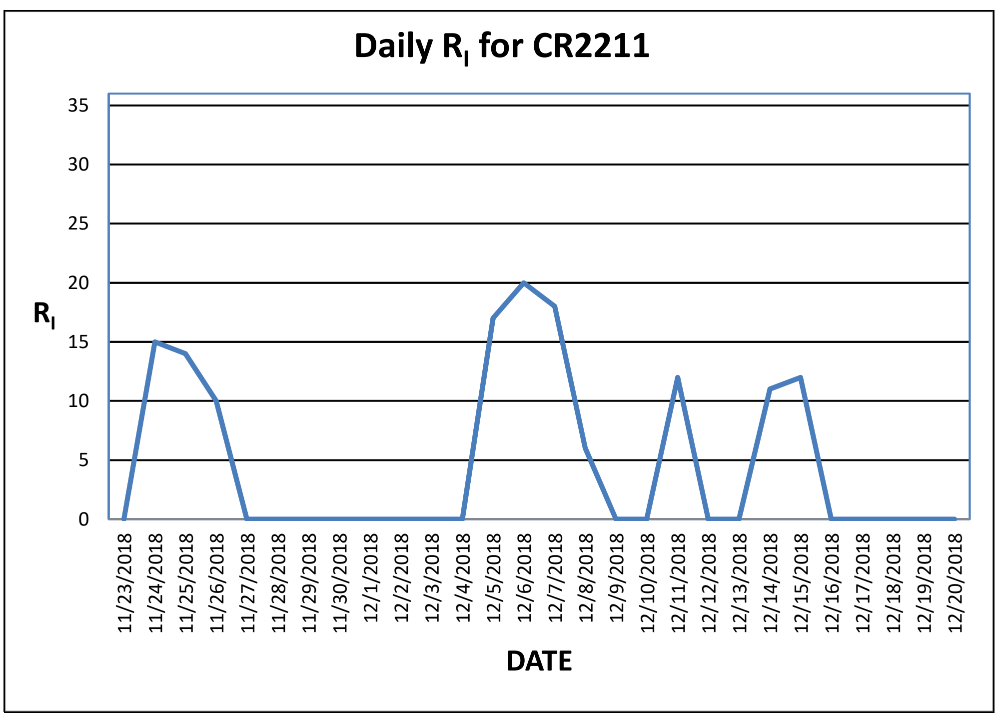
Carrington Rotation 2211

Dates: 2018 11 23.1743 to 2018 12 20.4944

Avg. R_I = 4.82
High R_I = 20 (12/6)
Low R_I = 0 (18 days)

Activity declined slightly from the previous rotation with two more days of zero spots (18 days total) and four active regions designated with only one, AR 2729, getting to 50 millionths of the disk on 12/7 when it was a Cro group (beta) near the west limb. It produced a few flares but none of any consequence. The region popped into existence on 12/5 as shown in a combined view by Ramakers and Grassmann. (Figure 6) Then Grassmann gives us a good look at this region on 12/6 the day before maximum development in H-a (11:04 UT) and CaK (11:15 UT) (Figure 7).





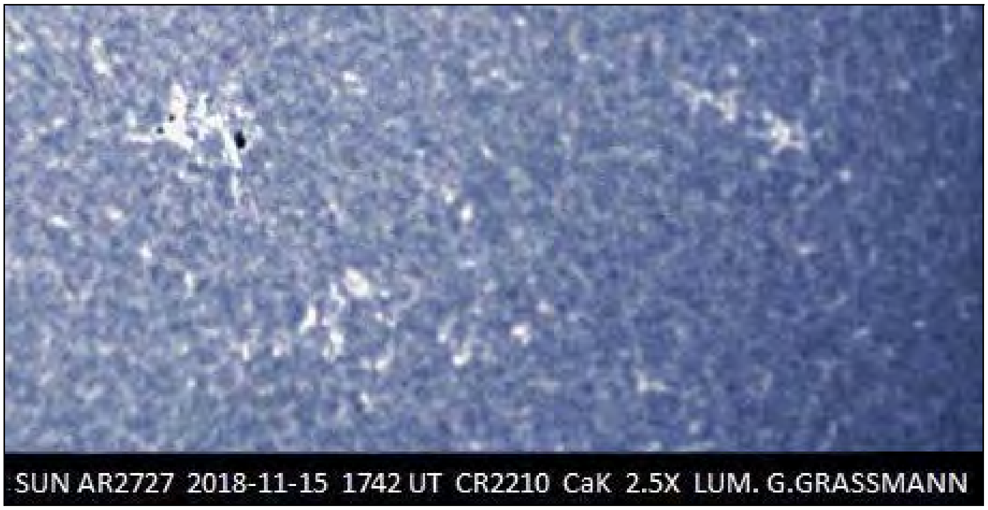


Figure 1. AR 2727 (to the left) in CaK by Grassmann on 11/15 at 17:42 UT.

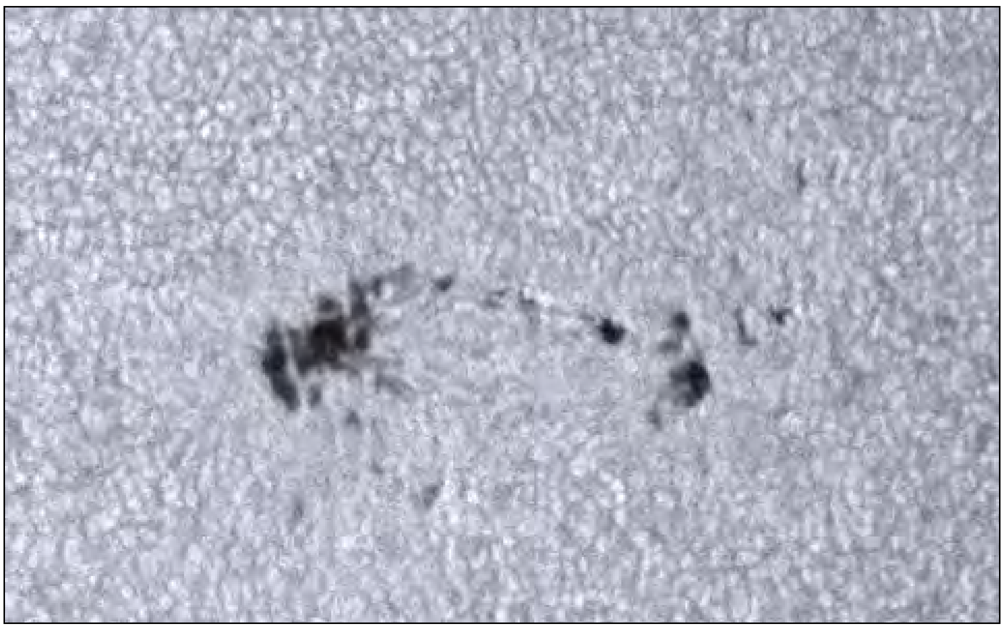


Figure 2. A fabulous sub-arc-second w-l image of AR 2727 by Tyler at 11:35 UT on 11/17.

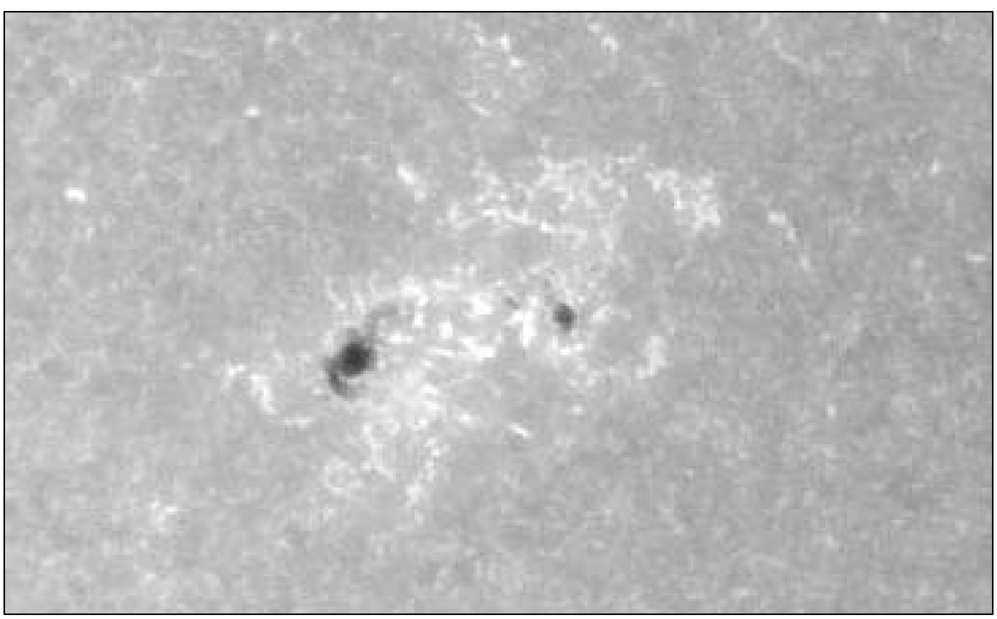


Figure 3. A CaK image of AR 2727 by Braga on 11/17 at 12:24 UT.

Figure 4. A small flare in AR 2727 by Melillo on 11/17 at 15:48 UT.

Figure 5. A Ramakers w-l image of AR 2727 on 11/18 at 13:58 UT.

Carrington Rotation 2212

Dates: 2018 12 20.4944 to 2019 01 16.8292

Avg. R_I = 2.56
High R_I = 16 (1/3)
Low R_I = 0 (22 days)

This rotation marked the lowest activity for the reporting period. In fact, it was the lowest activity in over a decade! But the bottom has not yet been reached.

There was only one region designated during this rotation, AR 2732. First recorded by Grassmann on 12/31 in CaK at 11:01 UT as a plage with a tiny spot, it only attained a maximum area of 90 millionths for a couple hours on 1/4. By 1/6 it was gone. A couple images from the archive represent the maximum development of this Cao (beta) region. White-light images by Carels, on 1/3 at 11:58 UT (Figure 8) and Tyler, on 1/4 at 11:43 UT (Figure 9) show a clear leader of four or five larger umbrae surrounded by penumbra followed by a few umbral spots and pores some with rudimentary penumbrae.

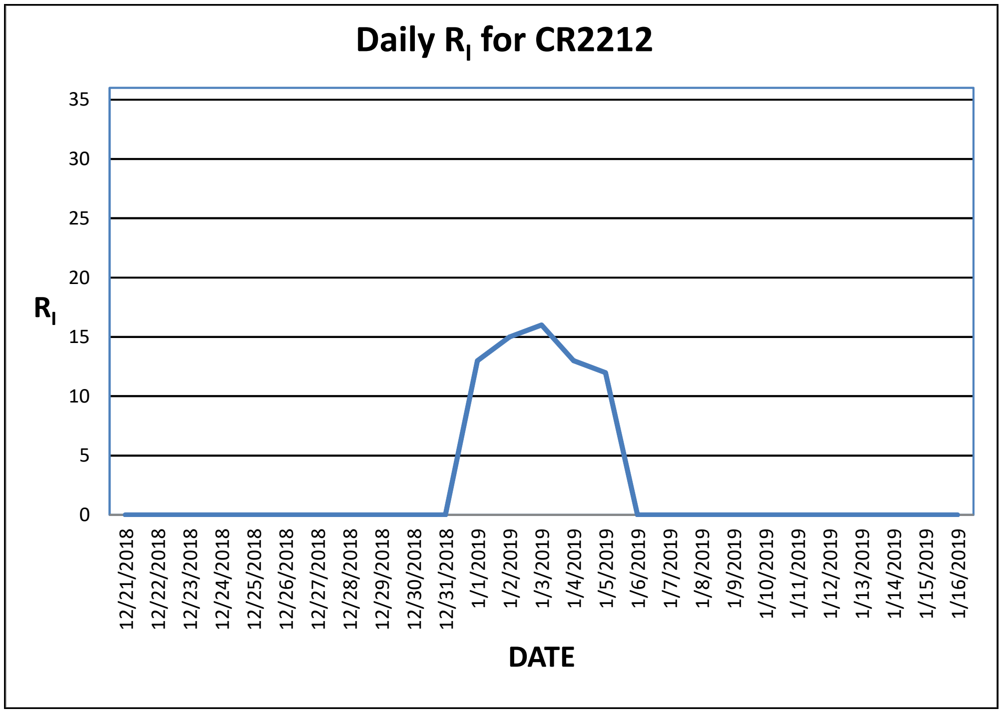
Carrington Rotation 2213

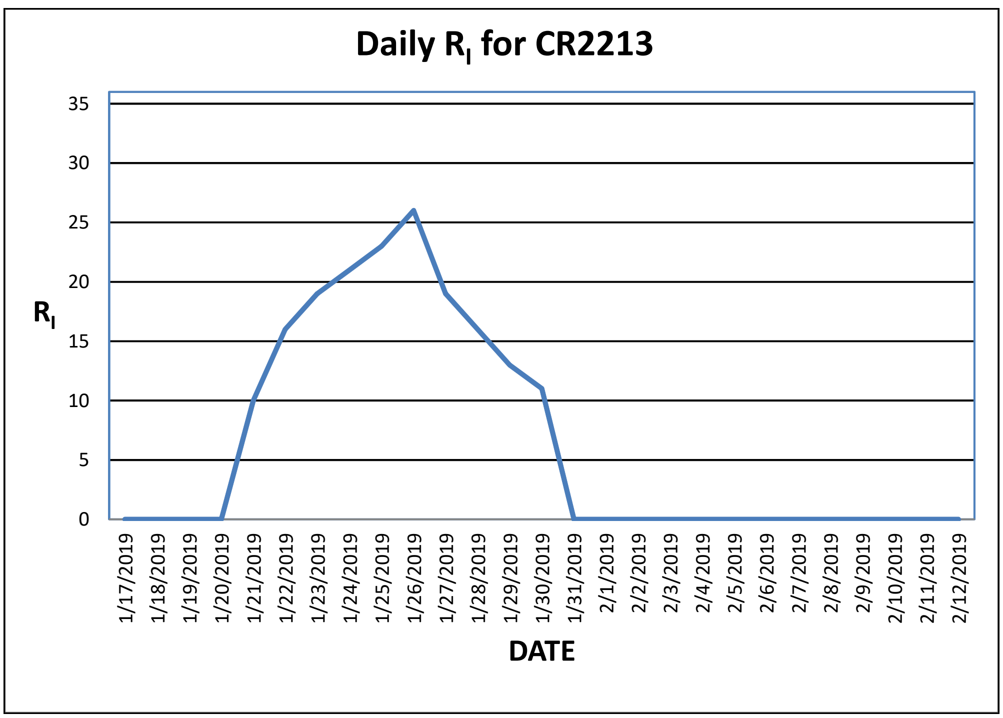
Dates: 2019 01 16.8292 to 2019 02 13.1708

Avg. R_I = 6.44
High R_I = 26 (1/26)
Low R_I = 0 (17 days)
Largest group = AR 2733
Formed on disk on 3/19
Max. area = 90 (1/27)
Left disk on 1/30 (Cao, beta 90)
On CM 1/24

This rotation saw a slight increase in activity but still had 17 days of zero spots. The peak R_I was 26 on 1/26 with the average being 6.44. There was only one region designated during the rotation, AR 2733.

AR 2733 was designated by NOAA on 1/22 but Ramakers in w-l and Grassmann in CaK both observed it as a small umbral spot or pore in a plage (or faculae in w-l). The day of maximum development was 1/27 when the region reached a whopping 90 millionths of the solar disk as a Dso group (beta). It was well observed by Eskildesen in a w-l, H-a and CaK at 15:57 UT, 16:00 UT and 16:06 UT respectively. (Figure 10) Then Melillo got a great three pane H-a sequence of the region from 16:15-27 UT as it flared. (Figure 11) Tyler got an excellent high resolution image of the region in w-l and H-a on 1/28 as it maintained it's classification and area heading for the limb. (Figure 12) It had been producing "B" flares for several days with an occasional "C" flare as the Melillo observation showed. From here the region slowly reduced in area and class leaving the disk on 1/30.





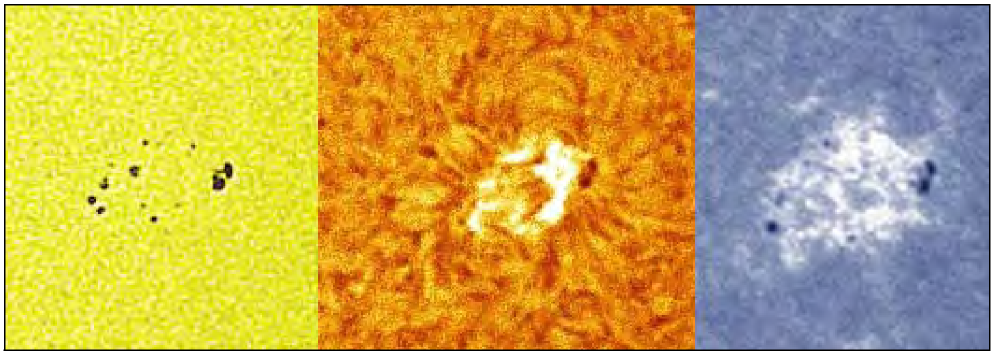


Figure 6. A panel of three images showing early views of AR 2729 on 12/05 by Ramakers w-l at 14:31 UT and H-a at 14:45 UT and Grassmann CaK at 11:19 UT.

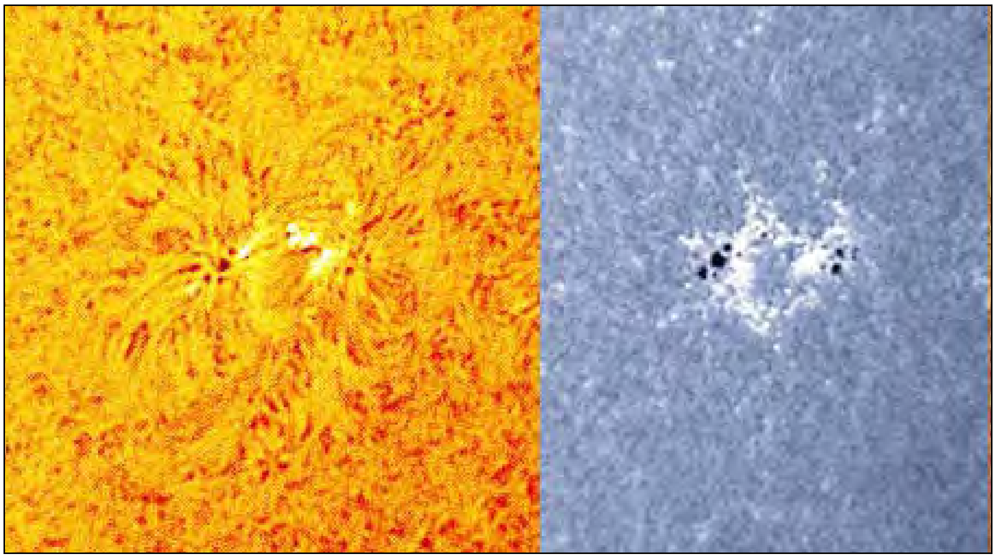


Figure 7. Two images of AR 2729 by Grassmann in H-a (11:04 UT) and CaK (11:15 UT).

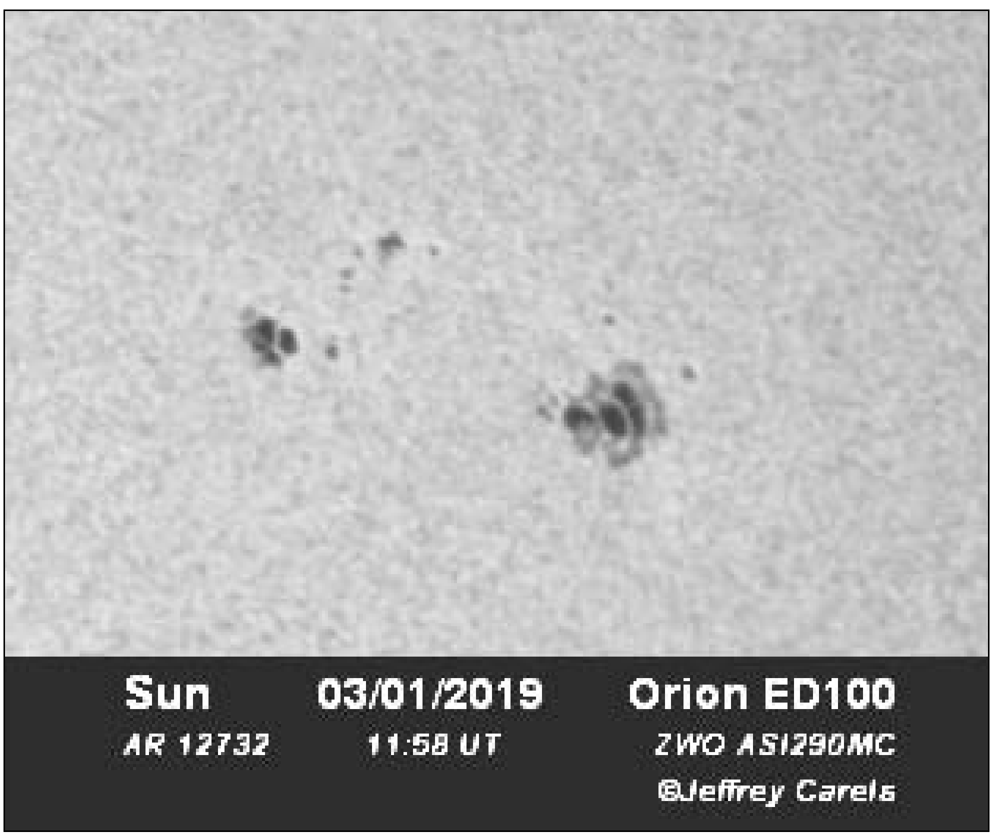


Figure 8. A w-l image by Carels of AR 2732 on 1/3 at 11:58 UT.

Figure 9. A w-l image of AR 2732 by Tyler on 1/4 at 11:43 UT.

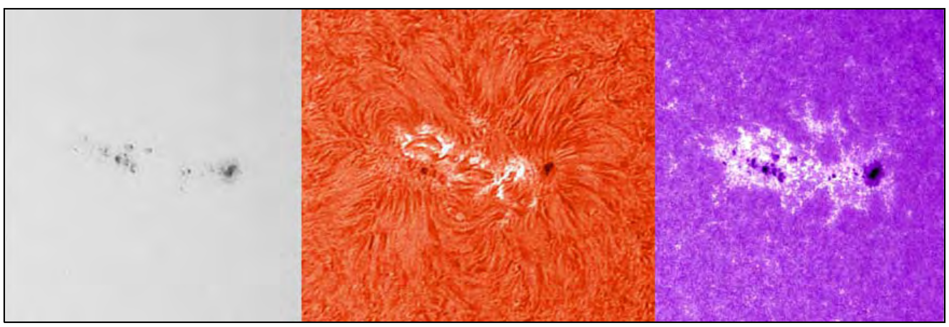


Figure 10. Three images by Eskildsen on 1/26 of AR 2733 in w-l (15:57 UT), H-a (16:00 UT) and CaK (16:06 UT)

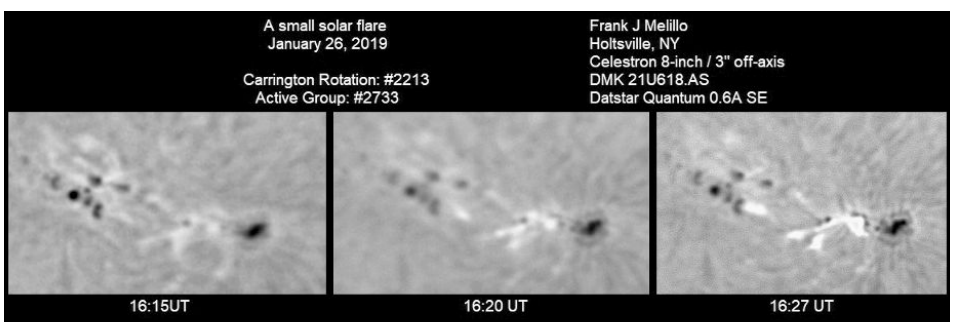


Figure 11. Three H-a images on 1/26 by Melillo of AR 2733 showing the development of a small flare. Times on the image.

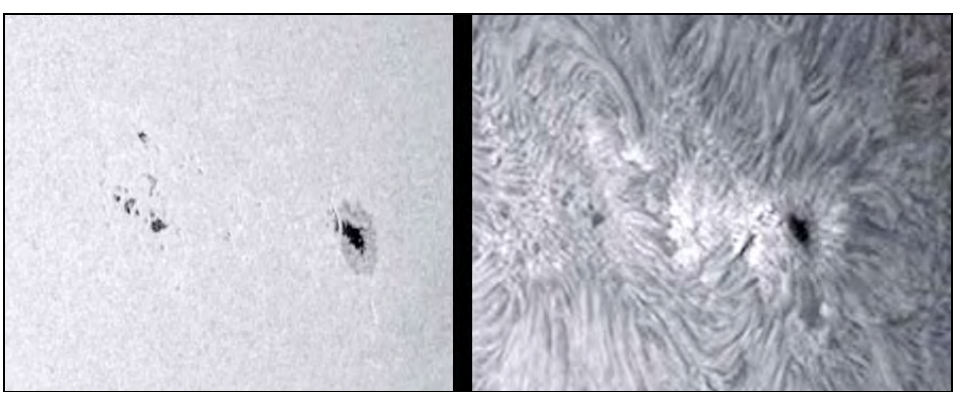


Figure 12. Two images by Tyler of AR 2733 on 01/28 in w-l (10:56 UT) and H-a (11:08 UT)

Carrington Rotation 2214

Dates: 2019 02 13.1708 to 2019 03 12.5007

Avg. R_I = 4.5
High R_I = 18 (3/6)
Low R_I = 0 (18 days)

Activity dropped down a bit in this rotation to an average R_I of 4.5 with a high on 3/6 of 18 and 18 days of zero spots. This was another rotation with only one active region, AR 2734. However, as the plot above shows, there was a single spot group that briefly appeared, too brief to get a designation, on 2/21 that was associated with a large H-a and CaK disturbance.

AR 2734 appeared on 3/6 and attained maximum area the next day. Grassmann and Ramakers both got AR 2734 at its maximum development on 3/6 at 11:25 UT and 15:20 UT respectively (Figures 13 and 14). At this time it was listed as Cro (beta) with an area of only 30 millionths. From this point on it reduced in area and was a diminishing single spot by 3/9.

Ramakers has been watching for Cycle 25 polarities in active regions and in this rotation found three such regions on the Sun at the same time on 3/4 at 19:12 UT. (Figure 15) So it appears the new cycle is gearing up now.

