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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 56, Number 2, Spring 2014

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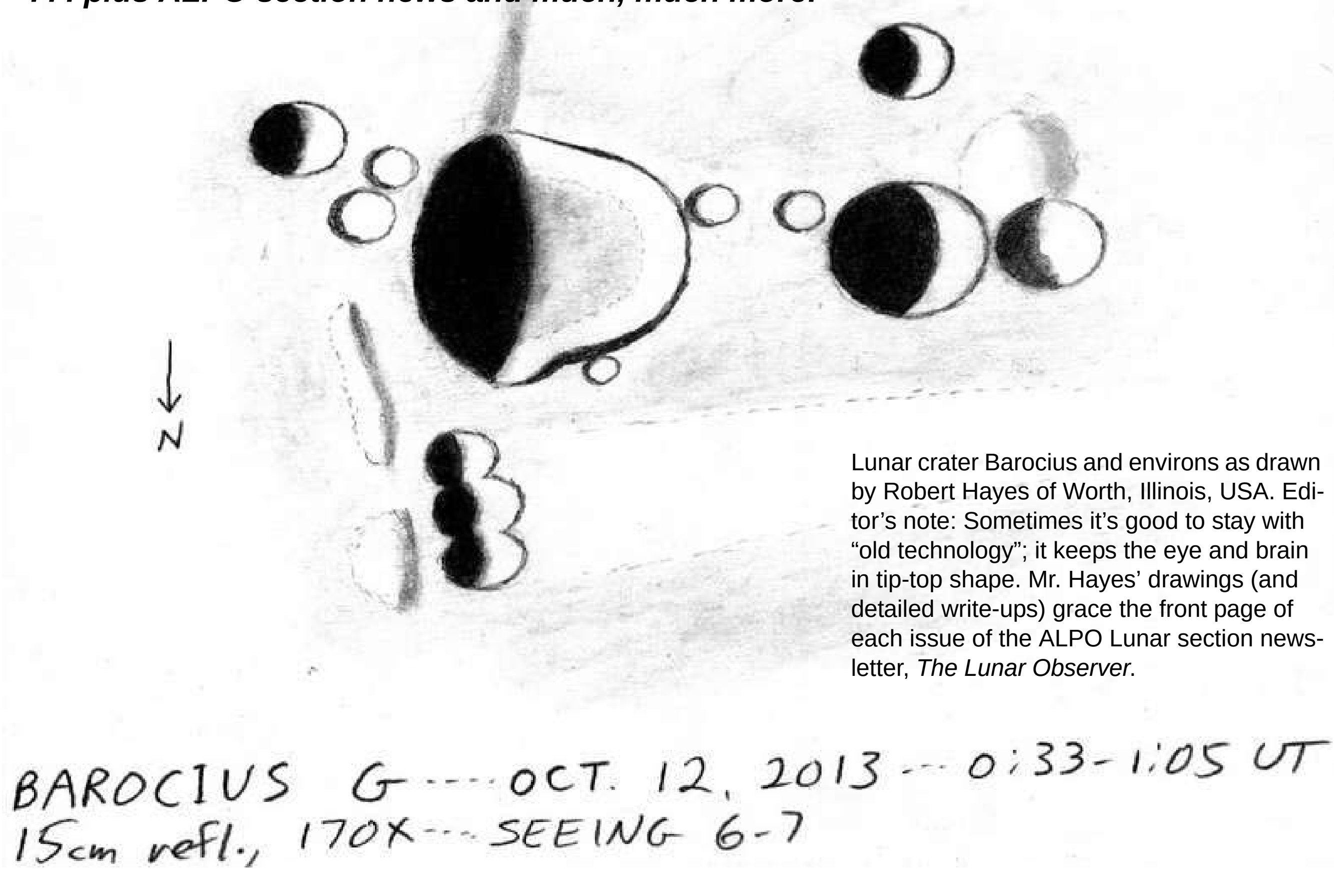
Association of Lunar & Planetary Observers — ALPO — Founded in 1947

In this issue

- ***News about and call-for-papers on the ALPO 2014 conference***
- ***China's First Lunar Lander: Chang'e 3 and Yutu***
- ***ALPO observations of Mercury in 2012 and Saturn in 2010-2011***

. . . plus ALPO section news and much, much more!



Lunar crater Barocius and environs as drawn by Robert Hayes of Worth, Illinois, USA. Editor's note: Sometimes it's good to stay with "old technology"; it keeps the eye and brain in tip-top shape. Mr. Hayes' drawings (and detailed write-ups) grace the front page of each issue of the ALPO Lunar section newsletter, *The Lunar Observer*.

33rd Annual Symposium on Telescope Science

Promoting Amateur Science and Professional-Amateur Collaboration in Astronomy

The Annual Symposium of the Society for Astronomical Sciences is the premier forum for astronomical research by amateur astronomers, students, and the professional researchers who utilize the data gathered by small-telescope users.

This year's Symposium will be a joint gathering of the Society for Astronomical Sciences, the American Association of Variable Star Observers, and the Center for Backyard Astrophysics.

Gathering these three organizations together will provide a wonderful chance for the small-telescope research community to share results and network with each other.

- Research Presentations
- Poster Paper Displays
- Guest Speakers
- Educational Workshops
- Amateur & Professional Astronomers
- New Product Introductions

Dates: **June 12-13-14, 2014**

Location: Ontario Airport Hotel, Ontario, CA

If you are involved in small-telescope research, or are curious about opportunities for amateur astronomers, students, and college observatories to contribute to astronomical knowledge, you will want to attend this Symposium.

Registration and other information is available at www.SocAstroSci.org.

Call for Papers:

We invite proposals for papers related to all aspects of small-telescope astronomical science and education. Submission instructions and format requirements, plus Proceedings from prior years and videos of technical presentations, are all available at the SAS website: www.SocAstroSci.org.

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 56, No.2, Spring 2014
This issue published in March 2014 for distribution in both portable document format (pdf) and also 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.

For membership or general information about the ALPO, contact:

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E-mail to: matt.will@alpo-astronomy.org

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

Founded in 1947

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Point of View
Making Things Better and Smoother for You

By Ken Poshedly, executive director, editor & publisher *The Strolling Astronomer*

If you're reading this, then it's a safe bet that you got your ALPO Journal either online or in the mail.

And if you're reading this on a desktop computer, laptop or other electronic device screen, you will have already used our brand new method we've adopted for distributing this publication as an online journal.

Up until now, most issues of our digital (pdf) version were password-protected to allow access by only our dues-paying membership. But there are several problems with that.

For one thing, a log must be kept of the various passwords. Even I don't remember them all — especially when I'm away from home and need to download an issue to check something. And for another thing, I'm sure that many of our members are just as annoyed with the password thing as well for the same reason I just stated above.

And finally, passwords are easy to pass around.

But the new method calls for only two things — both of which you surely know: your own e-mail address and your own ALPO membership number.

Now if you don't know your own e-mail address, there's nothing I can write here that's going to help you out. You either learn what is yours or you don't. It's your problem.

As for your ALPO membership number, there are two sources for you to check for that — your ALPO membership card and a letter recently sent by regular mail to all ALPO members.

If you don't already get the ALPO Journal via online access, the download method is really quite easy. First, contact Matt Will to arrange for your membership to be adjusted. Afterwards, simply click on a hyperlink inside a special announcement e-mailed to you, then at the next screen, enter your e-mail address and ALPO number and left-click on the (onscreen) “Submit” button. That's it! *The Strolling Astronomer* immediately starts strolling (or more correctly, racing) down the information highway right to your terminal.

The advantages to the digital (pdf) version are that you have it virtually immediately (no more waiting two weeks for the hard copy), it's in full color, and accessing various online websites and such is as easy as clicking on a link right in the file (no more having to type it out yourself).

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News of General Interest

ALPO 2014 Conference News

The ALPO board has voted via e-mail in January to hold its annual conference as part of Astronomical League convention (ALCon 2014) in San Antonio, Texas, July 9 thru 12.

More at http://www.astroleague.org/content/alcon-2014-san-antonio-tx-july-9-12

The ALPO has also been exploring the possibility of holding its annual meeting at the Pisgah Astronomical Research Institute (PARI) near Brevard, North Carolina. Plans are to possibly meet there in 2015, but more planning is involved.

A background story on the extremely fascinating and beautiful PARI facility appeared in the September 2013 issue of *Sky & Telescope* magazine. More at http://www.pari.edu/

ALPO 2014 Call for Papers

Interested parties are hereby invited to submit papers on the astronomy-related topics of their choice for presentation at the Astronomical League's 2014 convention, ALCon 2014, being held in San Antonio, Texas, Wednesday through Saturday, July 9 through 12.

The event will be Hilton San Antonio Airport Hotel.

This year, only a selection of several ALPO papers will be presented as part of the main program; the remainder of the ALPO papers will be presented, as usual, at a separate room near the main presentation hall.

Participants are encouraged to submit research papers, presentations, and experience reports concerning various aspects of Earth-based observational astronomy. Suggested topics for papers and presentations include the following:

- New or ongoing observing programs and studies, specifically, how those programs were designed, implemented and continue to function.
- Results of personal or group studies of solar system or extra-solar system bodies.
- New or ongoing activities involving astronomical instrumentation, construction or improvement.
- Challenges faced by Earth-based observers such as changing interest levels, deteriorating observing conditions brought about by possible global warming, etc.

The preferred format is Microsoft PowerPoint, though 35mm slides are also acceptable. The final presentation should not exceed 20 minutes in length, to be followed by no more than five (5) minutes of questions from the audience. A hard-copy version of the paper should be made available for future web site publication.

Please submit by June 1, 2014, the following:

- Title of the paper being presented.
- A four- or five-sentence abstract of each paper.
- The format in which the presentation will be.
- A 100-word biography and a recent photograph of the presenter for posting on the ALCon 2013 website and inclusion in the printed program guide.

E-mail is the preferred method for contact:

ken.poshedly@alpo-astronomy.org

If regular mail must be used, address all materials to:
ALCon 2014
c/o Ken Poshedly
1741 Bruckner Court
Snellville, Georgia 30078 USA

All fees and other details are listed in the registration form.

Announcing, the ALPO Lapel Pin

Now you can display your affiliation with our fine organization proudly with the new, colorful ALPO Lapel Pin.

With bright raised gold lettering against a recessed gold sandblast finish, each pin features the pupil of the ALPO "eye" in fluorescent aqua blue. A "pinch" clasp at the rear secures the pin in place. Pin dimensions are $1\,{}^{1}/_{8}$ in. by ${}^{9}/_{16}$ in.

Free for those who hold or purchase ALPO Sponsor level memberships.
Only $3.50 for those who hold or purchase Sustaining level memberships
Only $8.50 for all other ALPO members.
Not available to non-ALPO members.

Price includes shipping and handling.

Send orders to: ALPO, PO Box 13456, Springfield, IL 62791-3456. E-mail to: matt.will@alpo-astronomy.org

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ALPO Workgroup for Membership Growth Formed

A committee of ALPO members with diverse backgrounds has been formed to suggest and discuss ways to increase our organization's membership. Heading this ad hoc work group will be ALPO Membership Secretary Matt Will.

The committee members include the following:

- Julius L. Benton, Jr., ALPO board member, coordinator, ALPO Venus Section and Saturn Section
- Jim Goodridge. vice president, Saskatoon Centre, Royal Canadian Astronomical Society
- Douglas Liberati, board member, Sangamon Astronomical Society
- Steve Layman, president, Charlottesville (Virginia) Astronomical Society
- Tom Lynch, treasurer, the Astronomical League
- Jim Melka, assistant coordinator, ALPO Mars Section
- Theo Ramakers, board member, the Atlanta Astronomy Club, NASA Ambassador
- Tim Robertson, coordinator, ALPO Lunar & Planetary Training Program and Youth Program
- James Tomney, web developer
- Roger Venable, coordinator, ALPO Mars Section

According to Matt Will, the initial plan is gather various ideas from the group, then catalog and list them in either a Microsoft Word document or a spreadsheet for distribution and online discussion by the group. Then they can debate the pros and cons of each idea, select ones that have the best merit, and focus on accomplishing these goals.

Membership records dating back to mid-1977 show the ALPO with 810 members at that time. Over the years, membership has gradually declined to 366 members as of January 2014. Reasons for the decline range from

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general lack of interest to the belief that Earth-based observations are no longer valued because of the Hubble Space Telescope and other satellites and probes currently either in orbit around or on their way to various solar system bodies. In addition are cultural changes which have occurred over the years, resulting membership in virtually all organizations of any kind has declined.

"I'm excited about the formation of the workgroup and I appreciate your commitment to improving the ALPO," said Matt. "I look forward to working with all of you!"

A Request from Overseas

Every so often, we get requests from overseas for astronomical equipment and supplies of any kind. Recently, we heard from this individual and ask that you seriously consider helping his group in Romania.

"My name is Ciprian Vintdevara and Astronomical Observatory astronomer at the Museum Vasile Parvan Barlad, Vaslui, Romania, and coordinator (of the) Astronomy Club "Perseus" Barlad. We want (in) 2014 to have professional success and health. The Astronomical Observatory and Astroclub "Perseus" Barlad is at the beginning in promoting astronomy to the Romanian public and for this reason, (we ask that you) please support us by sending us promotional free materials astronomical education, for example: stickers CSA, DVDs movies astronomy documentaries, DVDs astronomy games, cards, solar eclipse glasses, posters, planisphere, magazine, T-shirts and caps. They will support and complement our portfolio astronomy materials for all Romanians who want to know the secrets of astronomy. Thank you!

My regular mail address is:

ALPO Online Section Created

Recognizing the continued expansion of not only websites, but other Internet-based methods for distributing information, the ALPO board voted unanimously via e-mail in January to roll its website function into a newly created "ALPO Online Section.
The section staff consists of current ALPO webmaster Larry Owens as coordinator, Jon Slaton as assistant coordinator and new ALPO member Steve Siedentop as an acting assistant coordinator.

Larry's duties have been and remain concerned strictly with the design and maintenance of the ALPO homepage and coordinating with the various ALPO section coordinators the appearance and/or content on the ALPO sub-pages.

Jon's duties have been and remain concerned with only the digital JALPO repository webpage. Due to his location, he remains firmly entrenched in lunar and planetary observing and is just not too interested in deep space objects, fuzzy smudges, or open clusters.

Steve Siedentop, a software engineer in metro Atlanta who joined only recently as an ALPO sustaining member, will be concerned with the ALPO online presence on the various social media (Facebook, Twitter, etc.).

(Clockwise from top, Larry Owens, Steve Siedentop and Jon Slaton.)

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Observatorul Astronomic Muzeul "Vasile Pârvan" Bârlad
Str. Vasile Pârvan nr.1, Bârlad, jud. Vaslui, România, cod 731003.

My phone number is: 0729074193

Please also visit us online at:

http://astrobarlad.wordpress.com

www.facebook.com/astrobarlad

Dumitru Ciprian Vîntdevarã
Muzeograf Planetariul / Observatorul Astronomic Bârlad
Coordonatorul Astroclubului "Perseus" Bârlad
Membru în Astroclubul "Cãlin Popovici" Galaþi

ALPO Interest Section Reports

ALPO Online Section

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

Follow us on Twitter, become our friend on FaceBook or join us on MySpace.

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

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

Computing Section

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

Important links:

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

Lunar & Planetary Training Program

Tim Robertson, section coordinator
cometman@cometman.net

Those interested in this VERY worthwhile program (or even those who wish to brush up on their skills) should contact Tim Robertson at the following addresses:

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

Send e-mail to: cometman@cometman.net

Please be sure to include a self-addressed stamped envelope with all correspondence.

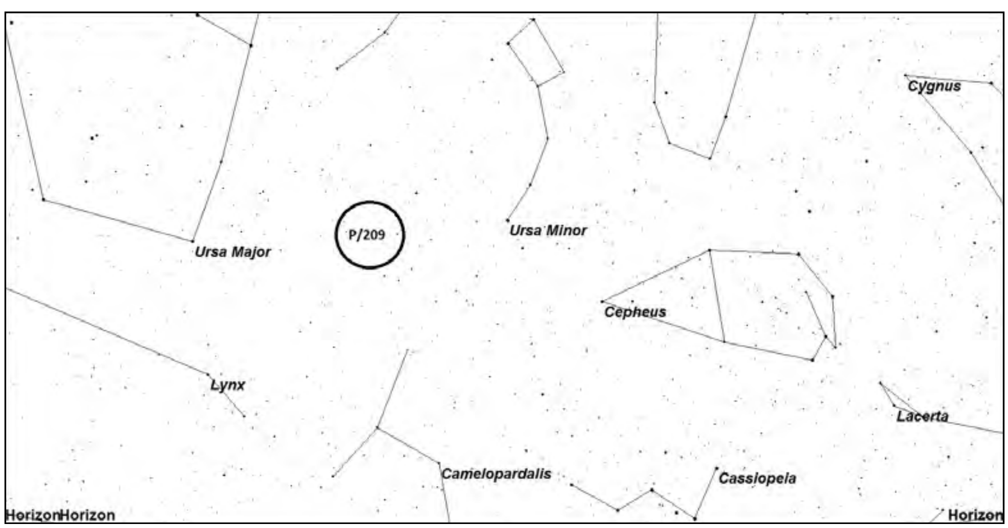
For information on the ALPO Lunar & Planetary Training Program, go to: www.cometman.net/alpo/

ALPO Observing Section Reports

Mercury / Venus Transit Section

John Westfall, section coordinator
johnwestfall@comcast.net

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



The radiant for meteors from comet P/209 LINEAR lies only 10 degrees from the north celestial pole in the constellation of Camelopardalis

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Meteors Section

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

On the evening/morning of May 23/24, 2014, the possibility exists that a meteor display may occur in the northern hemisphere.

Specifically, on May 24, between the hours of 7:00 and 8:00 UT, the Earth is expected to encounter numerous trails from comet P/209 LINEAR. These trails were produced as far back as 1798.

Unfortunately this comet is a very small object and its dust production (as least recently) has been very low. Therefore, a meteor storm is not expected but rather a display on par with the major annual meteor showers for an unknown length of time is more likely. The good news is that particles shed by this comet are expected to be larger than normal, therefore producing bright meteors.

More good news is that the time of maximum occurs favorably for North America, ranging from 23:30 PDT to 2:30 EDT. The Moon will be near its New phase and will not be a factor. These meteors will radiate from northern Camelopardalis, approximately 10 degrees from Polaris (Alpha Ursae Minoris). Therefore observers are urged to view northward between the hours of 7:00 and 8:00 UT on May 24. The best locations to view this display will lie along the northern tier of states up to approximately 50 degrees north latitude. Locations further north will not be in total darkness as twilight will last all night long this time of year. Locations too far south (south of 30° N) will see reduced activity due to the lower altitude of the radiant.

This is the most favorable circumstance for a meteor outburst since the 2002 Leonids. Any data on this display is extremely important. Potential observers should provide precise times of observations, limiting magnitude, and other factors affecting your data. Be sure to share your observations with us so that we may forward it to those analyzing this data.[1] ([1] Quanzhi Y and Paul A. Wiegert (2013), "Will Comet 209P/LINEAR Generate the Next Meteor Storm?")

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.

ALPO Comet Section Changes

Citing professional and other pressures, our ALPO Comets Section Coordinator, Gary Kronk, has decided to step down and assume the position of assistant coordinator of that section.

Says Gary: "This (Comet Section Coordinator) position was one that I had wanted since the late 1970s; however, when I first accepted this position in the late 1990s, I had already agreed to write my multi-volume *Cometography* for Cambridge University Press.
"

"Although I had resigned this position once before, because I was feeling bad about not being very productive for the ALPO, I took the position again when asked to. The problem is that I still cannot be a productive coordinator for the ALPO and am again feeling bad about holding this position. I am just too busy with *Cometography* and some recent other projects that have come my way.

Stepping up to take on the acting coordinator role will be Carl Hergenrother, who has been acting assistant coordinator for a relatively short time. His enthusiastic and highly informative reports will hopefully inspire at least some readers of this Journal to begin their own cometary observing program and contribute to this worthy group.

"The good thing is that Carl has come on strong," adds Gary, "and he has some great ideas for the ALPO Comet Section. I really appreciate the opportunity to have served the ALPO."

Meteorites Section

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

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

Comets Section

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

The past few months have seen submissions of observations of bright

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comets C/2013 R1 (Lovejoy) and C/2012 X1 (LINEAR). Even a few fainter comets were observed such as 154P/Brewington, 290P/Jager and C/2006 S3 (LONEOS).

The ALPO Comet Section Report usually focuses on comets that are expected to be brighter than magnitude 10. This April/May/June, two of the most interesting observable comets will actually be fainter than 10th magnitude.

- Comet 209P/LINEAR (T = 2014-May-06, q = 0.97 AU, P = 5.1 yr] will pass within 0.056 AU of Earth in late May. This places it in the Top 10 closest known approaches to Earth. Unfortunately 209P is a relatively low-activity comet and will only brighten to magnitude 10-11 as it rapidly races from the far northern to the far southern sky. Interest in 209P is also high due to a major meteor shower that it may produce on May 24. See also the ALPO Meteor Section report on page 6 of this Journal.

- The other faint, but worthy of close monitoring, comet is currently not a comet. Asteroid 2013 UQ4 [T = 2014-Jul-06, q = 1.08 AU, P = 467 yr] is on a very comet-like orbit that will bring it within 0.4 AU (37,200,000 miles) of Earth near perihelion. If the UQ4 remains inactive, it will only brighten up to magnitude 14 at the end of June. If it becomes active, it may be many times brighter.

Two long-period comets are expected to become bright enough for small telescope observations. The aforementioned C/2012 X1 (LINEAR) [T = 2014-Feb-21, q = 1.60 AU] should remain at 8th-9th magnitude object throughout the April-June period. Comet C/2012 K1 (PANSTARRS) [T = 2014-Aug-27, q = 1.05 AU] is still a bit of a question mark. Similar to other new comets making their first trip into the inner Solar System (we think), PANSTARRS' brightening trend has slowed down. How bright it will become is still in question but it is very possible it may reach 7th-8th magnitude by the end of June.

The following comets will be between 10th and 12th magnitude:

- C/2013 A1 (Siding Spring) [T = 2014-Oct-25, q = 1.40 AU]

- C/2013 R1 (Lovejoy) [T = 2013-Dec-22, q = 0.81 AU]

- C/134P/Kowal-Vavrova [T = 2014-May-21, q = 2.57 AU, P = 15.6 yr]

- C/290P/Jager [T = 2014-Mar-12, q = 2.16 AU, P = 15.2 yr]

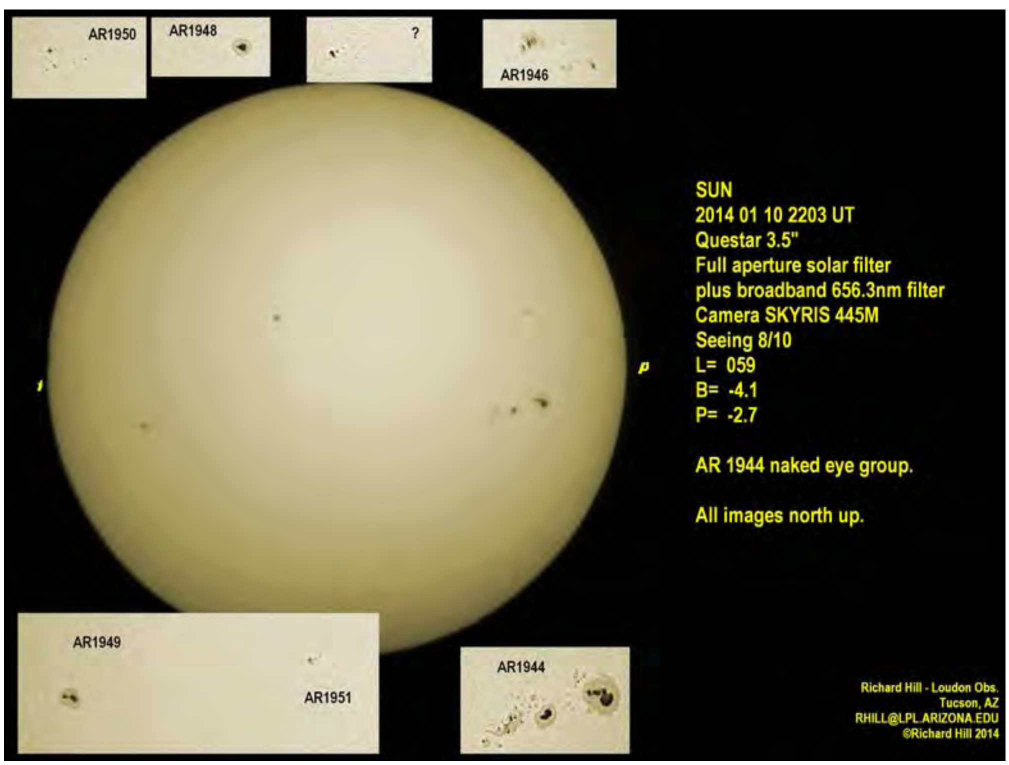
C/2013 A1 will be a news-making comet this October when it will pass within ~138,000 km (85,749 miles) of Mars allowing high-resolution imaging by orbiting Mars spacecraft.

C/2013 R1 reached 4th magnitude towards the end of 2013 and sported a multi-degree long tail. It is now in full retreat from the Earth and Sun.

Both C/134P and C/290P are short-period comets, each with a period of ~15 years.

As always, the ALPO Comet Section thanks those who have sent observations during 2013 and we solicit new images, drawings and magnitude estimates during the rest of this year.

The ALPO Comet Section solicits all observations of comets, including drawings, magnitude estimates, images



Solar image during CR 2146 by Rik Hill. See image for details.

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

Please send all observations and images to Carl Hergenrother at the e-mail address shown at the beginning of this section report.

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

Solar Section

Report by Kim Hay, section coordinator
kim.hay@alpo-astronomy.org

The Sun has demonstrated days of low-to-no activity over the past several months. Every now and then, though, something does happen. For instance, the large sunspot group AR1944 grew and produced an M4-class flare that reached the Earth on January 9. Auroras were detected in the northern parts of Canada and Norway. An image accompanying this report and taken by ALPO Solar Section Scientific Advisor Rik Hill shows the various groups including AR1944 in Carrington Rotation 2146.

Thankfully, we have images from our observers, as observing the Sun has been at an all-time low in many parts of the world due to inclement weather.

The television show *BBC Stargazing Live* (now in its 3rd year) took an airplane in the sky for the two nights to capture the aurora above the clouds. They were successful on the 3rd night. http://en.wikipedia.org/wiki/Stargazing_Live

After the auroral event, an interesting movie called *Has the Sun Gone to Sleep?* showed up on the BBC News Science & Environment website. Since most of the eastern United States and Canada can attest to the extremely cold weather this year, this story may have some credence. *http://www.bbc.co.uk/news/science-environment-25771510*

We are currently in CR2146 and still receiving images of the Sun and its morphology. If you wish to submit images or sketches, please send jpeg files no larger than 250K in size to *Kim.Hay@alpo-astronomy.org*

Keep up-to-date on the latest images and chats on solar activity by subscribing to the ALPO Solar Section e-mail list at *http://groups.yahoo.com/neo/groups/Solar-ALPO/info* . There are currently 320 members. We do collect images for archiving purposes. These can be up to 250K in either jpg or gif file format. They will be included in a Carrington Rotation set. Please include all observing equipment used, the Carrington Number, date, Universal Time of the image, and directions with North up. Looking forward to seeing your images and sketches.

We are always looking for members to submit an article to the JALPO on solar imaging and solar phenomena. Please send to myself (*kim.hay@alpo-astronomy.org*) or to Ken Poshedly (*ken.poshedly@alpo-astronomy.org)*

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

Mercury Section

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

The year 2013 was a slow one for the ALPO Mercury Section. Mercury observations of 2012 in this issue reported fewer observers than the previous years. I am hoping that we can bring some older members back to observe Mercury again.

Perhaps an evening apparition will help things out. Mercury will have its best evening apparition of the year in May. By the first week, it will be near its brightest (-1.5 magnitude) and will set an hour after the Sun. It will continue to inch away from the Sun as seen from

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Earth until May 24. That evening, Mercury will reach its greatest elongation at 23 degrees east of the Sun. Telescopically, it will display a diameter disk of 8.0 arc-seconds and the phase will be slightly half due to the elliptical orbit.

Mercury will dim considerably at +0.5 magnitude when compared to earlier in the month. In addition, Mercury will be furthest north at 25 degrees and it will set approximately 1 hour and 45 minutes after the Sun. If you have a clear N-NW horizon, it will be possible to see Mercury in almost total darkness!

The MESSENGER spacecraft has taken nearly 200,000 images of Mercury! Also, three members of the MESSENGER team have been honored this month for their accomplishments in planetary research and education and public outreach. It is now nine months into a second extended mission that is scheduled to conclude early in 2015.

Drawing of Mercury by Mario Frassati. See image for details.