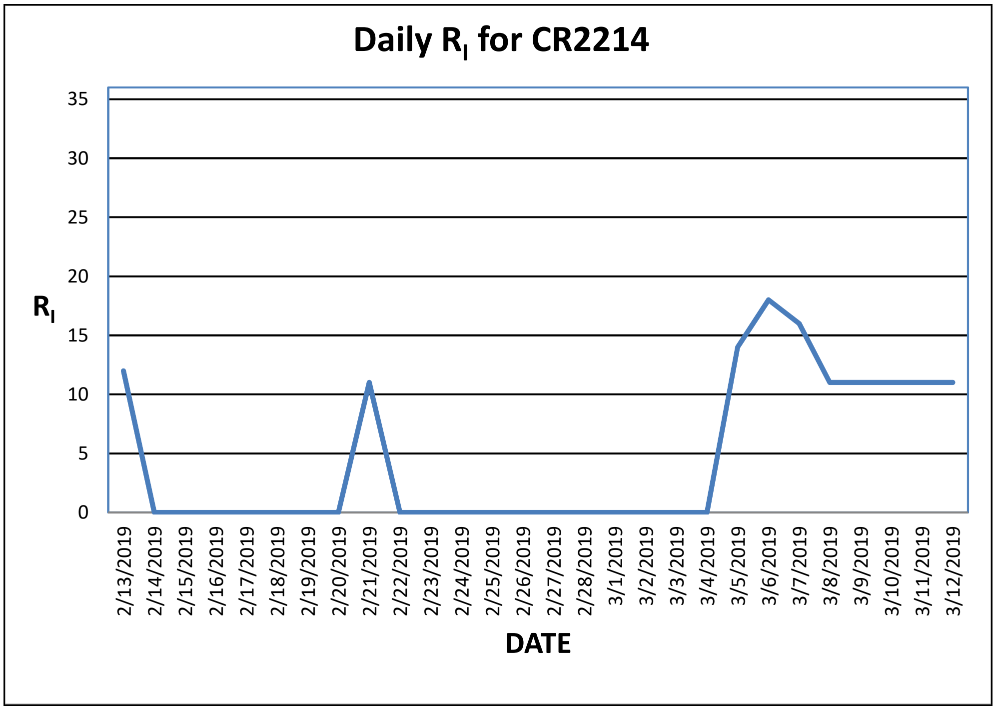
Carrington Rotation 2215

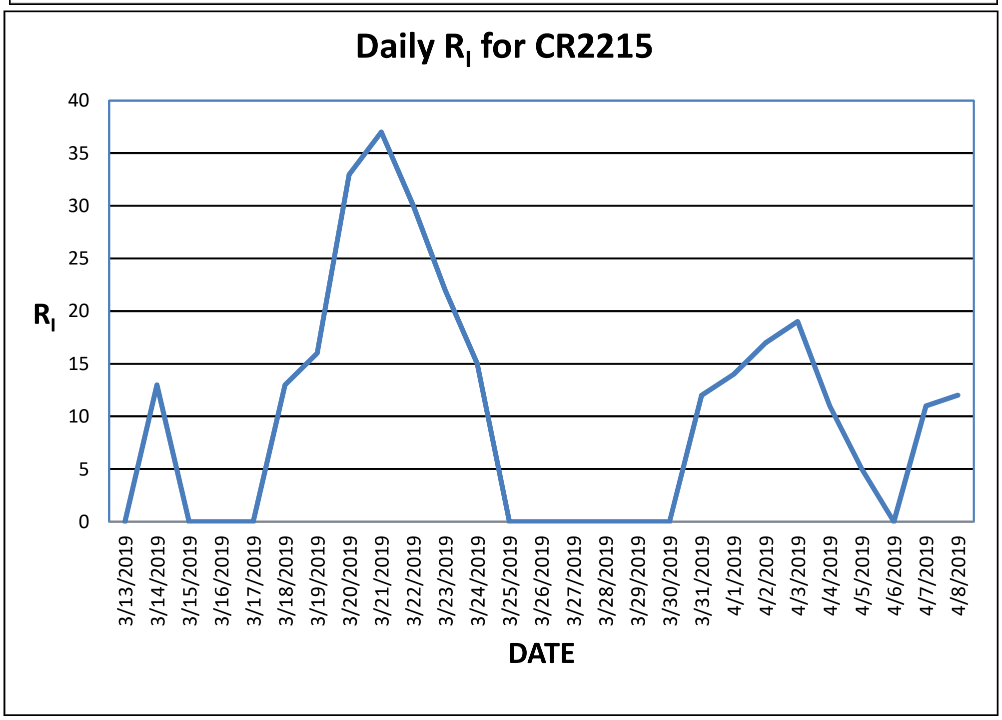
Dates: 2019 03 12.5007 to 2019 04 08.7993

Avg. R_I = 10.4
High R_I = 37 (3/21)
Low R_I = 0 (11 days)
Largest group = AR 2736
Formed on disk on 3/19
Max. area = 420 (3/22)
Left disk on 3/24

This rotation was the high point of the reporting period. The average R_I was 10.4 with a daily high of 37 on 3/21 and 11 days of zero spots, the lowest number of this report. There were four active regions (ARs 2735-38) the largest of which was AR 2736 and it was by far the largest in this whole report reaching a maximum area of 420 millionths on 3/23 as it was and Eki group leaving the visible disk.

AR 2736 first caught in w-l full disk image by Ramakers at 1640 UT on 3/19 as a single tiny umbral spot where other observers saw nothing 3 hours earlier. It was not officially designated until 3/20 and by that time was Cro (beta) of 20 millionths area and quickly grew to Dac (beta) of 50 millionths in a few hours. The evolution of this region is shown on a Ramakers four day w-l image montage. (Figure 16) It can be seen from this that it was 3 condensations of umbral spots on 3/20 with rudimentary penumbrae around each grouping. On 3/21 Eskildsen in a w-l image at showed the leader and follower spots to have become more organized in better





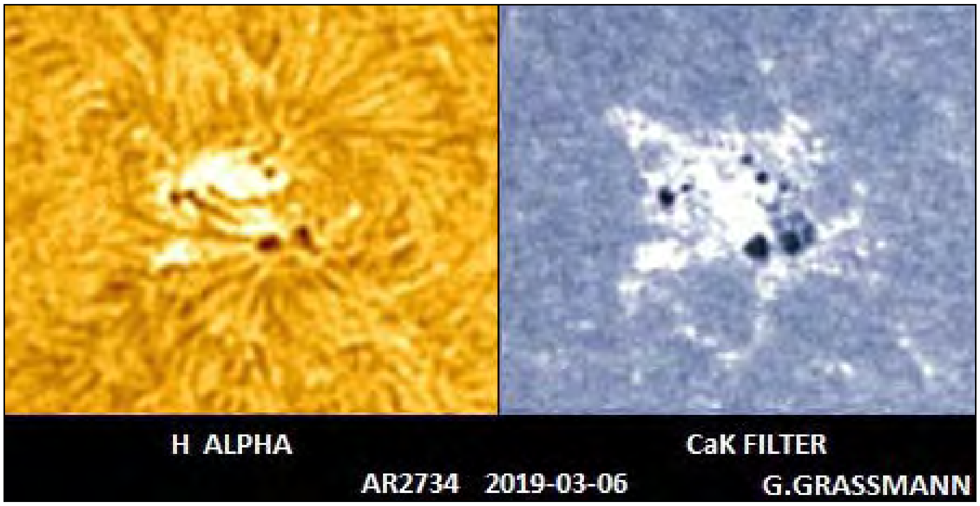


Figure 13. A Grassmann CaK image of AR 2734 on 03/06 at 11:25 UT.

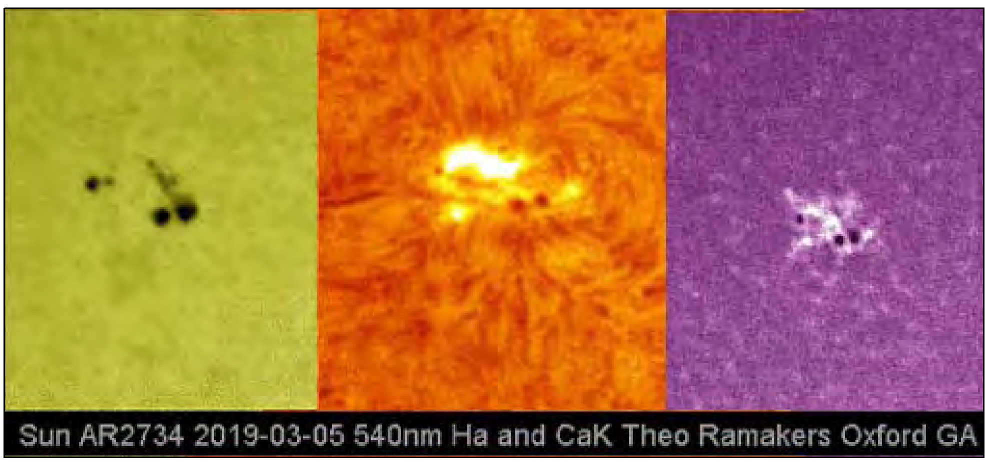


Figure 14 - Three images of AR 2734 by Ramakers on 03/06: w-l (15:16 UT), H-a (15:27 UT) and Cak (15:20 UT).

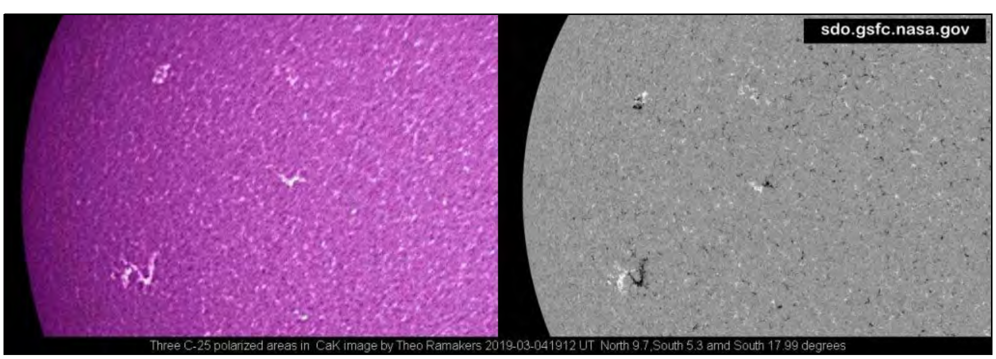


Figure 15. A Ramakers CaK image of the eastern equatorial portion of the sun on 3/4 at 19:12 UT combined with a NASA SDO magnetogram of the same region showing Cycle 25 polarities in the three regions there.

developed penumbrae while the middle spot cluster, still in rudimentary penumbra, was heading for a merger with the leader spot. (Figure 17) There were numerous pores between and south of the spots. The class was still Dac (beta) and an area of 210 millionths with the region producing a B or C class flare every two hours or so. The leader and the middle spots had merged by 3/22 as seen in the Ramakers montage and in a w-l image by Hill at 18:49 UT but there were still some umbral spots and some pores between the leader and follower spots. (Figure 18) This was the day of maximum development with a class of Eki (beta-gamma) and an area of 420 millionths. The follower spots had lost most of their penumbra while the leader's penumbra was more radial and the mass, larger. We have a spectacular CaK view by Viladrich at 12:01 UT showing the most active area to be between the leader and follower spots. (Figure 19). On 3/23 the middle spots were now all gone however some rudimentary penumbral material lingered about several of the follower spots. A combined panel by Grassmann shows the H-a and CaK view of this region as it headed for the limb. (Figure 20). As the top image in the Ramakers panel shows, this was the last clear view we have of this region, and no limb prominences were reported by observers.

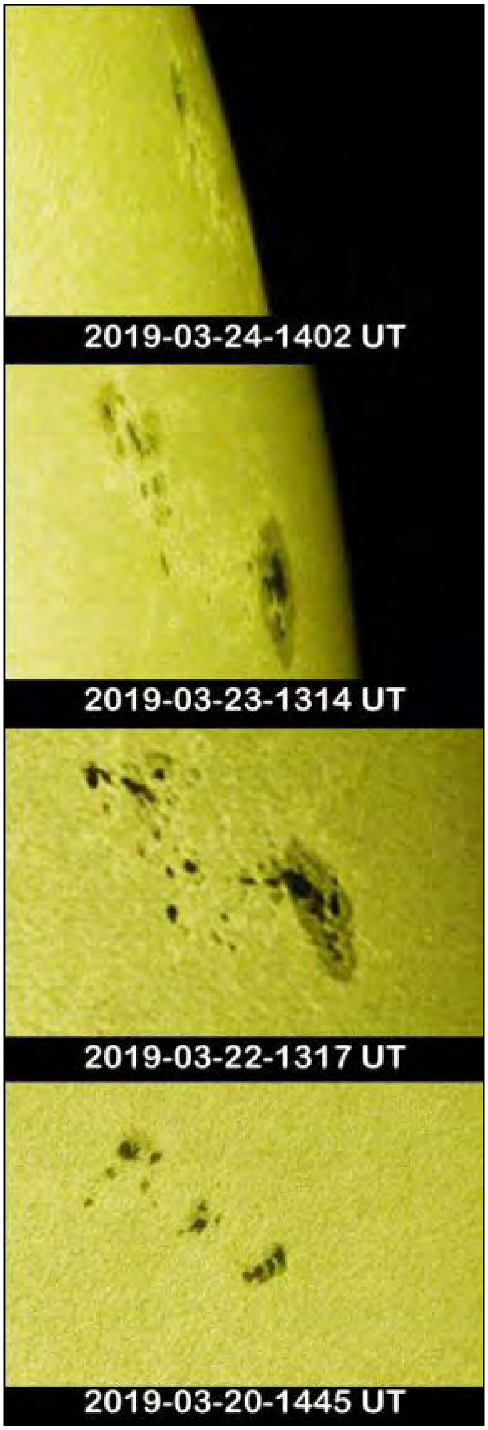


Figure 16. A nice four-day evolutionary w-l montage of AR 2736 by Ramakers. See image for dates and times.

Conclusion

One can certainly see that solar activity is still waning. We still have whole rotations of zero spots ahead of us but as Ramakers shows, Cycle 25 is beginning to make its appearance. As was pointed out in the final CR of this report, it would be useful for observers to note prominence activity over regions as they are on the limb especially in the case of sprays or flares. Please consider doing such observations if you have the proper equipment.

Some observers contributing to the Section Archives are not members of the ALPO. This is unfortunate. While we appreciate such submissions, we cannot include them in the official report as such inclusion needs to be a privilege of membership. Minimum membership is only $18 (US) which includes the digital Journal of the ALPO. For more information go to:

http://www.alpo-astronomy.org/member/ALPO_Standard_Memberships.html

Sunny skies to you all!

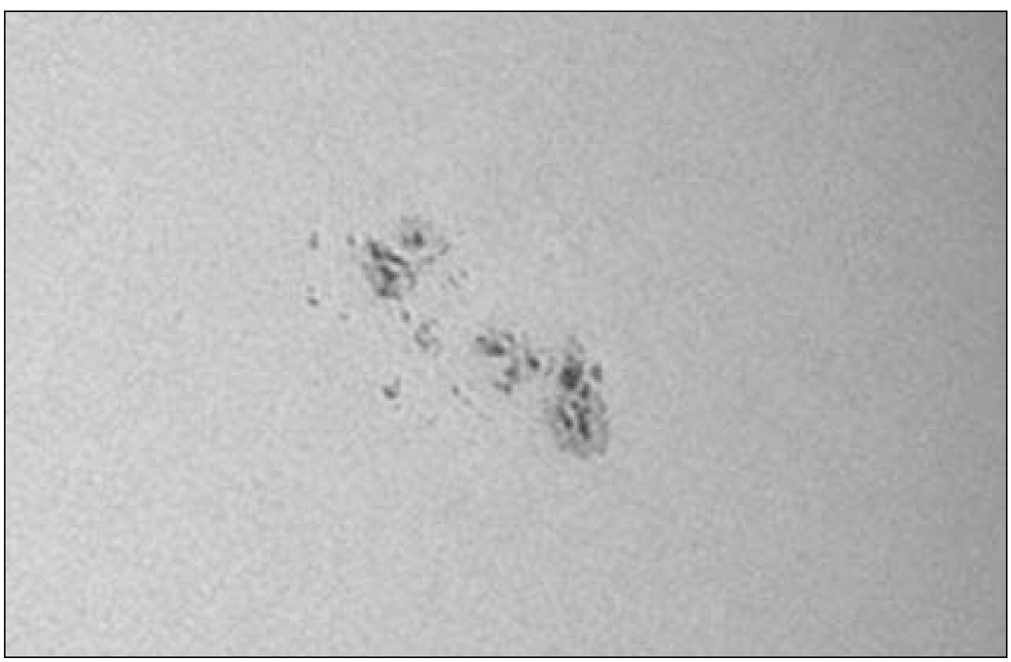
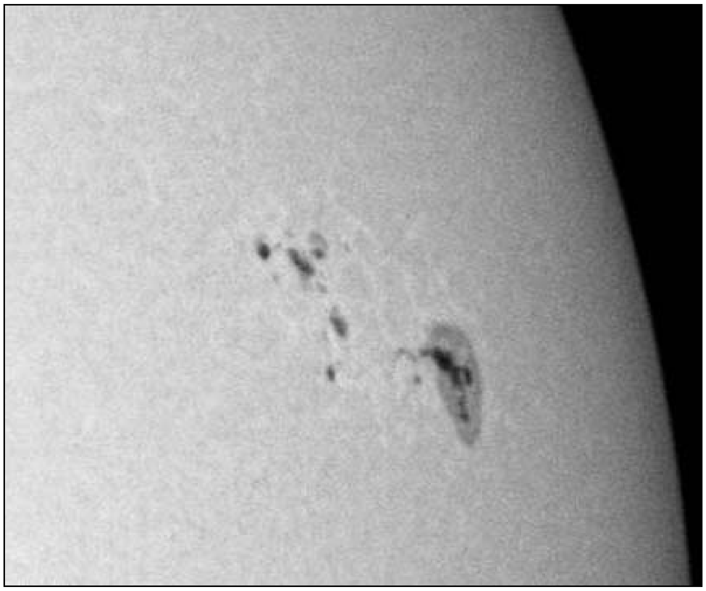
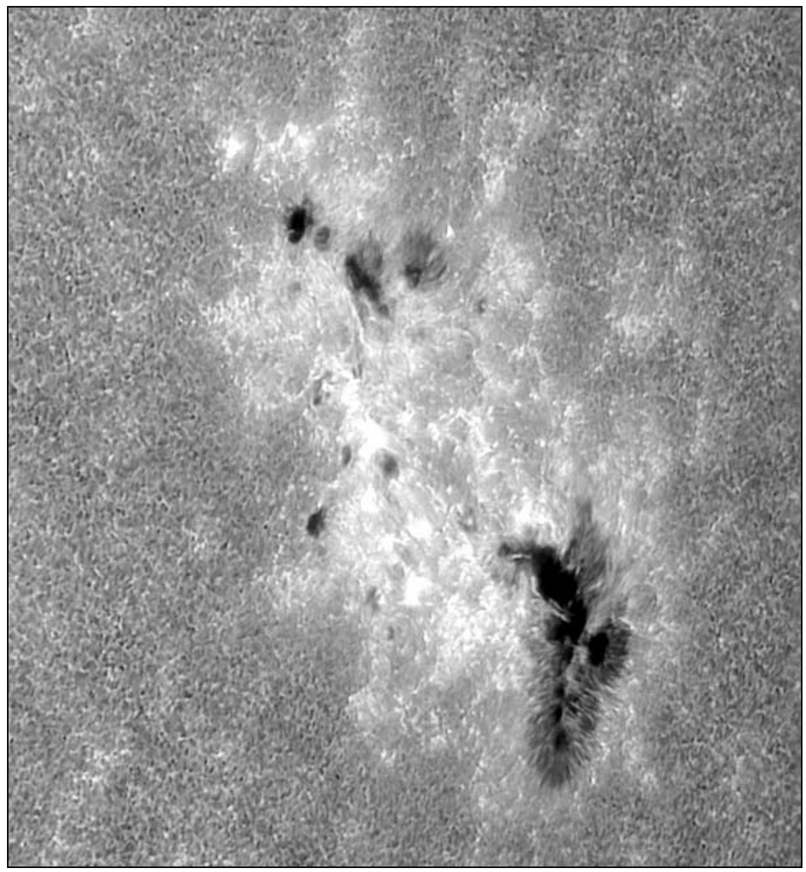


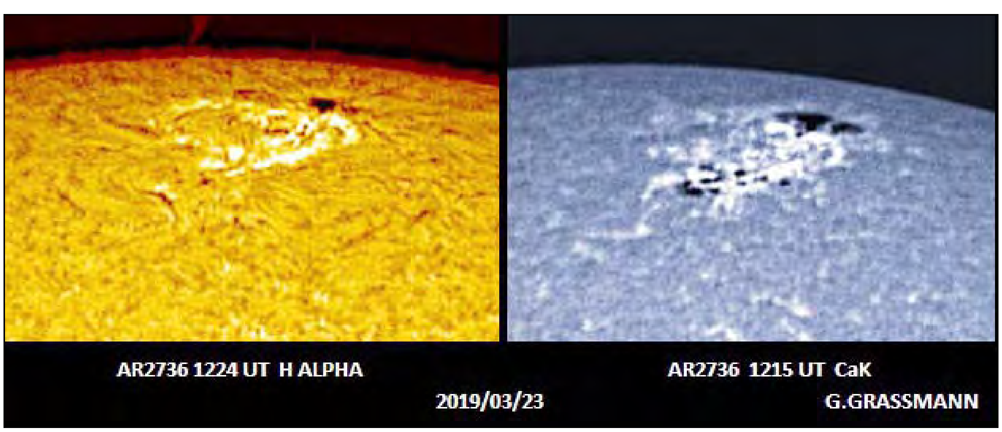
Figure 17. A w-l image of AR 2736 by Eskildsen on 3/21 at 14:05 UT.



(Left) Figure 18. AR 2736 as seen by Hill in w-l on 3/22 18:49 UT.



(Right) Figure 19. A spectacular sub-arc-second CaK image of AR 2736 by VIladrich on 3/22 at 12:01 UT



(Left) Figure 20. A last look at AR 2736 by Grassmann on 3/23 at 12:24 UT (H-a) and 12:15 UT (CaK).

ALPO Solar Section

OBSERVER____

ADDRESS____

DATE/TIME____UT

SEEING____________ CLOUDS____________ WIND____________

APERTURE__________mm FOCAL LENGTH__________mm TYPE______

EYEPIECE_______mm FILTRATION__________________________

OBSERVATION: ***DIRECT*** OR ***PROJECTED***? (CIRCLE ONE)

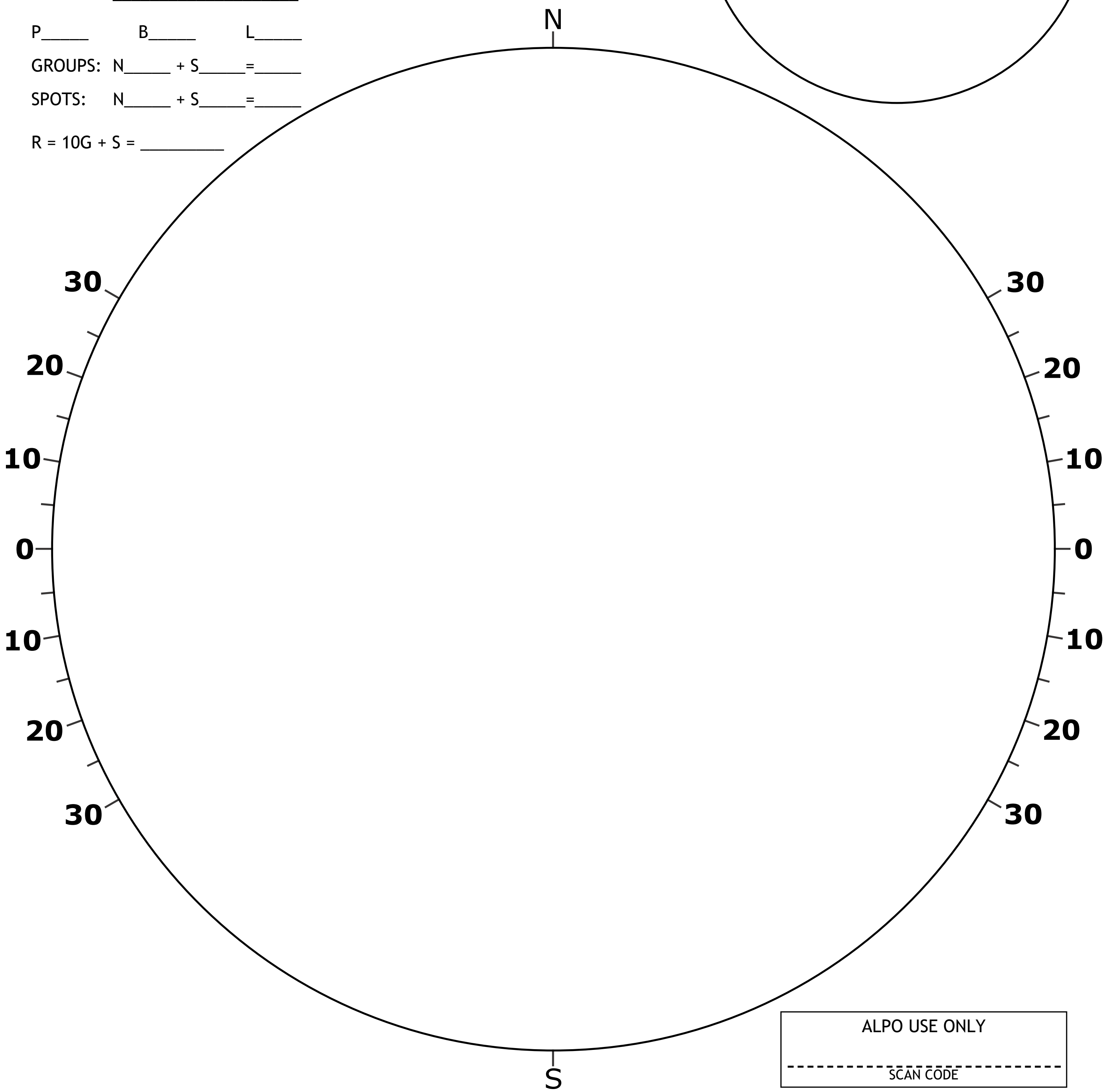
ROTATION______________

P_____ B_____ L_____

GROUPS: N_____ + S_____=_____

SPOTS: N_____ + S_____=_____

R = 10G + S = _________



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ALPO SOLAR SECTION

ACTIVE REGION DRAWING REPORT FORM

SKY/SITE

Date/Time(UT) ____

Rotat.No. ______ A.R. _________ Cen.Meridian ________ Altitude ________

Sky cond. ___________ Seeing _________ Clouds ___________ Wind _______

Observatory type (circle one): roll off roof, roll off bldg., dome, none

TELESCOPE:

Inst. type _____________________ Mounting type _______________________

Clock drive? _____ Type of drive ______________________________________

Full aperture _______________________ Focal length __________ f/_______

Aperture stop/type _______________________ Final f/____________________

Address: Phone No. ( )area code____________________

Papers & Presentations

J and H filter Brightness Measurements of Mars in 2015-2017

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ALPO Mars Section (photometry and polarimetry)
schmude@gdn.edu

Abstract

This paper summarizes 59 J-filter and 63 H-filter brightness measurements of Mars made between late 2015 and mid-2017. The J-filter is sensitive to 1.15-1.35 µm and the corresponding range for the H-filter is 1.5-1.8 µm. The major findings of this work are: 1.) that planet is up to 0.4 magnitudes brighter when the central meridian longitude is near 130° W than between 250° W and 70° W; 2.) the normalized brightness, corrected for the phase angle, is nearly constant at central meridian longitudes of between 250° W and 70° W; 3.) Mars had opposition surges of ~0.10 and ~0.07 magnitudes in the J- and H-filters, respectively at a solar phase angle of 1° and 4.) the I/F value of Mars remains nearly the same for the J- and H-filters. In addition to these findings, the first I/F values in the J- and H-filters are reported.