Beyond that, it will depend how much funds are left.

While the MESSENGER spacecraft has been in orbit since 2011, it has taken enough images to produce a full 360-degree flat map. See the March 2014 issue of *Sky & Telescope* magazine, where there is a pullout map of Mercury's surface.

In addition, S&T announces the first-ever globe of Mercury. It is 12 inches in diameter and it comes with a fact sheet. I am planning to get one and hopefully you should, too. I will tell a little more about it in a future issue of the ALPO journal.

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

Venus Section

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

Venus entered Inferior Conjunction on January 11, 2014, and will become visible in a twilight sky just before sunrise during February, attaining greatest brilliancy on February 15th at apparent visual magnitude -4.9, moving westward relative to the Sun as the 2014 Western (Morning) Apparition progresses.

Venus is passing through its waxing phases (a progression from crescent through gibbous phases), and it will attain Greatest Elongation west of 47° on March 22, with theoretical dichotomy (half phase) on March 23.

The table of geocentric phenomena in Universal Time (UT) that accompanies this report is presented for the convenience of observers for the 2014 Western (Morning) Apparition.

As of the conclusion of the 2013-14 Eastern (Evening) Apparition, observers had submitted about 100 images and drawings of Venus, but contributions will continue to arrive for the previous observing season as observers organize and wrap up their data.

Observers are again reminded that images are important and still needed by the Venus Express (VEX) mission, which started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006.

This Professional-Amateur (Pro-Am) effort continues, and observers should submit images to the ALPO Venus Section as well as to the VEX website at:

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

Regular Venus program activities (including drawings of Venus in integrated light and with color filters of known transmission) are also valuable throughout the period that VEX is observing the planet.

On November 19, 2010, the European Space Agency's (ESA) Science Program Committee approved the extension of VEX mission operations until December 31, 2014, so Pro-Am cooperation fortunately continues this apparition.

The observation programs conducted by the ALPO Venus Saturn 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. Observers are urged to carry out digital imaging of Venus at the same time that others are imaging or making visual drawings of the planet (i.e., simultaneous observations).

Although regular imaging of Venus in both UV, IR and other wavelengths is extremely important and highly

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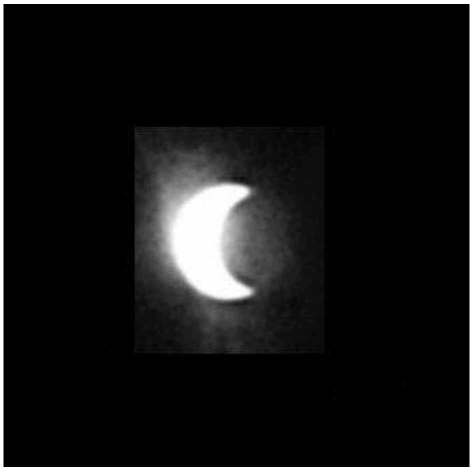

Frank Melillo of Holtsville, NY submitted this 1,000nm IR image of the crescent of Venus on December 27, 2013 at 22:10 UT using a 25.4 cm (10.0 in.) SCT. At these wavelengths, the hot surface of the planet becomes quite apparent and occasionally mottling shows up as in this image, attributed to the presence of cooler, dark higher-elevation terrain and warmer, bright lower surface areas in the IR. In order to capture the dark hemisphere of Venus, the crescent is over-exposed. The apparent diameter of Venus is 56.9", phase (k) 0.070 (7.0% illuminated), and visual magnitude -4.5. South is at top of image.

encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates and reporting visual or color filter impressions of features seen or suspected in the atmosphere of the planet (for instance, categorization of dusky atmospheric markings, visibility of cusp caps and cusp bands, measurement of cusp extensions, monitoring for the Schröter phase effect near the date of predicted dichotomy, and looking for terminator irregularities).

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

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

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

Lunar Section

Lunar Topographical Studies / Selected Areas Program

Report by Wayne Bailey, program coordinator

wayne.bailey@alpo-astronomy.org

The ALPO Lunar Topographical Studies Section (ALPO LTSS) received a total of 140 new observations from 15 observers during the October-December quarter. Two contributed articles were published in addition to numerous commentaries on images submitted.

The *Focus-On* series continued with an article on the Schickard-Wargentin area. Upcoming *Focus-On* subjects include Aristarchus, and Mare Frigoris.

The big news this quarter was that China landed its Chang'e 3 spacecraft, with a rover, on December 14 near Sinus Iridum. This was the first soft lunar landing since the Russian Luna 24 in 1976.

Meanwhile, NASA's LADEE has begun low altitude science observations.

As announced in the last issue of this Journal, Jerry Hubbell is now an acting assistant coordinator for this section. All electronic submissions should be sent to Jerry at *jerry.hubbell@alpo-astronomy.org* or myself at *wayne.bailey@alpo-astronomy.org*.

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

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Visit the following online web sites for more info:

- ALPO Lunar Topographical Studies Program *moon.scopesandscapes.com/alpo-topo*
- ALPO Lunar Selected Areas Program *moon.scopesandscapes.com/alpo-sap.html*
- The Lunar Observer (current issue) *moon.scopesandscapes.com/tlo.pdf*
- The Lunar Observer (back issues) *moon.scopesandscapes.com/tlo_back.html*
- Banded Craters Program: *moon.scopesandscapes.com/alpo-bcp.html*

Geocentric Phenomena of the 2014 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2014	Jan 11 (angular diameter = 63.1 arc-seconds)
Greatest Illuminated Extent		Feb 15 (m_v = –4.9)
Greatest Elongation West		Mar 22 (Venus will be 47° west of the Sun)
Predicted Dichotomy		Mar 23.73 (exactly half-phase predicted)
Superior Conjunction		Oct 25^{d} (angular diameter = 9.7 arc-seconds)

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Lunar Calendar for Second Quarter 2014 (All Times UT)

Apr	01	02:30	Moon Descending Node
	04	06:52	Moon-Aldebaran: 2.1° S
	05	07:12	Moon North Dec.: 19° N
	07	08:31	First Quarter
	08	14:52	Moon Apogee: 404500 km
	14	18:24	Moon-Mars: 3.7° N
	15	03:56	Moon-Spica: 1.8° S
	15	07:42	Full Moon
	15	07:47	Total Lunar Eclipse
	15	13:23	Moon Ascending Node
	17	07:42	Moon-Saturn: 0.4° N
	19	12:55	Moon South Dec.: 18.9° S
	22	07:52	Last Quarter
	23	00:27	Moon Perigee: 369800 km
	25	23:16	Moon-Venus: 4.5° S
	28	11:36	Moon Descending Node
	29	06:04	Annular Solar Eclipse
	29	06:14	New Moon
May	01	15:51	Moon-Aldebaran: 2.1° S
	02	15:59	Moon North Dec.: 19° N
	06	10:22	Moon Apogee: 404300 km
	07	03:15	First Quarter
	11	13:32	Moon-Mars: 3.2° N
	12	12:47	Moon-Spica: 1.8° S
	12	22:06	Moon Ascending Node
	14	12:41	Moon-Saturn: 0.6° N
	14	19:16	Full Moon
	16	20:10	Moon South Dec.: 19° S
	18	11:58	Moon Perigee: 367100 km
	21	12:59	Last Quarter
	25	15:43	Moon-Venus: 2.4° S
	25	17:56	Moon Descending Node
	28	18:40	New Moon
	30	00:38	Moon North Dec.: 19° N
Jun	03	04:25	Moon Apogee: 405000 km
	05	20:39	First Quarter
	08	00:44	Moon-Mars: 1.7° N
	08	22:05	Moon-Spica: 1.9° S
	09	05:36	Moon Ascending Node
	10	19:11	Moon-Saturn: 0.6° N
	13	04:11	Full Moon
	13	06:03	Moon South Dec.: 19° S
	15	03:34	Moon Perigee: 362100 km
	19	18:39	Last Quarter
	21	20:30	Moon Descending Node
	24	12:54	Moon-Venus: 1.4° N
	25	06:22	Moon-Aldebaran: 2.1° S
	26	08:34	Moon North Dec.: 19° N
	27	08:08	New Moon
	30	19:09	Moon Apogee: 405900 km

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

- The Lunar Discussion Group: *tech.groups.yahoo.com/group/Moon-ALPO/*
- The Moon-Wiki: *the-moon.wikispaces.com/Introduction*
- Chandrayaan-1 M3: *pds-imaging.jpl.nasa.gov/portal/chandrayaan-1_mission.html*
- LADEE: *www.nasa.gov/mission_pages/ladee/main*
- LROC: *lroc.sese.asu.edu/EPO/LROC/lroc.php*
- GRAIL: *http://www.nasa.gov/mission_pages/grail/main/*

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

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

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

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

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

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Mars Section

Report by Roger Venable, section coordinator
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Join us in the Mars observers group on Yahoo at groups.yahoo.com/neo/groups/marsobservers/info

Note that this is a new web address, as Yahoo has changed its group addresses. If you type into your browser the previous Mars observers group address, you will be automatically redirected to this new one.

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

Minor Planets Section

Frederick Pilcher, section coordinator
pilcher@ic.edu

Some highlights published in the *Minor Planet Bulletin*, Volume 41, No. 1, 2014 January - March, are hereby presented. These represent the recent achievements of the ALPO Minor Planets Section.

Brian Warner has published an improved model of the spin axis orientation and shape of the Earth-approaching asteroid 1627 Ivar. He has also reported on detection of four binary asteroids. For 5968, 15822, and 76818 narrow dips in the lightcurve were observed due to transit, occultation, or shadow of the secondary. This is analogous to an eclipsing binary system.

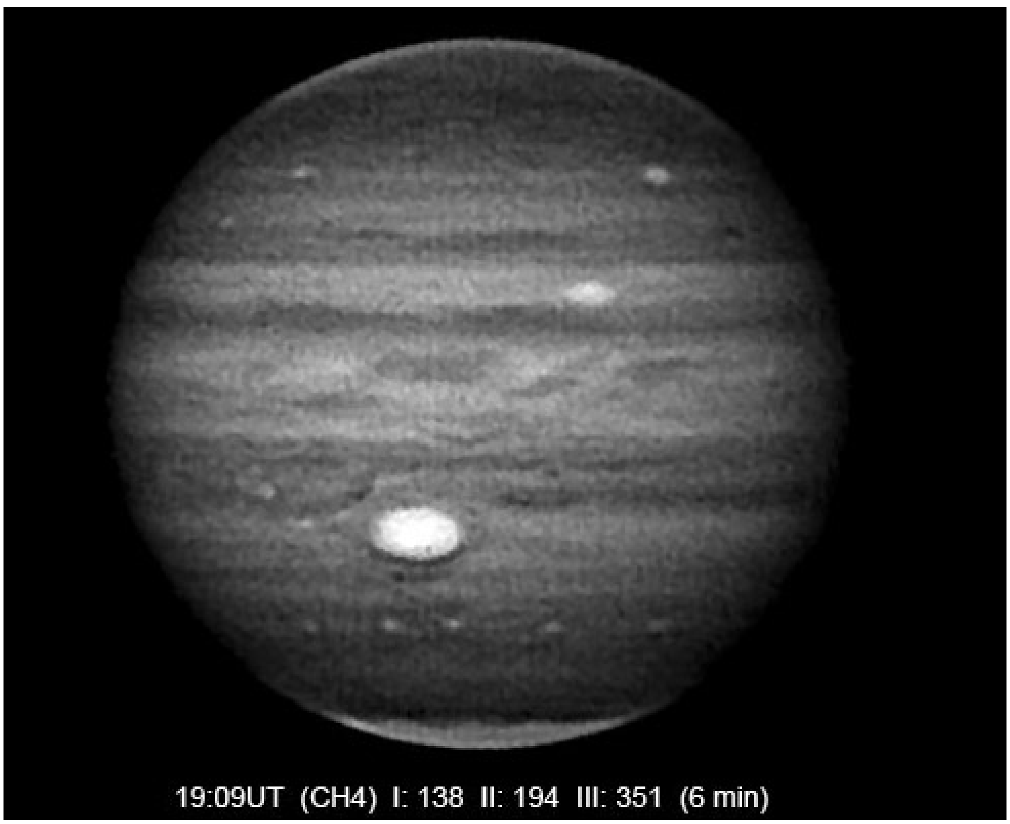
For 15822 and 76818, several events were observed and the revolution period of the satellite was found. For 5968, only a single dip was found. The binary nature must be considered tentative, with the revolution period completely unknown.

For 11217, no dips due to transit, occultation or shadow were observed, an indication that at the time of observation, the orbital plane was not close to the line of sight.

Normal lightcurves with two different periods could be resolved with the dual period search feature. This indicates that primary and satellite have asynchronous rotations. The revolution period could not be measured.

Lightcurves with derived rotation periods are published for 94 other asteroids. These are of asteroids numbered 205, 330, 482, 541, 570, 582, 682, 899, 1030, 1058, 1137, 1198, 1314, 1468, 1486, 1632, 1799, 1874, 1920, 2055, 2112, 2185, 2213, 2272, 2495, 2858, 2911, 3138, 3225, 3255, 3562, 3657, 3782, 3977, 4404, 4764, 4952, 5095, 5369, 5427, 5431, 5577, 6249, 6401, 6495, 6602, 6618, 6635, 6911, 7660, 7959, 8059, 9084, 9950, 10502, 10531, 11405, 11441, 15692, 16421, 16896, 20231, 20691, 24445, 30958, 32814, 35055, 35194, 39665, 41503, 41660, 45898, 48336, 51926, 53431, 56777, 65637, 137199, 152664, 168378, 216910, 277475, 285263, 329437, 330825, 350988, 361071, 368644, 2006 EE1, 2010 TN54, 2012 TC4, 2013 OM9, 2013 QJ10.

Some of these provide secure period determinations, some only tentative ones. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previous period determinations which may be consistent or inconsistent with the earlier values.



Methane band (CH_4) image on December 3, 2013 at 19:09 UT by Christopher Go showing bright WSZ at north 19 degrees latitude.

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

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

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

Jupiter Section

Report by Ed Grafton, acting section coordinator
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Jupiter reached opposition January 5th 2014. This opposition was particularly favorable for northern hemisphere observers, reaching a declination of over 22 degrees and an apparent diameter of about 46 arc-seconds.

Jupiter's Great Red Spot has been somewhat pale the last few years but this opposition, the coloration has intensified, making it more easily observed with amateur telescopes.

Interestingly during November of 2013, white spot z (WSZ) began to display an orange coloration and brightness in the methane band of the spectrum and has remained so through January 2014.

Many high resolution images have been received by the ALPO Jupiter section thus far this opposition with observations in near infrared, methane CH_4 and the visible spectrum, while ALPO Jupiter Section Assistant Coordinator Richard Schmude has been making photometric magnitude observations in ultraviolet.

In addition, Mike Phillips has produced a full-rotation Jupiter animation using WINJUPOS software along with a 360-degree Jupiter map.

Mike's map and animation were compiled from five nights of imaging taken from December 30, 2013 to January 15, 2014. Mike's work can be seen at these URLs.

- Jupiter map at *http://i.imgur.com/ozbDbYK.png*
- Jupiter animation at *http://www.youtube.com/watch?v=izRld2t-Xw8*

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

Galilean Satellite Eclipse Timing Program

Report by John Westfall, program coordinator
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Galilean Satellite With Jupiter now past the midpoint of its 2013-2014 Apparition, it's now time to look ahead to the apparition of 2014-2015, which begins with solar conjunction on 2014 Jul 24, is centered on opposition on 2015 Feb 6, and ends with solar conjunction on 2015 Aug 26.

The 2014-2015 Apparition will be favorable for northern observers, with the planet at 16.5° N at opposition. The

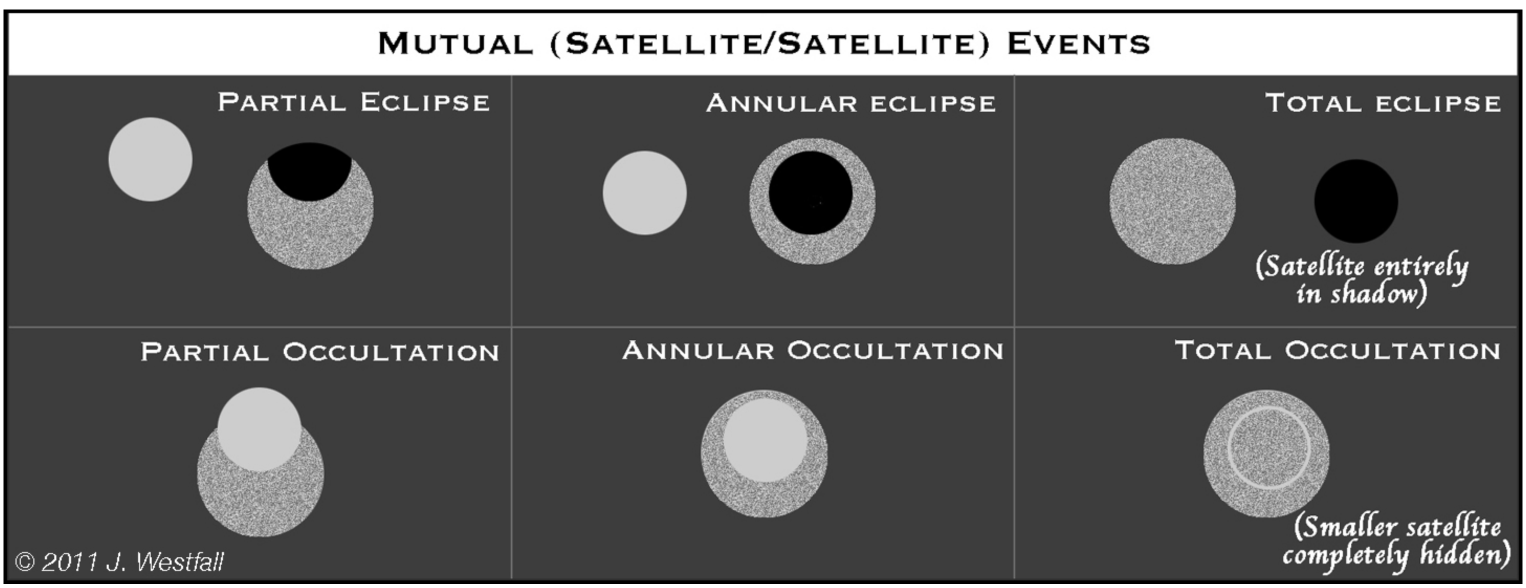

Diagram of various mutual Galilean satellite events.

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current series of Callisto events — occultations, eclipses, transits and shadow transits — will continue throughout 2014-2015. As a matter of fact, the Sun will cross Jupiter's equator, moving N to S, on 2015 Feb 5. The Earth crosses Jupiter's equatorial plane three times: 2014 Nov 8 (N to S), 2015 Apr 10 (S to N) and 2015 May 5 (N to S).

Jupiter's Galilean satellites orbit close to the planet's equatorial plane. As the Sun and Earth will also be near Jupiter's equatorial plane, we will be treated to a series of satellite *mutual events*—when the four satellites eclipse and occult each other. The series begins on 2014 Aug 17 and continues through 2015 Aug 22, with no less than 534 mutual events predicted. Unlike other, recent mutual-event series, the one coming up is conveniently centered about Jupiter's opposition, so every observer will have a chance to watch a large number of phenomena.

Satellite mutual events are interesting to view, sketch, or image. And careful CCD photometry of them can even provide scientifically valuable information on the bodies' orbits. The diagram that accompanies this report shows the different types of phenomena that will be taking place. The observing program for the 2014-2015 series, called "PHEMU2015", is coordinated by the French IMCCE (Institut de Méchanique Céleste et de Calcul des Éphémérides), with complete information (largely in English as well as French) at: *http://www.imcce.fr/langues/en/observateur/campagnes_obs/phemu15/index.php?popup=3*

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

Image taken on January 14, 2014 at 18:02 UT by Anthony Wesley observing from Murrumbateman, Australia, using a 36.8 cm (14.5 in.) Newtonian at RGB wavelengths. Notice that a few subtle bright areas appear within the EZn as well as various belts and zones on the globe of Saturn. The major ring components and divisions are quite apparent, such as Cassni's (A0 or B10), now visible all the way around the circumference of the rings, as well as Encke's complex (A5), possibly Keeler's (A8), and other "intensity minima" the ring ansae. The wide, dark shadow of the globe on the rings is situated toward the East (left), and the remarkable hexagonal feature at Saturn's North Pole is also seen. Seeing was about average in this image. Apparent diameter of Saturn's globe is 16.1" with a ring tilt of +22.2°. CMI = 196.9°, CMII = 66.2°, CMIII = 296.4°. S is at the top of the image.

Geocentric Phenomena for the 2013-14 Apparition of Saturn in Universal Time (UT)	
Conjunction	2013 Nov 6^d
Opposition	2014 May 10^d
Conjunction	2014 Nov 18^d
Opposition Data:	
Equatorial Diameter Globe	18.6 arc-seconds
Polar Diameter Globe	16.6 arc-seconds
Major Axis of Rings	42.2 arc-seconds
Minor Axis of Rings	15.5 arc-seconds
Visual Magnitude (m_v)	0.1 m_v (in Libra)
B =	+21.6°
Declination	-15.4°

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Saturn Section

Report by Julius Benton, section coordinator
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Saturn entered conjunction with the Sun on November 6, 2013, ending the 2012-13 apparition. As the month of February 2014 begins, Saturn rises a couple of hours after midnight, so observers in many locations have already been able to get favorable views and capture images of the planet located in the constellation of Libra in eastern sky before sunrise.

During the 2013-14 observing season, with the rings tilted about +22° toward Earth, the northern hemisphere of the globe and north face of the rings will be visible to better advantage than in several preceding apparitions.

The accompanying table of geocentric phenomena for the 2013-14 apparition is presented for the convenience of readers who wish to plan their Saturn observing activities.

As of this update in the early days of the 2013-14 apparition, observers have already begun submitting images and drawings of Saturn. Although there have been no reports of discrete atmospheric phenomena so far other than brightenings along the EZn, it will be interesting to see if diffuse bright areas or dusky features among the zones and belts of the planet's northern hemisphere will manifest themselves this apparition as in the past few observing seasons. Thus, observers are encouraged to keep Saturn under careful surveillance in the weeks to come.

The observation programs conducted by the ALPO Saturn Section are listed on the ALPO Saturn Section web page at *www.alpo-astronomy.org/saturn* as well as in considerable 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 carry out digital imaging of Saturn at the same time that others are imaging or visually watching Saturn (i.e., simultaneous observations). Although regular imaging of Saturn is extremely important and highly encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time. So this type of visual work is strongly encouraged before or after imaging the planet.

The ALPO Saturn Section appreciates the dedicated work by so many observers who regularly submit their reports and images. *Cassini* mission scientists, as well as other professional specialists, are continuing 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

Please be sure to submit your 2013-2014 observations to me as soon as possible. I plan to begin work on the 2013-2014 Remote Planets report this coming June. I have already received a good number of accurate brightness measurements from Jim Fox. His Neptune measurements are excellent and consistent with that planet becoming a bit brighter than in 2011-2012.

In addition to brightness measurements, excellent images have also been submitted. For example, Peter Gorczynski of Oxford, Connecticut, USA, submitted an image taken on August 17, 2013, with a 14-inch Schmidt-Cassegrain telescope equipped with an Astronomik 742 IR filter. His image shows a bright area near Neptune's southern limb, probably a bright polar area.

And finally, using the 1.0-meter (39 in.) telescope at Pic du Midi Observatory in the French Pyrenee mountains, F. Colas and M. Delcroix submitted their near-infrared image of Uranus showing at least one bright band.

This coordinator is currently compiling all Uranus and Neptune brightness measurements recorded since 1991. He, along with another astronomer, will then publish a review paper of these measurements, probably in the professional journal *Icarus*.

To all remote planet observers, please keep up the good work!

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

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

Reader Comments

Mr. Dobbins,

Your two articles about planetary telescope development and progression in *The Strolling Astronomer* (55:1 and 56:1) are superb – especially the latter one. You obviously know optics, have researched well and documented the historical data, and write with a clear and inviting script. I thoroughly enjoyed these visits into the (my) past. The selected ads/photos nicely complemented the text.

Thanks for publishing them -- and Happy New Year.

Wycliffe Hoffler, Titusville, FL

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Feature Story

ALPO Observations of Mercury During the 2012 Apparitions

By Frank J Melillo, coordinator, ALPO Mercury Section
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Abstract

There were six apparitions of Mercury in 2012. During the course of the year, there were only six observers who collectively submitted 14 drawings, 4 webcam images and 1 CCD image for a total of 19 observations. Their telescope apertures ranged from 15 to 27.5 cm (6 to 11 in.). The features they identified showed good correlation with the MESSENGER spacecraft flybys and the 1971 albedo chart prepared by Murray, Smith and Dollfus (Murray, Smith, and Dollfus, 1972) that was adopted officially by the International Astronomical Union (IAU).

Introduction

This paper reports observations of the three evening and three morning Mercury apparitions during the year 2012. The dates and characteristics of these apparitions are presented in Table 1.

Mercury is the most difficult of the classical planets to observe (Melillo, 2004,) but some recent advances in amateur observations of it have been made (Boudreau, 2009). Despite such advances, there were fewer observations submitted to the ALPO Mercury Section than in 2011, which was a continuation of the trend of recent years (Melillo, 2010b, 2011a, 2011b, 2013.)

Most of the submissions were drawings, some were made by lucky imaging with "webcams," and one was by CCD camera. The drawings are important in that they show us the actual appearance of the planet, and allow a comparison of its appearance to classical observations.

On the other hand, images can provide more accurate mapping of albedo features.

The observers, their locations, their instruments and their observations are summarized in Table 2.

Apparition 1: Evening, 6 February – 21 March

Mercury became an evening object on 6 February. It was mid-winter in the northern hemisphere and some observers braved the cold weather to observe this little planet.

Carl Roussell made the first drawing on 20 February (CM = 031°). It is difficult to determine what features were seen, but perhaps Tricrena may be seen as a bright area in the equatorial region.

Mario Frassati drew his three observations of Mercury from 24 February (CM = 048°) thru 27 February (CM = 061°). All three drawings showed Aurora as a bright area in the north, and a dark equatorial area with a bright spot to its south.

Aron Kiss and Carl Roussell were the last to observe during this apparition, on 10 March (CM = 123°) and 11 March (CM = 130°) respectively, and both drew a fat crescent phase. However, the surface details that they depicted are hard to associate with known features (see Figure 1).

This apparition ended with inferior conjunction on 21 March.

Online Features

Left-click your mouse on:

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

Apparition 2: Morning, 21 March – 27 May

The morning apparition lasted more than two months, but it was a poor presentation as seen from the northern hemisphere.

Carl Roussell made one drawing on 15 May (CM = 134°) and it showed a bright northern polar region with a dark collar. He drew the disc as quite shady, with dark areas in the south equatorial region that may be Solitudo Jovis and Solitudo Martis (see Figure 2).

This apparition ended with superior conjunction on 27 May.

Apparition 3: Evening, 27 May – 28 July

This evening apparition also lasted two months and was quite poor for northern hemisphere viewers.

John Boudreau imaged Mercury on 2 July (CM = 344°), revealing a fat crescent (see Figure 3.) Solitudo Aphrodites, the darkest feature of the planet's surface, can be seen near the limb north of the equator, along with a

Table 1: Characteristics of the Apparitions of Mercury in 2012 (all dates UT)

Number and Type	Beginning Conjunction*	Greatest Elongation	Final Conjunction*	Aphelion	Perihelion
1. Evening	06 Feb (s)	5 Mar	21 Mar (i)	—	2 Mar
2. Morning	21 Mar (i)	18 Apr	27 May (s)	15 Apr	—
3. Evening	27 May (s)	1 Jul	28 Jul (i)	12 Jul	29 May
4. Morning	28 Jul (i)	16 Aug	9 Sept (s)	—	25 Aug
5. Evening	09 Sept (s)	26 Oct	17 Nov (i)	8 Oct	—
6. Morning	17 Nov (i)	4 Dec	17 Jan (2013) (s)	4 Jan (2013)	21 Nov

* (i) is inferior conjunction, (s) is superior conjunction

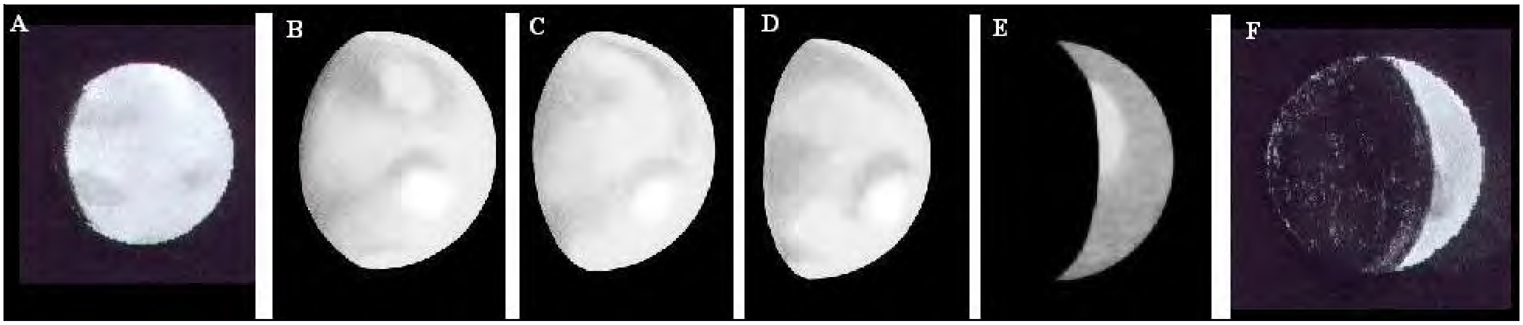


Figure 1. Six drawings of Mercury during Apparition 1. In this and all other figures in this article, north is up and celestial west (planetary east) is to the right.