Introduction

Many factors affect the brightness of Mars. Two of these are planet-encircling dust storms and albedo features. Aleksandrov and Lupishko (1976) reported it brightened by 0.35 magnitudes (or about 35%) during the 1971 planet-encircling dust storm in light with a wavelength of 0.717 µm. Furthermore, Lupishko et al. (2011) reported Mars brightened by ~0.25 magnitudes (or 25 %) during the 1971 planet-encircling dust storm in light with a wavelength of 0.536 µm. Interestingly, both groups reported that planet's ultraviolet brightness (wavelength = 0.366 mm) dropped by ~0.25 magnitudes (or about 25%) during the 1971 planet-encircling dust storm. More recently, Schmude (2002) reported the V-filter magnitude brightened by 0.25 magnitudes in July and August of 2001 during the planet-encircling dust storm that year. Preliminary data show that the planet encircling dust storm caused a ~0.2 magnitude brightness increase on June 25, 2018 in the J and H filters. Albedo features also affect the brightness of Mars. Schmude (2002) reported Mars also underwent a ~0.25 magnitude brightness change as a result of different albedo features facing Earth. More recently, Schmude (2016) reported it was ~0.3 magnitudes (or about 30%) brighter when the central meridian longitude was near 150° W than at 0° W during April 2014-February 2015. This is based on J and H filter measurements.

This paper summarizes brightness measurements made of Mars in the J and H filters. This is a continuation of the study made by Schmude (2016). One goal of this paper is to construct a reflectivity versus longitude graph for Mars. A second goal is to develop a photometric model of that planet for at least some longitudes. A third goal is to present a reflectance (or I/F) curve for measurements in the J and H filters. These curves are useful to astronomers using spacecraft data.

Brightness values are reported on the J and H magnitude system described in Henden (2002, pp. 16-18). Essentially brightness is described in terms of stellar magnitudes instead of units like Watts/m^2. These may be converted to metric units using the appropriate procedures (Shepard, 2017, pp. 62-63). Towards the end of this report, the brightness of Mars is also reported in terms of the amount of light it receives from the Sun (the I/F value).

> **Online Features**
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> 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).

Method

An Optec SSP-4 photometer was used in making all near-infrared measurements (Optec, 2005) along with a 0.09 m Maksutov telescope. The sensitivity of the J and H filters is given in the abstract. Their sensitivity is beyond that of most commercially available CCD cameras and, hence, the measurements here are some of the first brightness measurements ever done of Mars in the 1.15 to 1.8 µm range. Measurements were carried out using all-sky measurements. The comparison stars were usually far from the target. Comparison star magnitudes are from Henden (2002, pp. 16-18). In some cases, check stars were used and the mean results were consistent with literature values to within 0.06 magnitudes. The estimated uncertainty for brightness measurements is 0.05 magnitudes except for those recorded in May 2017 where the estimated uncertainty is 0.1 magnitude since Mars was at such a low altitude then. The low extinction coefficients (0.088 magnitude/air mass and 0.066 magnitude air mass for the J and H filters, respectively) helped reduce uncertainty from extinction.

Table 1. Measured J and H filter Brightness Values of Mars in 2015-2017

Date	J filter	H filter	Date	J filter	H filter
2015			2016		
Oct. 17.41	–0.14	–0.39	May 21.19	–3.82	–4.10
Oct. 22	–0.17	–0.50	May 22.10	–3.95	–4.21
Nov. 13.44	–0.22	–0.47	May 22.14	–3.95	–4.19
Nov. 20.43	–0.32	–0.59	May 23.21	–3.89	–4.17
Dec. 15.44	–0.39	–0.68	May 23.23	---	–4.16
2016			May 23.25	–3.87	–4.07
Jan. 19.42	–0.82	–1.07	May 28.29	–3.81	–4.11
Jan. 29.43	–0.97	–1.32	May 28.32	–3.79	–4.06
Mar. 5.27	–1.61	–1.96	June 1.15	–4.03	–4.27
Mar. 5.33	–1.67	–1.99	June 21.18	–3.39	–3.70
Mar. 5.45	---	–1.97	June 23.16	–3.30	–3.60
Mar. 5.47	–1.66	---	June 24.09	–3.37[a]	–3.67
Mar. 14.41	–1.91	–2.24	July 2.10	–3.33	–3.68
Mar. 17.38	---	–2.39	July 2.15	–3.30	–3.61
Mar. 17.40	–2.03	–2.38	July 8.11	–3.29	---
Mar. 21.31	–2.38	–2.73	July 8.13	---	–3.62
Mar. 21.33	–2.41	–2.69	July 27.14	–2.73	–3.03
Mar. 22.44	–2.27	–2.59	Aug. 13.06	---	–2.91
Mar. 30.37	–2.43	–2.72	Aug. 13.08	–2.65	---
Mar. 30.40	–2.45	–2.77	Aug. 26.05	–2.10	–2.45
Mar. 30.42	---	–2.83	Aug. 31.06	–2.14	–2.41
Apr. 6.30	–2.54	–2.82	Sept. 6.06	–2.03	–2.36
Apr. 6.33	–2.56	–2.78	Sept. 9.07	–2.01[a]	–2.37[b]
Apr. 27.46	–3.36	–3.67	Sept. 15.04	–2.06[a]	–2.30
May 5.36	–3.56	–3.84	Sept. 16.04	–2.02	–2.42
May 5.39	–3.57	–3.89	Sept. 17.06	–2.05	–2.34
May 6.14	–3.50	–3.69	Sept. 20.04	–2.17	–2.38
May 6.17	–3.40	–3.66	Sept. 24.05	–1.97	–2.17
May 7.25	–3.40	–3.70	Sept. 29.03	–1.68	–1.92
May 7.29	–3.43	–3.73	2017		
May 11.12	–3.57	–3.82	Jan. 14.02	–0.76	–1.07
May 11.18	–3.57	–3.86	May 7.05	---	–0.38
May 14.10	–3.58	–3.97	May 10.06	–0.04	–0.34
May 14.13	–3.67	–3.91	May 26.06	---	–0.47
May 21.18	–3.85	---			

[a] Large data scatter

[b] Only two measurements made; clouds moved in preventing a third measurement.

Results

Table 1 summarizes all J and H filter measurements made during the 2015-2017 apparition. These were corrected for atmospheric extinction and color transformation using the procedures in Hall and Genet (1988, p. 199-200).

Distances and the phase angle affect brightness. Therefore, before the goals of this paper can be accomplished, corrections for changing distance and phase angle must be applied to the data.

All measurements in Table 1 were corrected for distance (normalized) using:

$$X(1, \alpha) = Mx - 5 \log [r \times \Delta] \quad (1)$$

In this equation, X is either the J or H filter, M_X is the measured J or H filter magnitude, r is the Mars-Sun distance and Δ is the Mars-Earth distance. Both r and Δ are in astronomical units (au). The X(1, α) is corrected for distance and is the normalized magnitude. An example is worked out for Jan. 19.42, 2016. At that time, the J-filter magnitude was -0.82, r = 1.649 au and Δ = 1.500 au.

$$J(1,\alpha) = -0.82 - 5\text{Log}[1.649 \times 1.500]$$

$$J(1,\alpha) = -0.82 - 5\text{Log}[2.4735]$$

$$J(1,\alpha) = -0.82 - 1.97$$

$$J(1,\alpha) = -2.79$$

Therefore, if Mars was 1.0 au from both the Earth and Sun, its brightness would have been -2.79 magnitude on that date.

Corrections for phase angle should also be made. One complicating factor, however, is Mars had a 0.3 magnitude change as it rotated in 2014-2015. This will lead to a large scatter if all data are combined. Therefore, the data were placed into 12 central meridian longitude groups starting with 10° - 40° W to reduce the effects of longitude-dependent brightness changes. (The central meridian longitude corresponds to the longitude at the disk center as seen from Earth.) Afterwards, the normalized magnitudes for each filter were plotted against the phase angle and fit to a linear equation in the same way as in Schmude (2016, p. 48). (I did not include measurements made at phase angles below 5.0° because of possible interference from the opposition surge.) The resulting slope (phase coefficient) describes how the normalized magnitude changes with the phase angle. The J(1, 0) and H(1, 0) magnitudes are the extrapolated normalized magnitudes to a phase angle of 0° without the opposition surge. Figure 1 shows a sample graph for the H filter for the 10° W – 40° W interval. The points were fit to a linear equation using Microsoft Excel. The y-intercept is -3.488 in Figure 1 and represents the normalized magnitude extrapolated to a phase angle of 0°. The slope of the line, 0.0129, has units of

Table 2. Summary of Measured Normalized Magnitudes X(1, 0) and Phase Coefficients in the J and H Filters During 2015-2017

Longitude Range (°W)	J(1, 0) Magnitudes	Phase Coeff. Mag./degree	H(1, 0) Magnitudes	H(1, 0) Mag./degree
10-40	-3.22	0.014	-3.49	0.013
40-70	-3.34	0.017	-3.58	0.016
70-100	-3.59	0.023	-3.83	0.019
100-130	-3.53	0.016	-3.92	0.019
130-160	-3.54	0.014	-3.82	0.015
160-190	-3.48	0.015	-3.82	0.016
190-220	-3.42	0.015	-4.02	0.023
220-250	-3.28	0.012	-3.57	0.011
250-280	-3.45	0.019	-3.63	0.015
280-310	-3.26	0.014	-3.57	0.014
310-340	-3.27	0.013	-3.55	0.013
340-10	-3.40	0.017	-3.55	0.014
Mean	**-3.40**	**0.0156**	**-3.70**	**0.0155**

Table 3. A Summary of Brightness Models for Mars and Standard Errors for These Models

Parameter	Filter	Polynomial coefficients				Standard error
		a	b (deg.$^{-1}$)	c (deg.$^{-2}$)	d (deg.$^{-3}$)	
J(1, α)	J	–3.33	2.75	–7.56	11.2	0.046
H(1, α)	H	–3.57	2.10	–5.15	8.33	0.049
I/F	J	0.30	–0.634	1.65	–2.11	0.0086
I/F	H	0.28	–0.461	1.02	–1.38	0.0088

NOTE:
Brightness is expressed either as $X(1, \alpha) = a + b(\alpha/100) + c(\alpha/100)^2 + d(\alpha/100)^3$ (magnitude scale) or as $I/F (X) = a + b(\alpha/100) + c(\alpha/100)^2 + d(\alpha/100)^3$ (reflectance scale). In these equations X is either the J or H filter, α is the phase angle in degrees and a, b, c and d are listed in the table above. The standard error of estimate for the J(1, α) and H(1, α) parameters are in stellar magnitudes.

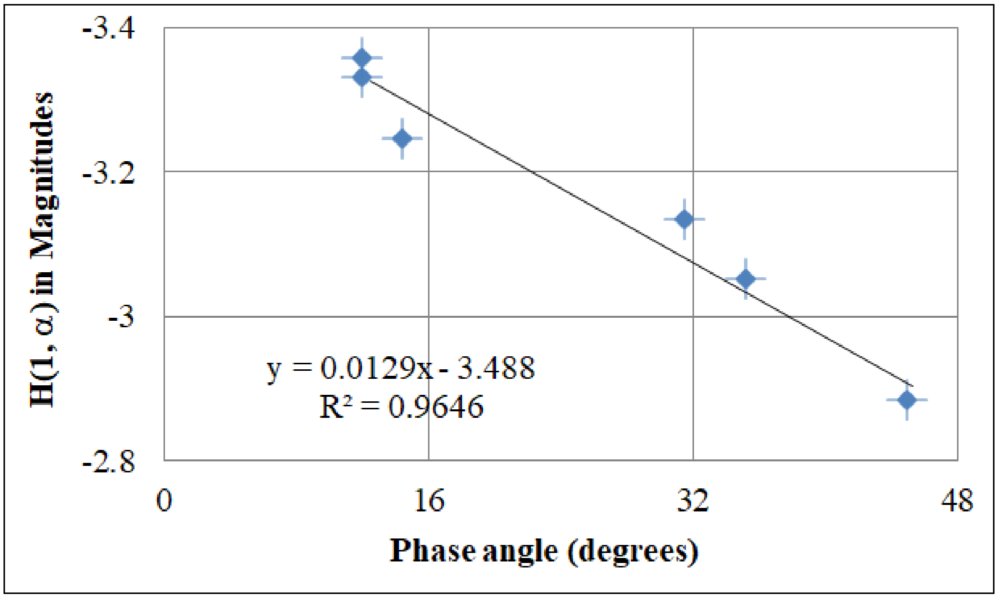


Figure 1: The H(1, α) values are plotted against the solar phase angle. Only values collected when the central meridian longitude was between 10° W and 40° W are included.

magnitude/degree and describes how the H(1, α) value changes with the phase angle. This is called the phase coefficient (Shepherd, 2017, p. 187). I felt there was no need to fit the data to higher order polynomial because of the small number of measurements.

Table 2 summarizes phase coefficients along with the J(1, 0) and H(1, 0) values. Mean phase coefficient values for the J and H filters are 0.0156 and 0.0155 magnitudes/degree, respectively. Therefore, the phase angle dependence has been evaluated. The only thing left before constructing the brightness versus longitude graph is to correct for different phase angles. Essentially, the J(1, 0) and H(1, 0) values for each value in Table 1 are computed using:

$$J(1,0) = M_J - 5.0 \log[r \times \Delta] - 0.0156\alpha \quad (2)$$

$$H(1,0) = M_H - 5.0 \log[r \times \Delta] - 0.0155\alpha \quad (3)$$

where α is the phase angle in degrees and M_J/M_H are the measured J/H magnitudes. Therefore, any change in the J(1, 0) value should only be caused by the disk albedo. The J(1, 0) and H(1, 0) values are plotted against the central meridian longitude and these are illustrated in Figure 2. The results are similar to those in the previous apparition (Schmude, 2016, p. 47). As in the previous apparition, Mars is dimmest for 250° W to 70° W. The brightness difference between maximum and minimum is ~0.4 magnitudes (or about 40 %).

One cannot plot Mars' normalized magnitudes and fit them to a polynomial equation because it varies by 0.3 magnitudes or more at it rotates. Furthermore, planet encircling dust storms may also affect brightness measurements. Therefore, to construct a brightness versus phase angle graph, one must search for a longitude range where the brightness is nearly constant under nearly dust-free conditions. The J(1, 0) and H(1, 0) values appear to be nearly constant at central meridian longitudes of between 250° W and 70° W. Therefore, I plotted the J(1, α) and H(1, α) values made in this range versus the phase angle. See Figure 3. Data from 2014-15 are included. The data were fit to a cubic polynomial equation of the form:

$$X(1,\alpha) = a + b(\alpha/100) + c(\alpha/100)^2 + d(\alpha/100)^3 \quad (4)$$

where a, b, c and d are coefficients to be determined and X is either the J or H filter. Table 3 summarizes the coefficients and standard errors of estimate. The standard errors were computed in the usual manner (Larson and Farber, 2006, p. 486).

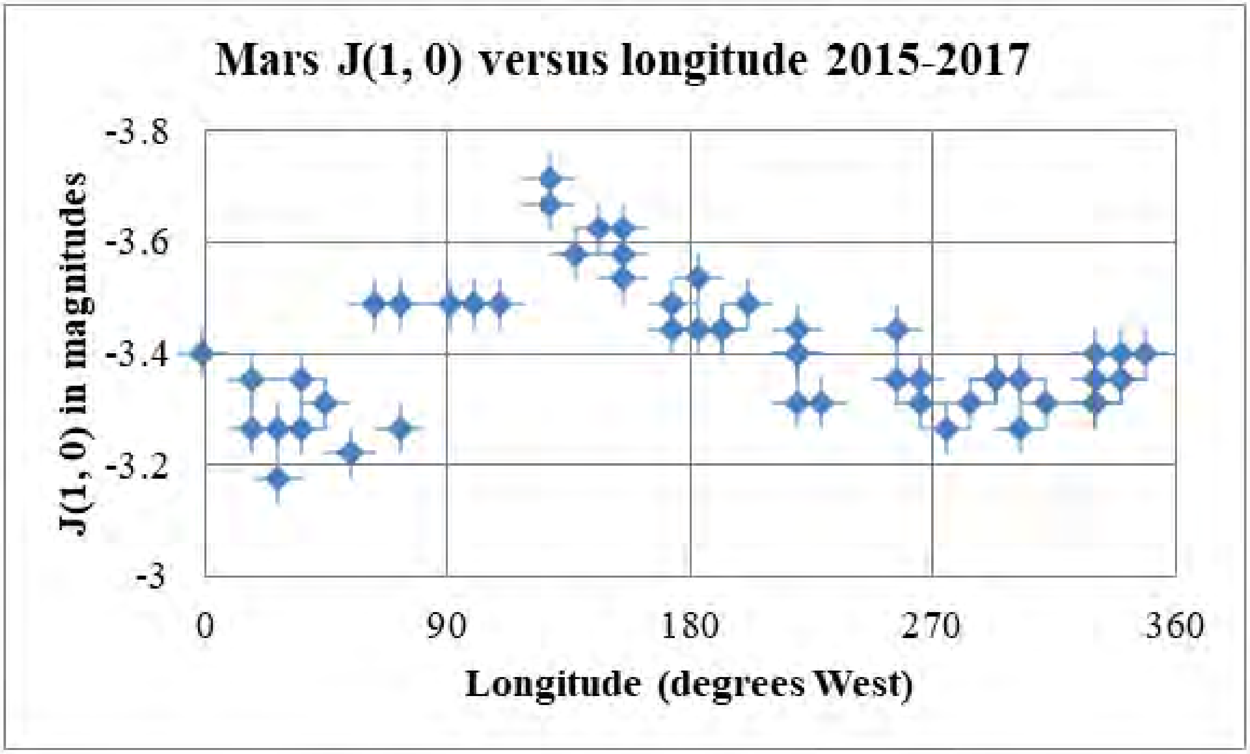
The results in Figure 3 were converted to I/F values in the same way as is described in Domingue et al. (2010, p. 107). In essence, the I/F value is proportional to the light reflected form the surface of a planet and the light incident on the surface from the Sun (Domingue et al., 2011, p. 1856). This quantity requires a value of the solid angle of Mars at 1.0 au. A radius of 3389.508 km is used (Carr, 2006, p. 16) in the solid angle equation, Ω = AREA/R2 where Ω is the solid angle in Steradians, AREA is the area of Mars' disc in km^2 and R is 1.496×10^8 km (Shepard, 2017). The solid angle of Mars, at a distance of 1.0 au, is 1.613×10^{-9} Steradians. The resulting I/F values plotted against the phase angle are illustrated in Figure 4. Normalized J and H filter magnitudes for the Sun were taken from Roddier et al. (2000, p. 306). Bear in mind this figure is only valid for central meridian longitudes between 250° to 70° W under nearly dust-free conditions. The I/F values in Figure 4 were fit to a cubic equation of the form:

$$I/F = a + b(\alpha/100) + c(\alpha/100)^2 + d(\alpha/100)^3 \quad (5)$$

where a, b, c and d are coefficients determined from a least squares routine. The resulting coefficients for the J and H filters are summarized in Table 3 along with the standard error of estimate.

Discussion

The phase coefficient of Mars deviates from a linear trend. As can be seen in Figure 3, it has a non-linear brightness increase at phase angles near 0°. This non-linear brightening is the opposition surge. This is the first evidence of an opposition surge for Mars in the J and H filters. The J(1, α) and H(1,α) values also have a non-linear downturn at phase angles exceeding 40°. Therefore, a cubic



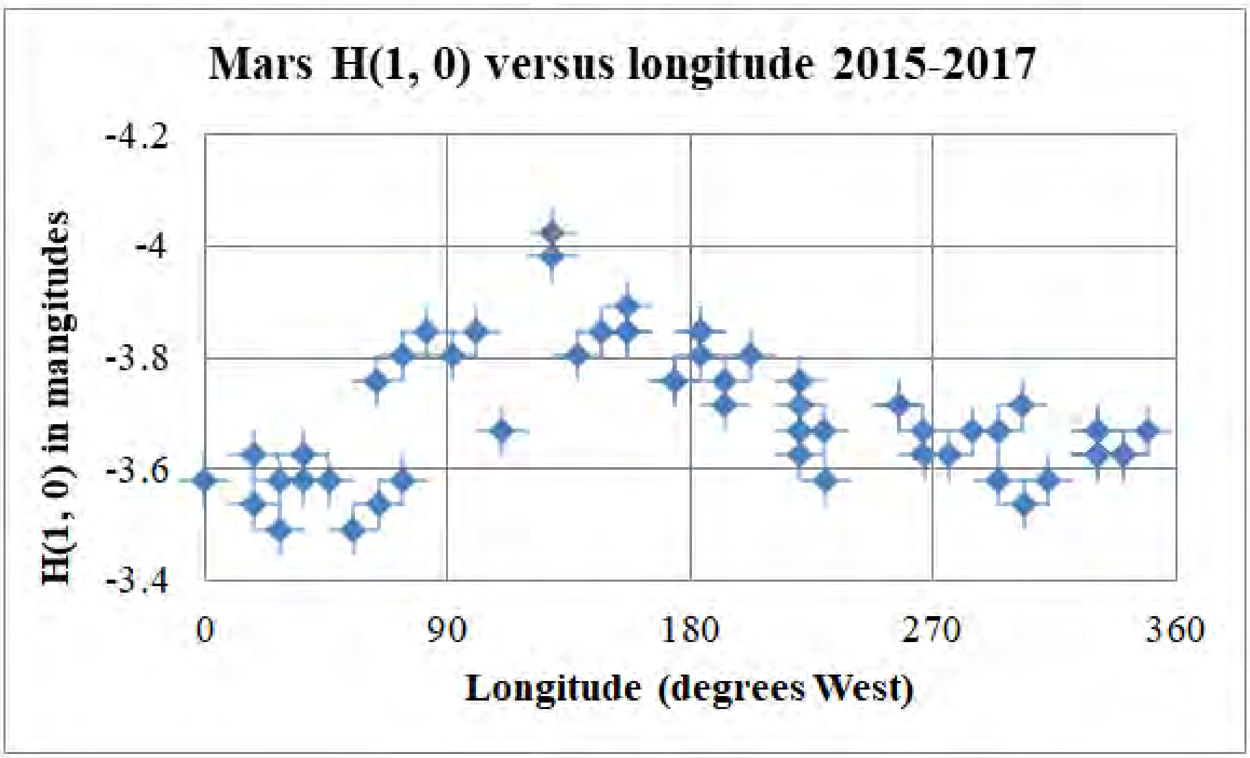
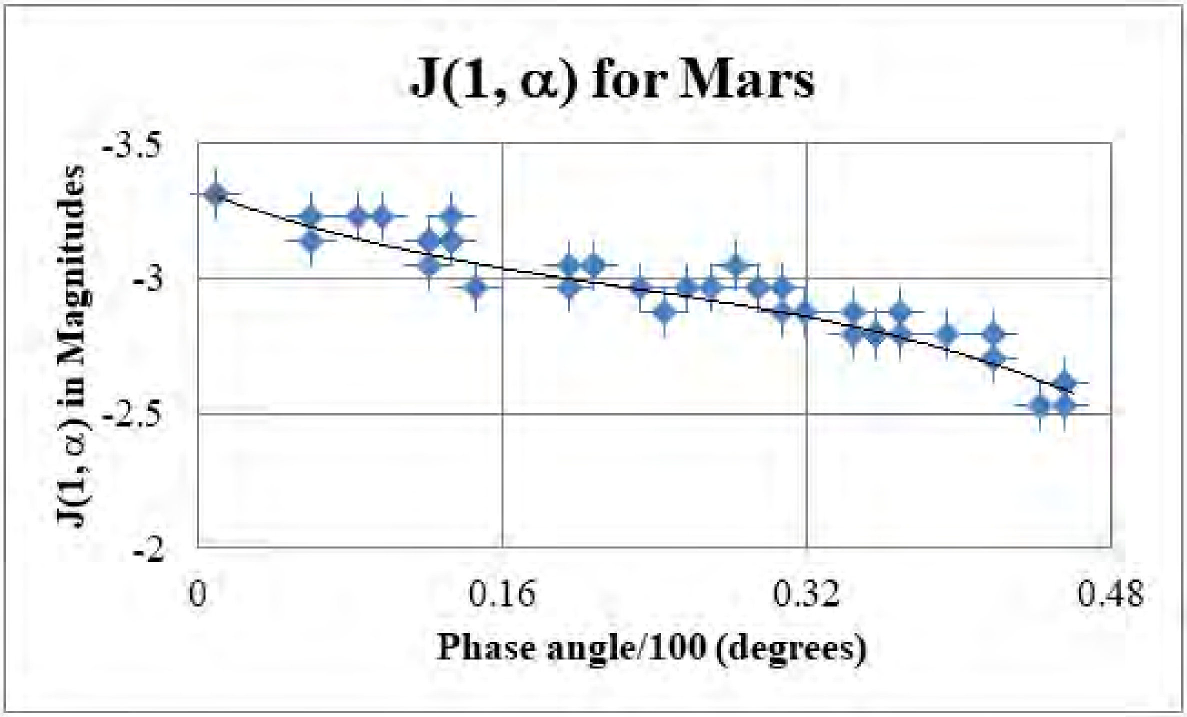


Figure 2: Graphs of the J(1, 0) and H(1, 0) values of Mars measured between Oct. 2015 and May 2017 plotted against the longitude of the central meridian. The central meridian is the longitude of the center of Mars' disk as seen from Earth.



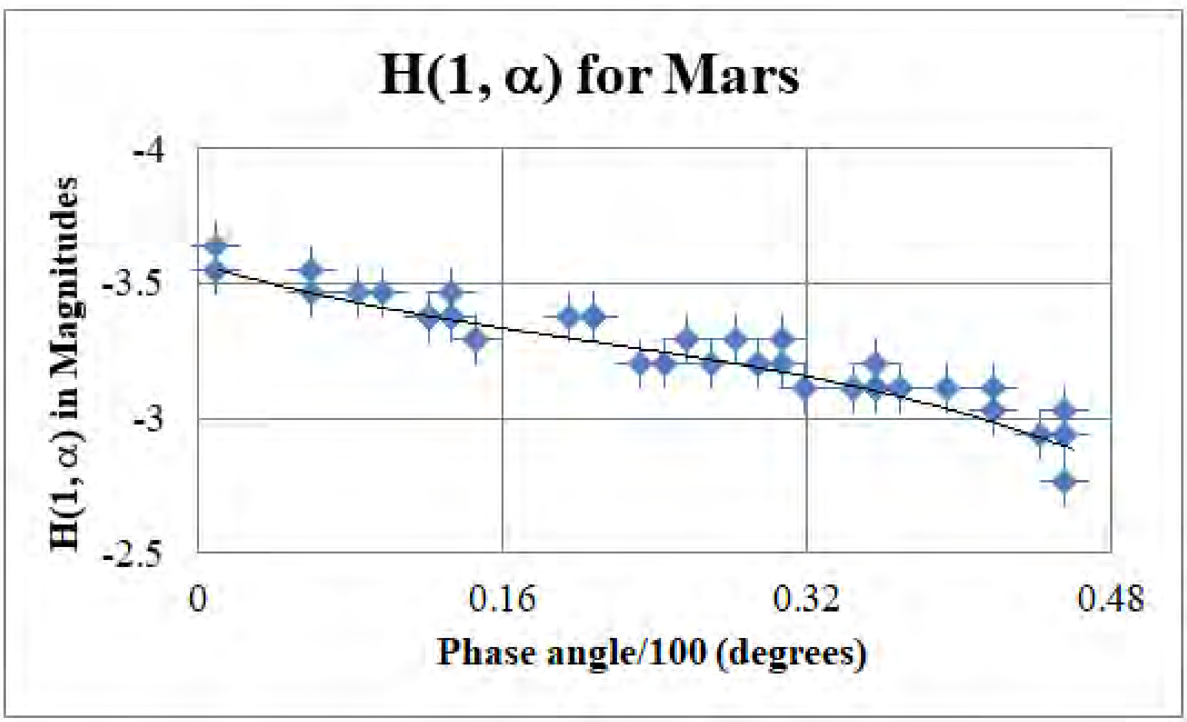
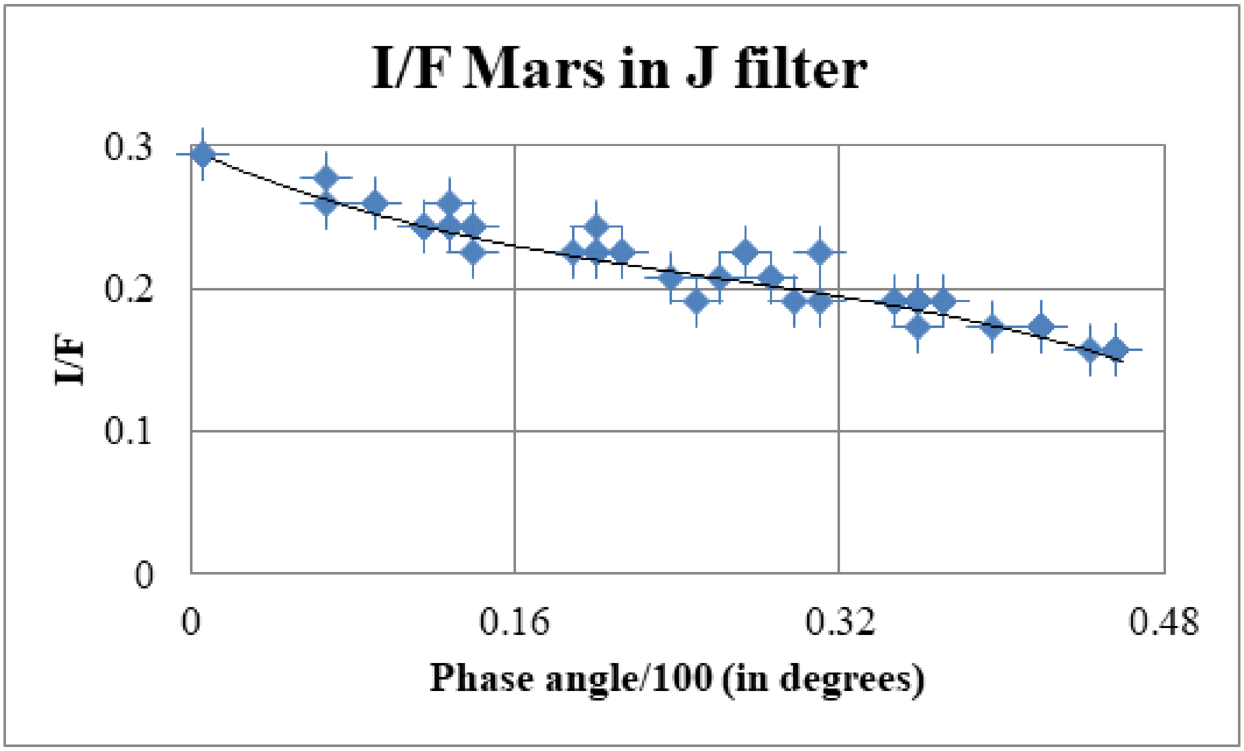


Figure 3. Graphs of the J(1, α) and H(1, α) values plotted against the phase angle. Only normalized magnitude made at central meridian longitudes of between 250° and 70° W are included. The phase angle is measured between the Sun and the observer from the center of Mars. The curve corresponds to the cubic equation with coefficients in Table 3. Data from 2014-15 and 2015-17 are included in these graphs.



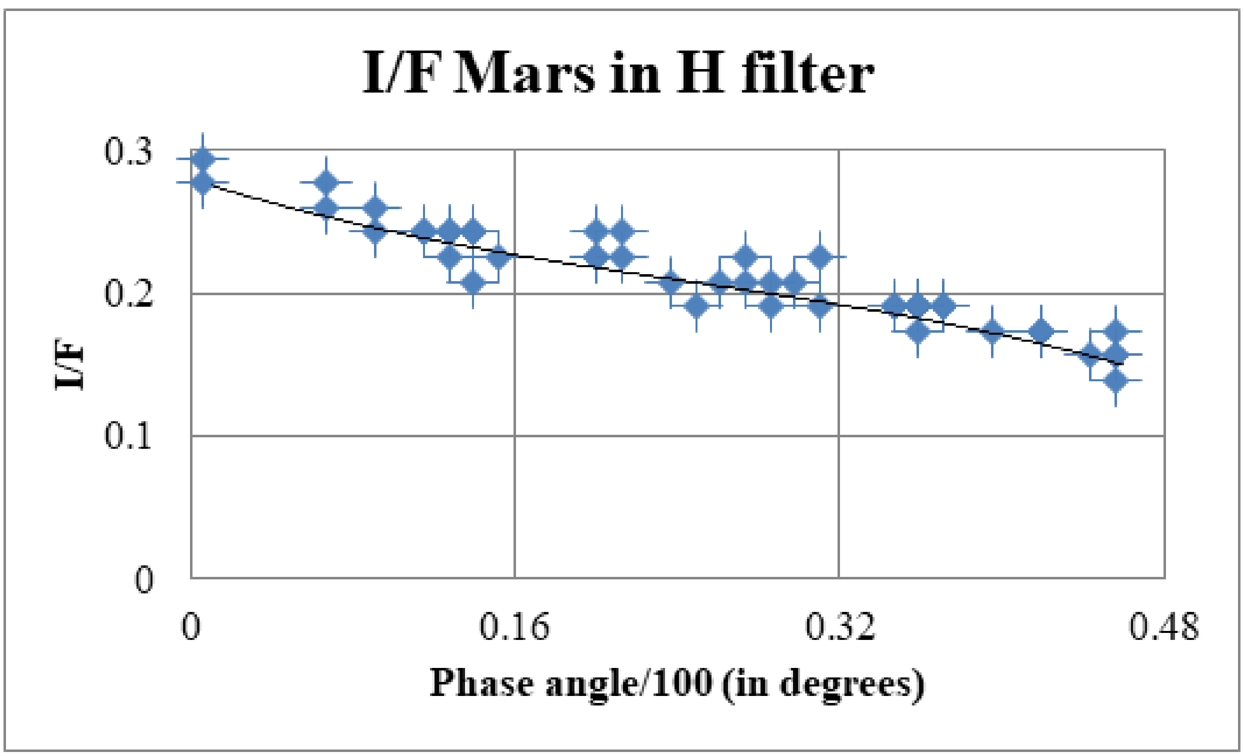


Figure 4. Graphs of the I/F for the J (top) and H (bottom) filters plotted against the phase angle. The phase angle is defined in Figure 3. The curve corresponds to the cubic equation with coefficients in Table 3. Data from 2014-15 and 2015-17 are included in these graphs.

equation is an appropriate model for the data.

The 2015-2017 geometric albedos of Mars were 0.32 ± 0.02 and 0.31 ± 0.02 for the J and H filters, respectively. These were computed from mean J(1, 0) and H(1, 0) values of -3.31 and -3.60 (based on equations 3 and 4). These are based on measurements made between 250° W and 70° W. Since Mars has an opposition surge, values of 0.10 and 0.07 magnitudes were subtracted from the average J(1, 0) and H(1, 0) values, respectively. The procedure in Mallama et al. (2007, p. 412) was used along with normalized Sun magnitudes of -27.86 and -28.17 for the J and H filters, respectively (Roddier et al., 2000, p. 306).

The trend of Mars reflecting more light as wavelength increases does not hold for the J and H filters like it was for wavelengths below 1.0 µm (Mallama, 2007, p. 413). In fact the geometric albedo may be less in the H than the J filter.

The J(1, 0) and H(1, 0) versus central meridian longitude graphs for 2015-2017 are similar to the corresponding graphs for the previous apparition (Schmude, 2016, p. 47). There are, however, minor differences. One difference is that in the current apparition there is a larger difference between brightest and dimmest magnitude (0.4 magnitudes versus 0.3 magnitudes in the previous apparition). The brightness peaks near 130° W in the current apparition versus 150° W in the previous one. Finally the phase angle coefficients in the current apparition 0.0155/0.0156 magnitude/degree are 11 % larger than those in the previous apparition. Part of the difference may be attributed to the difference in the sub-Earth latitude which is the latitude of the disk center as seen from Earth. During mid-2014 it was 25° N whereas in May 2016 it was 11° N. More measurements need to be made at other disk orientations.

Acknowledgement

The writer would like to thank Gordon State College for a Faculty Development Grant in 2014 which enabled him to purchase the SSP-4 photometer.

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Papers & Presentations

Using an IR Blocking Filter When Observing Mars

By Roger Venable,
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Mars went through conjunction with the Sun on September 2, 2019, ushering in a new apparition. This will be a good, perihelic apparition. A "pre-apparition report" will be published in this Journal soon.

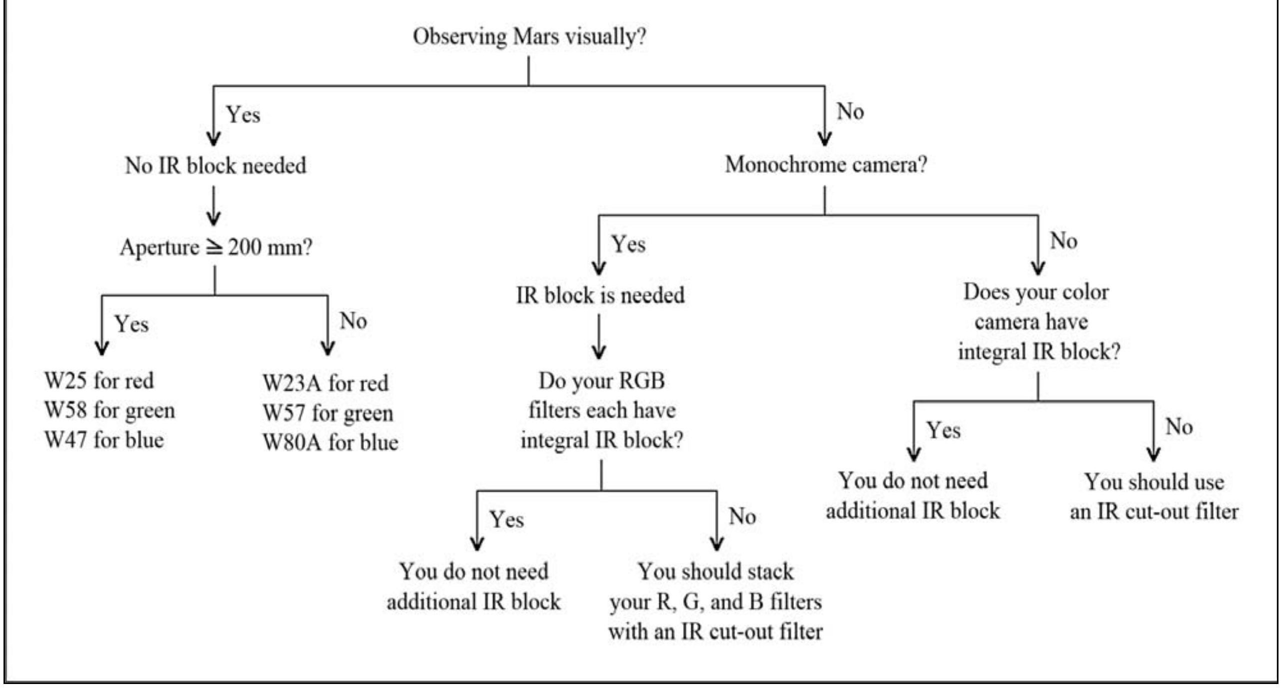
Recently it has come to our attention that the principles regarding the circumstances in which a Mars observer should use an infrared (IR) blocking filter have not been made entirely clear. I am including here a chart of a decision tree that explains the general principles.

Visually, red filters show the albedo features on Mars in high contrast. They also show most dust storms as bright areas, slightly brighter than the red "desserts" and often obscuring the expected albedo features. Deep blue filters show clouds brightly, but usually mask the albedo features because blue light is scattered by the atmosphere. A green filter may show bright areas that are not seen in blue because they are frosts, or low clouds or hazes, too low for blue light to penetrate well. The polar caps can be seen well with a red, green, or blue filter, but the polar hood clouds are best seen in blue. Since the eye is insensitive to IR, an IR blocker does not contribute to the visual observation of the planet.

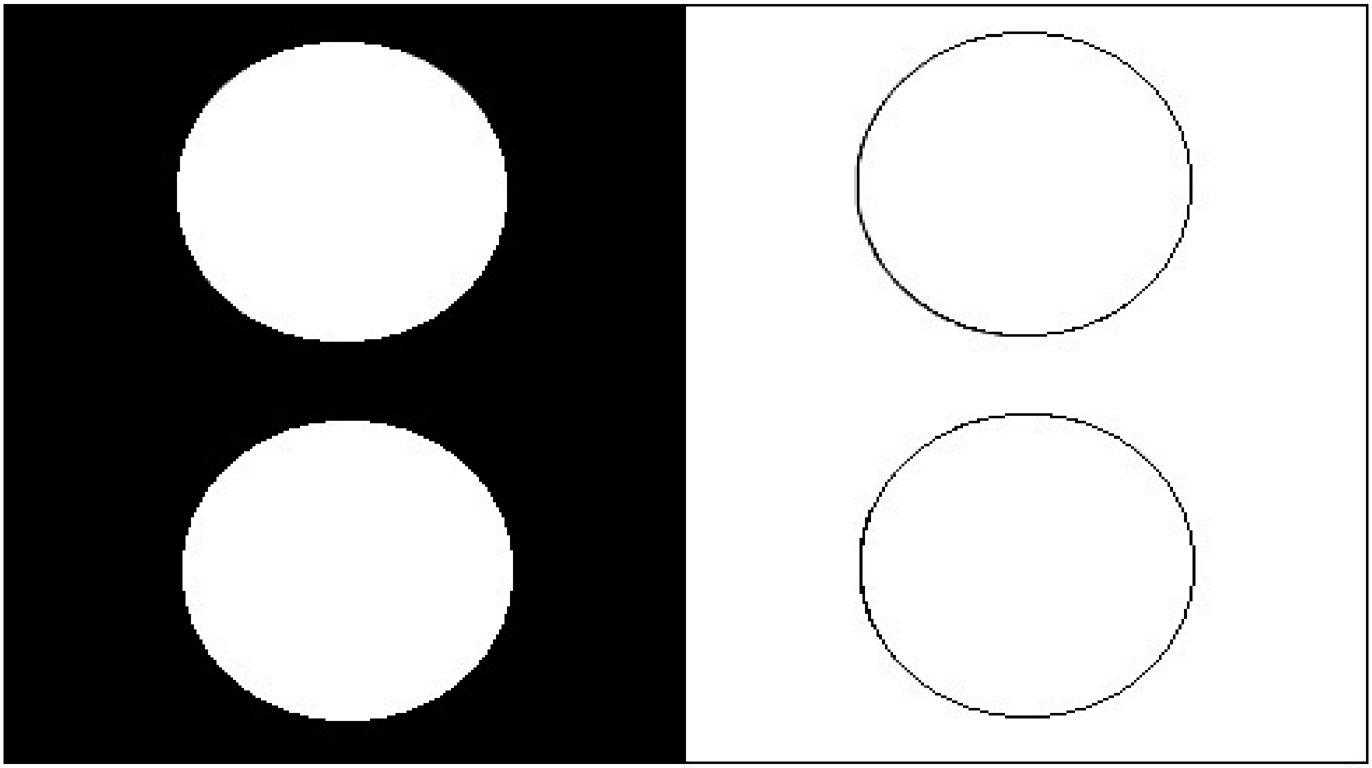
When imaging the red planet, an observer needs to know whether his camera admits IR light to the sensor. Some color cameras block IR, and some do not. Most monochrome cameras admit IR, and some RGB filter sets pass IR but some do not. If IR strikes the sensor, the red channel will show red plus IR, the green channel will show green plus IR, and the blue channel will show blue plus IR. That situation will not only make color balance most difficult, but it will frustrate the observer in his attempt to differentiate dust, frosts, and clouds. IR renders the albedo features in high contrast, but it penetrates atmospheric dust better than red, rendering dust storms less evident than they are in red.

Here is a tip regarding color balance. Using your planetary camera, take some daylight (outdoors) images of a colorful scene with the same IR cut-out filter that you use for Mars. Do this whether you use a color camera or a monochrome camera. Adjust the color balance of the images while you are looking at the scene you just imaged. After matching your monitor's presentation of color to the actual colors of the scene, make a note of the color adjustment settings, and use them on Mars. You'll be getting a realistic color view of the Red Planet. If you like, you can then increase the contrast without affecting the color. This is a powerful technique, but you may find that few observers make images showing the colors that you have determined. I suggest that you use the color balance that you ascertain to be accurate, rather than mimicking the colors used by other observers.

Decision Tree for the Use of Certain Filters for Mars Observations



ALPO Mars Section Observation



Top: Time (UT):__________________ CM:__________ ° W Filter:______________ (W / S)

Bottom: Time (UT):__________________ CM:__________ ° W Filter:______________ (W / S)

Date (UT):____________________
Time (UT):__________ - __________
CM: __________ ° W - __________ ° W
D_E:__________ ° - L_S:__________ °
Dia. ("):__________ k (phase): __________
Telescope:______ f/______ (in. / cm. ; RL . RR . SC)
Magnification:______x ______x ______x
Filters:____________________ (W / S)
Seeing (0-10):__________ Antoniadi (I-V):__________
Transparency (1-6):______ (Clear / Haze / Int. Clouds)
Blue (Violet) Clearing (0-3):__________

Observer:____________________
Address:____________________

Observing Station:____________________

E-mail (optional):____________________

Notes

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(Continue on back if needed)

Papers & Presentations

Visual Observations of the Minor Planets

By Andrew Salthouse
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This article originally appeared in the January-March 2019 (Vol. 46, No. 1) issue of the ALPO Minor Planets Section publication, *The Minor Planet Bulletin*. Its republication here is meant to inspire others to participate in this still very worthwhile activity.

Online Features

Left-click your mouse on the e-mail address in blue text to contact the author of this article. Clicking on the hyperlinks (also in blue text) will take you to those online locations.

Abstract

The author describes the processes for identifying minor planet targets, observational planning, identification criteria, and record keeping. He presents his lifetime observational totals from 50+ years of observing.

Identifying Potential Targets

There are several sources a minor planet observer can use to identify potential targets. One such resource is maintained by Brian Warner (http://www.MinorPlanet.info). By clicking "Observation Planning" on the main menu, one can access the "Ephemeris Generator" page, which allows the user to select parameters such as month and year, magnitude limit, declination limits, etc. Once these parameters are entered, the site produces a list of minor planets ordered by date of brightest appearance. The output includes the dates of closest approach and opposition, minimum distance, brightness, declination, etc.

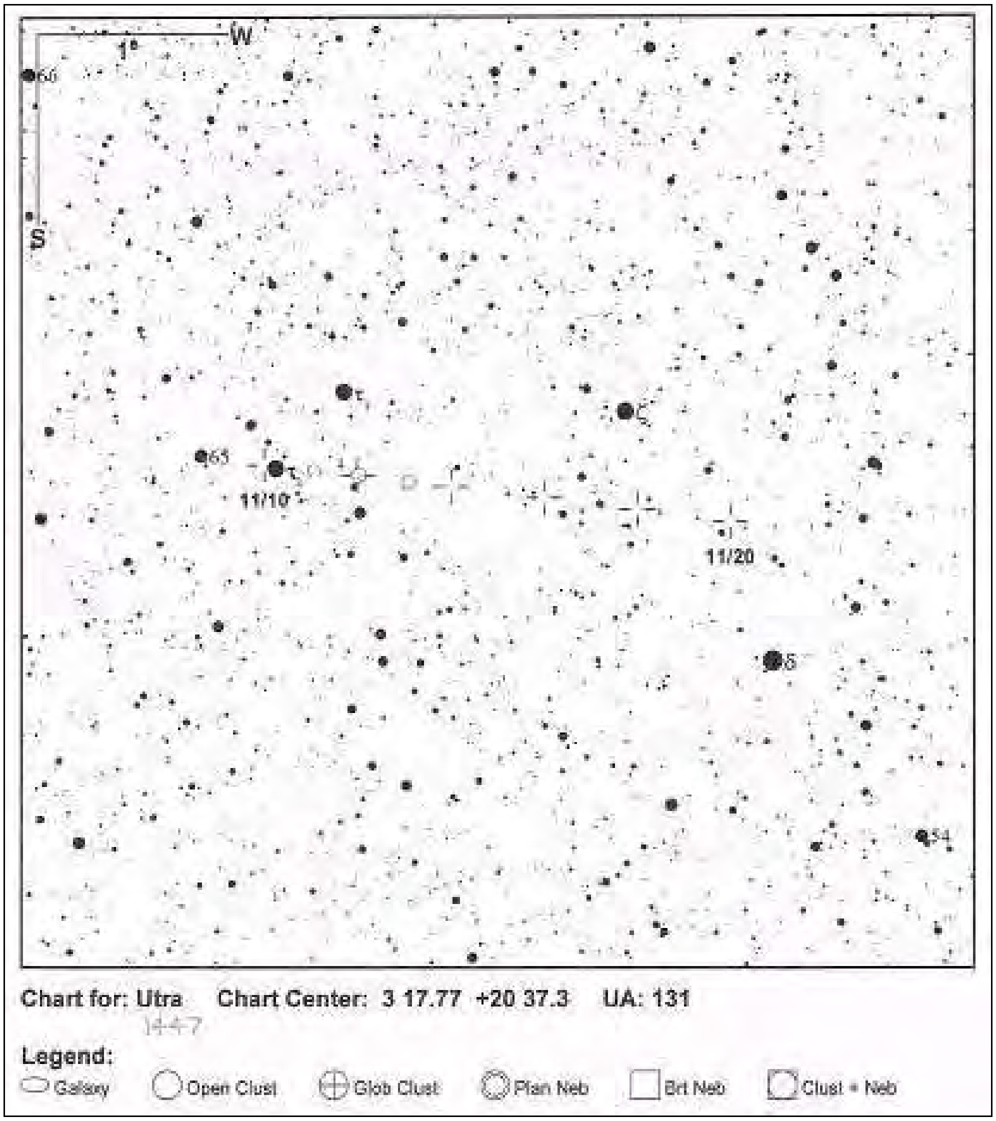

Figure 1. Chart of the path of 1447 Utra, produced from the Asteroid Viewing Guide on 2001 Nov 10. The hand-drawn circles along the path show the positions during times of observation. North is up.

This list is a starting point; the user will need to cull objects from this list based on personal criteria. A useful second step is to access the Minor Planet and Comet Ephemeris Service web site of the IAU Minor Planet Center

http://minorplanetcenter.net/iau/MPEph/MPEph.html

Entering the minor planet numbers from the list, and the desired date range, the IAU website will then provide an ephemeris for each selected minor planet for the desired range of dates. This information can be used to further cull the list of potential targets.

Observational Preparation

Next, the observer must prepare a chart for each target. The author has used two different methods for producing charts.

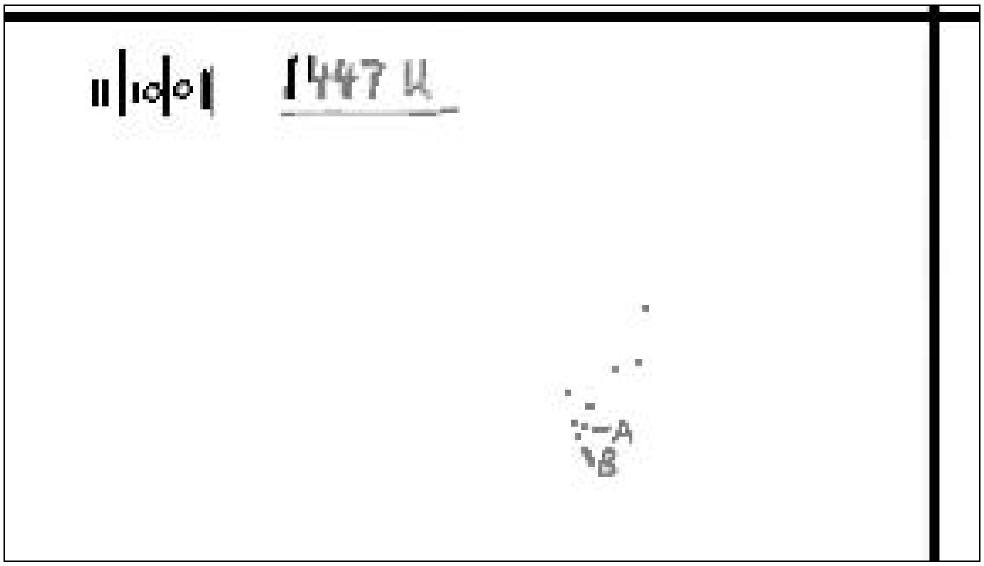

Figure 2. Motion of 1447 Utra recorded by the author at the telescope on 2001 Nov 10. Positions "A" and "B" correspond to local times 22:20 and 23:25 EST respectively (03:20 and 04:25 UT on 2001 Nov 11). North is to the lower right. [The image was digitally enhanced during production to increase contrast – Editor].

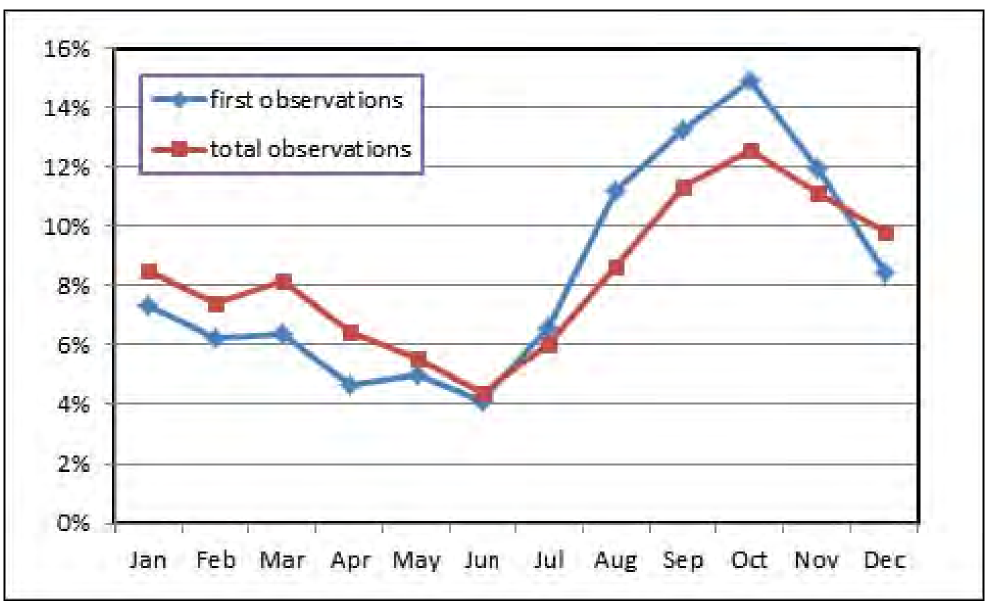

Figure 3. Monthly distribution of first sightings of each object (2,894 total) and of total observations (28,012 total) over the period 1966 to 2018.

The first is the Minor Planet Observer Asteroid Viewing Guide (Warner, 2018). This software package will produce a sky chart showing the path of the minor planet on selected dates. The user can select the minor planet, chart scale, magnitude limit of the background stars, and dates. Another useful source is the AAVSO site (http://aavso.org/apps/vsp). Like the MPOAVG, users can select the scale and magnitude limits, but this software does not produce a path track.