A. Image by John Carl Roussell, 20 Feb 2012, 16:06 UT, CM = 031°.
B. Image by Mario Frassati, 24 Feb 2012, 17:45 UT, CM = 048°.
C. Image by Mario Frassati, 26 Feb 2012, 17:46 UT, CM = 057°.
D. Drawing by Mario Frassati, 27 Feb 2012, 17:40, CM = 061°.
E. Drawing by Aron Kiss, 10 Mar 2012, 18:30 UT, CM = 123°.
F. Drawing by Carl Roussell, 11 Mar 2012, 23:11 UT, CM = 130°.

dark marking, possibly Solitudo Alarum, in the equatorial region. Boudreau used a 685 nm cut-off, near-IR filter to increase the contrast.

Figure 2. Drawing of Mercury during Apparition 2 by Carl Roussell, 15 May 2012, 22:45 UT, CM = 134°.

No other observations were received for this apparition.

This apparition ended with inferior conjunction on 28 July.

Apparition 4: Morning, 28 July – 9 September

This apparition made the best morning presentation of the year for Earth's northern hemisphere observers, and the warm summer weather may have contributed to its becoming the best observed apparition of the year.

Aron Kiss contributed six drawings made from 15 August (CM = 252°) through 29 August (CM = 318°; see Figure 4). All of his drawings show some crisscross markings on the disk. Most of these are difficult to relate to known features. However, his 24 August (CM = 296°) drawing may show Solitudo Aphrodites as a dark blotch near the central meridian north of the equator, while a trio of bright areas in the south appear to be the known rayed craters there.

Figure 3. Webcam image of Mercury during Apparition 3 by John Boudreau, 02 Jul 2012, 23:44 UT, CM = 344°.

Table 2: ALPO Observers of Mercury in 2012

Observer	Location	Instrument*	Observation** Number & Type	Apparition Observed
John Boudreau	Saugus, MA USA	27.5 cm Cat	2 W	3,4
Mario Frassati	Crencensto, Italy	20.3 cm Cat	3 D	1
Aron K Kiss	Vac, Hungary	9.0 cm RL 6.6 cm RR	8 D	1,4,6
H.G. Lindberg	Skultana, Sweden	18.0 cm Cat	2 W	4
Frank J Melillo	Holtsville, NY	25.0 cm Cat	1 CCD	6
Carl Roussell	Hamilton, Ontario, CA	15.0 cm RL	3 D	1,2

* Cat = catadioptric, RR = refractor, RL = reflector; ** CCD = CCD imaging, W = webcam lucky imaging, D = drawing

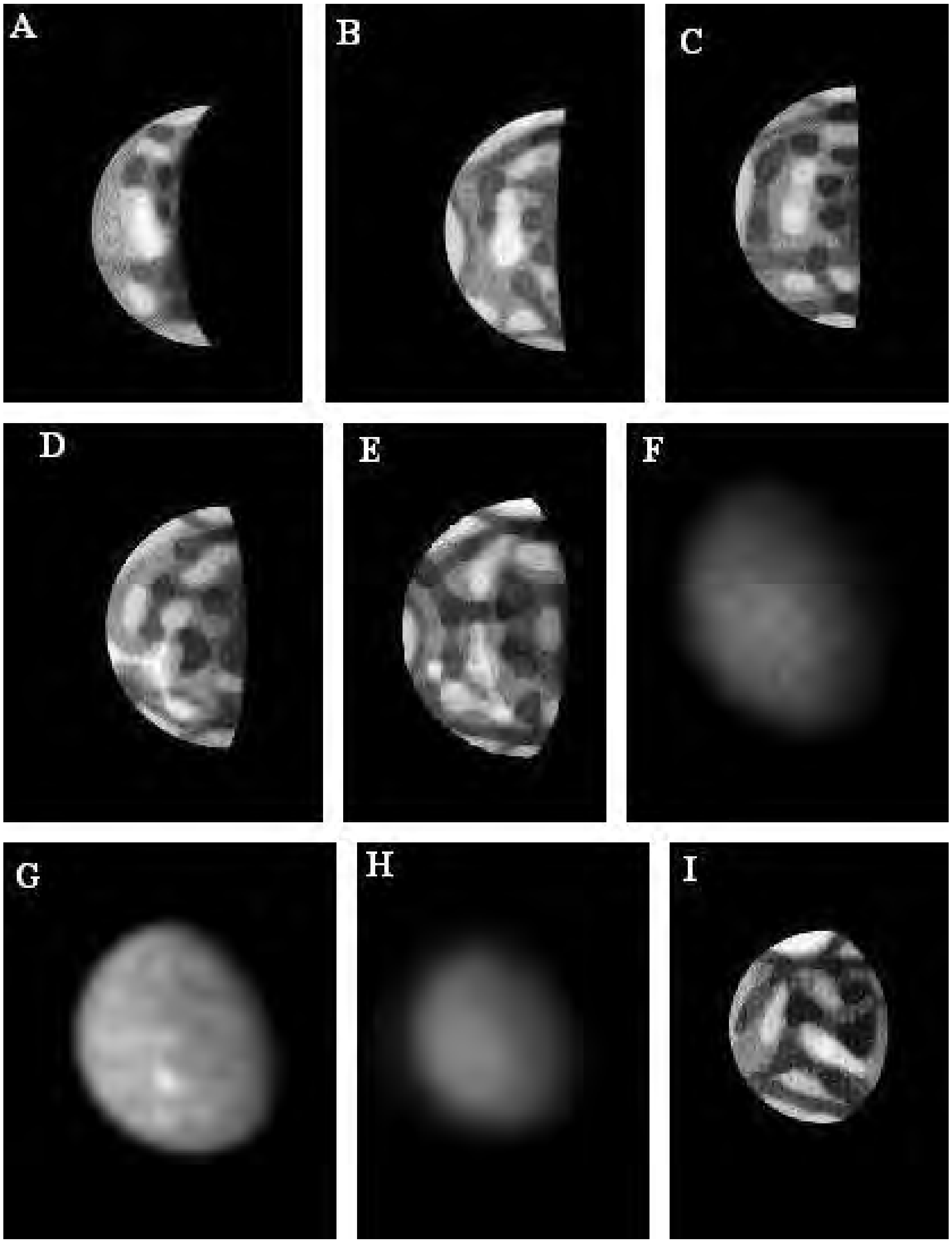


Figure 4. Three webcam images and six drawings of Mercury during of Apparition 4.
A. Drawing by Aron Kiss, 15 Aug 2012, 3:30 UT, CM = 252°.
B. Drawing by Aron Kiss, 18 Aug 2012, 03:30 UT, CM = 267°.
C. Drawing by Aron Kiss, 19 Aug 2012, 3:45 UT, CM = 273°.
D. Drawing by Aron Kiss, 20 Aug 2012, 04:00 UT, CM = 277°.
E. Drawing by Aron Kiss, 24 Aug 2012, 04:03 UT, CM = 296°.
F. Image by H. G. Lindgerg, 27 Aug 2012, 8:45 UT, CM = 310°.
G. Image by John Boudreau, 27 Aug 2012, 14:04 UT, CM = 311°.
H. Image by H. G. Lindgerg, 28 Aug 2012, 8:14 UT, CM = 314°.
I. Drawing by Aron Kiss, 29 Aug 2012, 4:00 UT, CM = 318°.

It can be compared to John Boudreau's image of August 27 (CM = 311°; also presented here in Figure 4). That webcam image clearly shows Solitudo Aphrodites in the north and the three rayed craters in the south. It matches very well with other images of the same longitude made in recent years (Melillo, 2010a, 2010b, 2011a, 2011b, 2013.)

Figure 5. CCD image of Mercury during Apparition 6 by Frank J Melillo, 13 Dec 2012, 14:15 UT, CM = 152°.

H.G. Lindberg made two webcam images, on 27 August (CM = 310°) and 28 August (CM = 314°; also see Figure 4), showing a gibbous phase with no details clearly seen. His 27 August image was taken only 5½ hours earlier than Boudreau's.

This apparition ended with superior conjunction on 9 September.

Apparition 5: Evening, 9 Sept - 17 November

This was rather poor apparition as seen from Earth's northern hemisphere. Unfortunately, no observations of it were received.

Apparition 6: Morning, 17 Nov – 17 Jan (2013)

This was the second best morning apparition of the year, but only two observations were received.

Aron Kiss started with his observation on 27 November (CM = 66°), showing a crescent phase with some unknown markings. The author captured his first image of Mercury in two years on 13 December (CM = 152°). The image showed a slight gibbous phase with possible shady details such as Solitudo Jovis and Solitudo Martis just south of the equator (see Figure 5).

Mercury ended the morning apparition on 17 January (2013) with a superior conjunction with the Sun.

References

Boudreau J (2009). Imaging Elusive Mercury. *Sky & Telescope 118*(4):70-74.

Melillo FJ (2004). Mercury in the Morning. *Sky & Telescope 108*(3):78-80.

Melillo FJ (2010a). Mercury Observations During the Second and Third MESSENGER Flybys. *Journal of the Assn Lunar & Planetary Observers, 52*(3):19-22.

Melillo FJ (2010b). ALPO Observations of Mercury During the 2008 Apparitions. *Journal of the Assn Lunar & Planetary Observers, 52*(4):23-28.

Melillo F J (2011a). ALPO Observations of Mercury During the 2009 Apparitions. *Journal of the Assn of Lunar & Planetary Observers, 53*(1):21-26.

Melillo FJ (2011b). ALPO Observations of Mercury During the 2010 Apparitions. *J Assn Lunar Planetary Obs 53* (4):19-24.

Melillo, F J (2013). ALPO Observations of Mercury During the 2011 Apparitions. Journal of the Assn of Lunar & Planetary Observers, Vol 55 (1): 24 – 29.

Murray JB, Smith BA and Dollfus A (1972). Cartography of the Surface Markings of Mercury. *Icarus,* 17(Dec):576-584.

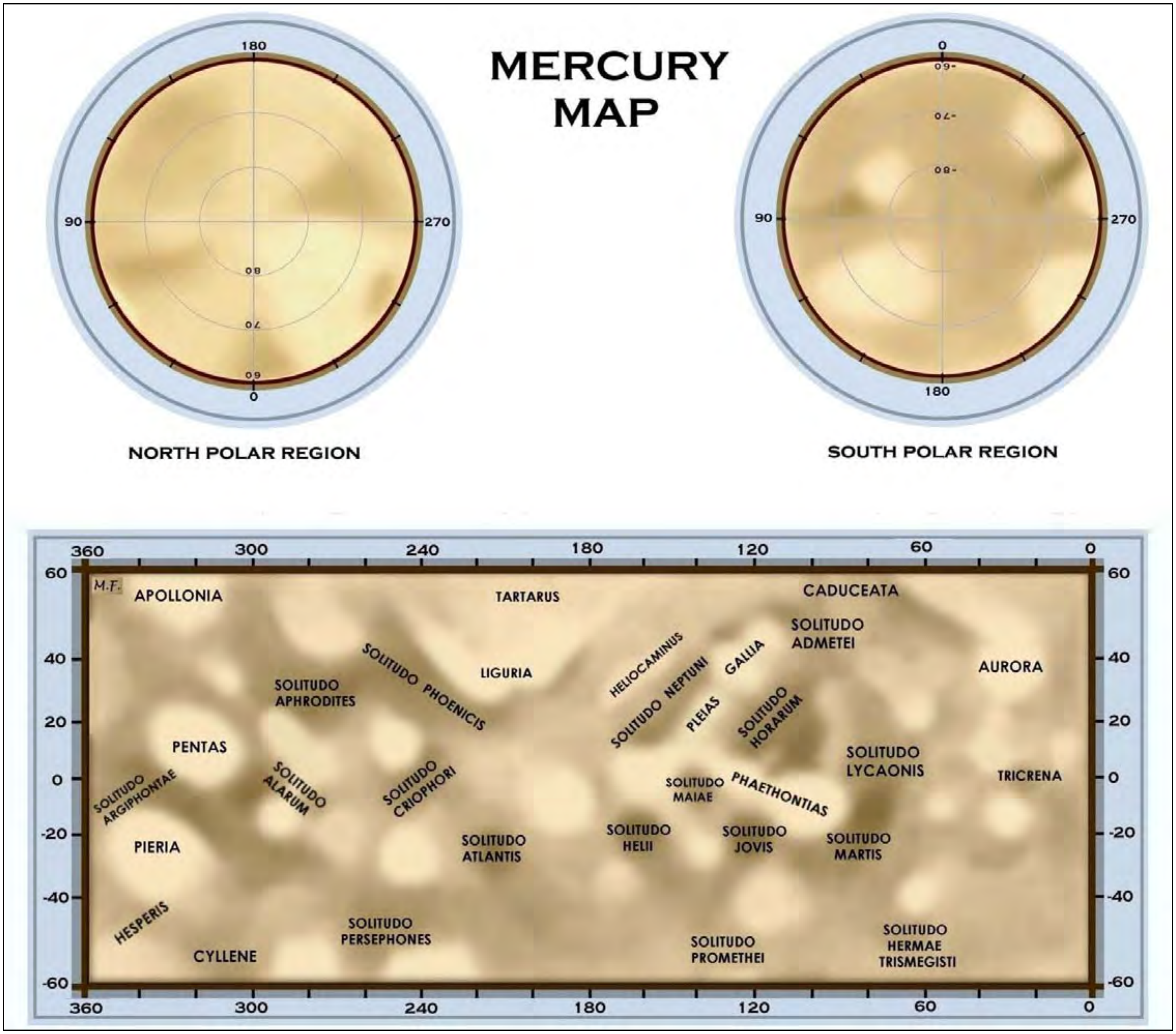


Figure 6. Map of the regolith albedo of Mercury based on 144 visual studies by Mario Frassati at Crescentino (VC), Piedmont, Italy, between January 1997 and January 2006 with a 203mm catadioptric telescope, 250x -400x. (Annotated with IAU nomenclature and used with permission of M. Frassati.

ALPO MERCURY SECTION

NAME______________________________

ADDRESS___________________________

____

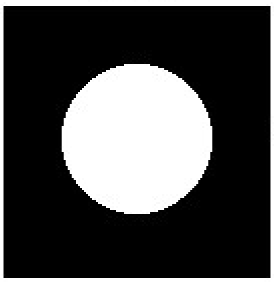
APPARITION:
Morning_____
Eveining_____

ARC SECONDS____"
ELONGATION:
_____° from the sun

For Coordinator Only:

Sketch

NORTH



WEST

Central Meridian Longitude______°

DATE__________________
TIME (UT)______________
Telescope__________________________
Magnification_______________________
Filter(s)____________________________
Seeing (10-best/1-worst)______________
Visual Description:

Photo or CCD

DATE:_____________
TIME (UT):__________

Image 1

Central Meridian Longitude______°

Telescope:____________________
Camera Type:__________________
Exposure:_____________________
f/ratio:_______________________
Filter:________________________

Comments:

Date:________________
TIME (UT):____________

Image 2

Central Meridian Longitude______°

Telescope____________________
Camera Type__________________
Exposure_____________________
f/ratio_______________________
Filter________________________

Comments:

Send all observations to: Frank J Melillo
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Holtsville, NY 11742

E-mail for questions, special observations and alerts: frankj12@aol.com

Feature Story:
China's First Lunar Lander: Chang'e 3 and Yutu

By Wayne Bailey,
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Wayne.Bailey@alpo-astronomy.org

Online Readers

Left-click your mouse on the e-mail address in blue text to contact the author of this article and any of the additional information sources in blue text at the end of this paper for more information.

Introduction

After more than 37 years, a spacecraft has again made a soft landing on the Moon. On December 14, 2013 at 13:11 UT, the Chinese National Space Administration's Chang'e 3 touched down on Mare Imbrium. The landing site is about 40 km south of the 6 km diameter crater Laplace F at 44.12° N 19.52° W (see Fig. 1). In addition to its own scientific instrumentation, the lander carried a rover named Yutu which was deployed on December 14, 2013 at 20:35 UT. The most recent previous lunar soft landing was the Russian sample return mission Luna 24 which landed in Mare Crisium August 22, 1976 at 17:55 UT.

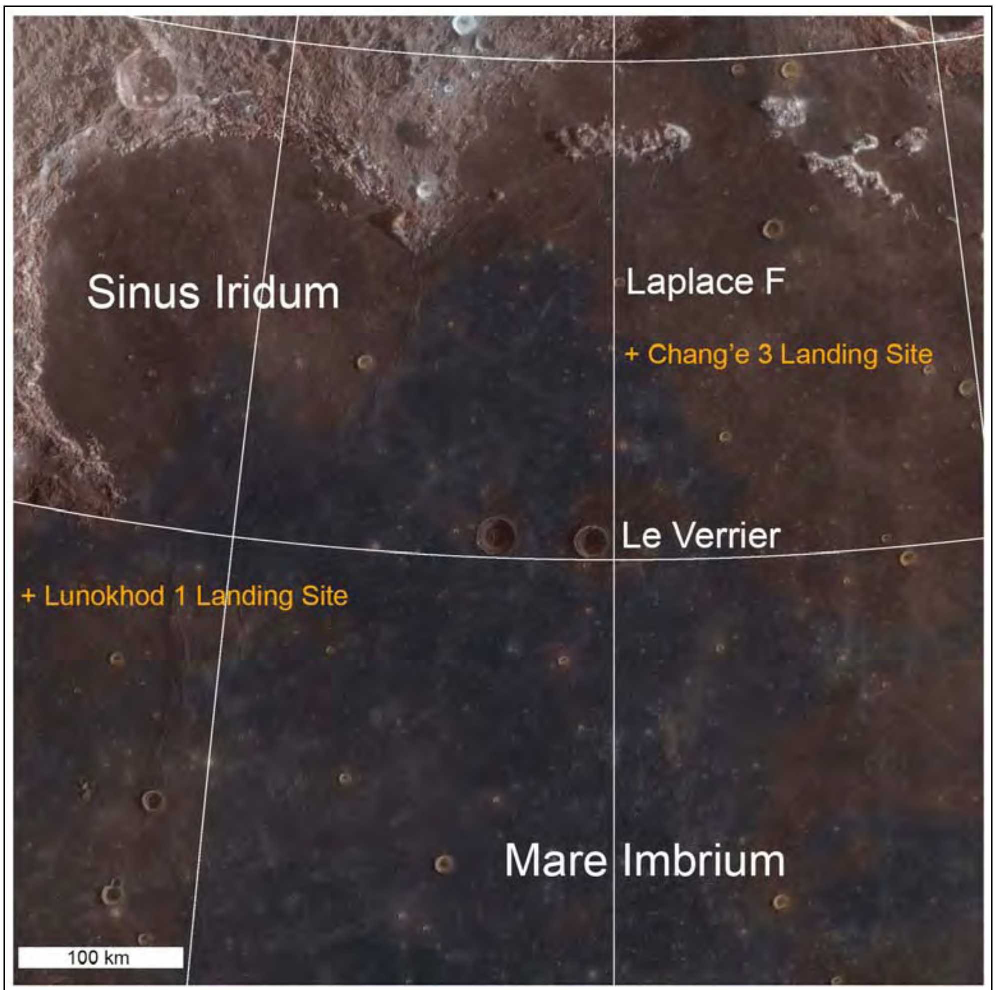

Figure 1. LRO image of Chang'e 3 landing site in Mare Imbrium. Source NASA/GSFC/ASO.

The scientific objectives of Chang'e 3 include:

- Study the lunar surface topography and geology
- Determine the surface composition
- Conduct lunar based astronomical observations
- Study the Sun-Earth-Moon space environment
- Perform first direct measurement of lunar soil properties to 30 m depth
- Investigate the lunar crust structure to several hundred meters depth

The lander is intended to operate for one year on the lunar surface. The rover, Yutu, is intended to operate for three months, explore 3 km^2 around the lander, and travel up to 10 km during that time.

History

As its name implies, Chang'e 3 is the third in a series of Chang'e lunar missions. Chang'e 1, launched October 24, 2007, was an orbiting mapping mission that imaged the entire surface of the Moon to support landing site selection for Chang'e 3. Upon completion of its mission, it intentionally impacted the Moon on March 1, 2009.

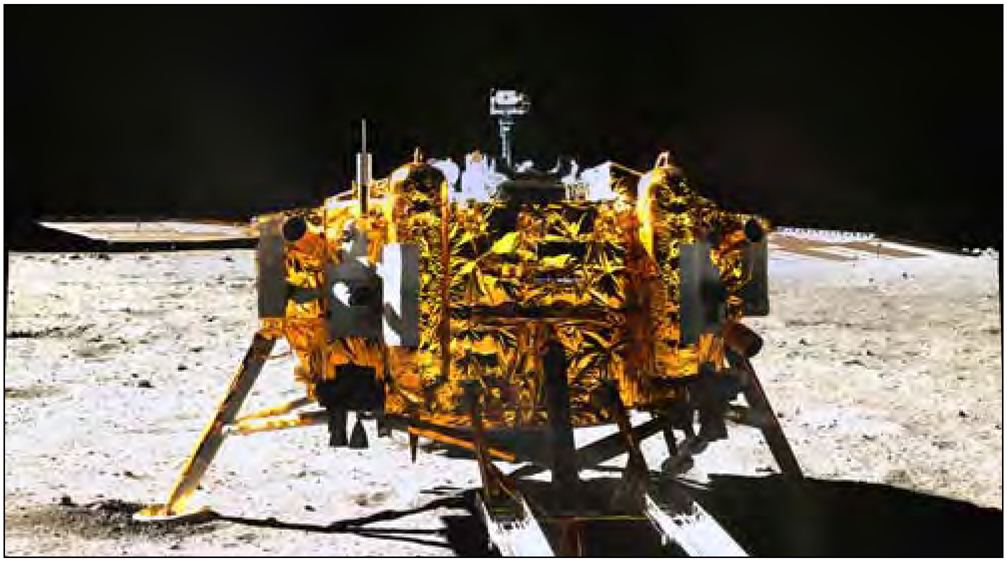

Figure 2. Chang'e 3 lander as viewed from Yutu. Source: Chinese Academy of Sciences, *http://english.cas.cn*

Chang'e 2 was a higher resolution follow-up to Chang'e 1. Launched on October 1, 2010, it entered a 100 km altitude lunar orbit for imaging. Upon completion of its imaging mission, it left lunar orbit on June 8, 2011 to be placed in orbit at the Sun-Earth L2 Lagrangian point as a test of the Chinese Tracking and Control network. On April 25, 2012, Chang'e 2 left L2 for a flyby of asteroid 4179 Toutatis. Closest approach to the asteroid occurred on December 13, 2012 at 3.2 km.

Future plans for this mission series include another lander, Chang'e 4, currently planned for 2015 (which will use the backup Chang'e 3 spacecraft), and a sample return mission, Chang'e 5, tentatively scheduled for 2017.

This mission series is named after Chang'e, the goddess of the Moon. Legend has it that after swallowing a magic pill, Chang'e took her pet white rabbit, flew to the Moon where she became a goddess, and has lived there ever since with the white jade rabbit. The name of the rover, Yutu, was chosen after an on-line poll. It translates as "jade rabbit", in reference to the pet rabbit of Chang'e.

Hardware

Launch Vehicle

The launch vehicle for the Chang'e missions has been the Chinese Long March 3B. It's a three-stage vehicle, with four strap-on boosters assisting the first stage. All stages and the boosters are liquid-fueled, although the fuel is not the same for all. This is China's most powerful launch vehicle.

Lander

The lander is octagonal, with four legs that also serve as shock absorbers during landing (see Fig. 2). The legs span 4.76 m. It has a dry mass of 1,200 kg, including the 140 kg rover. Wet mass (fully fueled) is limited by the launch vehicle payload capacity to less than about 3,700 kg. It has solar arrays to provide electrical power during the lunar day, and radioisotope thermal generators to provide both heat and electrical power during the long cold lunar night.

In addition to its own support systems (power, thermal control, communications & control, propulsion, attitude control) and Yutu with its deployment system, six (or possibly seven) scientific instruments are mounted on the lander.

Rover Deployment System

Since the rover is carried on the upper deck of the lander, a means has to be provided to transfer it to the surface. This is a combination elevator-and-ramp device. The ramp is stowed vertically on the side of the lander. For use, it is raised to a horizontal position so that Yutu can drive onto it. It is then lowered to the surface at an angle (<20°) that is acceptable for Yutu to drive down onto

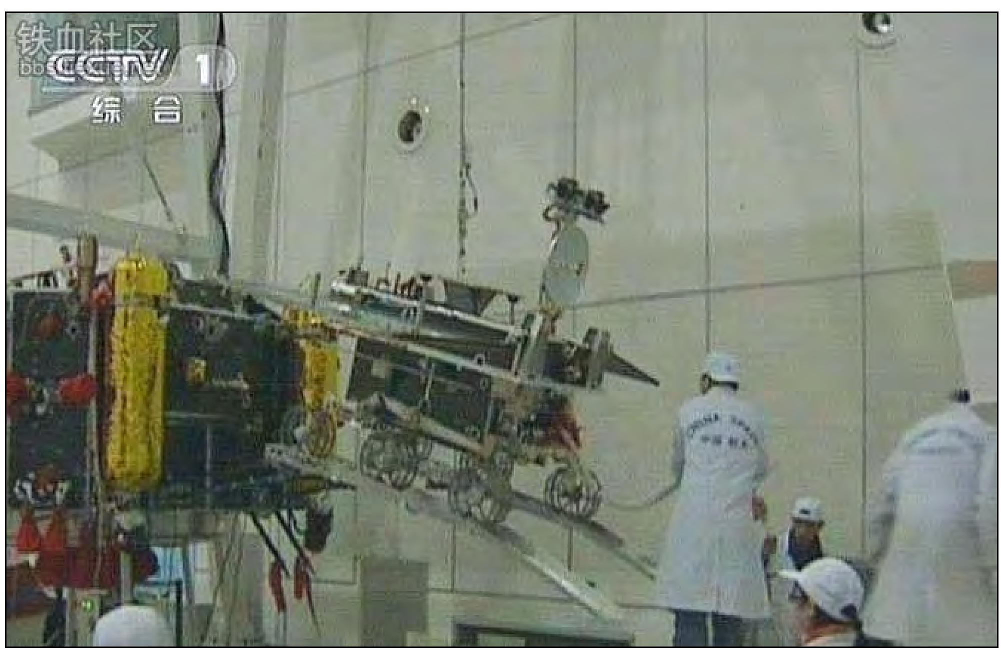

Figure 3. Rover deployment test. Source: Chinese Academy of Sciences, *http://english.cas.cn*

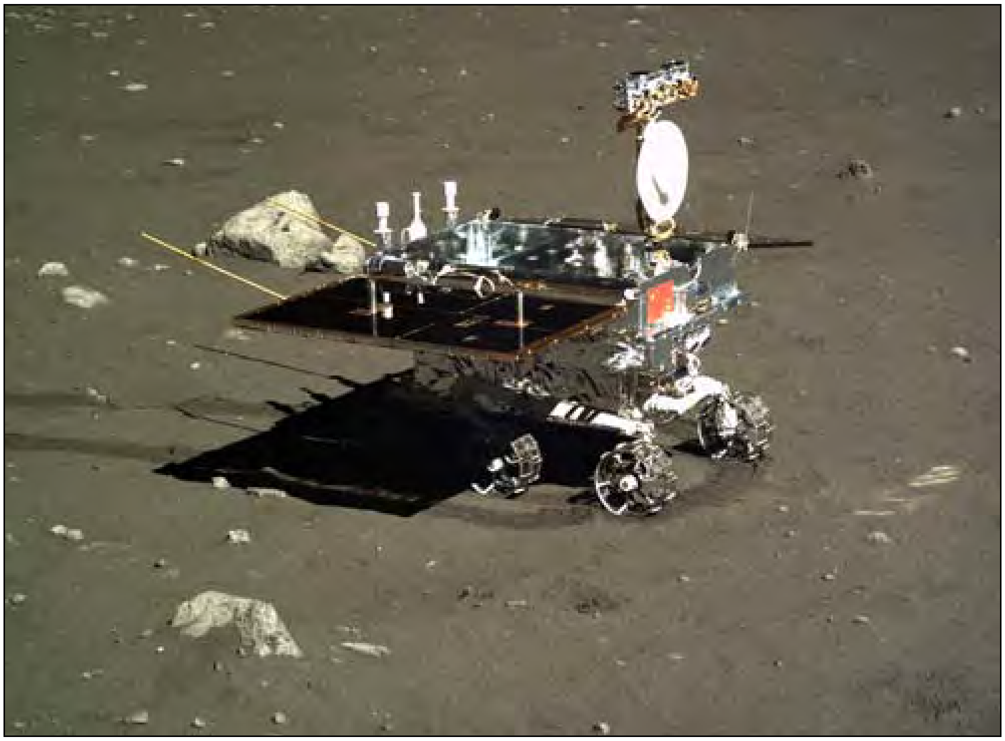

Figure 4. Yutu as viewed from Chang'e 3. Source: Chinese Academy of Sciences, *http://english.cas.cn*

the surface. An image (see Fig. 3) of a ground test shows the upper portion lowered below the lander upper deck as is necessary, since its length is limited to the height of the deck by the vertical stowage position. A video from China TV that illustrated the deployment mechanism has been posted on YouTube (http://www.youtube.com/watch?v=cFb1E63AxNI).