Finally, the user needs to select the targets for observation on a given night. In the author's youth he would select up to 30 targets for a single night, but as his stamina declined with age he limited it to just 10 or so. Observing minor planets visually can be hard work, and an observer needs to understand his limitations.

Once the observer has selected a list of targets and produced star charts (with tracks plotted on them) for each one, he is ready to observe. If the observer has a "go-to" telescope with RA and Dec inputs, then he can locate the star field quickly. Otherwise, he must identify the bright stars on the chart and locate them in the sky with a good quality atlas. The author uses the Atlas of the Heavens (Becvar, 1962), Sky Atlas 2000 (Tirion and Sinnott, 1998), or the Sky & Telescope Pocket Atlas (Sinnott, 2006), depending on the brightness of the targets. Standard star-hopping techniques can be used to find the target.

When observing, one should record the telescope aperture, magnifications used, date and time, transparency, seeing, and other relevant factors such as moonlight.

Once a target is located in the telescope, the observer draws the relevant field of view, and identifies suspected targets. This drawing must be sufficiently accurate that a motion of 0.5 arc minutes would be noticeable. The less accurate the drawing, the greater the motion must be to be noticed and, therefore, the longer the wait until that motion becomes clear. The author has found that eyepieces producing a field of view of 10 to 20 arc minutes are most helpful. Figure 1 shows a target path created from the Asteroid Viewing Guide, and Figure 2 shows the drawing of the visual field made by the author at the eyepiece.

After sufficient time has passed for the motion of the suspect to be identified, the observer must re-observe the field of view and note the second position of the target, if it has moved. If no motion is detected, then either the target was not seen at all, or the time interval to detect its motion was insufficient. Most minor planets move at least 0.5 arc minutes per hour, although some may be slower, particularly near stationary points. Like the outer planets, nearly all minor planets will retrograde at opposition, but they can be near a stationary point several weeks before or after opposition. Thus, the middle of the opposition is the best time to observe any given minor planet because the motion will be most obvious and the target will be at or near its brightest.

ASTEROID NUMBER			TOTAL SEEN	TOTAL OPPNS	GROSS OBSNS
2	-	200	199	2,056	6,312
201	-	400	200	1,330	3,905
401	-	600	199	1,026	3,019
601	-	800	194	796	2,326
801	-	1000	191	593	1,749
1001	-	1300	260	642	1,955
1301	-	1600	240	504	1,580
1601	-	2000	244	457	1,474
2001	-	3000	373	585	1,949
3001	-	5000	378	539	1,866
5001	-	10000	236	293	1,054
10001	-		180	197	823
MINOR PLANETS			2,894	9,018	28,012
COMETS			58	62	416
DWARF PLANETS					
		Ceres	1	26	88
		Pluto	1	22	180
GRAND TOTAL			2,954	9,128	28,696

Table I. Lifetime total observations of minor planets, comets, and dwarf planets as of 2018 June 30. Ceres was upgraded from minor to

Once the observer has confirmed the observation of the minor planet by showing it at two different locations at two different times on the same night, the observation needs to be logged and recorded. The author recommends making a visual estimate of the object's magnitude.

In the early years, the author came to realize that drawings can be imperfect and errors of identification can be made. For example, multiple faint stars very near the target can cause the observer to misidentify the target, especially if the transparency changes between the first and second observations. For this reason, the author does not consider the observation of the minor planet to be fully confirmed until additional observations can be made on subsequent nights. This is the "three observations" rule: the object should be seen on two different nights and at least twice on one of those nights. This rule was always followed when observing a minor planet for the first time, but eventually it was relaxed when observing brighter asteroids ($V < \sim 13$) at second and subsequent oppositions.

Record Keeping

It is critical that clear records be maintained. Besides the actual drawings and notes made at the eyepiece, there is a need for a summary record, generally digital. The author has kept all of his notes and drawings since 1965, and also maintains several digital records covering the last 50+ years. Microsoft Excel® is useful for this purpose since pivot tables can be constructed that allow slicing the data by minor planet number (or groups of numbers), month or year, and other parameters. Of course, Microsoft Excel® did not exist when the author started observing, but he began converting paper records to digital form in the 1990s.

Successful minor planet observing requires all the aforementioned processes, and some skill at the eyepiece, but also the discipline to keep observing night after night. One will not find any minor planets by staying indoors on cold winter nights or on sweltering hot summer evenings. The author has endured hundreds of bitterly cold nights in an effort to identify as many asteroids as possible. Largely because of this persistence, he has accumulated over 28,000 visual observations of nearly 2,900 distinct objects.

Seasonality

The orbits of the main-belt asteroids lie between the orbits of Mars and Jupiter. These will account for more than 90% of all minor planets observed. Jupiter's orbit has an eccentricity of 0.049, meaning that the aphelion is more than 10% further from the Sun than the perihelion. Consequently perihelic oppositions of Jupiter (around October) are noticeably brighter than aphelic oppositions (around April). Due to its great mass, Jupiter perturbs the orbits of the minor planets, with the effect that many of their orbits line up their perihelia in the same general direction as Jupiter's perihelion. Thus, asteroids at opposition in October tend to be brighter on average than those at opposition in April. This creates a distinct seasonal pattern.

This pattern is abundantly clear in the author's data. About 67% of all minor planets were first identified in the six-month period of August through January, leaving only 33% in the six-month period of February to July. In terms of total observations, 62% were made in August to January and 38% in February to July. These patterns are shown in Figure 3.

Any observer setting out to capture minor planets in his telescope is likely to see a similar pattern. There will be far more available targets in the second half of the year than in the first half.

Although the lines of apsides of the minor planets are not randomly distributed around the ecliptic, the positions of these objects in their orbits are random. Since most main-belt asteroids have orbital periods ranging from three to six years, with most having orbital eccentricities of at least 0.10, they will have both aphelic and perihelic oppositions. A typical object will be a full magnitude or more fainter at aphelic than at perihelic opposition. Thus, many potential targets may be visible only near perihelion. Consequently, in order to capture as many objects as possible, an observer must commit to an observing program lasting up to six years. The author is nearing completion of his fifth six-year program since building his observatory in 1990.

Summary of Results

The author's lifetime totals are included in Table 1, showing the number of distinct objects, the number of oppositions, and the number of observations. Note that the recently classified dwarf planets Ceres and Pluto have been removed from the minor planet subtotal and listed separately.

Acknowledgements

The author thanks Mr. Brian Warner for his support, providing valuable help with the Minor Planet Observer website and software. He also thanks Mr. Lawrence Garrett and Mr. Gerard Faure for their support of the Magnitude Alert Program (now defunct) in which the author participated for several years. Finally, he thanks Ms. Mary Ellen Salthouse, Mr. Roger Harvey, and Mr. Frederick Pilcher for their ongoing support and encouragement.

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Papers & Presentations

Timing Jupiter's Satellite Eclipses: The 2012-2013 Apparition

By: The late John E. Westfall,
Program Coordinator,
Galilean Satellite Eclipses

Abstract

During the 2012/13 Jupiter apparition, three observers made 75 visual timings of the eclipses of three of Jupiter's Galilean satellites - Io, Europa and Ganymede. We compare the means of their observed eclipse disappearance and reappearance times with the predictions of the IMCCE (Institut de Méchanique Céleste et de Calcul des Éphémérides) E-5 ephemeris.

Introduction

The apparition covered here is the 35th observed by the ALPO Jupiter Section's Galilean Satellite Eclipse Timing Program, which conducts visual timings of the eclipses by Jupiter of the four Galilean satellites Io, Europa, Ganymede and Callisto (note that Callisto did not undergo eclipses in 2012/13). Our observers timed the "last speck" visible when a satellite entered Jupiter's shadow (*disappearance*) and the "first speck" visible when it 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, 2016a, 2016b, 2017, 2018a, 2018b and 2018c.] We have compared our reduced timings with the IMCCE predictions, using the INPOP13C planetary theory and Lieske E-5 satellite theory.

Table 1 lists the pertinent dates and other circumstances of the 2012/13 Apparition.

This apparition saw the Sun and Earth at relatively high northerly latitudes relative to Jupiter's equator, which lies very near the orbital planes of the Galilean satellites. This circumstance meant that Callisto did not undergo eclipses in 2012/13, while Ganymede entered and left Jupiter's shadow at highly oblique angles. The high terrestrial and solar latitudes, combined with Jupiter having recently passed through perihelion (2011 March 17), meant that both disappearance and reappearance were observable for the same eclipses of Europa, a fairly rare situation.

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Table 1. Circumstances of the 2012/13 Jupiter Apparition

Apparition		Observing Season	
Initial solar conjunction	2012 MAY 13, 13h	First eclipse timing§	2012 JUL 29 (+77d)
First maximum phase angle	2012 SEP 06, 04h (11.56°)	Last eclipse timing§	2013 APR 05 (-75d)
Closest approach to Earth†	2012 DEC 01, 15h (D = 48.4")	Duration	250 d
Opposition to the Sun*	2012 DEC 03, 02h (δ = +21.3°)	Solar Elongation Range	057°W – 057°E
Second maximum phase angle	2013 FEB 26, 16h (11.23°)	Sources: Meeus 2015; *Astronomical Almanac*, 2012 and 2013 editions; JPL *HORIZONS* website. Dates and times throughout this report are in Universal Time (UT).	
Final solar conjunction	2013 JUN 19, 16h		
Zenocentric latitude of Sun	+3.55° - +2.64°	* 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 (-).	
Zenocentric latitude of Earth	+3.36° - +2.64° (Max. +3.47° 2012 NOV 05)		

Observations and Observers

The 75 timings received for 2012/13 brought our 35-apparition total to 11,104 observations, but show a decrease from the 85 received for the 2011/12 Apparition. Table 2 gives descriptive statistics for the 2012/13 observations.

There remains an imbalance between the number of disappearance and reappearance observations. This inequality is understandable, given the inconvenience of observing after midnight, but the statistical significance of our results would be improved were the observations more evenly distributed.

Table 3 lists the participants in our program during 2012/13, with their nationalities, instrument apertures and number of timings, both short-term and long-term.

It is pleasing to see that all our observers, although small in number, have continued with our program for multiple apparitions.

The contributors used moderate-size telescopes in the aperture range 6.3-15 cm. The mean aperture, weighted by number of observations, was 13.3 cm.

Timings Analysis: Satellite Positions

The individual eclipse timings made by our participants in 2012/13 are listed in Table 5 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 E-5 ephemeris. All the residuals were corrected for oblique contact with Jupiter's shadow at disappearance and reappearance, using the formula $R' = R \cos \beta'$, where R' is the corrected residual, R the original residual, and β' the zenographic latitude of the satellite relative to Jupiter's shadow. This correction made a difference of 4-7 seconds for Io, 13-33 seconds for Europa, but ranged from 124 to 260 seconds for Ganymede.

In 2012/13 none of the three satellites timed - Io, Europa and Ganymede - differed significantly from the IMCCE E-5 ephemeris.

Table 2. Number of Eclipse Timings, 2012/13 Apparition

Number of Timings	75
Timings before Opposition	36 (48%)
Timings after Opposition	39 (52%)
Disappearance Timings	34 (45%)
Reappearance Timings	41 (55%)

Table 3. Participating Observers, 2012/13 Apparition

Observer and Telescope					ALPO Timing Program Total	
I.D. No.	Name	Nationality	Telescope Aper. (cm)	Number of Timings (total)	Number of Apparitions	Number of Timings
1a 1b	Büttner, D.	Germany	6.3 10	3 3 (6)	17	125
2a 2b	Hays, R.H., Jr.	USA (IL)	13 15	2 30 (32)	22	360
3	Westfall, J.	USA (CA)	12.7	37	32	605
Mean Number of Timings per Observer				25.0		

Table 4. Timing Residual Statistics, 2012/13 Apparition

Quantity	Satellite		
	Io	Europa	Ganymede
Disappearances: Number of Timings	16 (14)	8 (6)	10 (10)
Disappearances: Mean	+90.4±2.4s	+113.0±8.6s	+227.4±8.6s
Disappearances: Median	+91.5s	+110.5s	+234.5s
Reappearances: No. of Timings	20 (18)	12 (9)	9 (9)
Reappearances: Mean	-93.7±3.8s	-91.2±8.7s	-229.4±11.8s
Reappearances: Median	-99.5s	-95.0s	-233.0s
(Disap.+Reap.)/2: Means	-1.6±2.3s	+10.9±6.1s	-1.0±7.3s
(Disap.+Reap.)/2: Medians	-4.0s	+7.8s	+0.8s
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.			

Conclusion

The analysis of our program's timings made during the 2012/13 Jupiter apparition showed that the times of eclipses by Jupiter of Io, Europa and Ganymede did not differ significantly from the IMCCE E-5 ephemeris.

We thank the observers who contributed timings during 2012/13.

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See Table 5 on next page.

Table 5. Galilean Satellite Eclipse Timings, 2012/13 Apparition

UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif	UT	LD	Lat	ObN	STB	Dif
Io Disappearances						**Io Reappearances – cont.**						**Europa Reappearances – cont.**					
20729	17	+21	2b	000	+99	30131	22	+18	3	000	-85	30131	34	+35	3	000	-26
20816	20	+21	1a	010	+91	30209	22	+18	3	000	-93	30207	35	+35	3	100	-106
20821	21	+21	2b	000	+172	30216	22	+18	2b	000	-111	30224	35	+34	2b	001	-84
20823	21	+20	1a	002	+98				3	100	-72	30304	34	+34	2b	000	-154
20906	23	+20	2b	000	+103	30217	22	+18	2b	000	-83	30405	26	+33	2b	000	-145
20913	23	+20	3	100	+92	30225	22	+18	2b	000	-117	**Ganymede Disappearances**					
20920	23	+20	3	100	+83	30304	22	+18	2b	000	-115	20831	52	+60	3	211	+370
20929	23	+20	3	101	+79				3	100	-85				2b	100	+497
			2b	000	+106	30320	20	+18	2b	200	-125	20907	54	+60	3	000	+455
21006	22	+20	3	121	+67	30327	18	+17	2b	100	-108	21006	52	+59	2b	000	+491
			2b	000	+107	**Europa Disappearances**						21013	49	+59	3	000	+452
21022	19	+20	2b	000	+104	20806	29	+35	2b	100	+142	21118	17	+57	2b	000	+460
21029	17	+20	3	101	+94	20914	36	+35	2a	100	+112	21125	9	+57	3	000	+322
			2b	000	+111				3	000	+119	30107	9	+55	3	100	+383
21105	14	+20	3	101	+97	20921	36	+35	3	000	+128	30212	26	+53	3	000	+390
21107	13	+20	3	101	+85	21019	30	+35	1a	000	+143	30320	21	+51	2b	100	+393
Io Reappearances									1b	000	+184	**Ganymede Reappearances**					
21207	3	+19	3	100	-44	30207	0	+34	3	000	+62	20817	26	+60	1b	000	-519
21209	4	+19	3	100	-28	30214	1	+34	3	000	+78	20831	30	+60	3	201	-340
21223	11	+19	2b	000	-107	**Europa Reappearances**						21006	26	+58	2b	000	-504
21225	12	+19	3	001	-73	20817	1	+36	1b	000	-68	21013	22	+58	3	100	-418
30102	15	+19	2b	000	-112	20907	3	+36	3	100	-30	21231	4	+54	3	000	-333
30108	17	+19	2b	000	-104	20914	3	+36	3	000	-74	30205	53	+53	2b	010	-427
30110	18	+19	2b	000	-114	21212	8	+35	2a	001	-117				3	000	-383
30115	19	+19	3	100	-70	21219	13	+35	3	200	-1	30212	54	+52	3	000	-320
30117	19	+19	3	000	-95	21223	16	+35	2b	000	-135	30320	47	+50	2b	100	-411
30124	21	+19	2b	100	-110	30113	28	+35	3	100	-117						

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 = zenographic 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. Underlined timings were excluded during analysis due to unusually large differences from the other observations, usually due to unfavorable observing conditions. Note that these "raw" residual values have not been corrected for oblique contact with Jupiter's shadow.

Papers & Presentations:

ALPO Observations of Saturn During the 2014 - 2015 Apparition

By Julius L. Benton, Jr.,
Coordinator, ALPO Saturn Section
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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 Observing Section Publications* in the ALPO Resources section of this Journal for hardcopy availability.

Abstract

The ALPO Saturn Section received 317 visual observations and digital images for the 2014-15 apparition spanning the period from January 5, 2015 through October 18, 2015. Observations were submitted by 25 observers in Australia, Brazil, Colombia, France, Greece, Italy, Malta, New Zealand, Philippines, South Africa, Slovenia, United Kingdom, and United States. Instruments utilized for the observations ranged in aperture from 9.0 cm (3.5 in.) up to 63.5 cm (25.0 in.). Imaging during 2014-15 revealed a considerable amount of discrete activity within Saturn's northern hemisphere. Such features included very sporadic small bright spots within the NTrZ (North Tropical Zone), the North Temperate Zone (NTeZ), and the NEBn (North Equatorial Belt, northern edge). Recurring white spots were imaged from late May through mid-October 2015 in the EZn (Equatorial Zone, northern half), as well as apparently short-lived white areas in the EZs (Equatorial

Table 1. Geocentric Phenomena in Universal Time (UT) for Saturn During the 2014-2015 Apparition

Conjunction	2014	Nov	18^d
Opposition	2014	May	23^d
Conjunction		Nov	30^d

Opposition Data

Visual Magnitude		0.0
Constellation		Libra
Declination		18.3°
B		+24.4º
B’		+24.6º
Globe	Equatorial Diameter	18.5″
	Polar Diameter	16.5″
Rings	Major Axis	41.9″
	Minor Axis	17.2″

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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, 2014-2015 Apparition of Saturn

	Observer	Location	No. of Observations	Telescopes Used
1.	Barry, Trevor	Broken Hill, Australia	58	40.6 cm (16.0 in.) NEW
2.	Benton, Julius L.	Wilmington Island, GA	2 2 5 2 2	10.2 cm (4.0 in.) REF 12.0 cm (4.7 in.) REF 12.7 cm (5.0 in.) MAK 15.2 cm (6.0 in.) REF 18.0 cm (7.1 in.) MAK
3.	Collins, Maurice	Palmerston North, NZ	1	11.0 cm (4.3 in.) REF
4.	Combs, Brian	Buena Vista, GA	1	35.6 cm (14.0 in.) SCT
5.	da Silva, Vlamir	San Paolo, Brazil	8	20.3 cm (8.0 in.) SCT
6.	Delcroix, Marc	Tournefeuille, France	9	32.0 cm (12.6 in.) NEW
7.	Foster, Clyde	Centurion, South Africa	40	35.6 cm (14.0 in.) SCT
8.	Galdies, Charles	Msida, Malta	2	35.6 cm (14.0 in.) SCT
9.	Go, Christopher	Cebu City, Philippines	20	35.6 cm (14.0 in.) SCT
10.	Hill, Rik	Tucson, AZ	2 5	9.0 cm (3.5 in.) MAK 20.3 cm (8.0 in.) MAK
11.	Hood, Mike	Kathleen, GA	1 5	20.3 cm (8.0 in.) REF 35.6 cm (14.0 in.) SCT
12.	Jackson, David	Reynoldsburg, OH	2	25.4 cm (10.0 in.) NEW
13.	Jakiel, Richard	Douglasville, GA	6	30.5 cm (12.0 in.) SCT
14.	Kardasis, Manos	Athens, Greece	19	35.6 cm (14.0 in.) SCT
15.	Maxson, Paul	Phoenix, AZ	58 26	31.5 cm. (12.4 in.) DALL 35.6 cm. (14.0 in.) SCT
16.	Melillo, Frank J.	Holtsville, NY	2	25.4 cm (10.0 in.) SCT
17.	Melka, Jim	St. Louis, MO	2	45.0 cm (17.7 in.) NEW
18.	Peach, Damian	Norfolk, UK	8	35.6 cm (14.0 in.) SCT
19.	Phillips, Jim	Charleston, SC	1	25.4 cm (10.0 in.) REF
20.	Plante, Phil	Braceville, OH	2 2 4	15.2 cm (6.0 in.) NEW 25.4 cm (10.0 in.) NEW 63.5 cm (25.0 in.) NEW
21.	Rosolina, Michael	Friars Hill, WV	1	35.6 cm (14.0 in.) SCT
22.	Smrekar, Matic	Luibliana, Slovenia	1	30.5 cm (12.0 in.) NEW
23.	Triana, Charles	Bogota, Colombia	2	25.4 cm (10.0 in.) SCT
24.	Wesley, Anthony	Murrumbateman, Australia	13	36.8 cm (14.5 in.) NEW
25.	Zannelli, Carmelo	Palermo, Italy	1 2	28.0 cm (11.0 in.) SCT 35.6 cm (14.0 in.) SCT
	TOTAL OBSERVATIONS		**317**	
	TOTAL OBSERVERS		**25**	

Instrumentation Abbreviations:
NEW = Newtonian, SCT = Schmidt-Cassegrain, MAK= Maksutov-Cassegrain, REF = Refractor,
DALL = Dall-Kirkham, CAS = Cassegrain

*Zone, southern half) during most of July 2015. A particularly long-lived dark condensation or spot with a curious encircling white "collar" was imaged consistently in the North North North Temperate Zone (NNNTeZ) beginning in early March throughout the rest of the apparition. Small recurring dark spots within the EB (Equatorial Band) were captured on images from late July through mid-October 2015, and a small, less well-defined dark feature was imaged in the NTeZ (North Temperate Zone) from mid-January through early March 2015. Of continuing interest have been repeated amateur images of the extraordinary hexagonal feature at Saturn's North Pole at different wavelengths. Views of the major ring components, including Cassini's and Encke's divisions, were very favorable this apparition due to the increased inclination of Saturn's rings toward Earth since 2013-14. ALPO Saturn Section's dedicated team of visual observers and those who routinely imaged the planet at various wavelengths continued active participation in our Pro-Am efforts in support of the Cassini mission. The tilt of Saturn's ring system toward Earth, **B**, attained a maximum value of +25.03° on October 18, 2015 affording observers advantageous views during the apparition Northern Hemisphere of the globe and North face of the rings. A summary of visual observations and digital images of Saturn contributed during the 2014-15 are discussed, including results of determined efforts to try 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.*

Figure 1

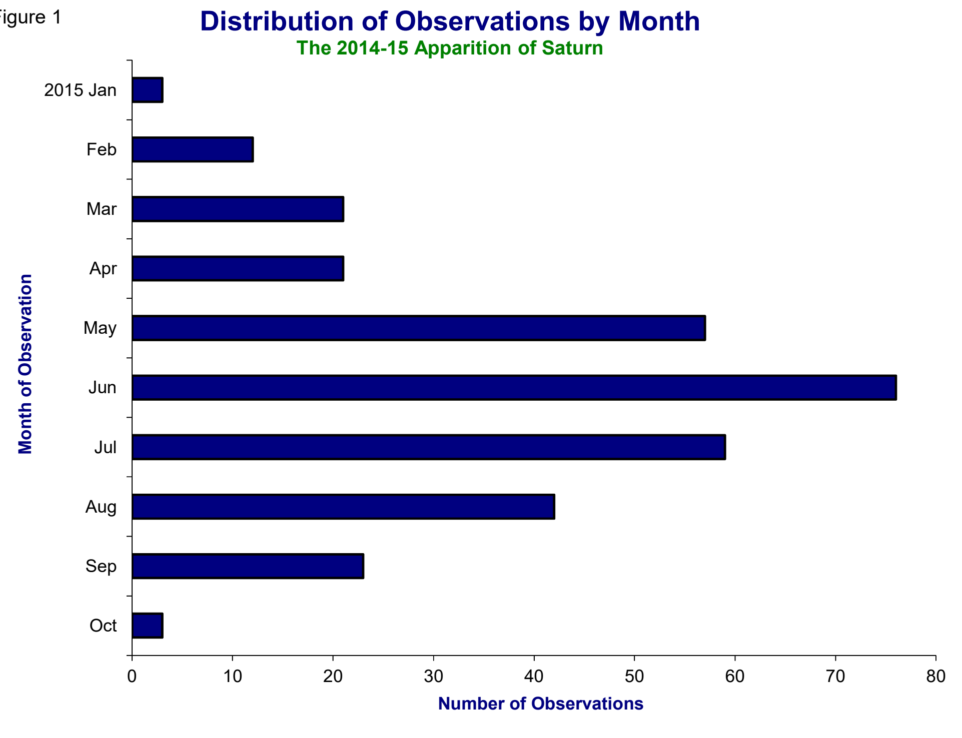
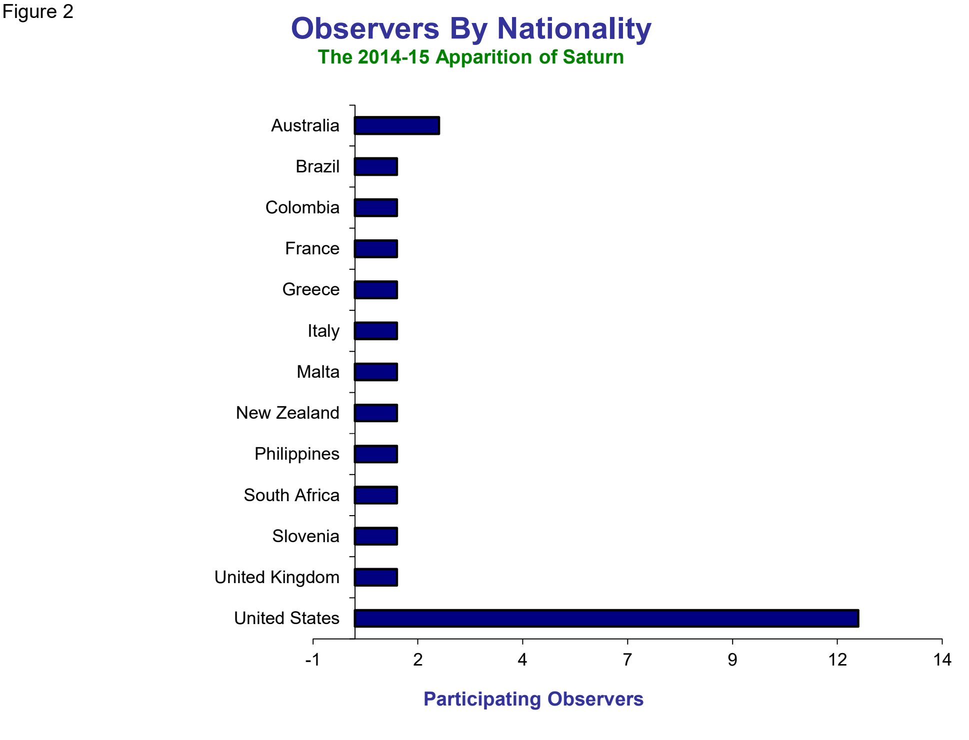


Figure 2



Introduction

This report is derived from an examination of 317 visual observations, descriptive notes, visual numerical relative intensity estimates, and digital images contributed to the ALPO Saturn Section by 25 observers from January 5, 2015 through October 18, 2015, referred to hereinafter as the 2014-15 "observing season" or apparition of Saturn. Examples of submitted drawings and images are included with this report, integrated as much as feasible 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 2014-15 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 +24.004° (July 21, 2015) and +25.034° (October 18, 2015). The value of **B'**, the saturnicentric latitude of the Sun, varied from +23.757° (January 5, 2015) to +25.393° (October 18, 2015).