Lunar-based Ultraviolet Telescope (LUT)

The LUT is a 150mm Ritchey-Chretien telescope for astronomical observations in the ultraviolet (245-340 nm) to magnitude 13 using a CCD detector. The telescope itself is fixed to the side of the lander, fed by a pointing mirror on a two-axis gimbal. It will study variable stars, binaries, novae, quasars and blazars, taking advantage of the Moon's lack of atmosphere and slow rotation. A similar instrument was included on Apollo 16. The LUT will produce better quality images and is planned to operate for a longer period of time.

Extreme Ultraviolet Telescope (EUV)

The EUV is a narrowband, wide-field-of-view system, intended to study the Earth's plasmasphere by observing the 30.4 nm He^{+} emission line. Its field of view is 15° (about 7.5 Earth diameters), angular resolution 0.1°, and time resolution 10 minutes. It will study the plasmasphere's structure, dynamics and response to solar activity.

Cameras

The lander has three panoramic cameras aimed in different directions, and one descent camera. Very little technical information is available about the panoramic cameras except that they produce color images and are capable of both still and video imaging. They are mounted on the mast to be used for surveying the terrain around the landing area and monitoring the rover's travels. Some reports state that they have no thermal protection, which, if correct, would indicate that they aren't intended to survive the lunar night. Many of the images released are jpegs that appear to be down-sampled. The best are 2,352 x 1,758 pixels, which appears to be the native image size.

The descent camera (1,280 x 1,024 CMOS monochrome detector) is mounted on the underside for use during landing. Its primary purpose is to guide the lander to a safe landing site during the 100 m altitude, horizontal maneuvering stage of the landing sequence, and probably all the way to the surface. Its images will also be used to help plan the rover's path of exploration, since it produced low altitude, high resolution pictures of the area surrounding the landing site.

Extensible Soil Probe

Some descriptions of the lander science payload have included an extensible soil probe for analyzing the lunar soil. It is not mentioned in recent press releases and no current information seems to be available, so it's doubtful that it is actually on the lander.

Rover – Yutu

Yutu is basically a rectangular box with six, independently driven, wheels, two solar panels, a deployable mast, and a robotic arm (see Fig. 4). The mast reaches 1.5 m above the surface, carrying the communication antenna, two stereo cameras and two navigation cameras. The robotic arm carries the sensors for the alpha particle x-ray spectrometer. In addition to the mast mounted navigation cameras, two hazard avoidance cameras are located on the lower front of the rover. There apparently are no rear-view cameras. All six wheels are driven. The front and back wheel pairs are steerable, and the suspension system allows Yutu to drive over obstacles up to 20 cm high with all six wheels maintaining ground contact. It can travel at up to 200 meters/hour. Yutu relies on batteries for electrical power during the lunar night. It apparently has multiple, one-watt, Radioisotope Heater Units which provide heat, but no electricity, so the batteries are needed to provide power for the standby electronics. During the lunar

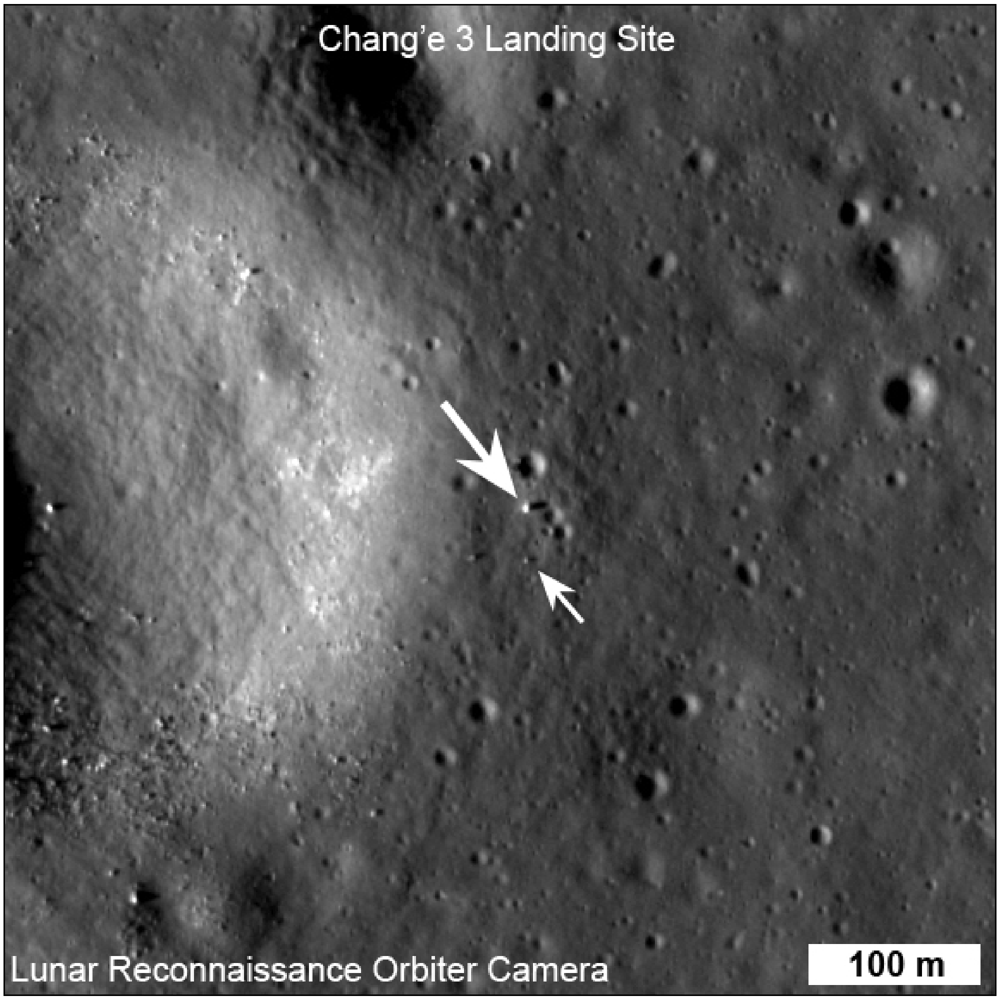

Figure 5. LRO image of Chang'e 3 and Yutu on the Moon. Source NASA/GSFC/ASO.

night, one of the solar arrays is retracted for use as a cover to reduce heat loss. Four scientific instruments packages are mounted on Yutu.

Yutu is capable of autonomous navigation, using its navigation and hazard avoidance cameras to recognize the target, plan its route, and avoid obstacles. Operation from the ground is also possible, with a delay of 2.5 seconds for two-way communication from the Earth (video downlink and command uplink).

Stereo Cameras

Two panoramic cameras are mounted on the mast to image the rover's surroundings. These cameras are used to provide three-dimensional images to map the lunar surface around the rover, monitor the lander, and select targets for the other instruments.

Alpha Particle X-ray Spectrometer (APXS)

The APXS is used to determine the composition of the lunar surface. A sensor head, consisting of an alpha particle source, an alpha particle detector and an x-ray detector are mounted on the rover's robotic arm. In use, the sensor is positioned close to the object to be analyzed so that it is irradiated with alpha particles. The energy spectrum of back-scattered alpha particles and x-ray emission spectrum is measured. The energy of the back-scattered alpha particles is related to the mass of the atomic nucleus that reflected it, so the atomic masses of the target can be determined. Additionally, the incident alpha particles ionize the target atoms by ejecting electrons from their inner shells. As electrons cascade down to refill the inner shell, x-rays are emitted whose energy (or wavelength) are characteristic of the element involved. A calibration sample of known composition is also included on the rover.

Visible/Near Infrared Imaging Spectrometer

Reflected sunlight is modified by absorption due to the minerals composing the lunar surface. By measuring the wavelength and amount of absorption, the composition can be determined. This instrument provides visible and near-infrared spectra of two-dimensional images to determine the mineral composition of the target. It has two channels, 450-950nm and 900-2400nm. The short wavelength channel provides <8nm spectral resolution over a 6° x 6° field of view. The long wavelength channel provides <12nm resolution over a 3° x 3° field of view. India's Chandrayaan-1 lunar orbiter had a similar instrument, the Moon Mineralogy Mapper, for remote sensing.

Ground-Penetrating Radar (GPR)

The ground-penetrating radar is mounted on the underside of the rover body to study the depth structure of the lunar soil and crust. It's a two-frequency radar, designed to penetrate unconsolidated soil to a depth of 30 m (depth resolution about 0.3 m) and solid crust to at least 100 m (depth resolution around one meter). Measurements of the shallow, subsurface structure will help determine the geologic and thermal history of the Moon, and will provide ground truth measurements to assist interpreting data from previously flown orbiting radars.

Landing

Chang'e 3 was launched from the Xichang Satellite Launch Center on December 1, 2013 at 17:30 UT and entered a 100 km altitude circular polar lunar orbit on December 6, 2013 at 09:53 UT. Later, the orbit periapsis was lowered to 15 km. On December 14th

Figure 6. Earth as imaged by Chang'e 3. Source: Chinese Academy of Sciences, *http://english.cas.cn*

the lander began its descent from the 15 km periapsis to 100 m above the lunar surface, where it hovered for about 20 seconds while obstructions were located and a safe landing spot identified by on-board systems using the descent camera. It then maneuvered to the chosen landing site while descending to four meters where the engines were shut off, and it was allowed to free-fall to the lunar surface, touching down at 13:11 UT. A video made from the descent camera images has been posted on YouTube at http://www.youtube.com/watch?v=QzZkF1MAsb8.

This is the first unmanned lander that could actively choose and maneuver to its landing spot. As far as I know, the only other landers that have used free-fall as their final touch-down technique have been the Mars Pathfinder and Mars Exploration Rover, both of which used airbags surrounding the lander to cushion them while they bounced to a stop.

The previously announced location for the landing was to be in Sinus Iridum, roughly 10° of longitude west of the actual landing site. The reason for the discrepancy has not been announced. It may have been changed for scientific reasons, since the actual landing site is near the boundary of two distinctly different magma flows. It may also have been the result of navigation errors, in which case the utility of the autonomous landing system was demonstrated. There were no large differences from the timeline announced pre-flight, however, so operational delays don't seem to be the cause. One result of landing east of the originally planned location, on the planned day, is that there was about one less day available for operation before the onset of lunar night. NASA's Lunar Reconnaissance Orbiter (LRO) has imaged Chang'e 3 and Yutu (see Fig. 5)

Lunar Operations

The Chang'e 3 lander science mission is expected to continue for one year on the lunar surface. The rover, Yutu, was expected to survive at least three lunar nights, which would allow operations for more than three months. At this writing (early February 2014), Chang'e 3's second lunar night is just ending.

Although there have been some operational problems, both the lander and rover survived the first two lunar days and one lunar night. Yutu experienced some unspecified mechanical problems, attributed to the harsh lunar environment, just prior to entering hibernation for the second night. It is not expected to have survived the latest lunar night, although its status will only be known for certain after the expected wake-up time. There should be an announcement of its status before this issue goes to press.

It's thought that mechanical problems with the solar array or mast, which are retracted to conserve heat, prevented their proper stowage. Apparently, one of the solar arrays is moved to a position at night where it serves as part of the thermal insulation for the rover. If it's not properly positioned, the Radioisotope Heating Units (typically one watt of heat output each) won't be able to keep components within their specified survival temperature range during the two-week lunar night when the temperature can reach -175° C. The other solar array also must be moved to a position where it will be illuminated by the rising sun to provide wake-up power.

Another possible explanation is that the mechanical problems prevented the rover from moving, leading to overheating. This would be consistent with its post deployment shutdown (see below). It would also imply that Yutu needs to change position periodically to maintain a uniform temperature, analogous to the Space Shuttle's barbeque mode that was required prior to closing the payload bay doors following certain sustained attitudes. Overheating would seem to be a problem during the lunar day rather than night, but may lead to an inability to properly prepare for hibernation.

Update

Radio signals have been received from both Chang'e 3 and Yutu after their second lunar night. Yutu didn't transmit at the expected wake-up time, prompting announcements of its demise. However, one day later, amateur radio operators reported receiving its signal, followed by Chinese announcements of its re-awakening. Chang'e 3 has also revived, apparently on schedule. The anomaly experienced by Yutu prior to hibernation still exists, but hope has been expressed that it can be resolved. No additional information concerning the status of the lander or rover has been released.

Chang'e 3 deployed Yutu on December 14, 2013 at 20:35 UT. It moved about nine meters north of the lander where, on the next day, Yutu and Chang'e 3 photographed each other.

Yutu experienced an operational anomaly on the 16th, when it turned itself off due to the extreme temperature difference between its lighted (>100° C) and shadowed sides (< 0° C). It remained off for several days, but China News reported that it was turned back on sooner than expected and resumed operation, apparently with no lingering effects.

Some results obtained during the first lunar day have been released. These include:

- An image of the Earth (see Fig. 6)
- A set of images forming a complete 360° panoramic view around the lander.
- Successful tests of the robotic arm on Yutu.

The LRO team produced an interesting combination of a Yutu image of the lander with an LRO overhead view that identifies features near the landing site (see Fig. 7).

On December 26, 2013, Chang'e 3 and Yutu began dormancy for their first lunar night. Yutu reawakened on January 10, 2014 at 21:09 UT and began its normal working mode. Chang'e 3 followed on January 12 at 00:21 UT and reported that its main color topography camera had failed. This probably was expected, since it seems to have no provision for thermal protection during the lunar night.

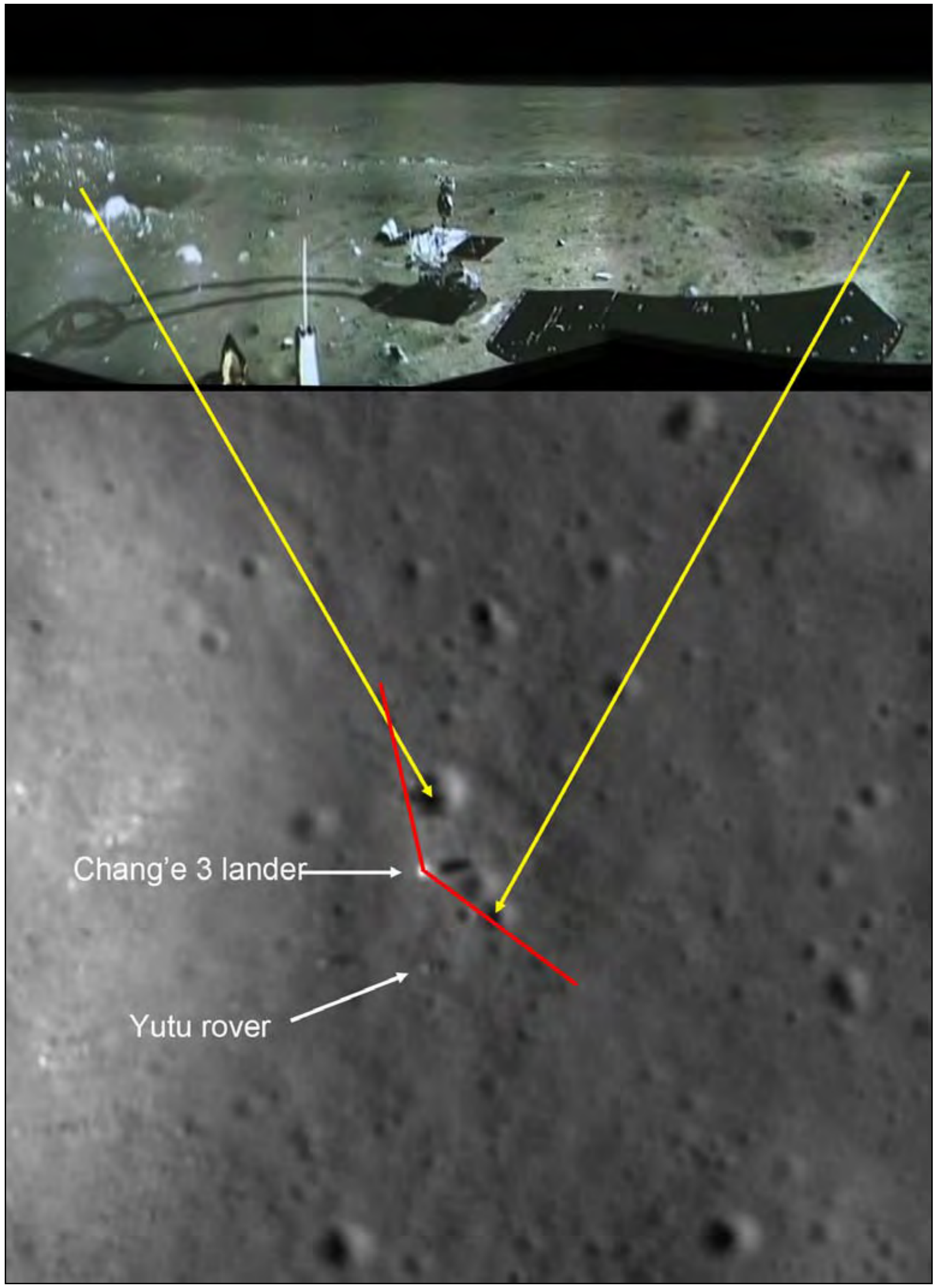

Figure 7. Yutu image of Chang'e 3 correlated to LRO view of the landing site. Source NASA/GSFC/ASO.

There have been several statements by Chinese sources (some made prior to the start of its first lunar night) that Chang'e 3 has accomplished all of its primary (probably engineering) objectives. This is consistent with reduction of the size of the control team needed to support continuing routine science operations. I haven't seen an explicit list of primary objectives, so the following is my guess. I've structured them as two levels, each apparently consistent with the timing of some of the various announcements.

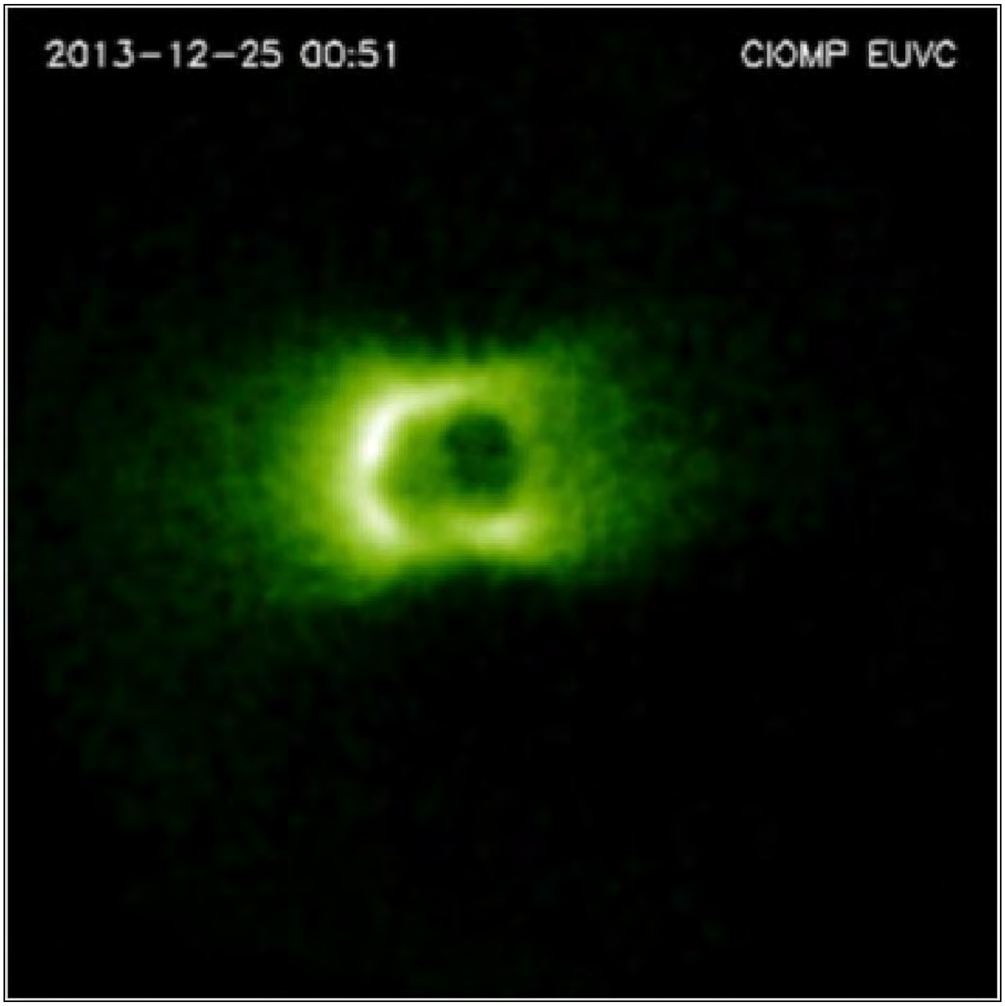

Figure 8. The Earth's plasmasphere as viewed by EUV. Source: Chinese Academy of Sciences, *http://english.cas.cn*

They may represent objectives of various groups within the Chang'e 3 mission team, or possibly just the opinions of enthusiastic supporters.

First, a successful landing, deployment of the rover, mutual photography and a complete panoramic image seem to be the minimum objectives, which were accomplished prior to lunar nightfall.

Second, survival through the lunar night, with continuing operations would complete what I consider a reasonable set of primary objectives.

Regardless, Chang'e 3 met all of them with the successful re-awakening and operation following its first lunar night.

Science instrument results were released about midway through the second lunar day. These include:

- An image of the Earth's plasmasphere from EUV (see Fig. 8).
- An ultraviolet image of the sky in Draco from LUT (see Fig. 9 & Table 1).
- Two sets of GPR data showing the sub-surface structure to 140 m and 10 m (see Fig. 10).
- A spectral image of lunar soil from the imaging spectrometer.
- An x-ray fluorescence spectrum of lunar soil from the APXS following calibration using the on-board basalt sample (see Fig. 11).

Shortly before the end of this lunar day, it was announced that Yutu had suffered an unspecified mechanical anomaly caused by the harsh lunar environment. Most speculations about the cause have centered on lunar dust preventing proper stowage of the mast and solar arrays resulting in thermal problems. This is a reasonable speculation since problems with the abrasive, clinging lunar dust have been recognized since at least the Apollo missions. The statements that have been released only refer to continuing efforts to resolve the anomaly. The reference to harsh lunar environment, however, could equally well refer to thermal problems.

Shutdowns for the mission's second lunar night began on January 24 and 25. Despite the dire predictions of its death, amateur radio operators detected Yutu's radio signal on February 12, followed by Chinese announcements that communication with the rover had been re-established, although the mechanical control anomaly still exists. That would indicate that the mast is properly deployed, since it carries the communication antenna. Announcements the previous day that the rover had failed to awaken indicate that something delayed its revival or ability to communicate. The announcements gave no additional information on the rover's status, except that they were hopeful the anomaly could be corrected. Little has been said about the lander, so presumably it awakened on schedule with no obvious failures.

Chang'e 3 and LADEE

NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) was operating at the Moon when Chang'e 3 arrived and landed. Despite the constraints imposed on information exchange between the U.S. and China, which limited pre-planning of data collection, LADEE instruments collected data before, during, and after Chang'e 3's landing. The maneuvering engine firings should add exhaust gases to the lunar atmosphere, and the landing should stir up the lunar dust. While this disturbs

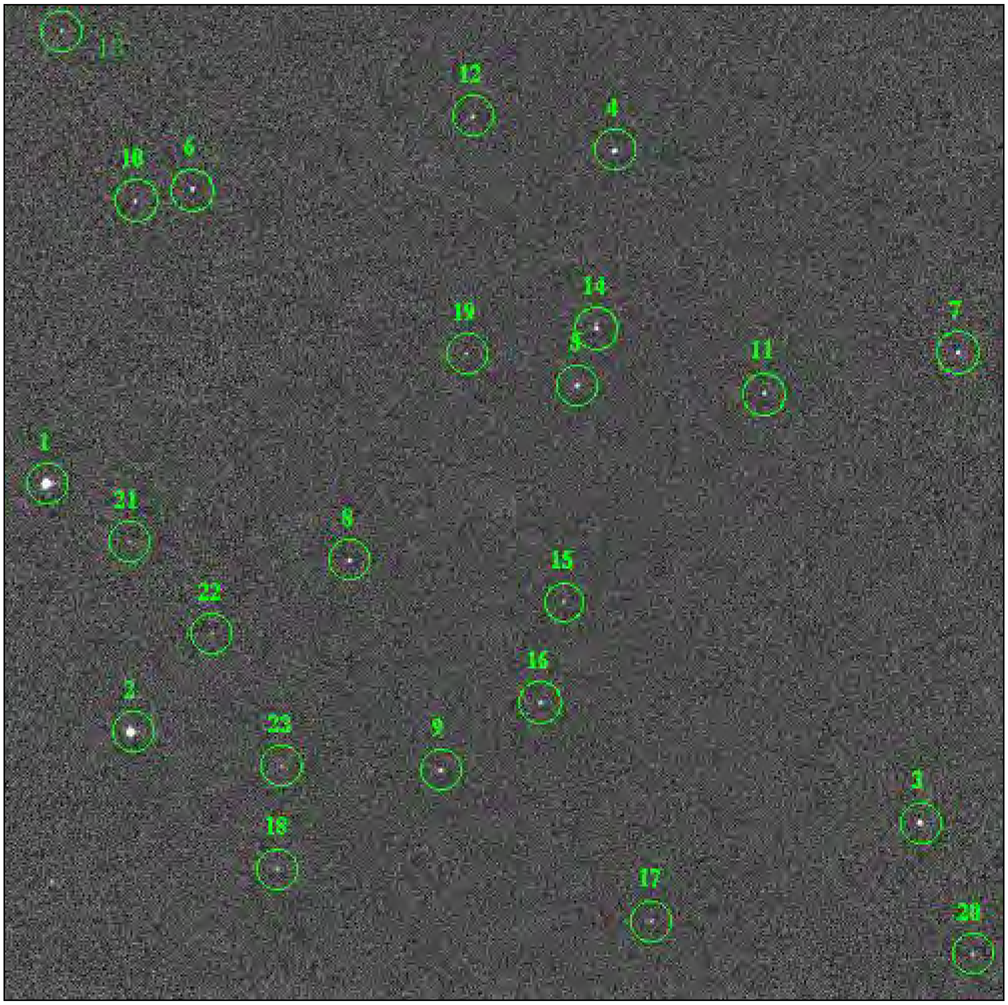

Figure 9. Star field in Draco as imaged in the ultraviolet by LUT. Numbered stars are identified in Table 1 (below). Source: Chinese Academy of Sciences, http://

Table 1: Key to the Numbered Stars in Figure 9

Star Number	Name	Number	Name
1	HD 151044	13	TYC 3505-598-1
2	HD 151387	14	HD 234341
3	HD 234351	15	IDS 16429+5037
4	TYC 3505-184-1	16	HD 234344
5	HD 234343	17	HD 234349
6	HD 234331	18	TYC 3503-567-1
7	TYC 3506-1864-1	19	TYC 3505-650-1
8	TYC 3505-398-1	20	TYC 3506-1008-1
9	TYC 3506-1196-1	21	TYC 3502-795-1
10	TYC 3505-138-1	22	TYC 3506-1242-1
11	HD 151444	23	TYC 3505-329-1
12	TYC 3505-328-1		

the natural lunar environment that LADEE is intended to study, it also provides an opportunity to study the dispersal and lifetime of gases and dust with known source location and time.

LADEE Project Scientist Richard Elphic posted some preliminary results on the LADEE website (http://www.nasa.gov/ames/ladee-project-scientist-update-milestones-maneuvers-and-moisture/). The dust detector results were initially confusing because the expected increase began hours before Chang'e 3's landing. This turns out to be due to the Geminid meteor shower which coincided with the landing date. Geminid meteor impacts were also adding lunar dust to the atmosphere. Since the dust input from the landing only lasted a short time, it appears that LADEE was not in a location where it was detectable. The neutral mass spectrometer has detected changes in gases produced by rocket exhaust before and after the landing however. Analysis is continuing, so watch the LADEE website for updates.

Conclusion

Chang'e 3 and its rover, Yutu, have successfully landed and operated on the lunar surface after a gap of more than 37 years since the last lunar landing.

Preliminary scientific results have been released from instruments designed to study areas including the structure and composition of the Moon, the stars, and the Earth's environment.

Some problems have been encountered, but they may be solvable. It's also encouraging that a similar follow-up mission, Chang'e 4, will use the existing back-up hardware, and a sample return mission is also planned for the near future.

Additional Information Sources

Chang'e 3 Diary: http://www.zarya.info/Diaries/China/ChangE/ChangE3Diary.php

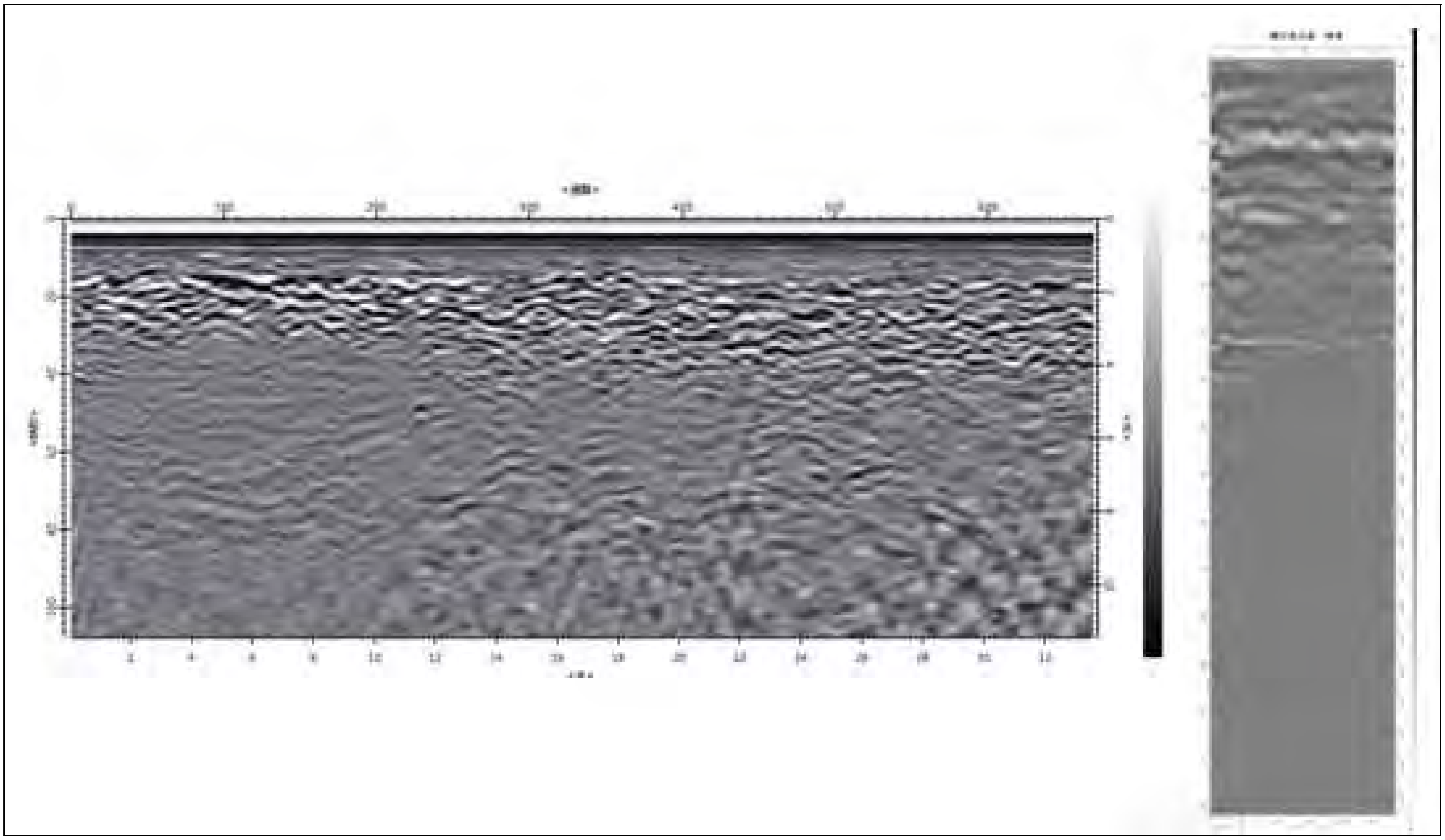

Figure 10. Subsurface structure measured by the GPR. Source: Chinese Academy of Sciences, *http://english.cas.cn*

China National Space Administration: http://www.cnsa.gov.cn/n615709/n620681/n771918/index.html

China News (English): http://www.xinhuanet.com/english/

China TV (English): http://english.cntv.cn/01/index.shtml

Chinese Academy of Sciences (English): http://english.cas.cn/

LADEE Project Scientist Blog: http://www.nasa.gov/ames/ladee-project-scientist-update-milestones-maneuvers-and-moisture/

LRO images: http://lroc.sese.asu.edu/news/index.php?/archives/849-Change-3-Lander-and-Rover-From-Above.html

NASA Space Flight: http://www.nasaspaceflight.com/news/chinese/

Planetary Society: http://planetary.org/

Smithsonian Air & Space: http://www.airspacemag.com/daily-planet/a-new-site-to-explore-on-the-moon-180948756/

Space.com: http://www.space.com

Spaceflight 101: http://www.spaceflight101.com/change-3.html

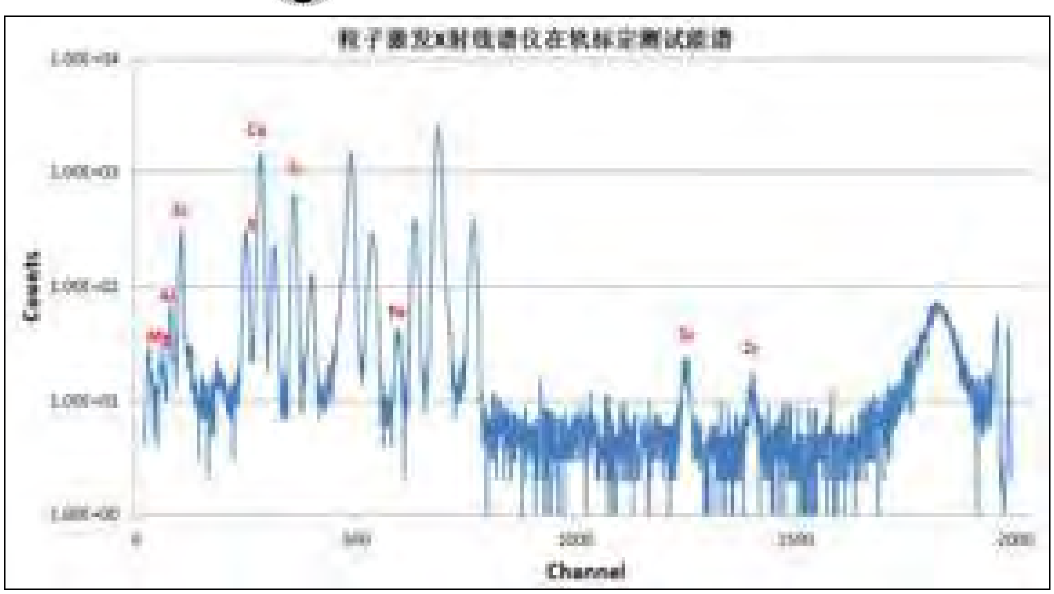

Figure 11. X-ray fluorescence spectrum of lunar soil by APXS. Source: Chinese Academy of Sciences, *http://english.cas.cn*

Feature Story: ALPO Observations of Saturn During the 2010 - 2011 Apparition

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This paper includes a gallery of Saturn images submitted by a number of observers.

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

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

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

Abstract

The ALPO Saturn Section received a combined total of 714 visual observations and digital images during the 2010-11 apparition (from October 31, 2010 through September 1, 2011). These observations were contributed by 57 observers in Canada, China, France, Germany, Brazil, Australia, Japan, The Netherlands, Philippines, Portugal, Spain, United Kingdom, United States, Puerto Rico, Greece, Slovenia and Poland. Instruments employed to perform the observations ranged from 10.2 cm (4.0 in.) up to 50.8 cm (20.0 in.) in aperture. Visual observers suspected sporadic, ill-defined dusky features in the North Temperate Belt (NTeB), as well as a few short-lived diffuse white ovals in the South Temperate Zone (STeZ) and South Tropical Zone (STrZ). These phenomena were occasionally apparent on digital images submitted throughout the apparition. The real highlight of the 2010-11 observing season, however, was the sudden emergence of a brilliant white storm in Saturn's North Tropical Zone (NTrZ), first detected by Cassini on December 5, 2010 at Saturnigraphic latitude +35°. Amateur observers began capturing images the storm on December 10,

Table 1: Geocentric Phenomena in Universal Time (UT) for Saturn During the 2010-2011 Apparition

Conjunction		2010	Oct	01^{d}
Opposition		2011	Apr	04^{d}
Conjunction		2011	Oct	13^{d}
Opposition Data				
Visual Magnitude		+0.4		
Constellation		Virgo		
B		+8.7°		
B'		+8.0°		
Globe	Equatorial Diameter	19.3"		
	Polar Diameter	17.5"		
Rings	Major Axis	44.6"		
	Minor Axis	6.6"		

All Readers

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

Online Features

Left-click your mouse on:

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

Observing Scales

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

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

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

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

Table 2: 2010-11 Apparition of Saturn, Contributing Observers

	Observer	Location	No. of Observations	Telescopes Used
1.	Abel, Paul G.	Leichester, UK	24	20.3 cm (8.0 in.) NEW
2.	Akutsu, Tomio	Cebu City, Philippines	27	35.6 cm (14.0 in.) SCT
3.	Arditti, David	Middlesex, UK	5	35.6 cm (14.0 in.) SCT
4.	Barry, Trevor	Broken Hill, Australia	46	40.6 cm (16.0 in.) NEW
5.	Benton, Julius L.	Wilmington Island, GA	83	15.2 cm (6.0 in.) REF
6.	Borges, Fabricio	Cariaccia, Brazil	1	20.3 cm (8.0 in.) NEW
7.	Boudreau, John	Saugus, MA	1	28.0 cm (11.0 in.) SCT
8.	Budine, Phillip W.	Port Crane, NY	1	12.8 cm (5.0 in.) MAK
9.	Casquinha, Paolo	Pamela, Portugal	1	35.6 cm (14.0 in.) SCT
10.	Chang, Daniel	Hong Kong, China	9	20.3 cm (8.0 in.) SCT
11.	Chavez, Rolando	Powder Springs, GA	1	35.6 cm (14.0 in.) SCT
12.	Chester, Geoff	Alexandria, VA	3	20.3 cm (8.0 in.) SCT
13.	Combs, Brian	Buena Vista, GA	24	35.6 cm (14.0 in.) SCT
14.	Delcroix, Marc	Tournefeuille, France	28	25.4 cm (10.0 in.) SCT
15.	Falcon, Israel	Las Palmas, Canary Islands	2	28.0 cm (11.0 in.) SCT
16.	Go, Christopher	Cebu City, Philippines	29	28.0 cm (11.0 in.) SCT
17.	Grego, Peter	Cornwall, UK	2	20.3 cm (8.0 in.) SCT
18.	Hansen, Torsten	Berlin, Germany	1	20.3 cm (8.0 in.) NEW
19.	Hill, Rik	Tucson, AZ	5	35.6 cm (14.0 in.) SCT
20.	Ikemura, Toshihiko	Osaka, Japan	20	38.0 cm (15.0 in.) NEW
21.	Jaeschke, Wayne	West Chester, PA	12	35.6 cm (14.0 in.) SCT
22.	Jakiel, Richard	Douglasville, GA	3	30.5 cm (12.0 in.) SCT
23.	Kardasis, Manos	Athens, Greece	5	28.0 cm (11.0 in.) SCT
24.	Kowollik, Silvia	Ludwigsburg, Germany	1	20.3 cm (8.0 in.) NEW
25.	Kraaikamp, Emil	Ruinerwold, Netherlands	4	25.4 cm (10.0 in.) SCT
26.	Llewellyn, Dan	Decatur, GA	2	35.6 cm (14.0 in.) SCT
27.	Lodigruss, Jerry	Vorhees, NJ	1	31.8 cm (12.5 in.) NEW
28.	Malinski, Piotr	Warsaw, Poland	13	20.3 cm (8.0 in.) SCT
29.	Maxson, Paul	Phoenix, AZ	96	25.4 cm (10.0 in.) DAL
30.	Melillo, Frank J.	Holtsville, NY	23	25.4 cm (10.0 in.) SCT
31.	Melka, Jim	St. Louis, MO	13	30.5 cm (12.0 in.) NEW
32.	Meriaus, Jean-Christophe	San Bruno, CA	2	28.0 cm (11.0 in.) SCT
33.	Mobberley, Martin	Suffolk, UK	2	30.5 cm (12.0 in.) NEW
34.	Morales, Efrain	Aquadilla, Puerto Rico	39	30.5 cm (12.0 in.) SCT
35.	Niechoy, Detlev	Göttingen, Germany	24	20.3 cm (8.0 in.) SCT
36.	Parker, Donald C.	Coral Gables, FL	18	40.6 cm (16.0 in.) NEW
37.	Peach, Damian	Norfolk, UK	22	35.6 cm (14.0 in.) SCT
38.	Phillips, Jim	Charleston, SC	23 1	20.3 cm (8.0 in.) REF 25.4 cm (10.0 in.) REF
39.	Phillips, Michael A.	Swift Creek, NC	3	20.3 cm (8.0 in.) SCT
40.	Prost, Jean-Pierre	Plateau de Calern, France	2	25.4 cm (10.0 in.) DAL

Table 2: 2010-11 Apparition of Saturn, Contributing Observers (Continued)

	Observer	Location	No. of Observations	Telescopes Used
41.	Rosolina, Michael	Friars Hill, WV	4	35.6 cm (14.0 in.) SCT
42.	Roussell, Carl	Hamilton, ON, Canada	2	15.2 cm (6.0 in.) REF
43.	Sabia, John D.	La Plume, PA	1	50.8 cm (20.0 in.) R-C
44.	Sanchez, Jesus	Cordoba, Spain	1	30.5 cm (12.0 in.) SCT
45.	Sharp, Ian	West Sussex, UK	1	28.0 cm (11.0 in.) SCT
46.	Smrekar, Matic	Krim, Slovenia	8	25.4 cm (10.0 in.) NEW
47.	Strackbein, Todd	Naples, FL	1	30.5 cm (12.0 in.) NEW
48.	Sussenbach, John	Houten, The Netherlands	2	28.0 cm (11.0 in.) SCT
49.	Sweetman, Michael E.	Tucson, AZ	33	10.2 cm (4.0 in.) REF
50.	Taggart, Ralph	East Lansing, MI	2	11.0 cm (4.3 in.) REF
51.	Viladrich, Christian	Paris, France	2	35.6 cm (14.0 in.) SCT
52.	Walker, Gary	Macon, GA	4	25.4 cm (10.0 in.) REF
53.	Walker, Sean	Manchester, NH	3	35.6 cm (14.0 in.) SCT
54.	Wesley, Anthony	Murrumbateman, Australia	8	36.8 cm (14.5 in.) NEW
55.	Willems, Freddy	Waipahu, HI	11	35.6 cm (14.0 in.) SCT
56.	Willinghan, James	Elk Ridge, MD	6	30.5 cm (12.0 in.) SCT
57.	Wilson, Tom	Woodstock, GA	3	25.4 cm (10.0 in.) NEW
	TOTAL OBSERVATIONS		714	
	TOTAL OBSERVERS		57	

Instrumentation Abbreviations:
NEW = Newtonian, CAS = Cassegrain, SCT = Schmidt-Cassegrain, MAK= Maksutov-Cassegrain, REF = Refractor, DAL = Dall-Kirkham, R-C = Ritchey–Chrétien

2010 as it rapidly expanded in width and eventually encircled the entire globe by late February 2011 between Saturnigraphic latitude +35° and +40°, displaying progressive morphological complexity in this region for the rest of the apparition. ALPO observers maintained an aggressive Pro-Am imaging campaign, as well as consistent visual observations, throughout the apparition significantly helping Cassini scientists track the storm as it has developed over time. The inclination of Saturn's ring system toward Earth, B, attained a maximum value of +10.3° on January 19, 2011. Although observers were able to view many of Saturn's traditional global features in both hemispheres at this ring inclination during 2010-11, it was the Northern Hemisphere of the planet and North face of the rings that were increasingly inclined toward Earth for visual observations and imaging. A summary of visual observations and digital images of Saturn contributed during the apparition are discussed, including the results of continuing efforts to image the curious bi-colored aspect and azimuthal brightness asymmetries of the rings. Accompanying the report are references, drawings, photographs, digital images, graphs, and tables.

Introduction

This report is based on an analysis of 714 visual observations, descriptive notes, and digital images contributed to the ALPO Saturn Section by 57 observers from October 31, 2010 through September 1, 2011, referred to hereinafter as the 2010-11 “observing season” or apparition of Saturn. Examples of submitted drawings and images are included with this report, integrated as much as practicable with topics discussed in the text, with times and dates all given in Universal Time (UT).

Table 1 provides geocentric data in Universal Time (UT) for the 2010-11 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 +10.3° (January 19, 2011) and +7.3° (June 8, 2011). The value of B', the saturnicentric latitude of the Sun, varied from +6.7° (October 31, 2010) to +10.9° (September 1, 2011).

Table 2 lists the 57 individuals who submitted 714 reports to the ALPO Saturn Section this apparition, along with their observing sites, number of observations, telescope aperture, and type of instrument. *Figure 1* is a histogram showing the distribution of observations by month, where it can be seen that 51.1% were made prior to opposition, 0.7% at opposition (April 4, 2011), and 48.2% thereafter. Although there usually is a tendency for observers to view Saturn more frequently around the date of opposition when the planet is well-placed high in the evening sky, coverage favored a wider span of time around opposition during the 2010-11 apparition (94.8% of all observations took place from December 2010 through late June 2011). As always, to get the best overall coverage, observers are urged to begin drawing and imaging Saturn as soon as the planet becomes visible in the eastern sky before sunrise right after conjunction. Our goal is to carry out consistent observational surveillance of the planet for as much of its mean synodic period of 378^d as possible (this period refers to the elapsed time from one conjunction of Saturn with the Sun to the next, which is slightly longer than a terrestrial year).

Figure 2 and *Figure 3* show the ALPO Saturn Section observer base and the international distribution of all observations submitted during the apparition. The United States accounted for 49.1% of the participating observers and 53.6% of the submitted observations. With 50.9% of all observers residing in Canada, China, France, Germany, Brazil, Australia, Japan, The Netherlands, Philippines, Portugal, Spain, United Kingdom, Puerto Rico, Greece, Slovenia and Poland, whose total contributions represented 46.4% of the observations, international cooperation continued to be strong this observing season.

Figure 4 graphs the number of observations this apparition by instrument type. Roughly two-fifths (41.7%) of all observations were made with telescopes of classical design (refractors, Newtonians, and Cassegrains). Classical designs with

Figure 1

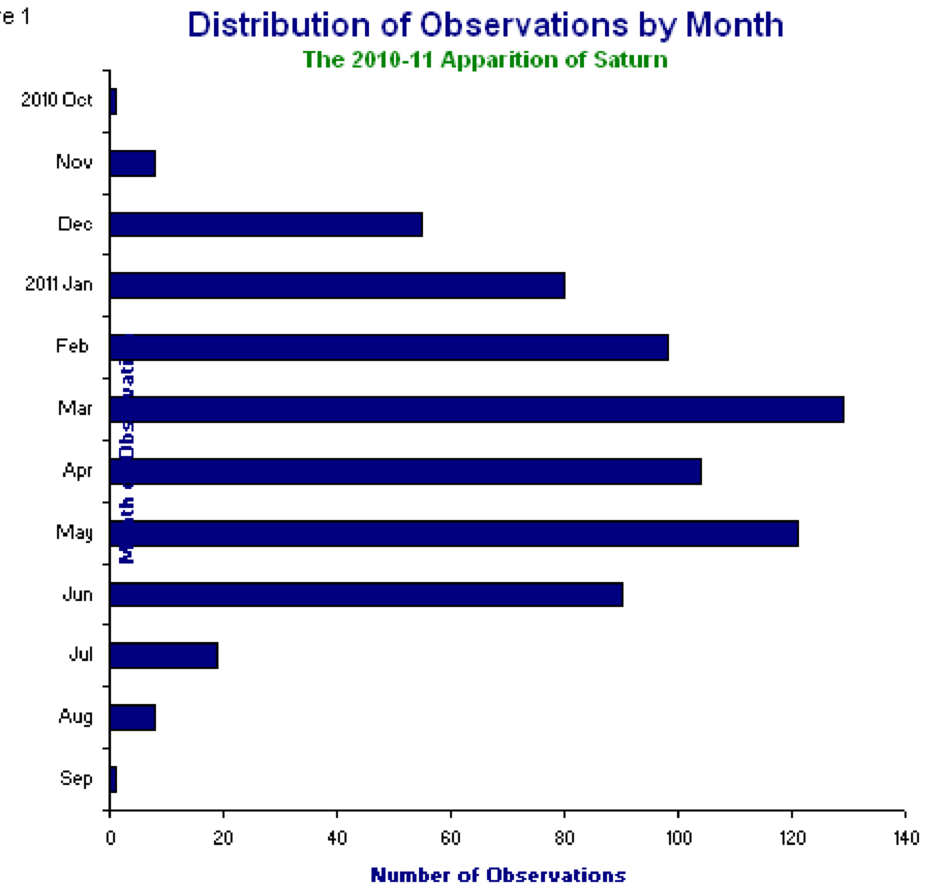


Figure 2

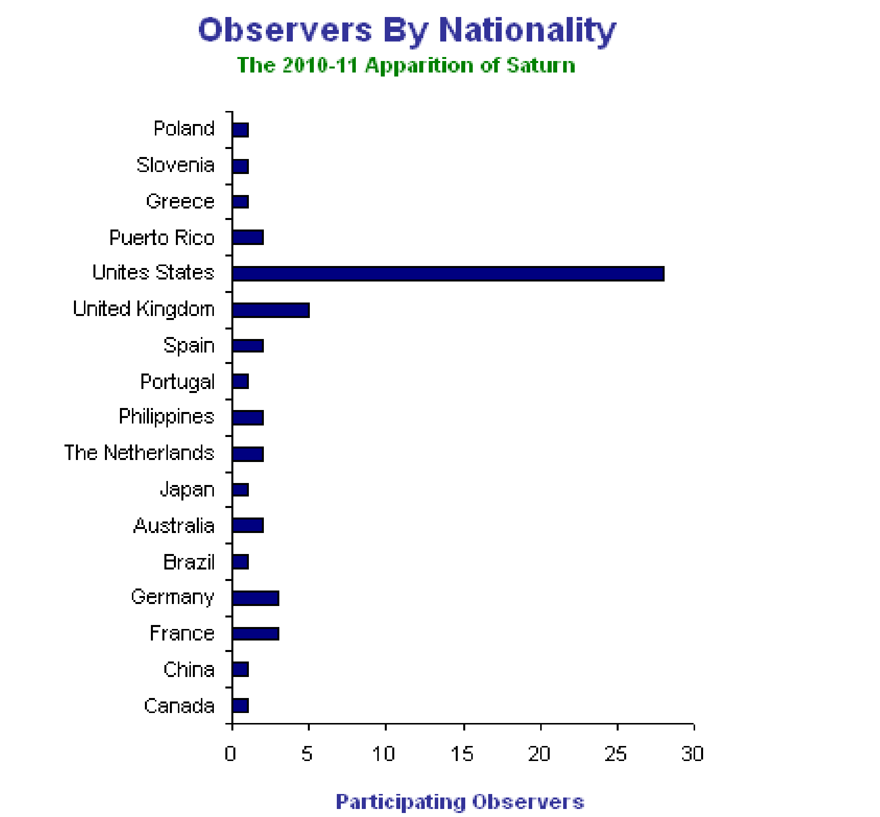


Table 3: Visual Numerical Relative Intensity Estimates and Colors for the 2010-11 Apparition of Saturn

Globe/Ring Feature	# Estimates	2010-11 Mean Intensity & Standard Error	Intensity Difference Since 2009-10	Mean Derived Color
Zones				
SPR	27	2.24 ± 0.15	-2.20	Very Dark Gray
STeZ	1	6.00 ± 0.00	+0.40	Yellowish-White
STrZ	3	5.17 ± 0.14	-1.50	Dull Yellowish-Gray
EZs	20	6.84 ± 0.07	-0.70	Light Yellowish-White
EZn	39	7.13 ± 0.06	-0.60	Bright Yellowish-White
NTrZ	34	7.07 ± 0.09	+1.20	Bright Yellowish-White
NTeZ	3	5.67 ± 0.54	-0.10	Yellowish-White
NPR	39	2.47 ± 0.09	-1.80	Dark Gray
Belts				
Globe S of Rings	36	5.40 ± 0.06	-0.70	Yellowish-Gray
SEBw (whole)	3	4.10 ± 0.17	-0.50	Grayish-Brown
NEBw (whole)	39	3.63 ± 0.06	-0.30	Dark Grayish-Brown
NTeB	3	4.50 ± 0.24	-0.20	Light Grayish-Brown
Globe N of Rings	32	5.16 ± 0.05	-0.70	Yellowish-Gray
Rings				
A (whole)	38	6.51 ± 0.04	+0.30	Dull Yellowish-White
A0 or B10	3	0.33 ± 0.27	+0.10	Grayish-Black
B (outer 1/3)	37	8.00 ± 0.00 **STD**	0.00	Brilliant White
B (inner 2/3)	36	7.47 ± 0.03	+0.70	Bright Yellowish-White
Ring C (ansae)	2	2.60 ± 1.13	—	Very Dark Gray
Sh G or R	5	0.00 ± 0.00	0.00	Black shadow
Sh R of G	3	0.67 ± 0.27	+0.70	Grayish-Black

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 2009-10" is in the same sense of the 2009-10 value subtracted from the 2010-11 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.

superb optics and precise collimation frequently produce high-resolution images with excellent contrast, a likely reason why they have often been the instruments of choice for visual studies of the Moon and planets. In recent apparitions, however, since a variety of adapters are readily available to attach digital imagers to them, employment of comparatively compact and portable Schmidt-Cassegrains and Maksutov-Cassegrains has been growing. It has been established repeatedly that such instruments outfitted with quality well-collimated optics produce very fine images of Saturn.

Telescopes with apertures of 15.2 cm (6.0 in) through 50.8 cm (20.0 in) were used for 95.0% of the observations contributed this apparition. Readers are reminded, however, that myriad historical examples abound where smaller instruments of good quality have been successfully utilized for quite a few of our Saturn observing programs. Accordingly, employment of instruments ranging from 10.2 cm (4.0 in) to 12.8 cm (5.0 in) accounted for 5.0% of the observations received in 2010-11.

The ALPO Saturn Section deeply appreciates all of the descriptive reports, digital images, visual drawings, and supporting data submitted by the observers listed in Table 2 for the 2010-11 apparition. Without such dedicated observers, this report would have been impossible. Those aspiring to join us in our numerous Saturn observing programs using visual methods (e.g., drawings, intensity and latitude estimates, CM transit timings) as well as digital imaging techniques are encouraged to do so in upcoming observing seasons as we strive to maintain the international flavor of our endeavors. All methods of recording observations are crucial to the success of our programs, whether there is a preference for sketching Saturn at the eyepiece or simply writing descriptive reports, making visual numerical relative intensity or latitude estimates, or pursuing routine digital imaging. It should be noted that, in recent years, too few experienced observers are making routine visual numerical relative intensity estimates, which are desperately needed for maintaining data that allow for a continued comparative analysis of belt, zone, and ring component brightness fluctuations over many apparitions. The Saturn Section, therefore, appeals to observers to set aside a few minutes while at the telescope to record intensity estimates (visual photometry) in integrated light and with standard color filters. The ALPO Saturn Section is always pleased to receive observations from novices, and the author will be delighted to offer assistance as one becomes acquainted with our programs.