Table 2 lists the 25 individuals who sent 317 reports to the ALPO Saturn Section this apparition, including their observing sites, number of observations, telescope apertures, and type of instrument. *Figure 1* is a histogram of the distribution of observations by month showing that 27.8% were made prior to opposition, 1.6% at opposition (May 23, 2015), and 70.7% thereafter. Although many observers view Saturn most frequently at or near opposition, when the planet is well placed high in the evening sky, coverage favored a wider period of time on either side of opposition during the 2014-15 apparition (81.1% of all observations took place from early March through late September 2015). To achieve the best overall coverage, observers are urged to begin viewing and imaging Saturn as soon as the planet becomes visible in the eastern sky before sunrise after conjunction with the Sun. The objective is to keep up a well-balanced observational surveillance of the

Figure 3

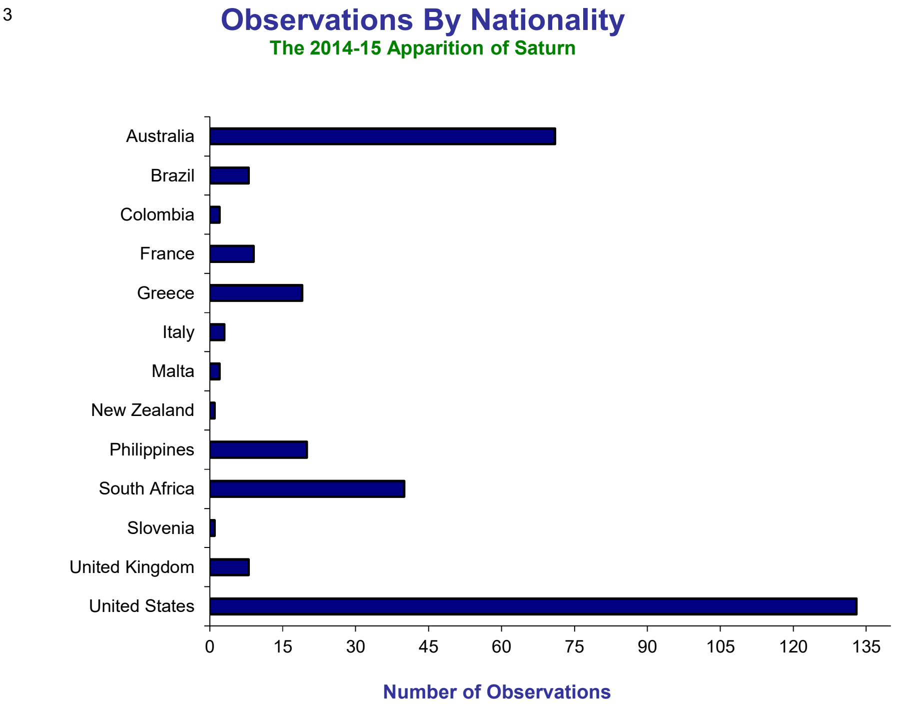


Figure 4

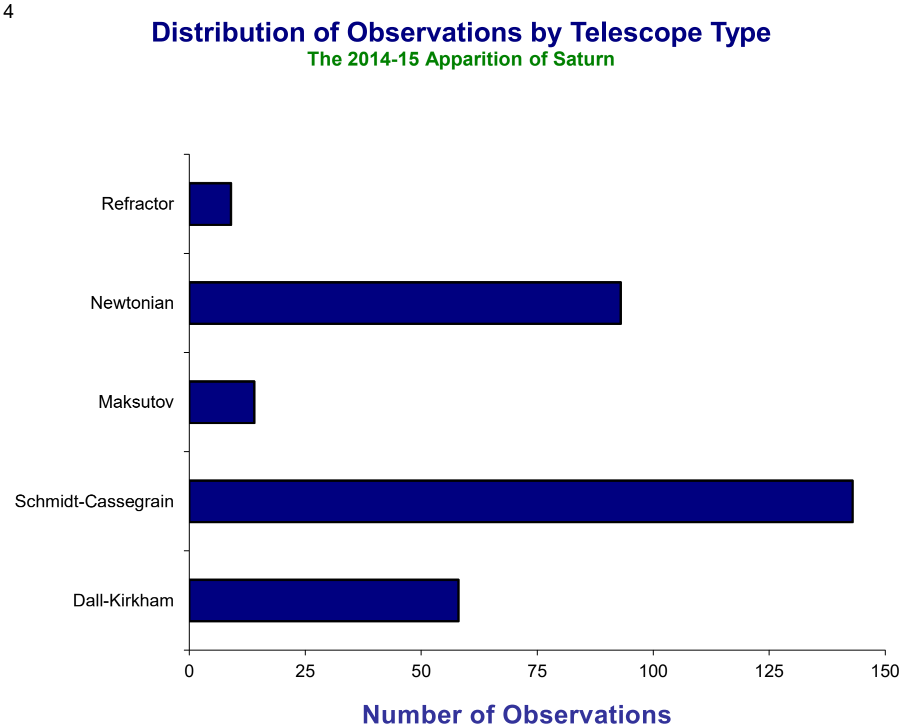


Table 3. Visual Numerical Relative Intensity Estimates and Colors for the 2014-15 Apparition of Saturn

Globe/Ring Feature	# Estimates	2014-15 Mean Intensity & Standard Error	Intensity Difference Since 2013-14	Mean Derived Color
Zones				
EZn	13	7.54 ± 0.04	-0.13	Bright Yellowish-White
NPR	12	4.21 ± 0.07	-0.15	Gray
Belts:				
NEBw (whole)	13	3.50 ± 0.05	-0.38	Dull Yellowish-Brown
Globe N of Rings	13	4.58 ± 0.11	-1.13	Light Yellowish-Gray
NPC	3	4.00 ± 0.00	—	Dull Gray
Rings				
A (whole)	13	6.00 ± 0.00	+1.57	Dull Grayish-White
Cassini's (A0 or B10)	13	0.08 ± 0.05	—	Black
Encke's (A5)	1	0.50 ± 0.00	—	Grayish-Black
B (outer 1/3)	13	8.00 ± 0.00 **STD**	0.00	Brilliant White
B (inner 2/3)	13	7.00 ± 0.00	+0.92	Yellowish-White
Ring C (ansae)	13	1.35 ± 0.08	-0.78	Very Dark Gray
Crape Band	13	2.02 ± 0.04	-0.98	Very Dull Gray
Sh G on R	11	0.05 ± 0.04	—	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 2013-14" is in the same sense of the 2013-14 value subtracted from the 2014-15 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.

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 48.0% of the participating observers and 42.0% of the submitted observations. With 52.0% of all observers residing in Australia, Brazil, Colombia, France, Greece, Italy, Malta, New Zealand, Philippines, South Africa, Slovenia, and United Kingdom, whose total contributions represented 58.0% of the observations, international cooperation remained excellent this observing season.

Figure 4 graphs the number of observations by instrument type in 2014-15. A little less than one-third (32.2%) of all observations were made with telescopes of classical design (refractors and Newtonians), while the remaining 67.8% were completed with catadioptrics (Schmidt-Cassegrains, Maksutov-Cassegrains, and Dall-Kirkhams). Telescopes with apertures ranging from 9.0 cm (3.5 in.) through 63.5 cm (25.0 in.) were utilized for recording observations this apparition. Readers are reminded, however, that there are numerous past instances where smaller instruments of good quality have been successfully utilized for many of our Saturn observing programs.

The ALPO Saturn Section truly appreciates all of the digital images, visual drawings, descriptive reports, and supporting data submitted by observers listed in *Table 2* for the 2014-15 apparition. Without this dedicated teamwork, this report would not have

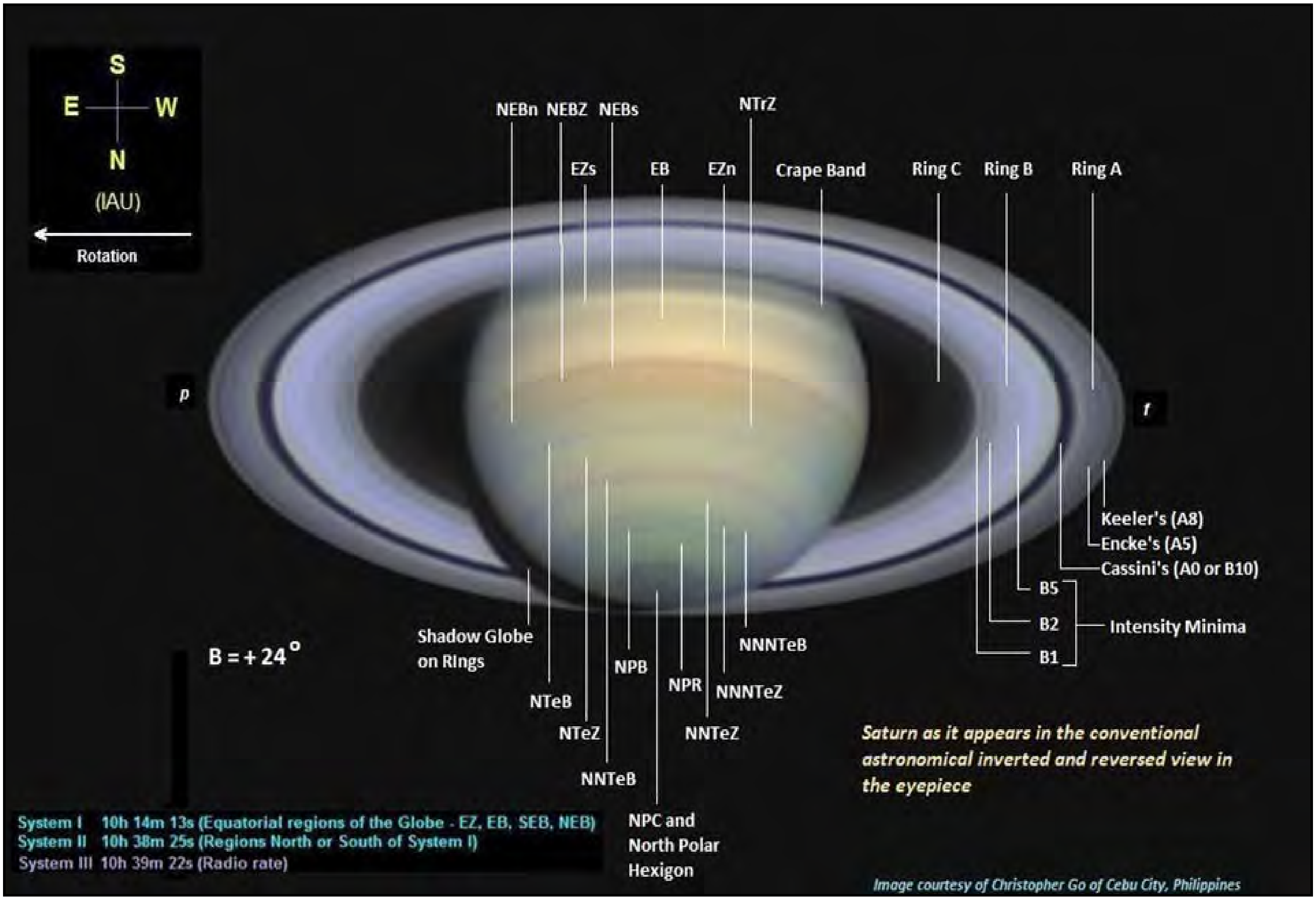


Figure 5. Saturn nomenclature, where A = Ring A, B = Band or Ring B or saturnicentric latitude of Earth, C = Ring C or Cap, E = Equatorial, f = following (celestial east), G = Globe, n = north component, N = North, p = preceding (celestial west), P = Polar, R = Ring(s) or Region, s = south component, 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.

been possible. Those wishing to join us in our various Saturn observing programs using visual methods in the form of drawings, estimates of visual numerical relative intensity, latitude estimates, and CM transit timings, as well as performing routine digital imaging, are encouraged to do so in upcoming observing seasons. The domestic and international flavor of our observational work is most encouraging and valuable, and we strive to maintain participation by observers everywhere. All methods of recording observations are crucial to the success of our programs, whether one's preference is sketching Saturn at the eyepiece or simply writing descriptive reports, making visual numerical relative intensity and latitude estimates, or pursuing systematic digital imaging. The ALPO Saturn Section emphasizes especially the ongoing need for more experienced observers to carry out regular visual numerical relative intensity estimates in integrated light and with standard color filters. Such estimates, which are simple to do, are greatly needed for maintaining our data for a recurring comparative analysis of belt, zone, and ring component brightness fluctuations over many apparitions. The ALPO Saturn Section is at all times happy to receive observations from novices, and the author is always delighted to offer assistance as one becomes acquainted with our programs.

All 317 observations submitted to the ALPO Saturn Section during 2014-15 were used 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. As applicable, for drawings or images provided herein as examples of 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 +25.034° during the 2014-15 apparition. Opportunities for viewing the belts and zones and other phenomena of the planet's northern hemisphere have gradually improved each observing season with the Earth situated north of the rings as they continue to increase their tilt toward our line of sight with maximum orientation of +27° coming in 2017 (the time of summer solstice in Saturn's northern hemisphere). The rings primarily hid features of the southern hemisphere as they crossed in front of the globe.

Minor fluctuations in intensity of Saturn's atmospheric features (see *Table 3*) may be attributable to the varying inclination of the planet's rotational axis relative to the Earth and Sun, although photometric work in past years suggests that small oscillations of about ±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 2013-14 intensity from its 2014-15 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 is important to evaluate contributed digital images of Saturn captured with different apertures using systematic filter techniques to understand the level of detail seen and how such phenomena compares with impressions by visual observers 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, Saturn observers are asked to systematically image the planet every possible clear night if possible. 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 next few paragraphs, our discussion of features on Saturn's globe proceeds 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, observers did not report the area during the 2014-15 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 with this report 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 obstructed from our view during 2014-15 where the rings crossed in front of those regions of the globe with the exception of the yellowish-white Equatorial Zone (EZs) appearing just south of the Equatorial Band (EB). No visual numerical relative intensity estimates were submitted during the observing season.

Equatorial Zone - Southern Half (EZs). Higher resolution images revealed a portion of the yellowish-white Equatorial Zone (EZs) just northward of the where the rings traversed the globe of Saturn [refer to Illustration No. 001]. Visual observers provided descriptions of the EZs but regrettably provided no visual numerical relative intensity estimates during 2014-15. The first report of discrete atmospheric phenomena associated with the EZs came from Anthony Wesley, who imaged a small white spot at 685nm IR wavelength on July 2, 2015 at 12:51UT [refer to Illustration No. 002]. Nearly two weeks later, on July 13, 2015, he reported the same feature at 12:18UT again using a 685nm IR filter [refer to Illustration No. 003]. Trevor Barry also captured the white spot in the EZs on July 19, 2015 at 11:20UT with a 685nm IR bandpass filter, suggesting that the spot was a bit fainter and somewhat elongated [refer to Illustration No. 004]. The last image of the EZs white spot this apparition came from Clyde Foster, who imaged the somewhat elongated diffuse feature near the CM at 16:15UT on July 26, 2015, also employing a 685nm IR filter [refer to Illustration No. 005].

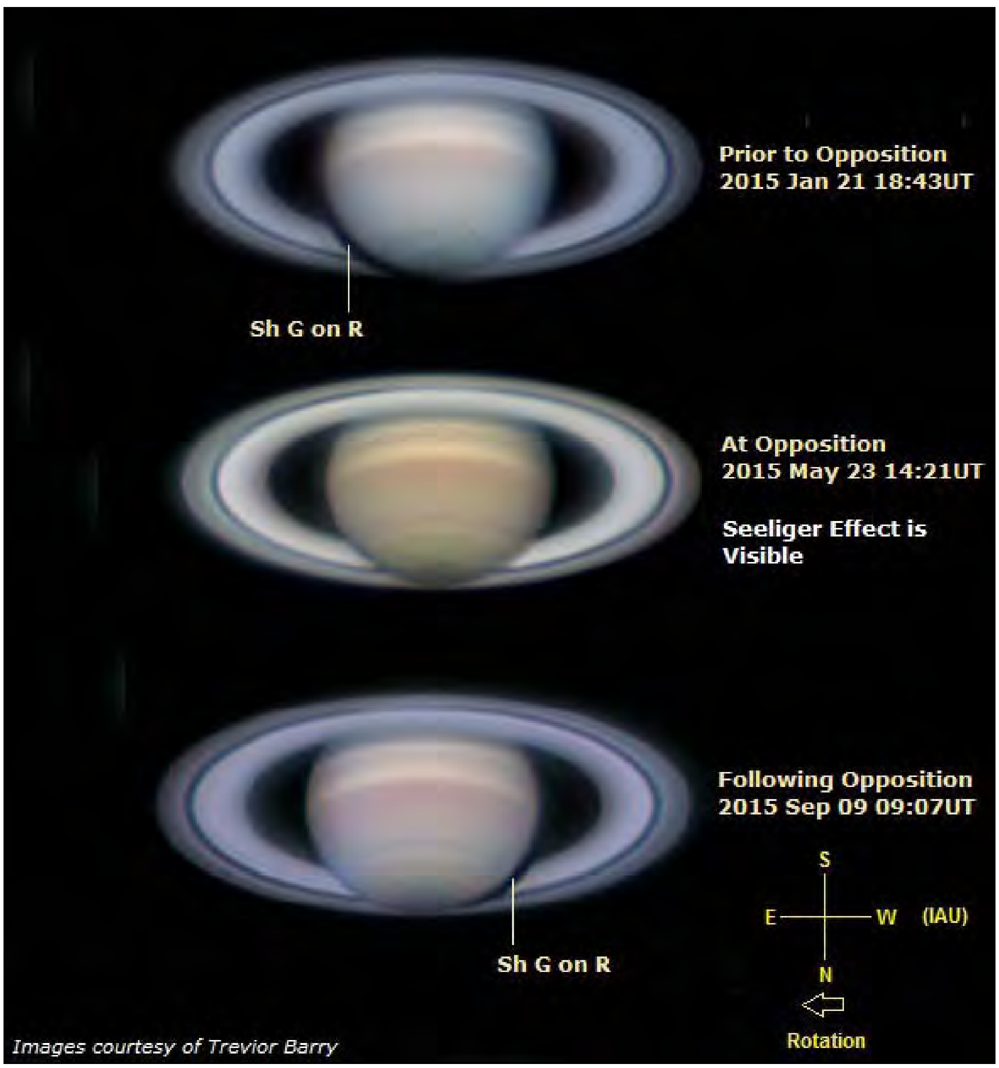
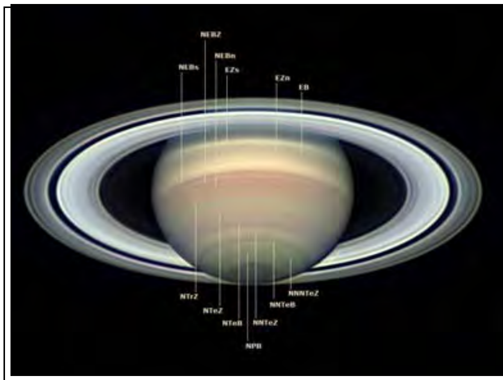


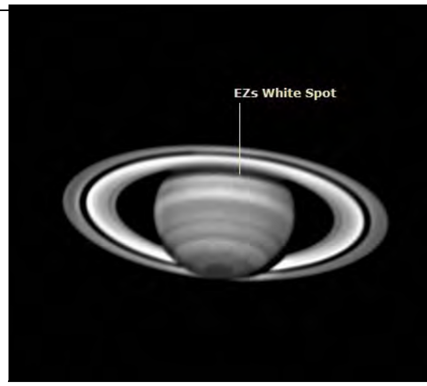
Figure 6. Three images digital images furnished by Trevor Barry on January 21, 2015 at 18:43UT (before opposition), May 23, 2015 14:21UT (at opposition), and September 9, 2015 at 09:07UT (after opposition).

Saturn's Globe: The Northern Hemisphere

Equatorial Band (EB). Visual numerical relative intensity estimates of the dusky Equatorial Band (EB) were lacking during 2014-15, but the belt was portrayed on several drawings in integrated light and noticeable on many of the digital images submitted during the observing season [refer to Illustrations No. 001 and 006]. On July 2, 2015, Anthony Wesley, using a 685nm IR filter, recorded a very dark streak in the EB at 11:54UT a little East of the CM and immediately South of a bright compact white spot in the EZn (see discussion concerning EZn bright spots in the next section) [refer to Illustration No. 007]. Three weeks later on July 26, 2015 at 16:16UT, Clyde Foster also used a 685nm IR filter to image a curious diagonally-elongated dark streak within

***General Caption Note for Illustrations 1-37** 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.*





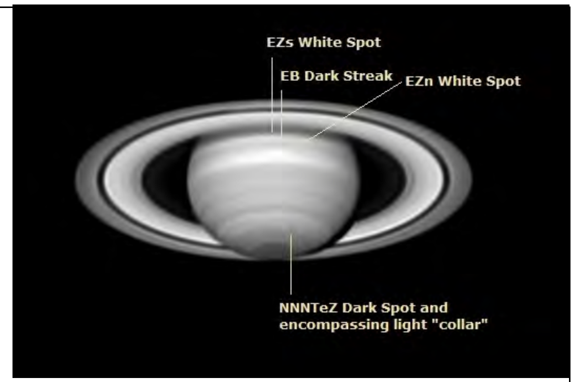


Illustration 001. 2015 June 02 13:32UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 8.0, Tr = 4.0. CMI = 42.1°, CMII = 198.0°, CMIII = 180.5°, B = +24.31°, B´ = +24.58°. The yellowish-white EZs is visible northward of the where the rings traversed the globe of Saturn. Other major belts and zones of Saturn's northern hemisphere are also labeled on this remarkably detailed image.

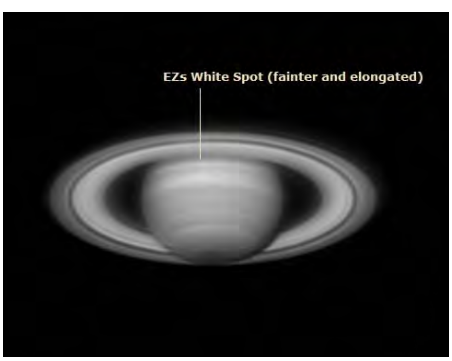
Illustration 002. 2015 July 02 12:51UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 675nm IR. S and Tr not specified. CMI = 148.0°, CMII = 55.8°, CMIII = 2.2°, B = +24.07°, B´ = +24.74°. Very faint small EZs white spot is shown approaching the CM.

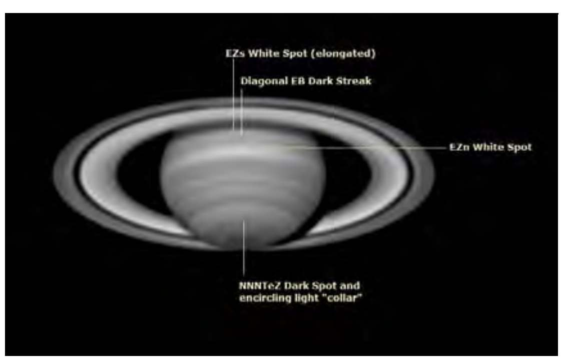
Illustration 003. 2015 July 13 12:18UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 675nm IR. S and Tr not specified. CMI = 55.7°, CMII = 329.0°, CMIII = 262.2°, B = +24.07°, B´ = +24.74°. Very faint small EZs white spot is on the CM. Nearby discrete phenomena obvious in this image is the EB dark streak north of the EZs spot, a slightly elongated EZn white spot immediately north of the latter EB feature, and in the far north, the NNNTeZ dark spot encompassed by a light "collar" (simultaneous observation of the EZn white spot with Trevor Barry on the same date).

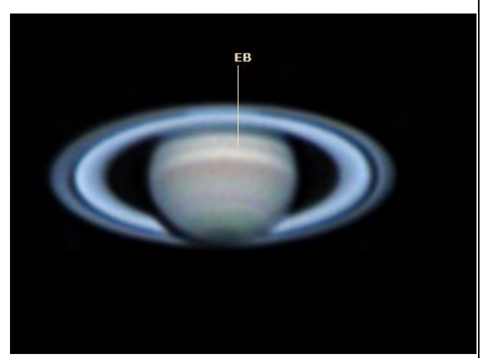
Illustration 004. 2015 July 19 11:20UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 4.5, Tr = not specified. CMI = 47.3°, CMII = 128.1°, CMIII = 54.1°, B = +24.02°, B´ = +24.83°. EZs white spot is just beyond the CM looking fainter than previously and more elongated in extent.

Illustration 005. 2015 July 26 16:15UT. Digital image by Clyde Foster. 35.6 cm (14.0 in.) SCT with 685nm IR filter. S = 8.5, Tr = 6.0. CMI = 10.0°, CMII = 218.1°, CMIII = 135.4°, B = +24.03°, B´ = +24.87°. The elongated EZs white spot (now looking more like a bright streak) is visible in very good seeing near the CM. Also prominent in the image is the EZn white spot, diagonal EB dark spot, and the curious NNNTeZ dark spot surrounded by a "collar" lighter-intensity.

Illustration 006. 2015 April 26 06:42UT. Digital image by Charles Triana. 25.4 cm (10.0 in.) SCT with RGB filters. S = 4.0, Tr = not specified. CMI = 238.3°, CMII = 159.5°, CMIII = 187.0°, B = +24.71°, B´ = +24.38°. The dusky EB is easily seen extending from limb to limb across the globe in this image.

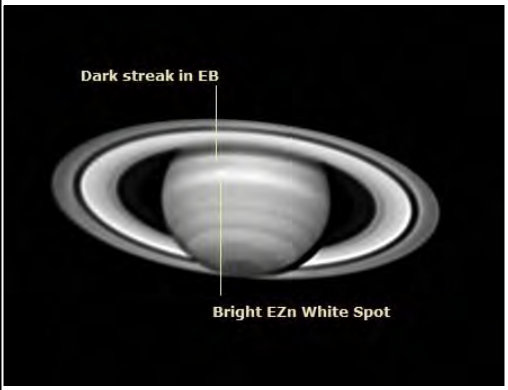


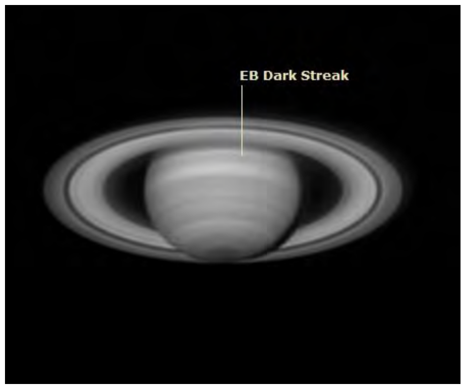




the EB near the CM. It was situated just

North of the aforementioned EZs bright spot and southward of the brighter EZn white spot (again see discussions in the previous and following sections concerning EZs and EZn white spots) [refer to Illustration No. 005]. Trevor Barry at 12:09UT on July 27th imaged a similar streak approaching the CM with a 685nm IR band pass filter [refer to Illustration No. 008], and based on his measurements, the feature was located at about +0.7° saturnigraphic latitude. It was not until August 14, 2015 that the EB dark streak was reported again, this time near the West or following limb (*f*) of Saturn as shown in Clyde Foster's 685nm IR image at 17:29UT [refer to Illustration No. 009]. Trevor Barry captured the EB dark streak at 09:51UT on August 17, 2015 using a 685nm IR filter about to rotate off the East or preceding (*p*) limb of the planet [refer to Illustration No. 010]. Of considerable interest was an image by Trevor Barry,





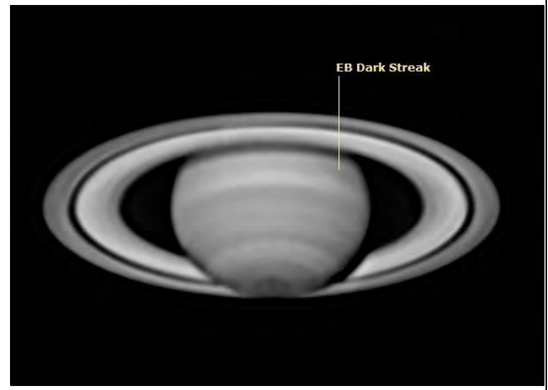


Illustration 007. 2015 July 02 11:54UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 685nm IR. S and Tr not specified. CMI = 114.6°, CMII = 23.7°, CMIII = 330.1°, B = +24.07°, B´ = +24.74°. A dark streak within the EB is depicted in this image along with a bright compact white spot in the EZn northward of the EB feature.