The Globe of Saturn

The 714 observations submitted to the ALPO Saturn Section during 2010-11 were used in preparation of this report. Drawings, digital images, tables and graphs are included so readers can refer to them as they study the content of this report. For drawings or images utilized as

Figure 3

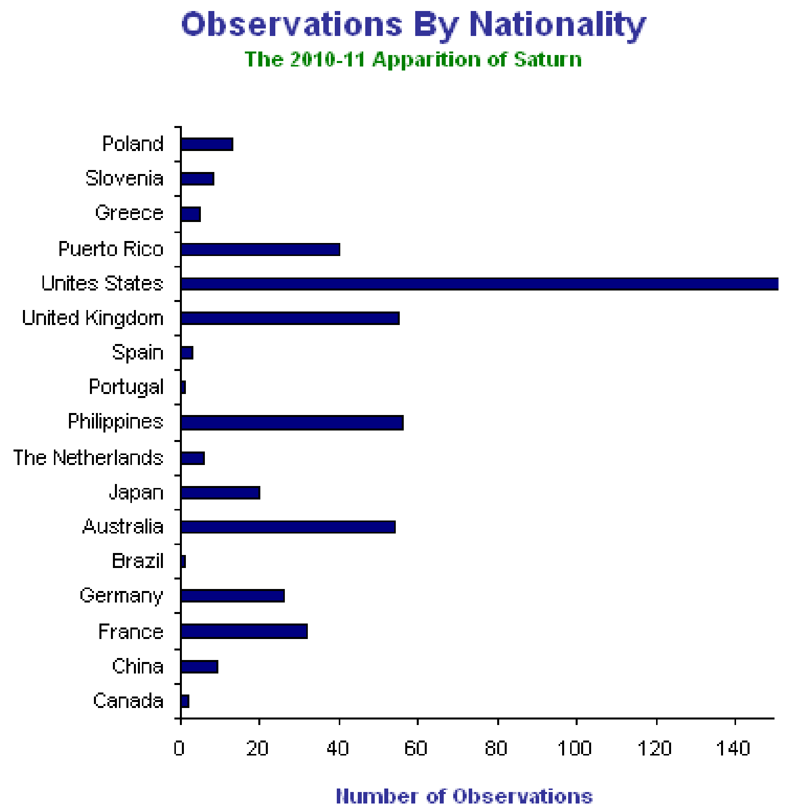
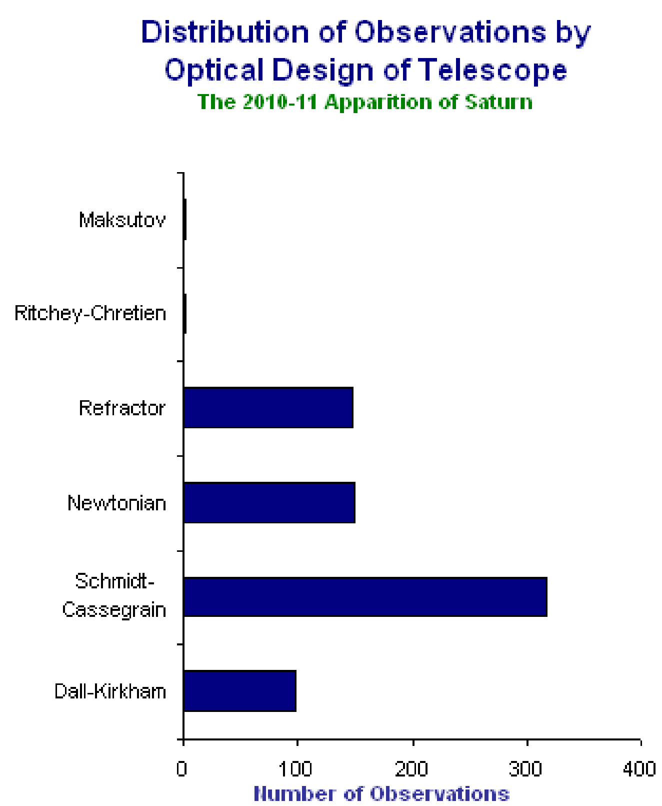


Figure 4



examples of the more notable features or phenomena occurring within Saturn's belts and zones, contributors are identified in the text along with dates and times of those specific observations for easy reference back to the relevant tables that list instrumentation employed, seeing, transparency, CM data, and so forth. In addition, captions associated with illustrations provide useful information.

With the numerical value of **B**, or the Saturnicentric latitude of the Earth referred to the ring plane attaining a maximum value of +10.3° during 2010-11, opportunities for studying regions of the planet's northern hemisphere (e.g., NEB, NTrZ, NTeZ, NPR and NPC) have steadily improved each observing season now that the Earth is north of the rings as they increase their tilt toward our line of sight. Even though features of the southern hemisphere are slowly becoming hidden from view by the rings as they cross in front of the globe, the inclination of the rings during 2010-11 was small enough to still facilitate comparison of analogous features in Saturn's northern and southern hemispheres.

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

The intensity scale routinely employed by Saturn observers is the standard *ALPO Standard Numerical Relative Intensity Scale*, where 0.0 denotes a totally black condition (e.g., complete 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 2009-10 intensity from its 2010-11 value. Suspected variances of ±0.10 mean intensity points are usually insignificant, while reported changes in intensity that do not equal or exceed

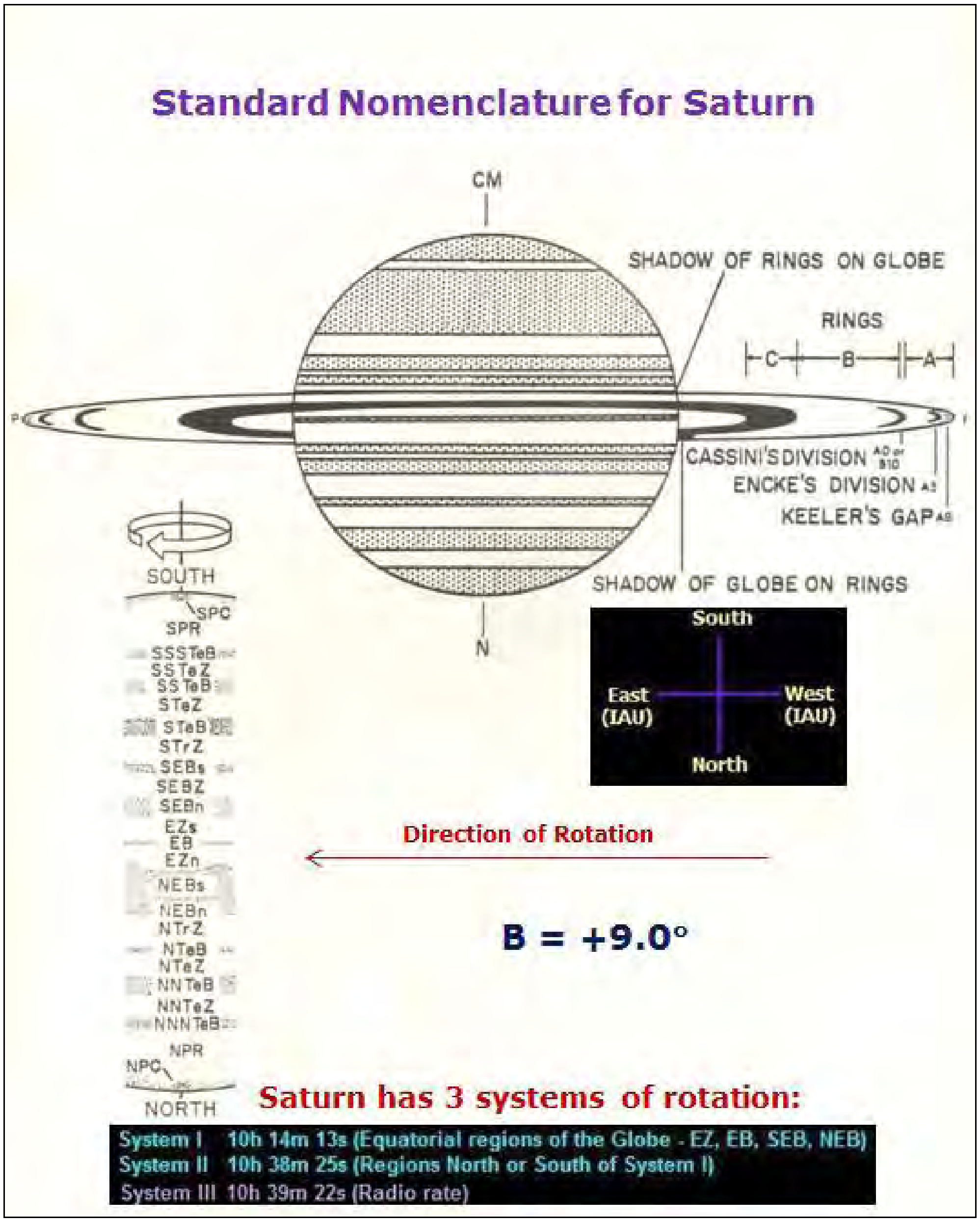


Figure 5. Saturn nomenclature, where A = Ring A, B = Band or Ring B or saturnicentric latitude of Earth, C = Ring C or Cap, E = Equatorial, f = following (celestial east), G = Globe, n = north component, N = North, p = preceding (celestial west), P = Polar, R = Ring(s) or Region, s = south component,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

roughly three times the standard error are probably not important.

It is important to evaluate digital images of Saturn contributed by ALPO observers using different apertures and filter techniques. Our goal is to understand the level of detail seen and how it compares with visual impressions of the globe and rings, including any correlation with spacecraft imaging and results from professional observatories. So, in addition to routine visual studies, such as drawings and visual numerical relative intensity estimates, Saturn observers should systematically image the planet every possible clear night to try to document individual features on the globe and in the rings, their motion and morphology (including changes in intensity and hue), to serve as comparative input 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.

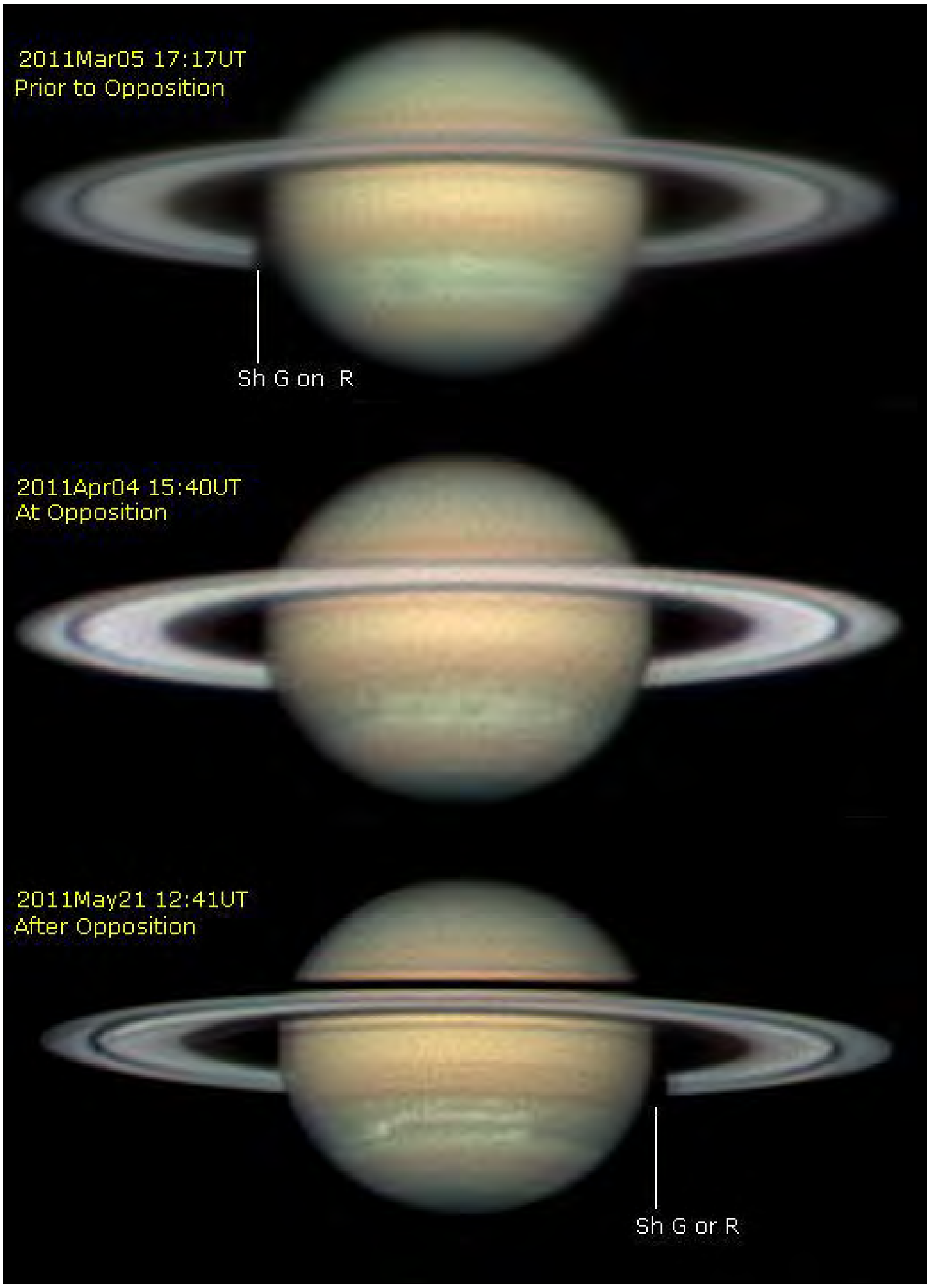


Figure 6. Three images digital images furnished by Christopher Go showing the position of the shadow of the globe on Saturn's rings on March 05, 2011 at 17:17 UT (before opposition), April 04, 2011 15:40 UT (at opposition), and May 21, 2011 at 12:41 UT (after opposition).

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 (O3), 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

***General Caption Note for Illustrations 1-42**. 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. 2011 Feb 09 18:17 UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB filters + IR blocker. S = 7.5, Tr = 4.0. CMI = 84.4°, CMII = 314.1°, CMIII = 34.8°, B = +10.1°, B´ = +8.0°. SSTeZ and SSTeB are barely visible across the globe in this image.

Illustration 002. 2011 May 10 02:08 UT. Digital image by Efrain Morales. 30.5 cm (12.0 in.) NEW with RGB filters + IR blocker. S and Tr not specified. CMI = 33.7°, CMII = 225.9°, CMIII = 197.6°, B = +7.4°, B´ = +9.3°. Small STeZ white spot is noted in this image near the W limb of the globe.

imaging Saturn in these near-IR and near-UV bands has provided some remarkable results in the past. The effects of absorption and scattering of light by the planet's atmospheric gases and clouds at various heights and with different thicknesses are often evident. Indeed, such images sometimes show differential light absorption by particles with dissimilar hues intermixed with Saturn's white NH_3 clouds.

In the forthcoming paragraphs, our discussion of features on Saturn's globe will proceed in the usual south-to-north order (normal astronomical inverted and reversed view). For clarity, the relative positions of major belts and zones can be identified by referring to the nomenclature diagram shown in Figure 5. If no reference is made to a global feature in this report, the area was not reported by observers during the 2010-11 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 so readers are aware of very subtle, but nonetheless recognizable, variations that may be occurring seasonally on the planet.

South Polar Region (SPR) — Visual numerical relative intensity estimates submitted during the 2010-11 apparition suggested that the very dark gray SPR had diminished considerably in brightness since 2009-10 (drop in mean visual intensity of -2.27). Due to the increased tilt of the southernmost limb of the globe away from our line of sight during 2010-11, only peripheral areas of the SPR were easily observable, and as one would expect, the South Polar Cap (SPC) was not reported by observers during the observing season. No drawings by visual observers or digital images revealed discrete activity in the SPR during the apparition. The normally dark gray South Polar Belt (SPB) encircling the SPR was not reported by visual observers during the apparition nor was it apparent on digital images received.

Illustration 003. 2011 Feb 11 03:53 UT. Digital image by Jesús Sánchez. 30.5 cm (12.0 in.) SCT with RGB filters S and Tr not specified. CMI = 186.6°, CMII = 11.1°, CMIII = 90.1°, B = +10.0°, B´ = +8.0°. Dusky STeB is visible crossing the globe of Saturn.

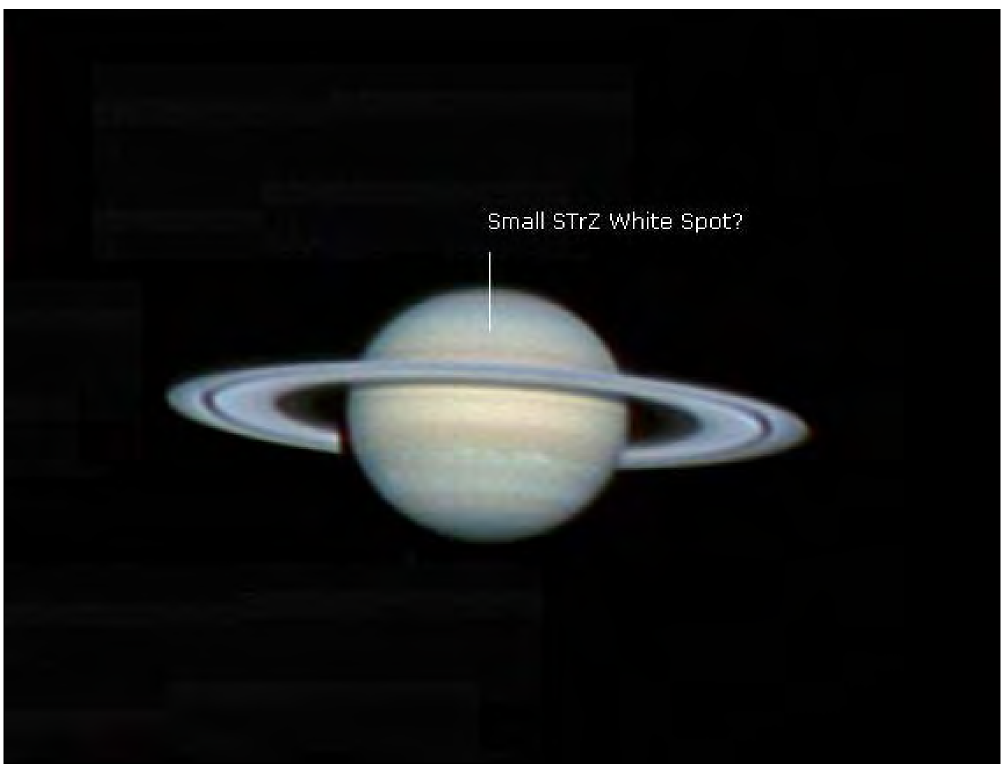


Illustration 004. 2011 Mar 12 14:42 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 7.5, Tr not specified. CMI = 214.6°, CMII = 167.8°, CMIII = 211.3°, B = +9.2°, B´ = +8.4°. Extremely small, compact white spot appears in the STrZ near CM.

South South Temperate Zone (SSTeZ) — The SSTeZ was not reported by visual observers during this observing season, thus no visual numerical relative intensity estimates were contributed. The SSTeZ was, however, barely perceptible on some of the best digital images submitted in 2010-11 [refer to Illustration No. 001].

South South Temperate Belt (SSTeB) — The SSTeB, typically light gray in appearance, was not described by contributing observers during 2010-11, although it could be seen as a rather ill-defined narrow belt, devoid of any activity, on a few high-resolution digital images [refer to Illustration No. 001].

South Temperate Zone (STeZ) — The yellowish-white STeZ was reported only once by a visual observer making visual numerical relative intensity estimates in 2010-11, but it was readily apparent on most digital images submitted. Although comparative intensity data between apparitions in Table 3 notes that the STeZ may have been slightly brighter by a mean factor of +0.40 since 2009-10, little confidence should be placed in very limited data. The STeZ was uniform in intensity across the globe of Saturn, and aside from an image by Efrain Morales of a very small white spot at 02:08 UT on May 10, 2011 [refer to Illustration No. 002], no similar activity was reported by other observers in this region.

South Temperate Belt (STeB) — Despite the appearance of a light grayish-brown STeB on many of the images submitted during 2010-11, visual observers did not call attention to this feature or make visual numerical relative intensity estimates during the apparition. High-resolution digital images showed this dusky feature during the apparition as devoid of discrete activity [refer to Illustration No. 003].

South Tropical Zone (STrZ) — Visual observers seldom reported the dull yellowish-white STrZ during the 2010-11, with limited visual numerical relative intensity estimates suggesting a possible darkening of this feature by -1.50 in mean intensity since 2009-10. On March 12, 2011 at 14:42 UT, Trevor Barry imaged what appeared to be an extremely small and rather compact white spot in the STrZ [refer to Illustration No. 004]. He also furnished similar images, all in reasonably good seeing, of what presumably was the same feature looking perhaps a little more ill-defined and diffuse at 14:00 UT on April 4th [refer to Illustration No. 005] and at 11:30UT on April 12th [refer to Illustration No. 006]. On April 30th at 02:56 UT, Brian Combs imaged the recurring STrZ white spot near the CM [refer to Illustration No. 007], while a few weeks later on May 22nd at 03:16 UT Jim Melka captured what eventually became the final image of the STrZ white spot contributed to the ALPO Saturn Section during 2010-11 [refer to Illustration No. 008].

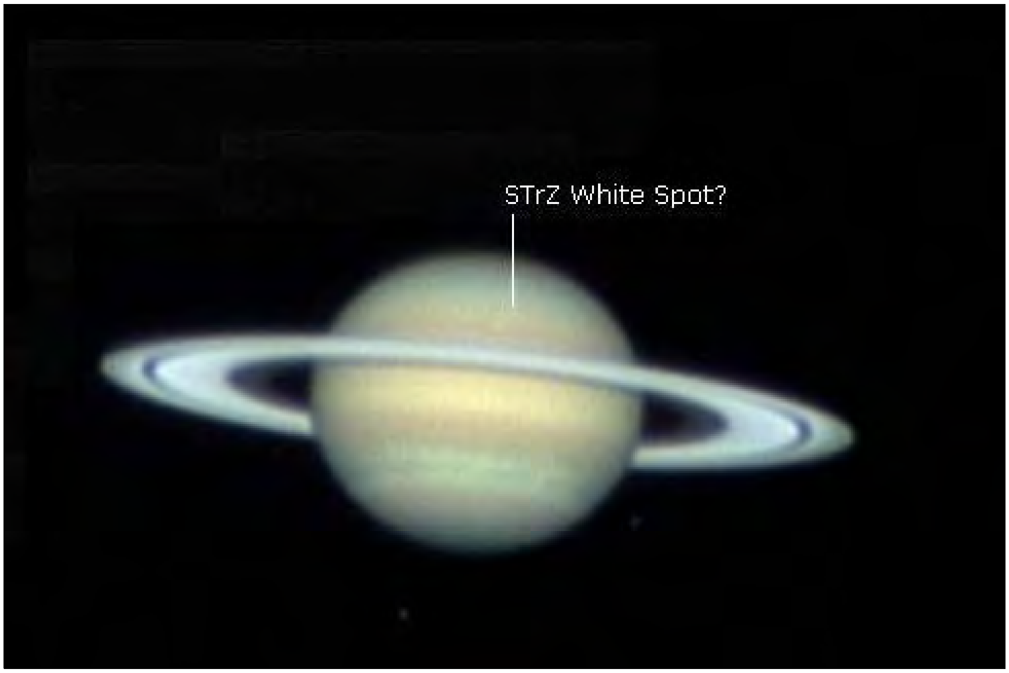


Illustration 005. 2011 Apr 04 14:00 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.5, Tr not specified. CMI = 170.8°, CMII = 102.0°, CMIII = 117.8°, B = +8.5°, B´ = +8.8°. Very small, faint white spot in the STrZ sighted in mid-March is still apparent near CM.

Illustration 006. 2011 Apr 12 11:30 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.5, Tr not specified. CMI = 357.7°, CMII = 33.9°, CMIII = 40.2°, B = +8.2°, B´ = +8.9°. The recurring small white spot, looking a bit more ill-defined, remains visible in the STrZ near W limb.

South Equatorial Belt (SEB) — The grayish-brown SEB was obvious on many of the full-disk drawings submitted by visual observers and on most digital images, but visual numerical relative intensity estimates were too few to offer much assurance that the comparative difference of -0.5 in mean intensity from 2009-10 to 2010-11 could mean that the SEB had slightly darkened. In looking at drawings and images of Saturn during 2010-11, what observers were actually reporting as the SEB was indeed the SEBs, because where the rings crossed in front of the globe, the SEBn was hidden from our view, giving the impression that the SEB this apparition was not subdivided into SEBn and SEBs components with the SEBZ in between (where “n” refers to the North Component and “s” to the South Component) [refer to Illustration No. 009]. Recurring visual accounts of suspected dusky markings within the SEB (or should we say the SEBs) were received sporadically during the 2010-11 observing season, but they all turned out to be ill-defined, transient features.

Equatorial Zone (EZ) — With the numerical value of **B** ranging between +7.3° and +10.3° this apparition, the small ring inclination to our line of sight, the southern and northern portions of the Equatorial Zone (i.e., the EZs and EZn, respectively), could still be seen and imaged to reasonable advantage. Based on intensity estimates and digital imaging, the northern half of the bright yellowish-white Equatorial Zone (EZn) did not seem quite as prominent in 2010-11 than in the previous observing season (dimmer by a mean intensity factor of -0.6). The EZn was the brightest zone on Saturn's globe and perhaps a little lighter by +0.29 mean intensity points than the EZs, while the light yellowish-white EZs showed a slight decrease in visual numerical relative intensity since 2009-10 by a factor of -0.7 [refer to Illustration No. 010]. There were no specific reports of white spot activity in the EZs or EZn during the observing season, but there were vague suspicions faint festoon activity in the EZn. Visual numerical relative intensity estimates of the very narrow Equatorial Band (EB) were lacking during 2010-11, but it was apparent on several drawings at visual wavelengths and quite obvious on many of the digital images submitted during the observing season. [refer to Illustration No. 011].

Illustration 007. 2011 Apr 30 02:56 UT. Digital image by Brian Combs. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S and Tr not specified. CMI = 134.5°, CMII = 320.8°, CMIII = 305.8°, B = +7.7°, B´ = +9.1°. In this superb detailed large-scale image, the small STrZ white spot is near the CM.

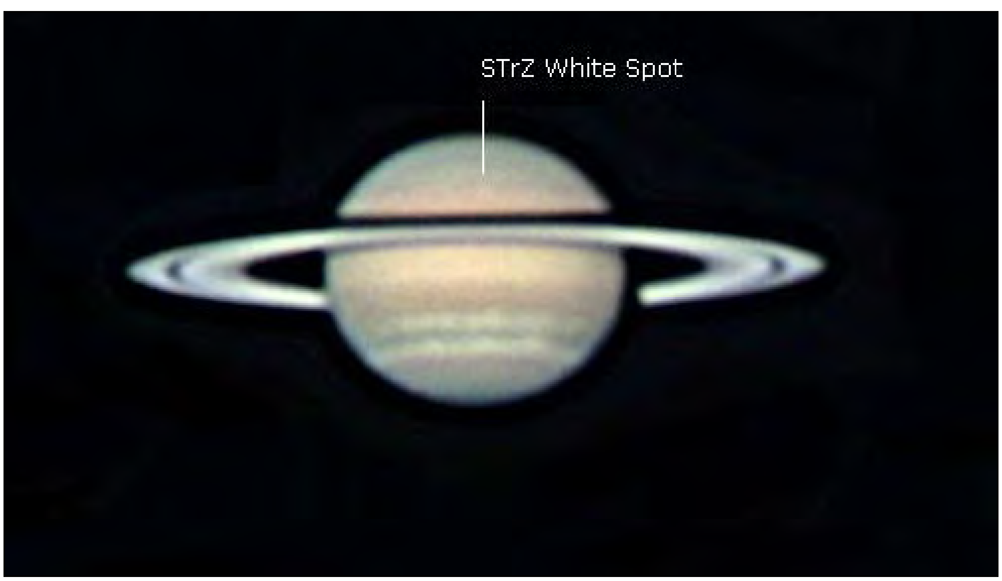


Illustration 008. 2011 May 22 03:16 UT. Digital image by Jim Melka. 30.5 cm (12.0 in.) NEW and RGB filters. S = 4.0, Tr = 4.0. CMI = 0.7°, CMII = 196.1°, CMIII = 154.5°, B = +7.3°, B´ = +9.4°. The STrZ white spot appears more diffuse approaching the CM; considerable detail in the NTrZ white storm is apparent.