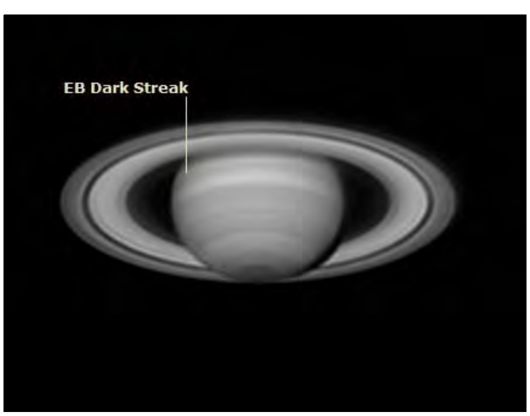
Illustration 008. 2015 July 27 12:09UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 350.0°, CMII = 171.4°, CMIII = 87.6°, B = +24.03°, B´ = +24.87°. The fuzzy dark EB diagonal streak is approaching the CM.

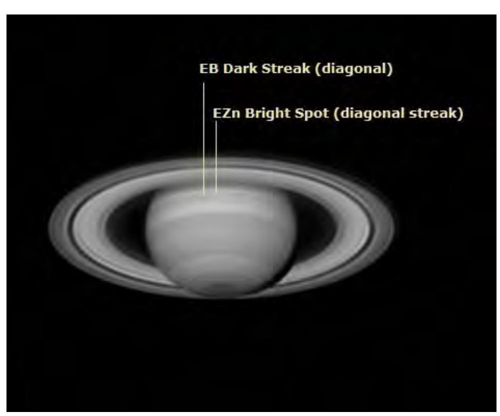
Illustration 009. 2015 August 14 17:29UT. Digital image by Clyde Foster. 35.6 cm (14.0 in.) SCT with 685nm IR filter. S = 7.0, Tr = 5.0. CMI = 253.5°, CMII = 206.3°, CMIII = 100.7°, B = +24.12°, B´ = +24.96°. The fuzzy dark EB diagonal streak is near the extreme West or following limb (f) of Saturn the CM.

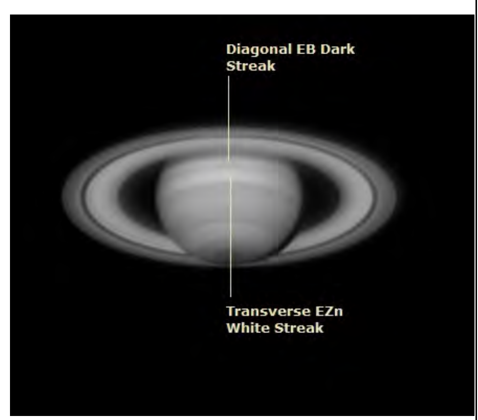
Illustration 010. 2015 August 17 09:51UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 357.6°, CMII = 223.8°, CMIII = 114.9°, B = +24.14°, B´ = +24.98°. The EB dark elongation is about to rotate off the East or preceding (p) limb of the planet in this image.

Illustration 011. 2015 August 28 09:12UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 260.8°, CMII = 132.6°, CMIII = 10.4°, B = +24.25°, B´ = +25.03°. This image depicts an interaction of the diagonal EB dark streak with a thin bright transverse elongated EZn white strip (apparently emanating from the EZn higher in Saturn's atmosphere) situated just to the West or following (f) side of the EB feature.

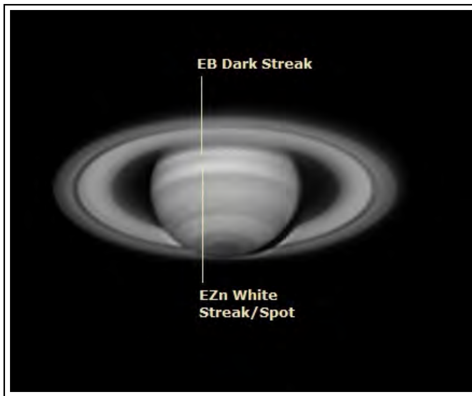
Illustration 012. 2015 September 25 09:30UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 147.7°, CMII = 194.8°, CMIII = 38.9°, B = +24.66°, B´ = +25.16°. Both the diagonal EB dark streak and thin bright transverse EZn white strip are situated on the CM.

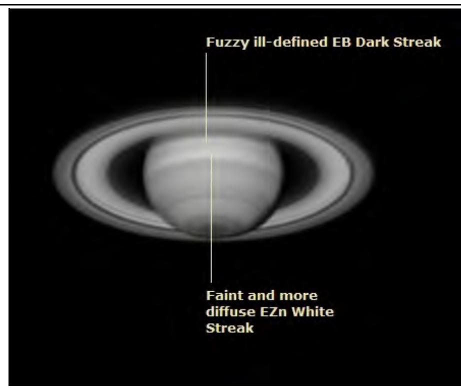






submitted at 09:12UT on August 28, 2015, depicting a very peculiar interaction of the diagonal EB dark streak with a thin bright diagonal strip situated just to the West or following (*f*) side of the EB feature best revealed at 685 nm IR wavelength [refer to Illustration No. 011]. Notice carefully in this image how the above-mentioned bright strip (apparently emanating from the EZn higher in Saturn's atmosphere) appeared to run transversely alongside the EB dark feature. Trevor Barry provided follow-up 685nm IR images on September 25, 2015 at 09:30UT and September 28, 2015 at 09:23UT both showing the EB dark streak (its center measured at saturnigraphic latitude +0.3°) and the associated EZn bright streak (its center measured at saturnigraphic latitude +7.6°) [refer to Illustrations No. 012 and 013]. Those two images in late September helped to further illustrate the morphological interaction of the features noticed nearly a month earlier on August 28, 2015, but the two features are seemingly more disassociated from one another and slightly more diffuse. In a subsequent image by Trevor Barry at 09:29UT on October 12, 2015 at 685nm IR, the EB dark streak and previously mentioned bright streak emanating from the EZn were hardly





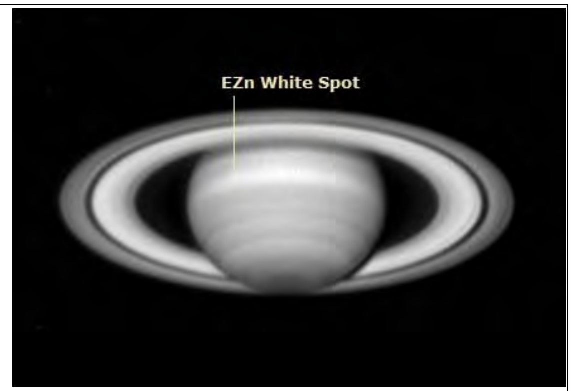


Illustration 013. 2015 September 28 09:23UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.0, Tr = not specified. CMI = 147.7°, CMII = 194.8°, CMIII = 38.9°, B = +24.66°, B´ = +25.16°. The EB dark streak and bright EZn white area both seem to have disassociated slightly from one another and appear a bit more diffuse than in late August.

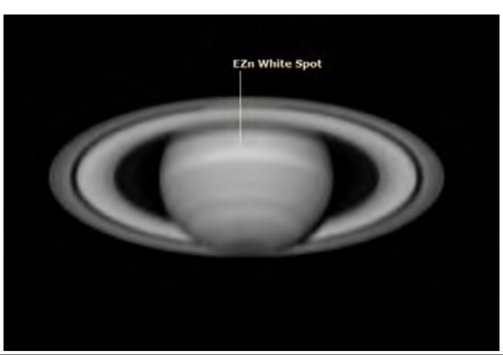
Illustration 014. 2015 October 12 09:29UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 97.6°, CMII = 315.6°, CMIII = 139.2°, B = +24.95°, B´ = +25.24°. The EB dark streak and bright EZn white area are only barely perceptible in this image, both features apparently having faded as the apparition has progressed.

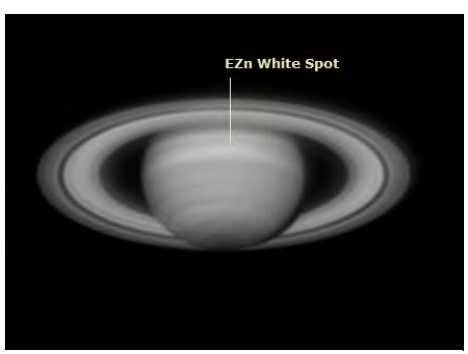
Illustration 015. 2015 June 21 21:36UT. Digital image by Marc Delcroix. 32.0 cm (12.6 in.) NEW with 685nm IR filter. S and Tr not specified. CMI = 168.4°, CMII = 59.7°, CMIII = 19.0°, B = +24.13°, B´ = +24.69°. A diffuse white spot is located along the southern edge of the EZn in apparent contact with the EB.

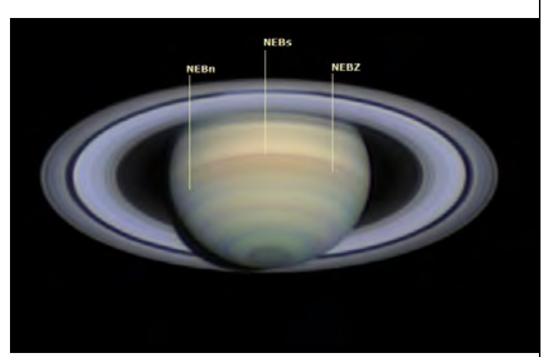
Illustration 016. 2015 June 30 22:28UT. Digital image by Damian Peach. 35.6 cm (14.0-in) SCT with a red filter. S and Tr not specified. CMI = 237.7°, CMII = 197.2°, CMIII = 145.5°, B = +24.07°, B´ = +24.73°. The somewhat diffuse EZn white spot is just past the CM looking as though it is rising above and extending slightly over the north edge of the EB in this image.

Illustration 017. 2015 July 13 12:13UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 52.8°, CMII = 326.2°, CMIII = 259.4°, B = +24.95°, B´ = +25.24°. Very faint small EZs white spot is on the CM (simultaneous observation of the EZn white spot with Anthony Wesley on the same date).

Illustration 018. 2015 February 26 09:43UT. Digital image by Damian Peach. 35.6 cm (14.0-in) SCT with a RGB filters. S and Tr not specified. CMI = 206.5°, CMII = 228.5°, CMIII = 327.0°, B = +25.00°, B´ = +24.03°. A grayish-brown NEBs looks narrower and darker than the wider and more diffuse grayish-brown NEBn with a vaguely perceptible yellowish-gray NEBZ lying in between.

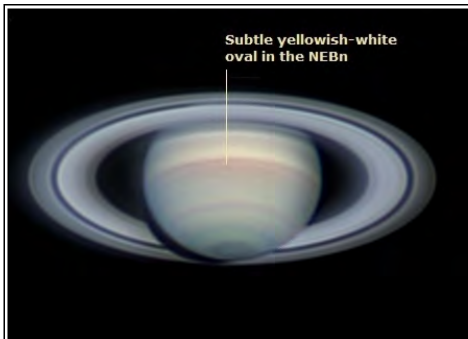


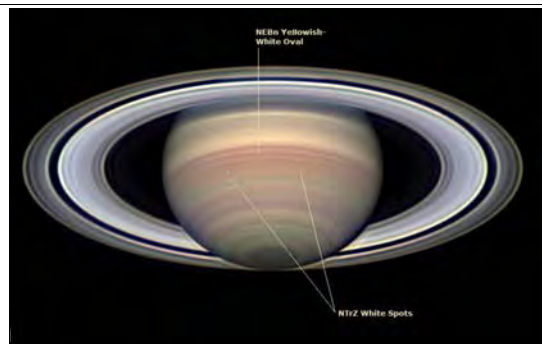




perceptible, fading in prominence, but also because Saturn was situated lower in the western sky at the time of observation and affected by poorer seeing [refer to Illustration No. 014]. From the preceding results, these EB and EZn features were clearly easier to distinguish at the IR wavelengths and seldom very obvious with RGB filter combinations.

Equatorial Zone - Northern Half (EZn). With the numerical value of **B** ranging between the extremes of +24.004° (July 21, 2015) and +25.034° (October 18, 2015), the northern half of the Equatorial Zone (EZn) was seen and imaged to best advantage in 2014-15. Based on limited visual numerical relative intensity estimates and numerous digital images, the bright yellowish-white Equatorial Zone (EZn) displayed no significant change in brightness since 2013-14 (a mean intensity difference of only -0.13 is considered negligible), yet it was always the brightest zone on Saturn's globe in 2014-15 [refer to Illustration No. 001]. The first report to the ALPO Saturn Section of a white spot in the EZn came from Marc Delcroix by way of an image taken at 685nm IR at 21:36UT on June 21, 2015. The bright feature was located at approximately +7.9° saturnigraphic latitude along the southern edge of the EZn in apparent contact with the EB [refer to Illustration No. 015]. Less than ten days later, on June 30, 2015, Damian Peach submitted a monochrome image taken at





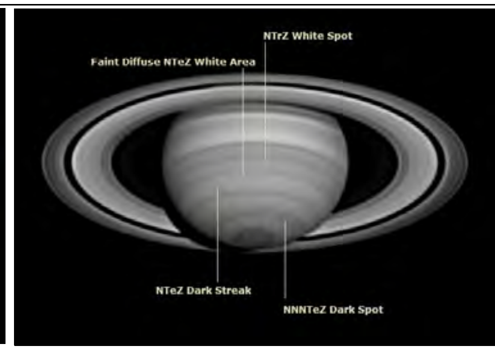


Illustration 019. 2015 February 20 18:21UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 6.0, Tr = not specified. CMI = 124.2°, CMII = 328.4°, CMIII = 73.7°, B = +24.99°, B´ = +24.00°. A very subtle yellowish-white oval is just past the CM within the NEBn.

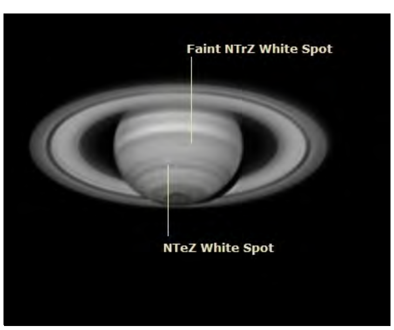
Illustration 020. 2015 June 08 13:29UT. Digital image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S = 8.0, Tr = 4.0. CMI = 66.5°, CMII = 28.6°, CMIII = 3.9°, B = +24.25°, B´ = +24.62°. The yellowish-white NEBn spot is easily seen in this highly detailed image, including white spots in the NTrZ on either side of the CM.

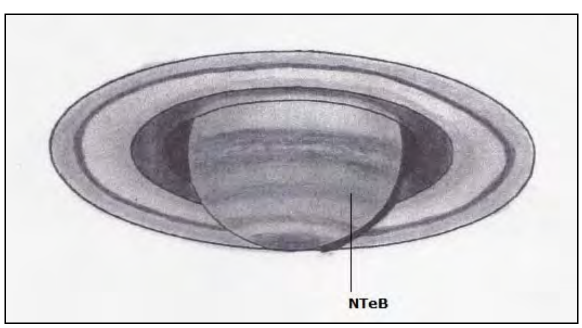
Illustration 021. 2015 March 02 09:44UT. Monochrome digital image by Damian Peach. 35.6 cm (14.0-in) SCT. S and Tr not specified. CMI = 344.5°, CMII = 237.3°, CMIII = 331.0°, B = +25.01°, B´ = +24.06°. A fuzzy white spot in the NTrZ is located on the following (f) or West side of the CM. Notice also a faint diffuse white area in the NTeZ, a dark streak in the NTeZ, as well as the recurring NNNTeZ dark spot with a lighter "collar" surrounding it.

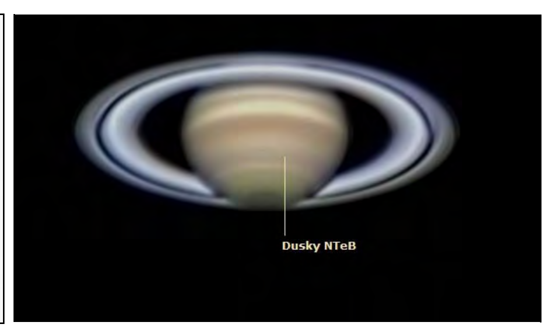
Illustration 022. 2015 September 24 09:08UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 6.0, Tr = not specified. CMI = 10.7°, CMII = 90.6°, CMIII = 295.9°, B = +24.64°, B´ = +25.16°. A very faint diffuse white region within the NTrZ is located on the following (f) or West side of the CM. A slightly elongated white spot is also seen in the NTeZ between the CM and the preceding (p) or East limb.

Illustration 023. 2015 July 05 02:50UT. Drawing by Phil Plante. 25.4 cm (10.0 in.) NEW in Integrated Light (no filter) at 244X. S = 5.0, Tr = 3.0. CMI = 168.5°, CMII = 352.9°, CMIII = 296.2°, B = +24.05°, B´ = +24.76°. The dusky NTeB is fairly wide in the sketch in Integrated Light and average seeing.

Illustration 024. 2015 May 31 04:48UT. Digital image by Rich Jakiel. 30.5 cm (12.0 in.) SCT with RGB filters. S = 5.0, Tr = 6.0. CMI = 206.1°, CMII = 78.3°, CMIII = 63.7°, B = +24.33°, B´ = +24.57°. Wide and dusky NTeB is obvious in this image (compare with the drawing by Phil Plante on 2015 July 05 at 02:50UT).







22:28UT showing a diffuse bright EZn white spot just past the CM looking as though it was rising above and extending slightly over the north edge of the EB [refer to Illustration No. 016]. On July 2, 2015, Anthony Wesley captured the EZn white spot at 685nm IR East of the CM at 11:54UT showing a comparable close association between the EB dark streak and the EZn white spot [refer to Illustration No. 007]. In simultaneous observations both occurring on July 13, 2015 (each observer employing 685nm IR bandpass filters), Trevor Barry (at 12:13UT) [refer to Illustration No. 017] and Anthony Wesley (at 12:18UT) [refer to Illustration No. 003] imaged the EZn white spot near the CM. Notice especially in Trevor Barry's July 13th image how the EB dark streak appears situated almost exactly between the larger and brighter EZn white spot and the smaller compact EZn white oval. Clyde Foster's image at 16:15UT on July 26, 2015 with a 685nm IR filter shows the EZn white spot on the CM [refer to Illustration No. 005] along with the aforementioned EZs white spot and the dark diagonal EB streak. As pointed out in the previous discussion of an odd-looking diagonal EB dark streak, the bright EZn white spot became more noticeable as it developed morphologically into a transverse bright streak just to the West or following (*f*) side of the EB feature as illustrated in Trevor Barry's August 28, 2015 image at 09:12UT [refer to Illustration No. 011]. Although on a much smaller scale than more strikingly prominent bright features and storms in Saturn's atmosphere in past apparitions, the EZn white spot

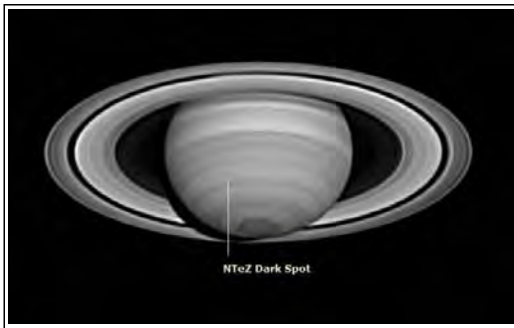


Illustration 025. 2015 February 26 09:43UT. Monochrome digital image by Damian Peach. 35.6 cm (14.0-in) SCT. S and Tr not specified. CMI = 206.5°, CMII = 228.5°, CMIII = 327.0°, B = +25.00°, B´ = +24.03°. A very tiny dark spot is just noticeable between the CM and the preceding (p) or East limb.

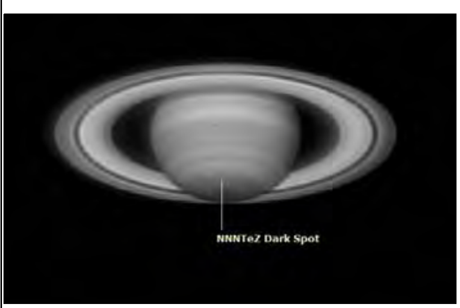
Illustration 026. 2015 May 20 16:05UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 675nm IR. S and Tr not specified. CMI = 314.9°, CMII = 167.3°, CMIII = 165.4°, B = +24.45°, B´ = +24.51°. The prominent dark spot in the NNNTeZ is surrounded by a curious "collar" of much lighter intensity in this IR image.

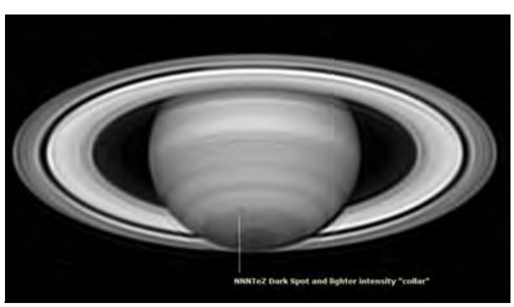
Illustration 027. 2015 May 25 14:08UT. Monochrome digital image by Christopher Go. 35.6 cm (14.0 in.) SCT. S = 8.0, Tr = 4.0. CMI = 148.2°, CMII = 201.7°, CMIII = 193.9°, B = +24.39°, B´ = +24.54°. The NNNTeZ dark spot and light encircling "collar" resides near the preceding (p) or East limb in this excellent image.

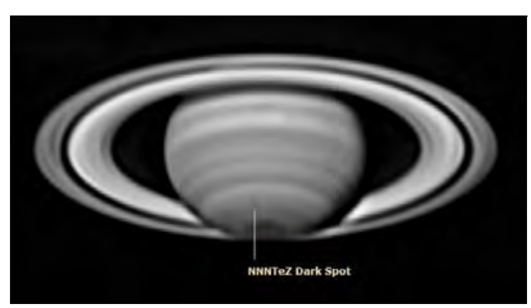
Illustration 028. 2015 June 08 12:33UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 742nm IR filter. S = 5.5, Tr = not specified. CMI = 33.6°, CMII = 357.0°, CMIII = 332.4°, B = +24.25°, B´ = +25.62°. The NNNTeZ dark spot and light "collar" has just passed the CM (simultaneous observation with Christopher Go on the same date at 12:49UT).

Illustration 029. 2015 June 08 12:49UT. Monochrome image by Christopher Go. 35.6 cm (14.0 in.) SCT. S = 8.0, Tr = 4.0. CMI = 43.0°, CMII = 6.1°, CMIII = 341.4°, B = +24.25°, B´ = +24.62°. The NNNTeZ dark spot and light "collar" has just passed the CM (simultaneous observation with Trevor Barry on the same date at 12:33UT).

Illustration 030. 2015 July 25 19:46UT. Digital image by Manor Kardasis. 35.6 cm (14.0 in.) SCT. S and Tr not specified. CMI = 9.5°, CMII = 245.1°, CMIII = 163.5°, B = +24.03°, B´ = +24.86°. The NNNTeZ dark spot and lighter "collar" is seen just beyond the CM.







showed some plausible structural evolution between late June and late September 2015 at a measured saturnigraphic latitude of +7.6°. Such changes over three months may likely be the result of brighter material emerging through the upper NH_3-ice cloud layer becoming sheared diagonally and gradually overlaying a region of the adjacent EB. Other than the discrete activity just described, there were no accounts received of other white spot activity in the EZn from observers using imaging techniques during the observing season, nor were there any reports of such features by visual observers. Visual observers did offer comment that the EZn remained quite prominent throughout the 2014-15 apparition.

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 2014-15 apparition. Visual observers reported the NEBw as a singular belt most of the observing season as opposed to it being separated into the NEBs and NEBn components with the NEBZ lying between the two components. The NEBw, showing a slightly dimmer appearance of only -0.38 mean intensity points since 2013-14, usually displayed a lighter-to-darker southward progression in intensity across its broad width, consistent also with its form on most digital images. Many digital images in 2014-15 revealed a grayish-brown NEBs appearing generally narrower and darker than the more diffuse and wider grayish-

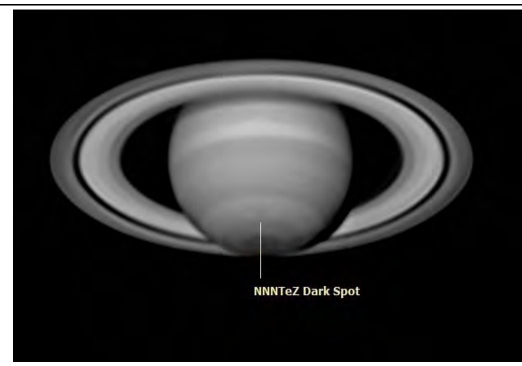


Illustration 031. 2015 July 31 11:33UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 675nm IR. S and Tr not specified. CMI = 105.8°, CMII = 158.8°, CMIII = 70.3°, B = +24.04°, B´ = +24.89°. The prominent dark spot in the NNNTeZ and accompanying lighter intensity "collar" is approaching the CM.

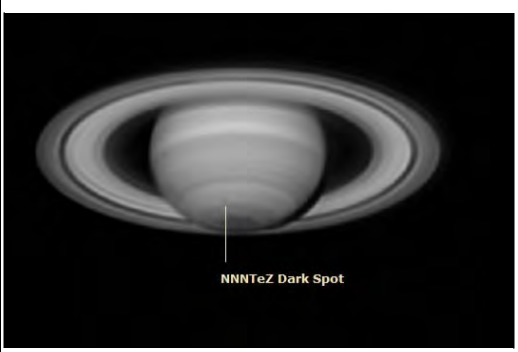
Illustration 032. 2015 August 10 02:59UT. Digital image by Paul Maxson. 31.5 cm. (12.4 in.) DALL at 685nm IR. S and Tr not specified. CMI = 326.7°, CMII = 68.2°, CMIII = 328.1°, B = +24.09°, B´ = +24.94°. The NNNTeZ dark spot and light "collar" is on the CM.

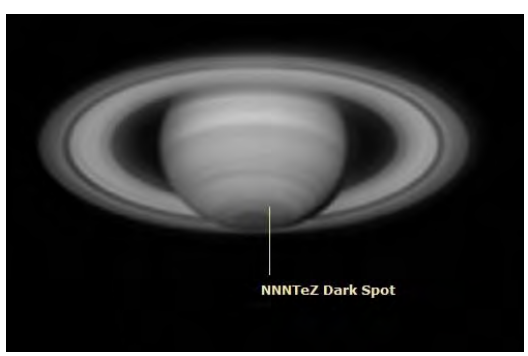
Illustration 033. 2015 August 23 16:57UT. Digital image by Clyde Foster. 35.6 cm (14.0 in.) SCT with 685nm IR filter. S = 6.0, Tr = 6.0. CMI = 272.5°, CMII = 295.3°, CMIII = 178.8°, B = +24.20°, B´ = +25.01°. The NNNTeZ dark spot is situated on the CM.