North Equatorial Belt (NEB) — The dark grayish-brown NEB was reported by visual observers much of the apparition. A very limited number of visual observers in 2010-11 described the NEB as being differentiated into the NEBs and NEBn with the NEBZ situated in between, but there were no accompanying separate visual numerical relative intensity estimates provided for these areas. For example, see the drawing made in variable seeing by Paul G. Abel on April 8, 2011 at 23:19 UT, showing the NEBs, NEBn and what seemed to the observer as a darker shading present in the NEBZ. He originally thought dark feature might be a contrast effect in poor seeing, but since it appeared to move as Saturn rotated during the observing session, the impression was that it was real [refer to Illustration No. 012]. The overwhelming consensus visually was that the NEB appeared singular during the observing season, although it often exhibited a steady lighter-to-darker northward gradation in intensity across its width, consistent with its form on most digital images. Visual numerical relative intensity estimates of the NEBw (i.e., the NEB considered as a whole) in 2010-11 suggested it was slightly darker than in 2009-10 (difference between apparitions of -0.30). It was also a little darker than the SEBw by -0.47 mean intensity points by visual accounts, essentially the same as its appearance on most digital images at visual wavelengths.

North Tropical Zone (NTrZ) and the Great White NTrZ Storm of 2010-11 — Visual observers described a bright yellowish white NTrZ that seemed much brighter overall in 2010-11 by a factor of +1.24 in mean intensity since 2009-10, and it was quite apparent on images captured in good seeing conditions throughout the observing season. Noteworthy above all else on Saturn's globe during 2010-11 was the unexpected appearance and swift development of a brilliant white spot in the NTrZ. The feature was initially detected by the radio and plasma wave instrument aboard Cassini on December 5, 2010 as an SED (Saturn Electrostatic Discharge) caused by atmospheric lightning flashes. Subsequent spacecraft images revealed a bright white storm emerging at Saturnigraphic latitude +35°, spanning 1,300km (800 m) North to South in latitude and 2,500km (1,600 m) East to West in longitude. The Cassini team issued an appeal to amateur astronomers worldwide to collect as many images as possible of this brilliant feature, and right away observers responded.

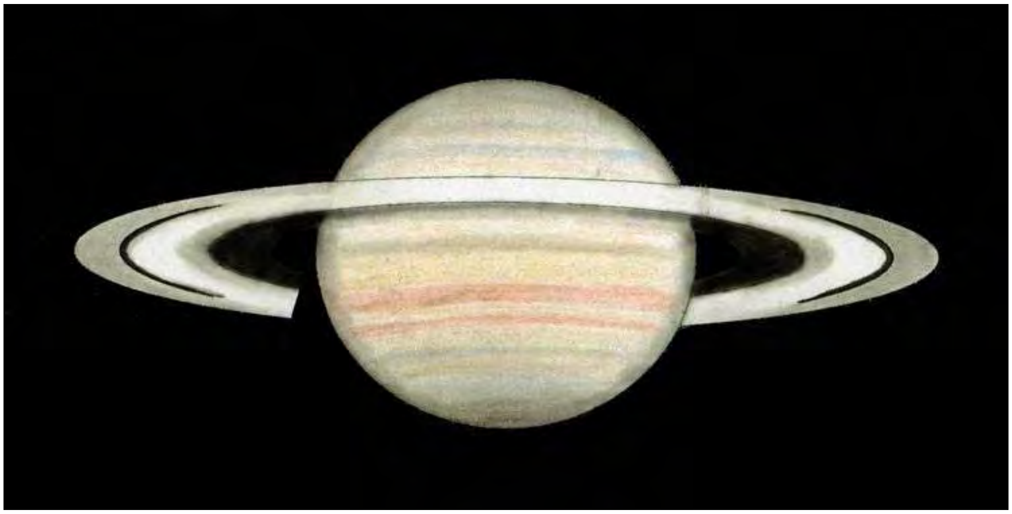


Illustration 009. 2011 Jan 09 06:44 UT. Excellent detailed drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 167 to 250X. S = 6.0, Tr = 5.0 (interpolated). CMI = 142.5°, CMII = 309.2°, CMIII = 67.9°, B = +10.1°, B´ = +7.6°. The dull SEBs is seen across the disk of Saturn just south of the rings.

Illustration 010. 2011 Feb19 09:58 UT. Digital image by Gary Walker. 36.8 cm (14.5 in.) NEW and green filter. S = 5.5, Tr = 4.5. CMI = 315.8°, CMII = 233.6°, CMIII = 302.7°, B = +9.8°, B´ = +8.1°. The EZn is slightly brighter than the EZs (just south of EB) in this image.

The first image submitted to the ALPO Saturn Section came from Anthony Wesley on December 10th at 18:01 UT, clearly showing a slightly elongated dazzling NTrZ bright white spot near the CM [refer to Illustration No. 013]. Myriad images started pouring in almost daily from ALPO and other observers worldwide, helping Cassini scientists in an aggressive Pro-Am (professional-amateur) observing campaign throughout 2010-11 to track the storm as it developed over time between Saturnigraphic latitude +35° and +40°. Images by Saturn observers vividly revealed that, by December 24th, the storm had grown to 10,000 km (6,000 m) in width (in latitude) and had extended nearly a third of the way around the globe of the planet, a distance of 100,000 km (62,000 m) longitudinally [refer to Illustrations No. 014 and No. 015]. As observational coverage persisted into January 2011, the rapidly developing storm had enlarged in latitudinal extent to some 15,000 km (9,000 m) at about +43° and by early February, the feature's “tail” had longitudinally nearly encircled the entire planet [refer to Illustrations No. 016 and No. 017]. As the 2010-11 apparition continued beyond early March, a steady flood of excellent images confirmed that the massive NTrZ storm was evolving toward significant morphological complexity analogous to features so common on Jupiter [refer to Illustrations No. 018 thru No. 020]. Imaging at different wavelengths also helped illustrate corresponding variability in the appearance of the NTrZ storm. Consider for example images taken by Trevor Barry on January 28th at RGB and IR wavelengths from 17:04 UT and 17:09 UT [refer to Illustration No. 021], as well as those by Don Parker on February 22nd between 07:56 UT to 08:18 UT at visual wavelengths as opposed to those captured employing UV and near-IR filters [refer to Illustration No. 022]. Interestingly, contrary to many of the previous similar storms on Saturn, the NTrZ white outburst in 2010-11 was brighter in visible wavelengths than in the near IR. Drawings contributed by visual observers throughout the 2010-11 apparition also established that the NTrZ white storm was quite noticeable with moderate apertures in integrated light and with various color filters and variable density polarizers [refer to Illustration No. 023].

White spots like the NTrZ storm of 2010-11 originate as columns of material suddenly emerge through the upper NH_3-ice cloud layer, then start spreading out quite dramatically in latitude and longitude. Over time, darker substances upwelling from greater depths within Saturn's atmosphere start to intermix with lighter material creating complex eddies, as seen in many of the images from Cassini as well as those contributed by ALPO observers this apparition [refer to Illustrations No. 024 thru No. 032]. The Great White NTrZ Storm of 2010-11, as it should be fittingly described, was at least several hundred times larger than white spots seen by Cassini and reported by ALPO observers in the STrZ during 2009-10.

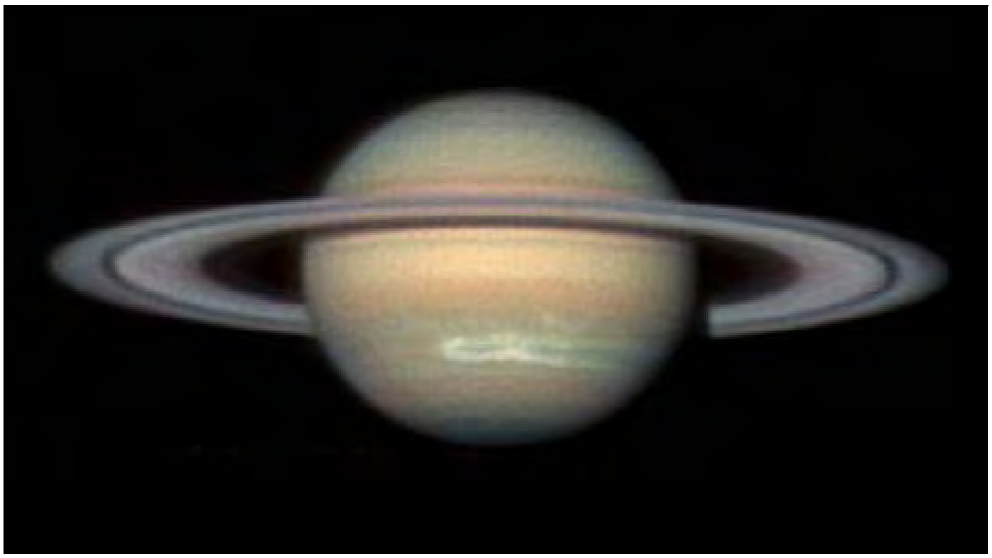


Illustration 011. 2011 Mar 02 17:11 UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 8.0, Tr = 4.0. CMI = 242.0°, CMII = 318.1°, CMIII = 36.0°, B = +2.1°, B´ = +3.6°. The narrow EB is readily visible across the globe of Saturn.

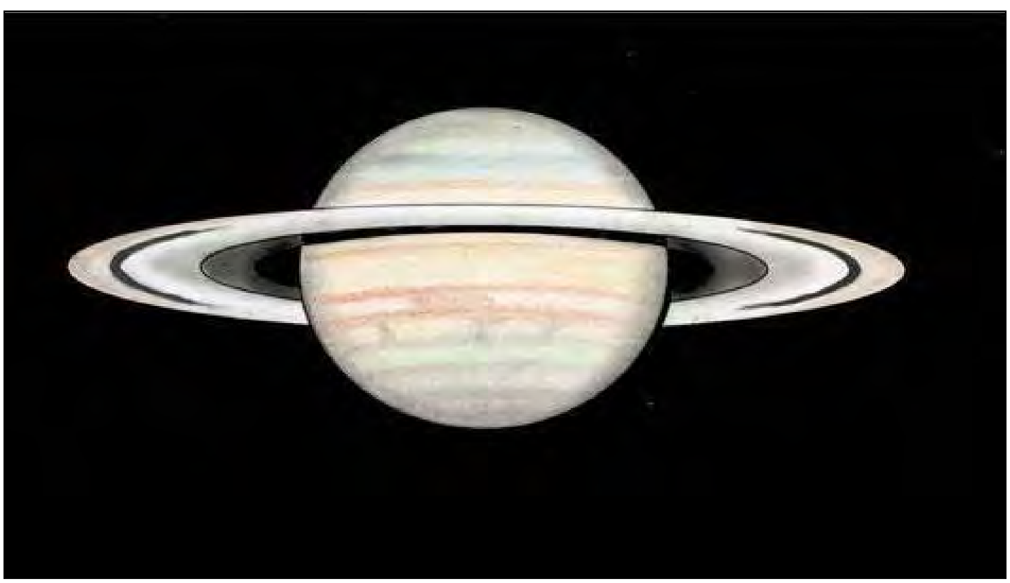


Illustration 012. 2011 Apr 08 23:19 UT. Detailed sketch by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 200X. S = 6.0, Tr = 4.0 (interpolated). CMI = 276.0°, CMII = 65.5°, CMIII = 76.0°, B = +8.3°, B´ = +8.8°. The NEBs and NEBn components, including an elongated dusky shading within the NEBZ, are obvious in this image.

Readers should note that, prior to the edgewise presentation of the rings in late 2009, the Sun had been south of the ring plane and shining on the planet's southern hemisphere. As a result, storm activity had been reported in the STrZ around Saturnigraphic latitude -35°, the region often referred as “storm alley” by Cassini scientists. During 2010-11 apparition, with the Sun then situated north of the plane of the rings, spring had begun in Saturn's northern hemisphere, and the emergence of the NTrZ storm at Saturnigraphic latitude +35° fittingly illustrates how changing seasons and varying insolation can effectively awaken weather systems on Saturn. Also, the varying position of the shadow of the rings on the globe apparently contributes to a seasonal effect. Professional astronomers are still trying to understand why Saturn builds up energy for decades, then seems to release it all at once, unlike Jupiter which has ongoing storm activity most of the time.

North Temperate Belt (NTeB) — The light grayish-brown NTeB was reported only occasionally by visual observers during 2010-11 without any noticeable activity. In visual numerical intensity, it was perhaps slightly dimmer than in 2009-10 by -0.2 mean intensity points. The NTeB was captured on many digital images contributed during the observing season, but there were no discrete phenomena detected in this belt on images submitted this apparition [refer to Illustration No. 033].

North Temperate Zone (NTeZ) — This yellowish-white zone was seldom reported by visual observers throughout 2010-11, relatively unchanged in mean intensity since the immediately preceding apparition (comparable difference of -0.10 is not generally considered noteworthy). Digital images showed this zone generally devoid of discrete phenomena during the apparition [refer to Illustration No. 034].

North North Temperate Belt (NNTeB) — The dull gray NNTeB was difficult to detect even on the best images taken in good seeing conditions in 2010-11 and visual observers did not report it.

North North Temperate Zone (NNTeZ) — During 2010-11, the usually dull yellowish-gray NNTeZ was not reported visually but was barely perceptible on the best images taken with larger apertures during the observing season [refer to Illustration No. 035].

North North North Temperate Belt (NNNTeB) — A light gray NNNTeB was not reported visually in 2010-11 but was sometimes evident on the sharpest images contributed during the apparition.

North Polar Region (NPR) — The dark gray NPR was frequently reported by visual observers and evident on digital images contributed during the 2010-11 apparition, appreciably darker by a mean intensity difference of -1.80 since 2009-10, and devoid of any recognizable activity. The NPR may have been marginally lighter by +0.20 in mean intensity than its Southern counterpart, the SPR. Although visual observers did not report the NPB (North Polar Belt) in 2010-11, this narrow feature was usually recognizable on higher-definition images [refer to Illustration No. 035].

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 2010-11. Any apparent variation of this shadow from a totally black intensity (0.0) during a given observing season is purely a consequence of bad seeing conditions or the presence of extraneous light. Digital images revealed this feature as completely black.

Illustration 013. 2010 Dec 10 18:01 UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW and RGB filters. S and Tr not specified. CMI = 49.7°, CMII = 90.2°, CMIII = 244.6°, B = +9.5°, B´ = +7.1°. First image submitted to the ALPO of the brilliant, slightly elongated and evolving NTrZ white spot.

Readers are reminded that the globe of Saturn casts a shadow on the ring system to the left (IAU East) prior to opposition, to the right (IAU West) after opposition, and on neither side precisely at opposition (no shadow) as illustrated in Figure 6 showing digital images furnished by Christopher Go on March 5, 2011 at 17:17 UT (before opposition), April 4, 2011 at 15:40 UT (at opposition), and May 21, 2011 at 12:41 UT (after opposition).

Latitude Estimates of Features on the Globe — Observers did not submit latitude estimates of features on Saturn's globe during 2010-11. Readers are encouraged to try the simple visual technique developed by Walter Haas over 60 years ago to estimate latitudes, which 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

The discussion in this section pertains to visual studies of Saturn's ring system with the usual comparison of mean intensity data between apparitions, as well as interpretations of digital images of the rings contributed during 2010-11. With the ring tilt toward Earth in 2010-11 increasing to as much as +10.6°, the major ring components were easier for observers to see and image effectively than in the last couple of apparitions (recall that the rings were edgewise to Earth in late 2009).

As the rings continue to open up over the next several years, more and more of the northern hemisphere of Saturn's globe and details in the north face of the rings will be seen to much greater advantage.

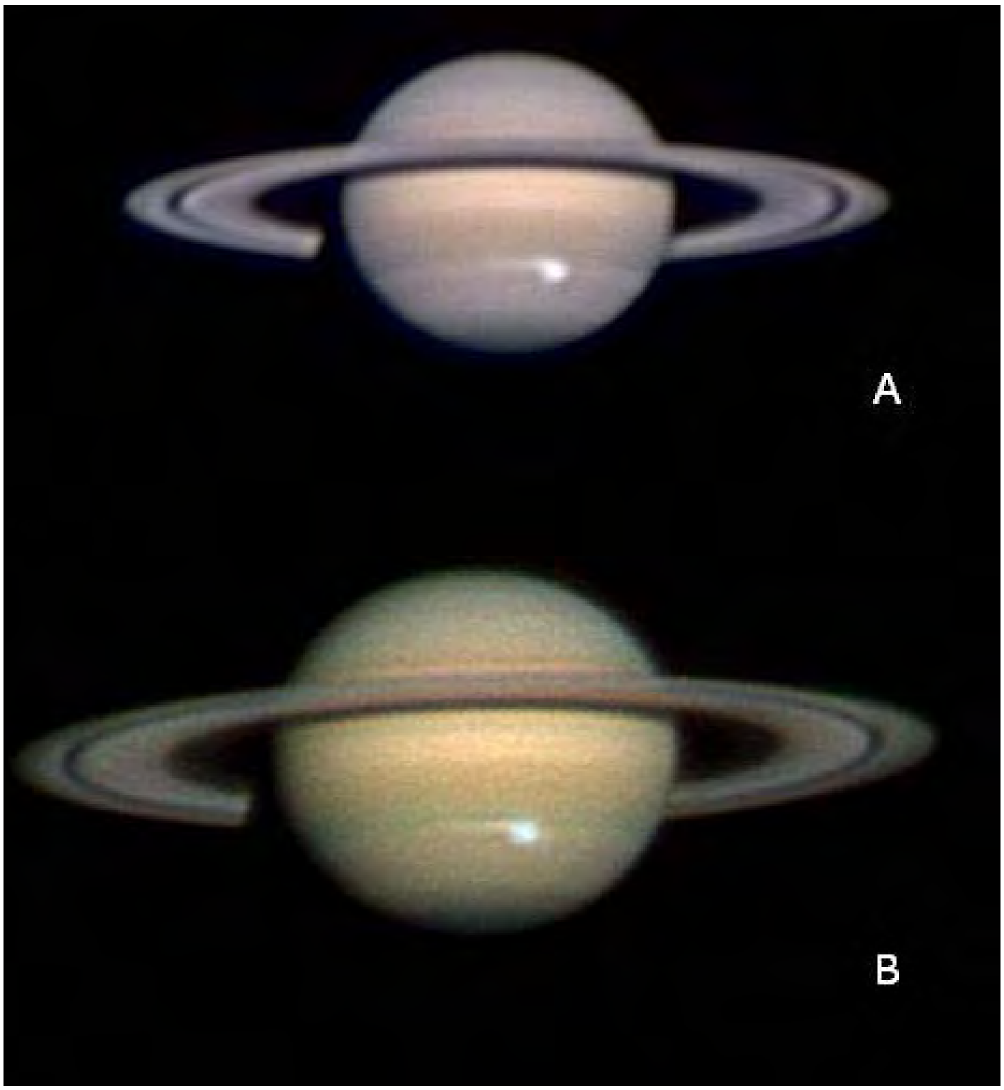


Illustration 014. Simultaneous Observations
2010 Dec 13 20:32 UT Digital image by Tomio Akutsu. 35.6 cm (14.0 in.) SCT with RGB filters. S = 6.5, Tr = 4.0. CMI = 151.1°, CMII = 91.4°, CMIII = 242.0°, B = +9.6°, B´ = +7.2°.
2010 Dec 13 20:39 UT Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 8.0, Tr = 3.0. CMI = 155.2°, CMII = 95.3°, CMIII = 245.9°, B = +9.6°, B´ = +7.2°.
In both images, the developing bright NTrZ white storm is approaching the CM in these simultaneous observations

Ring A — The majority of visual observers agreed that the dull yellowish-white Ring A, taken as a whole, appeared only very slightly brighter in 2010-11 than in 2009-10 based on visual numerical relative intensity estimates (difference of +0.30 mean intensity points). Visual observers usually described Ring A as being rather homogeneous rather than being subdivided into inner and outer halves.

Most digital images of Saturn in 2010-11, however, depicted inner and outer halves of Ring A, with the inner half slightly brighter than the outer half, especially at red wavelengths. Visual observers occasionally reported the very dark gray Encke's division (A5) in 2010-11 when the rings were near their maximum tilt but offered no visual numerical relative intensity estimates, while a few of the best images occasionally revealed A5 near the ansae. There were hints of Keeler's gap (A8) on some images in a few instances, but it was not described by visual observers [refer to Illustrations No. 035 and No. 036].

Ring B — The outer third of Ring B is the conventional 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 apparition, visual observers reported that the outer third of Ring B appeared brilliant white with no variation in intensity, and when 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 (which was described as bright yellowish-white and uniform in intensity) displayed a slightly lighter intensity by a factor of +0.7 than in the immediately preceding observing season. Digital images confirmed most visual impressions during 2010-11 [refer to Illustration No. 035 and No. 036].

Of interest when SEDs occur on Saturn, such as the NTrZ storm in 2010-11 or

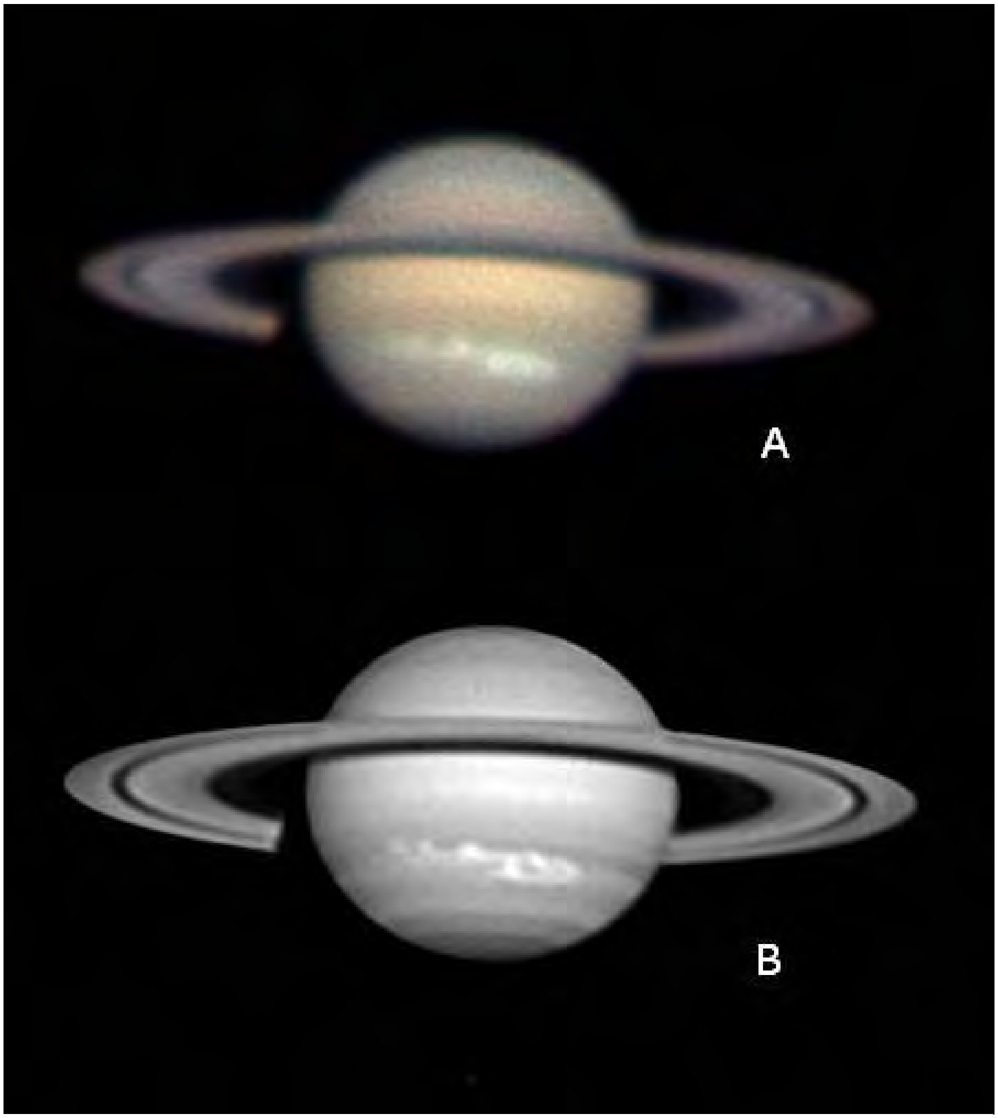


Illustration 015. Simultaneous Observations
2010 Dec 30 18:33 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 4.5, Tr not specified. CMI = 34.8°, CMII = 148.6°, CMIII = 278.8°, B = +10.0°, B´ = +7.4°.
2010 Dec 20 18:33 UT Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW Red filter. S and Tr not specified. CMI = 34.8°, CMII = 148.6°, CMIII = 278.8°, B = +10.0°, B´ = +7.4°.
In these simultaneous observations, the brilliant NTrZ white storm has grown considerably in width and now extends nearly 1/3 the distance around the globe.

the STrZ outburst back in 2009-10, is the conjectured linkage between these lightning storms and the appearance of Ring B spokes. Given that the diminutive ring particles (likely in the range of a few microns (?) or so) are apparently electrostatically levitated above the ring plane within Saturn's magnetic field, it would indeed be interesting to see how their appearance and duration are connected to atmospheric SEDs. With a higher percentage of individuals imaging the planet with larger apertures, it is suggested that observers fine-tune their efforts to see what results can be obtained.

Comparing visual impressions with images taken of the spokes can also be useful as a comparative exercise. Records of how the spokes vary in appearance, duration, and prominence with position of the SEDs on the globe as it rotates is valuable in trying to understand whatever correlation exists between the two phenomena. In short, this seems to be a project worthy of pursuing, and there is no better time to become watchful for Ring B spokes at the time prominent outbursts occur and are most active.

During 2010-11, there were times when visual observers vaguely suspected spoke-like features near the ansae in Ring B. For example, a drawing submitted by Paul G. Abel on March 11, 2011 at 01:18 UT showed what appeared to be spokes in Ring B at the E ansa [refer to Illustration No. 017A], while at least one observer, Marc Delcroix, believed he might have captured such features on an image in moderate seeing on March 7, 2011 at 03:18 UT in the near IR (610nm) [refer to Illustration No. 037].

Cassini's Division (A0 or B10) — Cassini's division (A0 or B10) was frequently reported by visual observers in 2010-11 (but with only a handful of intensity estimates). It was described as a grayish-black gap at both ansae, but still not completely traceable all the way around Saturn's ring system by visual observers due to the smaller numerical value of B this apparition. This was also true for most of the high-resolution images submitted.

While a black Cassini's division was usually apparent on many of the digital images received during the 2010-11 observing season, a deviation from a totally black intensity for Cassini's Division was a consequence of bad seeing, scattered light, or insufficient aperture. The general visibility of major ring divisions and other intensity minima across the breadth of the northern face of the rings was not favorable this apparition with the small ring tilt [refer to Illustration No. 038].

Ring C — The very dark gray Ring C was often apparent during 2010-11 at the ansae on most digital images, and

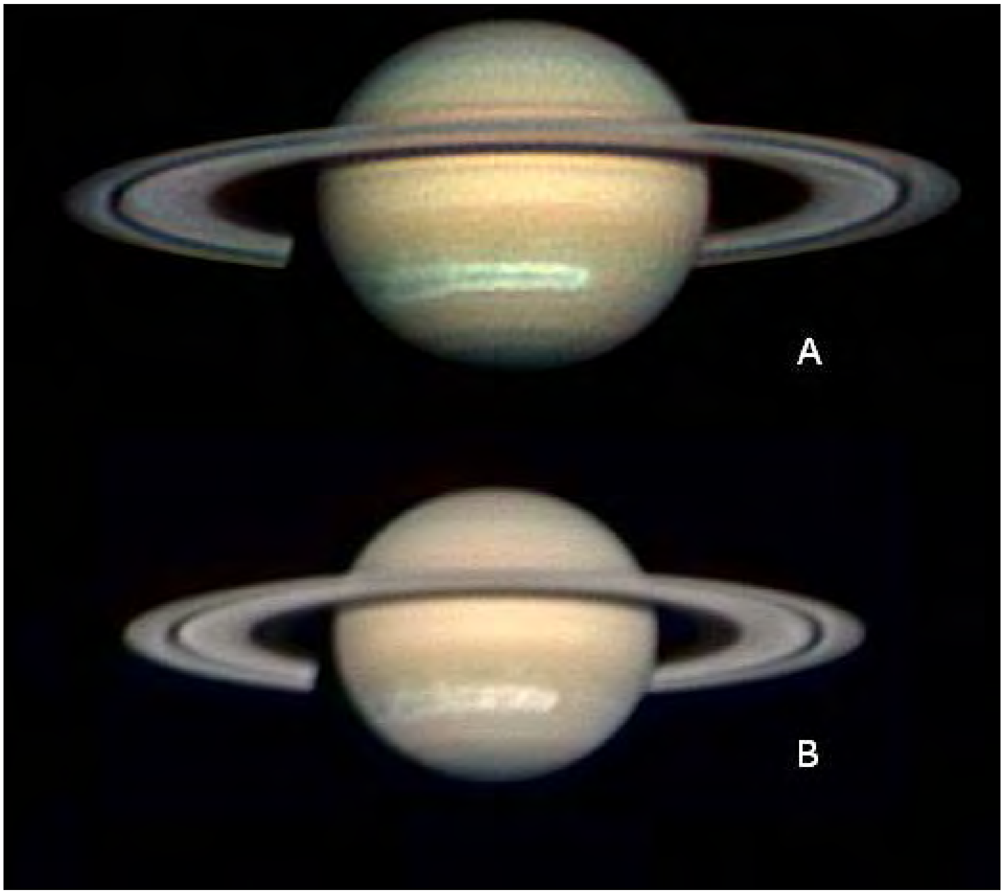


Illustration 016. Simultaneous Observations
2011 Feb 05 18:17 UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 7.5, Tr = 4.0. CMI = 306.9°, CMII = 305.8°, CMIII = 31.4°, B = +10.0°, B´ = +7.9°.
2011 Feb 05 18:19 UT. Digital image by Tomio AkutUTsu. 35.6 cm (14.0 in.) SCT with RGB filters. S = 7.0, Tr = 3.0. CMI = 308.1°, CMII = 306.9°, CMIII = 32.5°, B = +10.0°, B´ = +7.9°.
The NTrZ white storm has spread o UT longitudinally until it nearly encircles the globe of Saturn in these two simultaneous observations.

quite a few visual observers described it but rarely made visual numerical relative intensity estimates. The Crape Band (merely Ring C in front of the globe of Saturn) was reported by visual observers and appeared very dark gray in color and uniform in intensity, and it was generally visible on digital images [refer to Illustration No. 038]. Although mentioned in several visual reports, and noticeable in a number of digital images, observers did not offer intensity estimates of the Crape Band during the observing season.