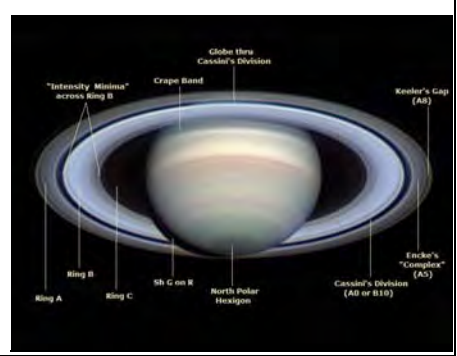
Illustration 034. 2015 September 09 08:52UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 6.5, Tr = not specified. CMI = 33.6°, CMII = 299.0°, CMIII = 143.7°, B = +24.41°, B´ = +25.09°. The NNNTeZ dark spot and light "collar" has just passed the CM.

Illustration 035. 2015 September 26 09:33UT. Trevor Barry. 40.6 cm (16.0 in.) NEW with 685nm IR filter. S = 5.5, Tr = not specified. CMI = 273.6°, CMII = 288.4°, CMIII = 131.2°, B = +24.67°, B´ = +25.17°. The NNNTeZ dark spot with its encompassing light "collar" is approaching the CM.

Illustration 036. 2015 April 01 19:07UT. Digital Image by Christopher Go. 35.6 cm (14.0 in.) SCT with RGB filters. S = 7.0, Tr = 4.0. CMI = 86.0°, CMII = 77.1°, CMIII = 134.1°, B = +24.91°, B´ = +24.24°. This superb image depicts the North Polar Hexigon clearly as well as the all major ring features and phenomena.







brown NEBn, sometimes with a vaguely perceptible yellowish-gray NEBZ lying in between, as illustrated in the image by Damian Peach on February 26, 2015 at 09:43UT [refer to Illustration No. 018]. In terms of activity in the NEB, Trevor Barry using RGB filters furnished an image of a small yellowish-white oval immersed within the NEBn at 18:21UT on February 20, 2015 that he measured at saturnigraphic latitude +26.9° [refer to Illustration No. 019]. Christopher Go noticed another spot in the NEBn at roughly the same latitude at RGB wavelengths on June 8, 2015 at 13:29UT [refer to Illustration No. 020]. It is rather uncertain if these spots imaged nearly three and a half months apart were the same feature. Because no other reports of NEBn spots were received in 2014-15, it might be concluded such activity was short-lived.

North Tropical Zone (NTrZ). Visual numerical relative intensity estimates of this zone were nonexistent, although visual observers described the yellowish-white NTrZ as rather subdued in brightness since 2013-14. The NTrZ was apparent on most images in good seeing conditions throughout the observing season, but this region also did not appear as bright as in the immediately preceding apparition. Damian Peach provided an RGB image on March 2, 2015 at 09:44UT of a fuzzy white spot in the NTrZ located on the following (*f*) or West side of the CM [refer to Illustration No. 021]. Three months later on June 8, 2015 at 13:29UT Christopher Go captured a pair of NTrZ white spots on either side of the CM situated near the northern diffuse edge of the NEBn [refer to Illustration No. 020]. Later in the apparition, Trevor Barry noticed a very faint diffuse white region within the NTrZ on September 24, 2015 at 09:08UT at about +44.0° saturnigraphic latitude, more noticeable with a 685nm IR bandpass filter [refer to Illustration No. 022]. No phenomena beyond these infrequent white spots in the NTrZ were noticed by Saturn observers this apparition.

North Temperate Belt (NTeB). The grayish-brown NTeB was rarely seen by visual observers during the observing season, and although no visual numerical relative intensity estimates were provided, when seen the belt was described as duskier in appearance and perhaps slightly wider since 2013-14 as shown in a drawing by Phil Plante on July 5, 2015 at 02:50UT [refer to Illustration No. 023]. Digital images of Saturn during the apparition also recorded a slightly wider NTeB in general agreement with visual impressions; for instance, consider the RGB image taken by Rich Jakiel in average seeing at 04:48UT on May 31, 2015 [refer to Illustration No. 024].

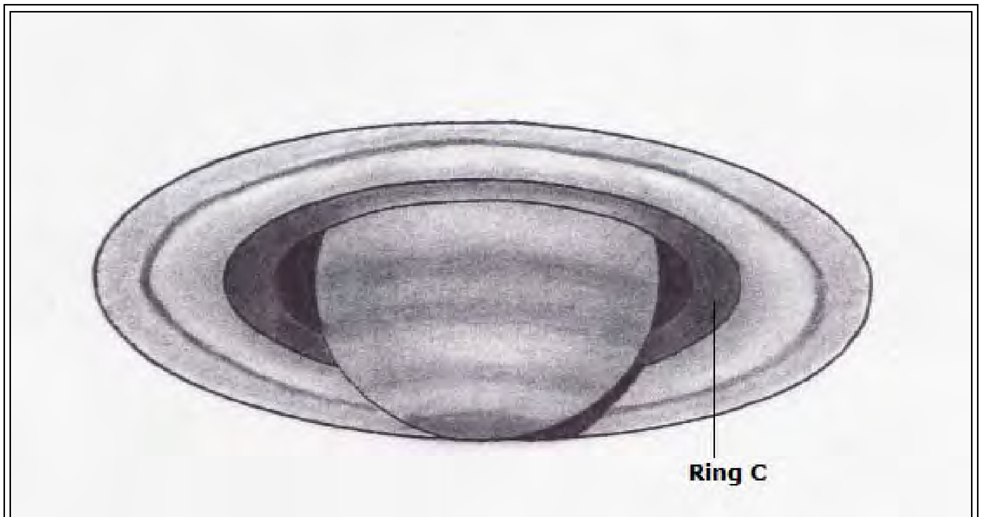


Illustration 037. 2015 August 13 01:38UT. Drawing by Phil Plante. 63.5 cm (25.0 in.) NEW in Integrated Light (no filter) at 294X. S = 4.5, Tr = 4.0. CMI = 291.8°, CMII = 298.2°, CMIII = 194.6°, B = +24.11°, B´ = +24.95°. The dark Ring C is visible on the drawing in Integrated Light in average seeing.

North Temperate Zone (NTeZ). There were no visual numerical relative intensity estimates of the yellowish-gray NTeZ contributed this apparition to evaluate any change in prominence of the zone since 2014-15. Nevertheless, the NTeZ was usually apparent on drawings submitted during the apparition and on the majority of digital images received. Where the NTeZ was a bit more conspicuous than the NTrZ on most images. Those who routinely imaged Saturn detected very limited bright spot activity in the NTeZ during 2014-15. For instance, the first report of a white spot in the NTeZ came by way of a monochrome image from Damian Peach on March 02, 2015, the feature having just passed the CM at 09:44UT [refer to Illustration No. 021]. Later in the apparition, at 09:08UT on September 24, 2015, Trevor Barry imaged a barely distinguishable and slightly extended white area in the NTeZ on the East or preceding (*p*) side of the CM [refer to Illustration No. 022]. Other discrete phenomena in the NTeZ in 2014-15 occurred in the form of sporadic dark spots, the first appearing as a minute dark oval in the NTeZ in a monochrome image by Damian Peach on February 26, 2015 at 09:43UT halfway between the CM and the East or preceding (*p*) limb [refer to Illustration No. 025], He also detected a dark spot again in his monochrome image of March 2, 2015 at 09:44UT halfway between the CM and the East or preceding (*p*) limb [refer to Illustration No. 021]. Visual observers reported none of these white and dark NTeZ spots in 2014-15.

North North Temperate Belt (NNTeB). The dull gray NNTeB was difficult to detect even on the best images taken in good seeing conditions in 2014-15, but Christopher Go's beautiful image of June 2, 2015 at 13:32UT easily shows the narrow belt [refer to Illustration No. 001]. Visual observers did not report the NNTeB during the observing season.

North North Temperate Zone (NNTeZ). During 2014-15, the often-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 [refer to Illustration No. 001]. Examination of images during the observing season, there was no obvious activity in this region.

North North North Temperate Zone (NNNTeZ). Visual observers did not report the yellowish-gray NNNTeZ during the 2014-15 apparition, but it was frequently shown in higher resolution images at various wavelengths. Damian Peach reported a recurring dark spot initially at 09:44UT on March 2, 2015 in his monochrome and RGB images [refer to Illustration No. 021]. Thereafter, more observers started reporting and tracking the long-lived NNNTeZ dark spot throughout the 2014-15 apparition with excellent images of the interesting feature. Hereinafter in this section, our discussion will focus on some of the best images of the NNNTeZ dark disturbance chronologically by date in 2014-15. For instance, consider an observation by Anthony Wesley on May 20, 2015 at 16:05UT at 685nm IR, showing the spot with what looks to be a lighter "collar" surrounding the feature [refer to Illustration No. 026]. Note also the superb IR image by Christopher Go on May 25, 2015 at 14:08UT, displaying a similar morphological appearance [refer to Illustration No. 027]. Continuing into June, a pair of near-simultaneous observations of the NNNTeZ dark spot encircled by a lighter-intensity peripheral "collar" were received, the first by Trevor Barry at 742nm IR on June 8, 2015 at 12:33UT [refer to Illustration No. 028] and the other, a monochrome image, by Christopher Go on the same date at 12:49UT [refer to Illustration No. 029]. The persistent NNNTeZ dark spot, along with the same bright border, was imaged at 685nm IR on July 13, 2015 at 12:18UT by Anthony Wesley [refer to Illustration No. 003], and almost two weeks later on July 25, 2015 at 19:46UT by Manos Kardasis [refer to Illustration No. 030]. A series of additional impressive images were contributed by Clyde Foster on July 26, 2015 at 16:15UT [refer to Illustration No. 005], by Anthony Wesley (at 675nm IR) on July 31, 2015 at 11:33UT [refer to Illustration No. 031], by Paul Maxson (at 685nm IR) on August 10, 2015 at 02:59UT, [refer to Illustration No. 032] by Clyde Foster (at 685nm IR) on August 23, 2015 at 16:57UT [refer to Illustration No. 033], by Trevor Barry (at 685nm IR) on September 9, 2015 at 08:52UT [refer to Illustration No. 034], and finally on September 26, 2015 at 09:33UT in an image by Trevor Barry at 685nm IR [refer to Illustration No. 035]. Various measurements of the NNNTeZ dark spot depicted on many of the higher definition IR images, including those especially by the aforementioned observers, resulted in its location at roughly +64° to +65° saturnigraphic latitude. There is no doubt that the NNNTeZ dark spot and the light-intensity "collar" surrounding it was far more obvious in IR filters as opposed to RGB wavelengths.

North Polar Region (NPR). Visual observers frequently reported the gray NPR, and it was evident on digital images contributed during the 2014-15 apparition. Visual numerical relative intensity estimates suggested only a trivial dimming of the NPR by -0.15 in mean intensity since 2013-14. 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 2014-15, this narrow feature was sometimes recognizable on detailed images encircling the [refer to Illustration No. 001]. The always intriguing North Polar hexagon was easily recognizable on many of the best images this apparition, such the one by Christopher Go taken on April 1, 2015 at 19:07UT [refer to Illustration No. 036].

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 2014-15. Any presumed variation of this shadow from a totally black intensity (0.0) during an apparition is purely a consequence of poor seeing conditions or the presence of extraneous light. Digital images showed feature as completely black. It should be recalled that the globe of Saturn casts a shadow on the rings toward the left or IAU East prior to opposition, to the right or IAU West after opposition, and on neither side at opposition (no shadow). This is illustrated in *Figure 6* showing digital images furnished by Trevor Barry on January 21, 2015 at 18:43UT (before opposition), May 23, 2015 at 14:21UT (at opposition), and September 9, 2015 09:07UT (after opposition).

Latitude Estimates of Features on the Globe. Observers did not submit latitude estimates of features on Saturn's globe during 2014-15, however, several of the sharpest images in good seeing were measured to ascertain as accurately as possible the saturnigraphic latitude of specific discrete phenomena discussed in this report. Readers are encouraged to try the historically effective 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.

Saturn's Ring System

This section addresses visual studies of Saturn's ring system with the accustomed comparison of mean intensity data between apparitions, as well as interpretations of digital images of the rings contributed during 2014-15. With the ring tilt toward Earth in 2014-15 increasing to as much as +25.034°, the major ring components were much easier to see and image as the rings progress toward their maximum inclination of +27° during the future 2016-17 apparition.

Ring A. Visual numerical relative intensity estimates suggested that the dull greyish-white Ring A (taken as a whole) appeared brighter in 2014-15 than in the immediately preceding apparition by a difference of +1.57 mean intensity points. Visual observers described Ring A as being largely homogeneous as opposed to being subdivided into inner and outer halves, but digital images of Saturn in 2014-15 often showed inner and outer halves of Ring A, with the inner half somewhat brighter than the outer half. Visual observers reported the very dark gray Encke's division (A5) at the ansae during the observing season in good seeing and with larger apertures, but there was only a single visual numerical relative intensity estimate (see *Table 3*). Many of the higher resolution images revealed Encke's division (A5) and Keeler's gap (A8), but the latter was seldom described by visual observers except with the largest instruments used [refer to Illustration No. 036].

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 2014-15 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 slightly lighter intensity by a mean factor of +0.92 compared with 2013-14. Digital images confirmed most visual impressions during this observing season, with those of the highest resolution in favorable seeing exhibited several “intensity minima” across the breadth of Ring B [refer to Illustration No. 036].

Cassini's Division (A0 or B10). Visual observers regularly saw Cassini's division (A0 or B10) in 2014-15, and visual numerical relative intensity estimates averaged out at +0.08, but any suspected deviation of Cassini's Division from a totally black intensity (i.e., intensity of 0.0) was almost certainly a result of poor seeing, scattered light, or insufficient aperture. Indeed, most visual observers viewing Saturn in good seeing conditions, and those submitting digital images, described or depicted it as a totally black gap at both ansae and usually traceable all the way around Saturn's ring system (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. 036]. The globe could be seen through Cassini's division (A0 or B10) in a quite a number of the best images submitted this observing season [refer to Illustration No. 036].

Ring C. The very dark gray Ring C was observed at the ansae on most digital images during 2014-15 and displayed on drawings made by visual observers [refer to Illustrations No. 036 and 037]. Intensity estimates this apparition suggested that Ring C (at the ansae) was darker by -0.78 mean intensity points than it appeared in 2013-14. The Crape Band (Ring C across the globe of Saturn) was reported by visual observers, appearing very dull gray with uniform intensity, and duller since 2014-14 by -0.98 intensity points, and it was routinely evident on digital images [refer to Illustration No. 036].

Opposition Effect. The Seeliger “opposition effect” was reported by a handful of observers on opposition date (May 23, 2015), which is a readily noticeable brightening of Saturn's ring system during a very brief interval on either side of opposition when the phase angle between Sun, Saturn, and the Earth is $\leq 0.3°$. This ring brightening is due to coherent back scattering of sunlight by µ-sized icy particles that make up the rings, scattering light far more efficiently than the particles of Saturn's atmosphere. In *Figure 6*, Trevor Barry's image at opposition on May 23, 2015 at

14:21UT clearly shows the Seeliger Effect.

Shadow of the Rings on the Globe (Sh R on G). The Sh G on R, when normally seen or imaged under the correct geometric circumstances in 2014-15, was designated by observers in good seeing as a fully black shadow situated 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 May 14, 2015 [refer to Illustration No. 036]. When both **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 May 14, 2015 through October 18, 2015 (the final observation received for the apparition). It should be pointed out that, since the rings blocked views of the southern hemisphere of the globe, it was not possible to see the Sh R on G from May 14, 2015 onward through the end of the apparition.

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 handful of instances when visual observers suspected this spurious feature during 2014-15. The TWS is an artificial contrast effect and not an intrinsic feature of Saturn's rings, but it is helpful to try to find any correlation that might exist between the visual numerical relative 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 2014-15, 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 2014-15 conducted no systematic visual estimates of Saturn's satellites using suggested ALPO Saturn Section methodology. Although 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 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.

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 the same as visual impressions because the peak wavelength response of the CCD chip is typically different from 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.

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 starting 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 verification of ill-defined or traditionally controversial phenomena. There were a few occasions during 2014-15 when simultaneous observations were accomplished fortuitously, and these corroborating reports helped strengthen the objectivity of the data received. As a good example, consider the pair of near-simultaneous observations mentioned earlier in this report of an NNNTeZ dark spot surrounded by a lighter-intensity peripheral "collar" on July 8, 2015 by Trevor Barry and Christopher Go, observing within about ten minutes of one another. To encourage and increase the likelihood of such conformational work, the ALPO Saturn Section has organized a simultaneous observing team so that several individuals in reasonable proximity to one another can maximize opportunities for viewing and imaging Saturn on any given night using similar equipment and methodology. Joint efforts like this significantly reinforce the level of confidence in the data submitted for each apparition.

Pro-Am Opportunities

Our involvement in professional-amateur (Pro-Am) projects continued in 2014-15 in support of the *Cassini* mission with ALPO observers submitting images of discrete phenomena sighted or imaged on the globe of Saturn. Readers of this Journal should remember the combined efforts of amateurs and professionals in keeping track of the dynamic, brilliant NTrZ white storm raging on Saturn during the past 2010-11 apparition. Ever since *Cassini* started observing Saturn at close range in April 2004, digital images at wavelengths ranging from 400nm to 1 have been actively sought by the professional community from amateurs and continues as a project of high significance. Advanced observers have been encouraged to 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, in addition to imaging through an 890-nm narrow band CH_4 (methane) filter. Therefore, to sustain our Pro-Am work with the *Cassini* team, ALPO observers are asked to continue systematically patrol of the planet every clear night for individual features, keeping track of their motions, locations, and morphology. Such reports provide input concerning interesting large-scale targets for on-board *Cassini* spacecraft imaging systems to include in close-up surveillance as the mission endures well into 2017. In addition, 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.

It is worth mentioning, as of the writing of this apparition report, the *Cassini* spacecraft remains in an excellent state of health with all of its subsystems operating normally except for the instrument issues described at:

http://saturn-archive.jpl.nasa.gov/news/significantevents/anomalies

Those who regularly visit the above link will also notice that the mission's newly designed website has finally gone live. It was specifically created to share the story of *Cassini* with the those interested in what is going on at Saturn like never before, plus the site features regular content updates, amazing visualizations and images, as well as fresh, vibrant, and engaging descriptions of how *Cassini* works and what the mission has achieved so far.

As a means of facilitating and stimulating active Pro-Am observational cooperation, readers are asked to contact the ALPO Saturn 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 pleased to offer guidance to novices, as well as observers that are more experienced. A meaningful resource for novices to learn how to observe and develop skill in recording data on Saturn is the ALPO Training Program, and it is recommended that beginners take advantage of this valuable educational resource.

Conclusions

Although the number of visual numerical relative intensity estimates were fewer than usual during 2014-15, features of Saturn's globe seemed marginally dimmer compared with the immediately preceding apparition. Saturn's southern hemisphere during 2014-15 was blocked from our view by the rings with the exception of the yellowish-white Equatorial Zone (EZs) just to the south of where the Equatorial Band (EB) crossed the globe.

Activity within Saturn's northern hemisphere during 2014-15 included features such as sporadic small bright spots in the North Temperate Zone (NTeZ), NTrZ (North Tropical Zone), and the NEBn (North Equatorial Belt, northern edge). From late May through mid-October 2015 recurring white spots were imaged in the EZn (Equatorial Zone, northern half), as well as short-lived white areas in the EZs (Equatorial Zone, southern half) during July 2015. A long-lived dark condensation or spot, surrounded curiously by a white "collar," was imaged regularly in the North North North Temperate Zone (NNNTeZ) starting in early March throughout the rest of the apparition. Small repetitive dark spots within the EB (Equatorial Band) were shown on images from late July through mid-October 2015. A tiny less well-defined dark feature was imaged in the NTeZ (North Temperate Zone) from mid-January through early March 2015. Observers continued to image the astonishing hexagonal feature at Saturn's North Pole at different wavelengths.

Observations of the major ring components, including *Cassini's* and Encke's divisions, plus occasional views of Keeler's division (A8) and "intensity minima" in Ring B, were even more favorable this apparition because of the improved inclination of Saturn's rings toward Earth since 2013-14. Although observers used standard procedures for trying to confirm any bi-colored aspect of the rings during the 2013-14 apparition, there were no reports of the phenomenon by visual observers, and its presence on digital images was not noticeable.

ALPO Saturn Section observers studying the planet by visual methods or through routine digital imaging of the planet at various wavelengths, kept active participation alive in our Pro-Am efforts supporting the ongoing *Cassini* mission. Digital imaging, which now occurs as routinely as visual studies of Saturn, frequently divulges minute detail on the globe and in the rings below the normal visual threshold. With a combination of both observational methods, opportunities markedly increase for detecting changes on Saturn during any given apparition. 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 discrete features in integrated light (no filter) and at various wavelengths.

With regard to Saturn's satellites, during the 2014-15 apparition observers did not submit magnitude estimates.

Acknowledgements

The author appreciates all of the efforts by dedicated observers mentioned in this report in submitting their excellent drawings, digital images, descriptive reports, simultaneous observations, and visual numerical relative intensity estimates during 2014-15.

Regular systematic observational work enriches our pursuits and reinforces Pro-Am collaboration we try to better understand Saturn as a planet. Observers everywhere are encouraged to join us in our activities in upcoming apparitions.

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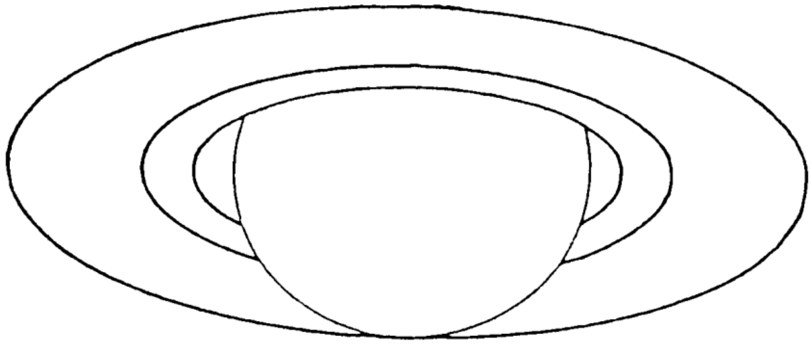

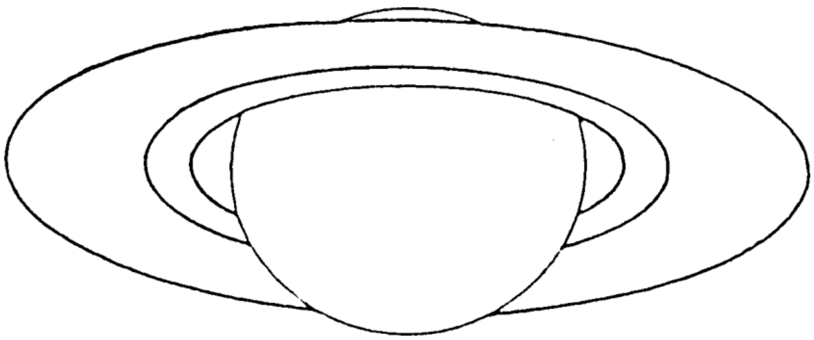

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Coordinates (check one): [ ] IAU [ ] Sky

Observer__________________________________Location____

UT Date (start) _______________ UT Start ______________ CM I (start) ____________° CM II (start) ____________° CM III (start) ____________°

UT Date (end) _______________ UT End ______________ CM I (end) ____________° CM II (end) ___________° CM III (end) ___________°

B = __________° B′ = __________° Instrument ____ Magnification(s) __________ x_{min} __________ x_{max}

Filter(s) IL(none) ______________ f_1 ______________ f_2 ______________ f_3 _____________ Seeing _____________ Transparency _______________

Saturn	**Visual Photometry and Colorimetry**					**Latitude Estimates**
Global and Ring Features	**IL**	**f_1**	**f_2**	**f_3**	**Absolute Color Estimates**	**ratio y/r**

Bicolored Aspect of the Rings: (*always use IAU directions*)

No Filter (IL) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa

Blue Filter (_________) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa

Red Filter (_________) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa

IMPORTANT: Attach to this form all descriptions of morphology of atmospheric detail, as well as other supporting information. Please do not write on the back of this sheet. The intensity scale employed is the *Standard A.L.P.O. Intensity Scale*, where 0.0 = completely black ⇔ 10.0 = very brightest features, and intermediate values are assigned along the scale to account for observed intensity of features.

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

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- **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:
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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:** (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.

- **Venus (Benton):** Introductory information for observing Venus, the comprehensive *ALPO Venus Handbook*, as well as all observing forms and ephemerides, can be conveniently downloaded as pdf files at no cost to ALPO members and individuals interested in observing Venus as part of our regular programs at http://www.alpo-astronomy.org/venus.

- **Mars:** Free resources are on the ALPO website at www.alpo-astronomy.org . Click on "Mars Section" in the left column; then on the resulting webpage, look for links to resources in the right column including “Mars Observing Form”, and "Mars Links". Under “Mars Links”, click on "Mars Observers Cafe", and follow those links to The New “Internet Mars Observer's Handbook.”

- **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*, from the Astronomical League Sales, temporarily out of stock. (*2*) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to *ALPO_Jupiter-subscribe@yahoogroups.com* (3) *Jupiter Observer’s Startup Kit*, $3 from Richard Schmude, Jupiter Section Coordinator.

- **Saturn (Benton):** Introductory information for observing Saturn,

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including all observing forms and ephemerides, can be conveniently downloaded as pdf files at no cost to ALPO members and individuals interested in observing Saturn as part of our regular programs at *http://www.alpo-astronomy.org/saturn*. The former *ALPO Saturn Handbook* was replaced in 2006 by *Saturn and How to Observe It* (authored by Julius L. Benton) and it can be obtained from book sellers such as *Amazon.com*.

- **Meteors:** (1) *The ALPO Guide to Watching Meteors* (pamphlet). $3 per copy (includes postage & handling); send check or money order to 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) *The ALPO Meteors Section Newsletter*, free (except postage), published quarterly (March, June, September and December). Send stamps, check or money order for first class postage to cover desired number of issues to Robert D. Lunsford, 14884 Quail Valley Way, El Cajon, CA 92021-2227.

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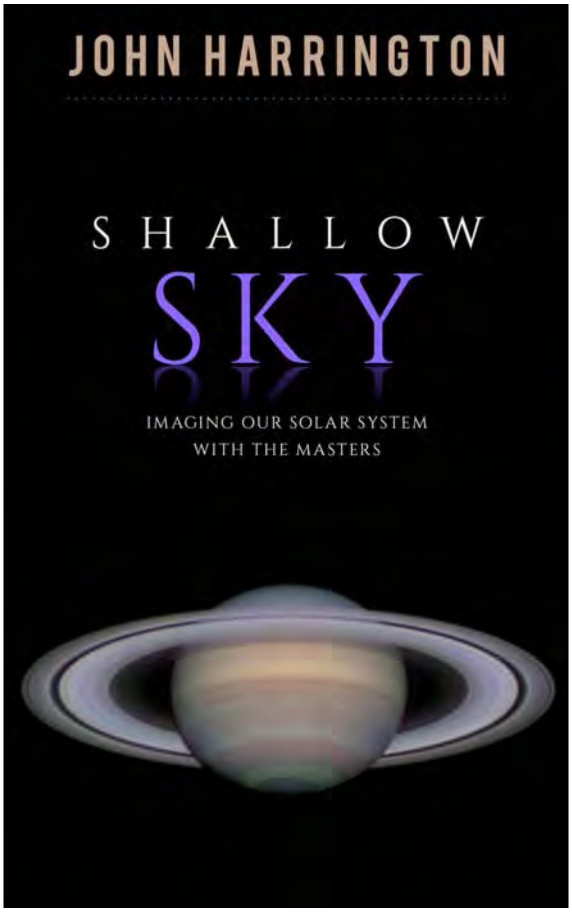

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