Opposition Effect — The Seeliger "opposition effect" was reported by several observers on opposition date (April 4, 2011), which is a perceptible brightening of Saturn's ring system during a very short interval on either side of opposition, typically when the phase angle between Sun, Saturn and the Earth is less than about 0.3°. This ring brightening is caused by coherent back-scattering of sunlight by the µ-sized icy particles that make up the rings, which do so far more efficiently than the particles of Saturn's atmosphere. Damian Peach was among several observers whose images depicted this brightening of the rings during 2010-11, exemplified in his image four days after opposition on April 8, 2011 at 23:47 UT [refer to Illustration No. 038].

Shadow of the Rings on the Globe (Sh R on G) — This shadow in 2010-11 was almost always described as a completely black feature where the rings crossed Saturn's globe. Those very few instances when the shadow appeared as grayish-black, a departure from an overall black (0.0) intensity, occurred for the same reason as previously noted in our discussion regarding the Sh G on R. When **B** and **B'** are both positive, and the value of **B** is greater than that of **B'**, the ring shadow is to the north of the projected rings, which happened prior to March 31, 2011 [refer to Illustration No. 039]. When **B** and **B'** are both positive, and the value of **B** is less than of **B'**, the shadow of the rings on the globe is cast to their south, circumstances that occurred starting about April 1, 2011 through September 11, 2011 (the final observation received for the apparition) [refer to Illustration No. 040], and the Crape Band then is seen south of the projected Rings A and B.

At times when the shadows of Ring A, Ring B and Ring C projection are superimposed, it is often very troublesome to distinguish between them in ordinary apertures and seeing conditions, and the shadow of Ring C is a further complication.

Terby White Spot (TWS) — The TWS is an apparent brightening of the rings immediately adjacent to the Sh G on R. There were only a few instances when this feature was reported by visual observers during 2010-110. It is merely an artificial contrast effect, not a real feature of Saturn's rings, but might be beneficial to try to find any correlation that might exist between the visual numerical relative intensity of the TWS and the varying tilt of the rings, including its brightness and visibility using variable-density polarizers, color filters, photographs, 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

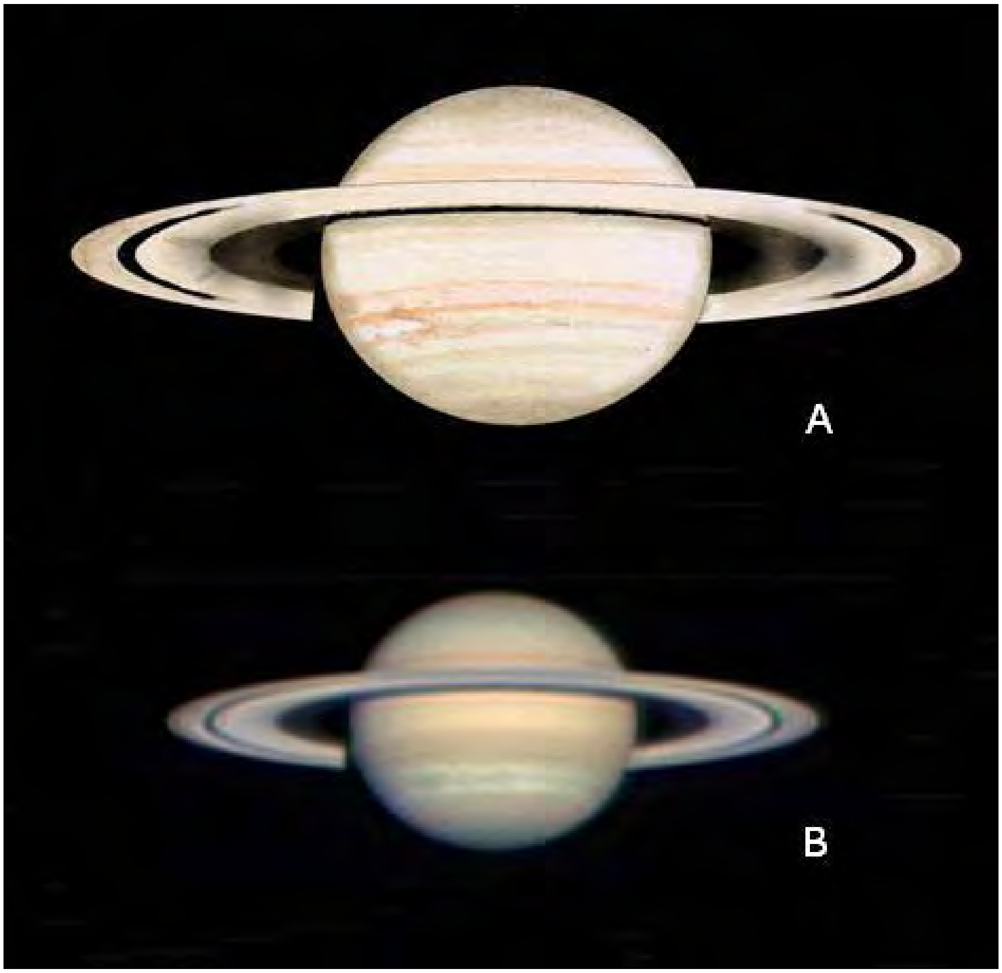


Illustration 017. Simultaneous Observations

2011 Mar 11 01:18 UT. Detailed sketch by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 6.0, Tr = 4.0 (interpolated). CMI = 338.7°, CMII = 342.3°, CMIII = 27.7°, B = +9.3°, B´ = +8.4°. The NTrZ white storm is depicted in this drawing made in reasonable seeing conditions. Spokes in Ring B are suspected at the E ansa.

2011 Mar 11 01:44 UT. Digital image by Mark Delcroix. 25.4 cm (10.0-in.) SCT with RGB filters. S = 7.0, Tr = 2.5. CMI = 354.0°, CMII = 356.9°, CMIII = 42.3°, B = +9.3°, B´ = +8.4°. The NTrZ white storm has widened and now extends around the entire globe of Saturn.

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 2010-11, 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 was 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. Unfortunately, during 2010-11 there were no images received suggesting evidence of this phenomenon, nor were there reported visual impressions of the bicolored aspect.

Professional astronomers are well-acquainted with Earth-based sightings of azimuthal variations in the rings (initially confirmed by *Voyager* spacecraft), which is probably a result 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

During the 2010-11 apparition, with the rings still tilted at relatively small angles to our line of sight (and the glare from Saturn's rings less than what it will be in upcoming apparitions), it was possible to visually detect and image faint objects like satellites closer to the planet. 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 2010-11 submitted no systematic visual estimates of Saturn's satellites employing recommended techniques by the ALPO Saturn Section.

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

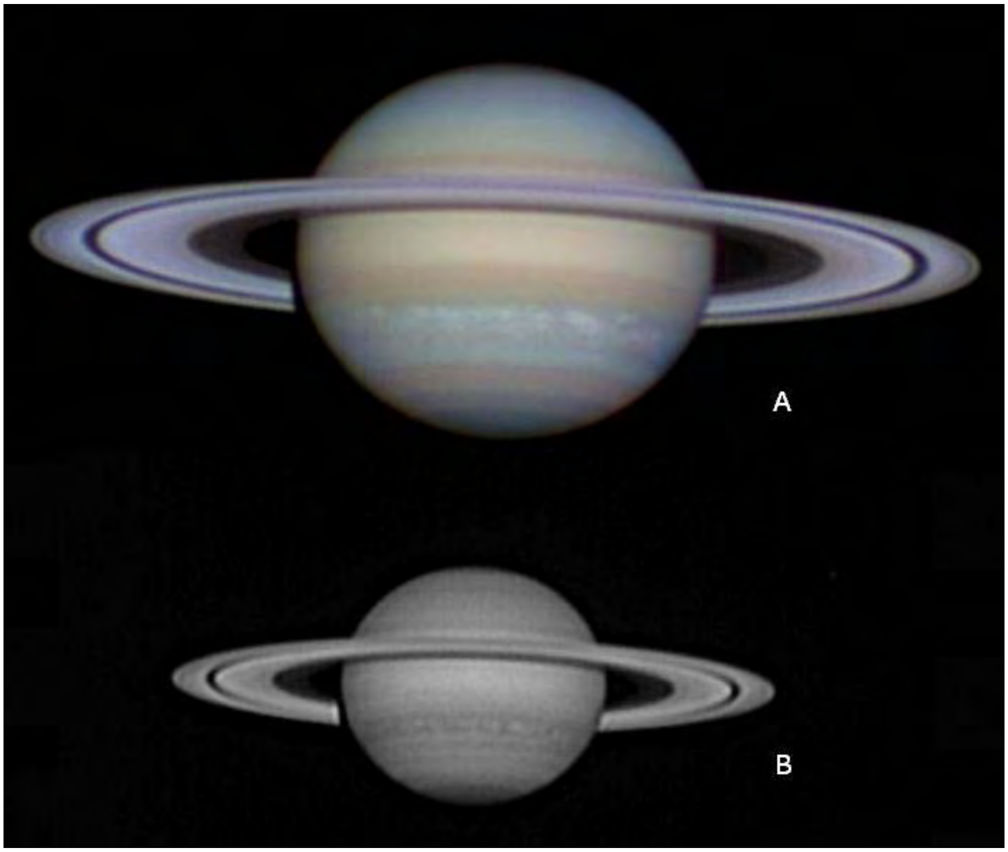


Illustration 018. Simultaneous Observations
2011 Mar 22 00:33 UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 240.7°, CMII = 249.9°, CMIII = 282.0°, B = +8.9°, B´ = +8.6°.
2011 Mar 22 00:35 UT. Digital image by Ian Sharp. 28.0 cm (11.0 in.) SCT with red filter. S and Tr not specified. CMI = 241.8°, CMII = 251.0°, CMIII = 283.2°, B = +8.9°, B´ = +8.6°.
Notice in these two simultaneous observations how internal differentiation has resulted in more complexity within the evolving white NTrZ storm.

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 pretty 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 cross-checking against ephemeris predictions of their locations and identities. It is important to realize, however, that the brightness of satellites and comparison stars on digital images will not necessarily be exactly the same as visual impressions because the peak wavelength response of the CCD chip is different than that of the eye.

Observers who have photoelectric photometers may also contribute measurements of Saturn's satellites, but they are notoriously difficult to measure owing to their faintness compared with the planet itself. Rather sophisticated techniques are required to correct for scattered light surrounding Saturn and its rings.

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, 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.

Transits of Saturnian Satellites and Their Shadows — During the 2010-11 apparition smaller inclinations of Saturn's ring plane to our line of sight afforded observers continuing chances to witness transits and shadow transits of satellites lying near the planet's equatorial plane. Apertures less than about 20.3 cm (8.0 in.) are insufficient to produce optimum views of these phenomena for satellites other than perhaps Titan, but observers with digital imagers in 2010-11 submitted some interesting results.

To mention a few of these, consider the excellent image of Saturn by Brian Combs on January 29, 2011 at 09:27UT showing Tethys and its shadow transiting the globe of the planet [refer to Illustration No. 041]. A similar image of Tethys and its shadow was captured by Tomio Akutsu on February 9, 2011 at 17:41UT [refer to Illustration No. 042].

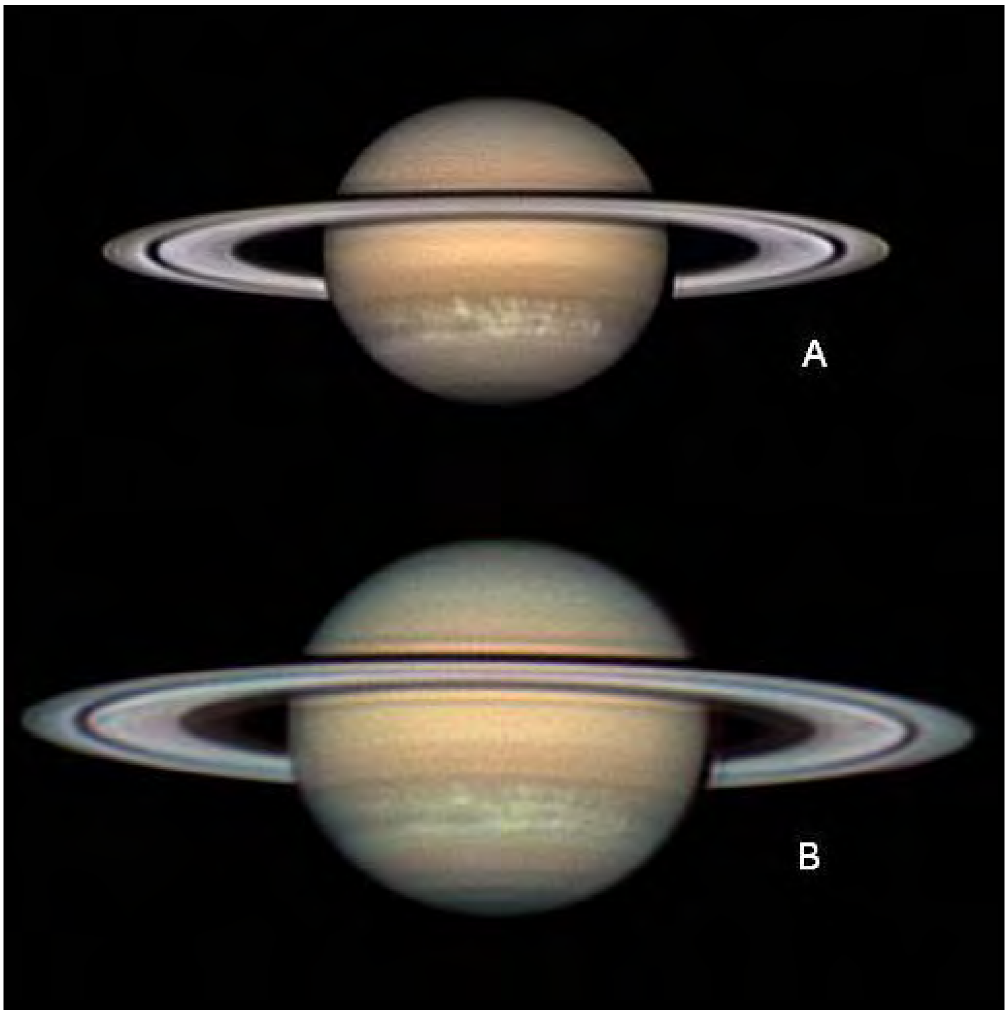


Illustration 019. Simultaneous Observations
2011 Apr 25 14:02 UT. Digital image by Tomio Akutsu. 35.6 cm (14.0 in.) SCT with RGB filters. S = 7.5, Tr = 4.0. CMI = 263.3°, CMII = 236.2°, CMIII = 226.7°, B = +7.8°, B´ = +9.1°.
2011 Apr 25 13:57 UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 7.5, Tr = 4.0. CMI = 260.4°, CMII = 233.4°, CMIII = 223.9°, B = +7.8°, B´ = +9.1°.
These two simultaneous observations depict how detailed the morphological structure of the NTrZ white storm has become.

Observations of satellite events at smaller ring inclinations remains a highly worthwhile and extremely interesting pursuit for those observers with adequate apertures. Simultaneous visual observations at the same time that imaging is occurring helps establish limits of visibility of such events using both methods. Precise timings should be made to the nearest second of ingress, CM passage, and egress of a satellite or its shadow across the globe of the planet at or near edgewise ring orientations. Notes should also be made of the belt or zone on the planet crossed by the shadow or satellite, and visual numerical relative intensity estimates of the satellite, its shadow, and the belt or zone it is in front of is important, as well as drawings of the immediate area at a given time during the event.

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 for firm verification of ill-defined or traditionally controversial phenomena.

The ALPO Saturn Section has organized a simultaneous observing team so that several individuals in reasonable proximity to each another can maximize the opportunities for viewing and imaging Saturn at the same time using similar equipment and methodology. Joint efforts like this significantly reinforce the level of confidence in the data submitted for each apparition. Examples of such observations of Saturn this apparition were cited earlier in this report, especially in connection with visual observations and digital imaging of the NTrZ white storm in the period from early December 2010 through May 2011. In forthcoming apparitions such continued valuable work is strongly encouraged.

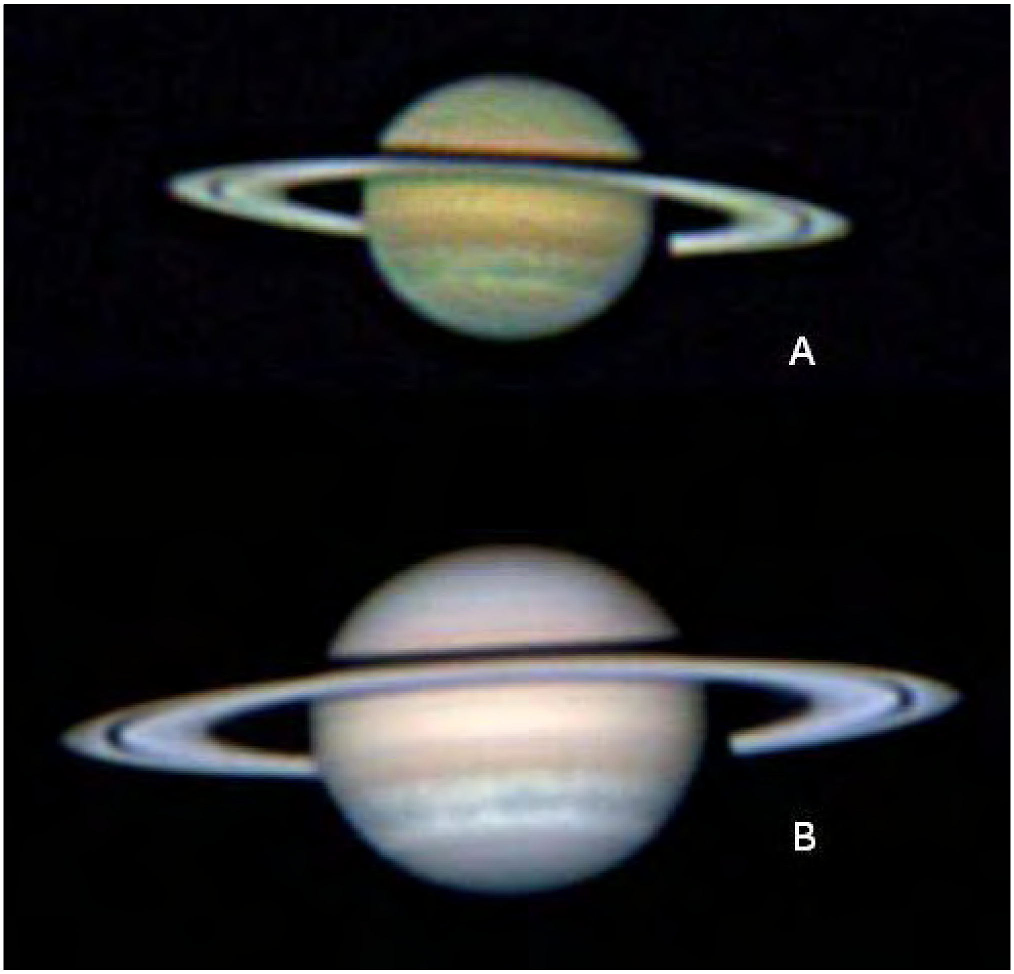


Illustration 020. Simultaneous Observations
2011 May 30 02:05 UT. Digital image by Geoff Chester. 20.3 cm (8.0 in.) SCT with RGB filters. S = 6.0, Tr = 6.0. CMI = 233.2°, CMII = 171.7°, CMIII = 120.6°, B = +7.2°, B´ = +9.5°.
2011 May 30 02:04 UT. Digital image by Jim Phillips. 25.4 cm (10.0 in.) REF with RGB + IR blocking filter. S and Tr not specified. CMI = 232.6°, CMII = 171.2°, CMIII = 120.0°, B = +7.2°, B´ = +9.5°.
The massive NTrZ white storm continuing to widen and differentiate internally as shown in these simultaneous observations.

Pro-Am Opportunities

Our cooperative involvement in professional-amateur (Pro-Am) projects continued in 2010-11 with an appeal to amateurs from Cassini scientists to collect as many images as possible of the brilliant NTrZ white storm raging on Saturn. It should be emphasized as well that this was not the first concerted Pro-Am effort in recent observing seasons. Readers of this Journal may recall a similar supportive role played by amateurs when the Cassini team requested imaging of Saturn's southern hemisphere for bright clouds following a sudden occurrence of radio noise caused by a dynamic storm in the STrZ in 2009-10. In fact, dating back to the time Cassini started observing Saturn at close range in April 2004, digital images at wavelengths ranging from 400nm - 1μ were solicited from amateurs by the professional community. So, persistent routine Pro-Am imaging by ALPO observers has been continuing for nearly a decade.

To play a part in these endeavors, observers simply need to utilize classical broadband filters (e.g., Johnson system: B, V, R and I) with telescope apertures of upwards of 30.5 cm (12.0 in.) or larger, while also imaging through a 890-nm narrow band CH_4 (methane) filter. The Cassini team requests that observers systematically patrol the planet every clear night for individual features, keeping track of their motions and morphology, and subsequently furnish input of interesting large-scale targets for on-board spacecraft imaging systems to begin close-up surveillance. Visual observers with apertures ranging upwards from 10.2 cm (4.0 in.) can play a very meaningful role by making routine visual numerical relative intensity estimates and record suspected variations in belt and zone reflectivities (i.e., intensity) and color.

The Cassini team combines ALPO Saturn Section images with data from the Hubble Space Telescope and from other professional ground-based observatories for immediate and future study. As a means of facilitating regular Pro-Am observational cooperation, readers are asked to contact the ALPO Saturn 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 glad to offer guidance to novices, as well as more experienced observers.

A meaningful resource for learning how to observe and record data on Saturn is the ALPO Training Program, and it is recommended that beginners take advantage of this valuable educational resource.

Conclusions

Based on mean visual numerical relative intensity estimates during 2010-11, the South Polar Region (SPR), North Polar Region (NPR), and South Tropical Zone (STrZ) each exhibited a reasonably apparent darkening trend compared the immediately preceding apparition. A more subtle dimming seemed possible for most of the other belts and zones that had visual intensity values assigned to them during the apparition. The more

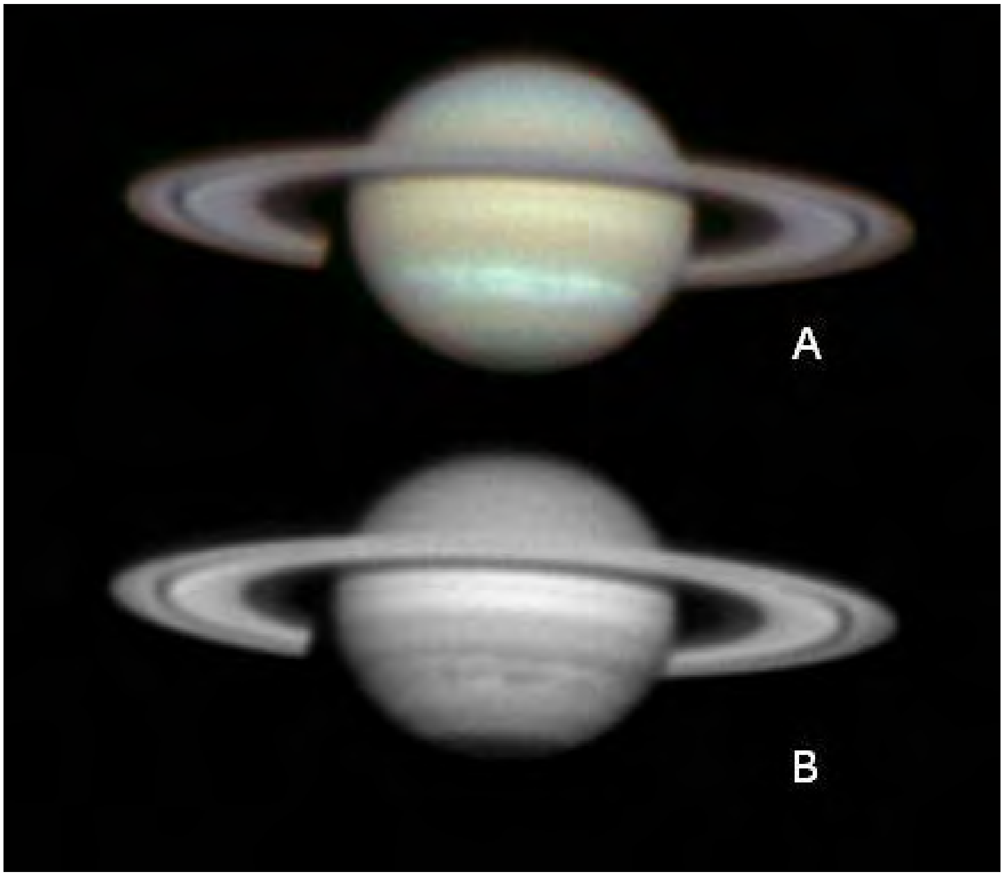


Illustration 021. Comparative Wavelength Images
2011 Jan 28 17:04 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 6.0, Tr not specified. CMI = 349.0°, CMII = 248.0°, CMIII = 343.3°, B = +10.1°, B´ = +7.8°.
2011 Jan 28 17:09 UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and IR 807nm filter. S = 6.0, Tr not specified. CMI = 352.0°, CMII = 250.8°, CMIII = 346.1°, B = +10.1°, B´ = +7.8°.
These two images illustrate how the appearance of the NTrZ white storm changes with different wavelength transmission filters.

notable exceptions were the South Temperate Zone (STeZ), which was only slightly lighter in overall intensity, and the North Tropical Zone (NTrZ) that was unquestionably brighter due to the emergence of the strikingly obvious NTrZ white storm.

Although sporadic, poorly-defined dusky features were seen or imaged in the North Temperate Belt (NTeB) and several short-lived diffuse white ovals in the South Tropical Zone (STrZ), there is no question that the sudden arrival and fast development of the spectacular NTrZ white storm signaled an obvious increase in activity within Saturn's northern hemisphere in 2010-11. After the Cassini team issued an appeal to amateur astronomers worldwide to collect as many images as possible of this brilliant feature, the rapid response by ALPO observers worldwide, with almost daily coverage, is highly commendable and sets a precedence for future Pro-Am cooperation.

With respect to the Ring System, apart from routine visual observations and digital images showing Cassini's (A0 or B10), Encke's (A5), and possibly Keeler's (A8) divisions, several less conspicuous intensity minima at different locations within Ring B were recorded with digital imagers. Although observers used standard methodology in looking for the bi-colored aspect of the rings during the 2010-11 apparition, there were no reports of the phenomenon by visual observers or indications of its presence on digital images submitted.

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

With regard to Saturn's satellites during the 2010-11 apparition, the relatively small ring inclination allowed observers to witness and image transits of satellites lying near the planet's equatorial plane and their shadows (e.g., Tethys and its shadow).

The author truly appreciates all of the continuing observation support by those mentioned in this report who submitted drawings, digital images, descriptive reports, simultaneous observations, and visual numerical relative intensity estimates during the 2010-11 apparition. Dedicated systematic observational work enhances our programs, bolstering Pro-Am collaboration as we collectively seek to better understand Saturn as a planet. Observers everywhere are encouraged to join us in our endeavors in future apparitions.

References

Alexander, A.F. O'D. (1962). *The Planet Saturn*. London: Faber and Faber.

Benton, J.L., Jr. (2005). *Saturn and How to Observe It*. London: Springer-Verlag.

________ (1996). *Visual Observations of the Planet Saturn: Theory and*

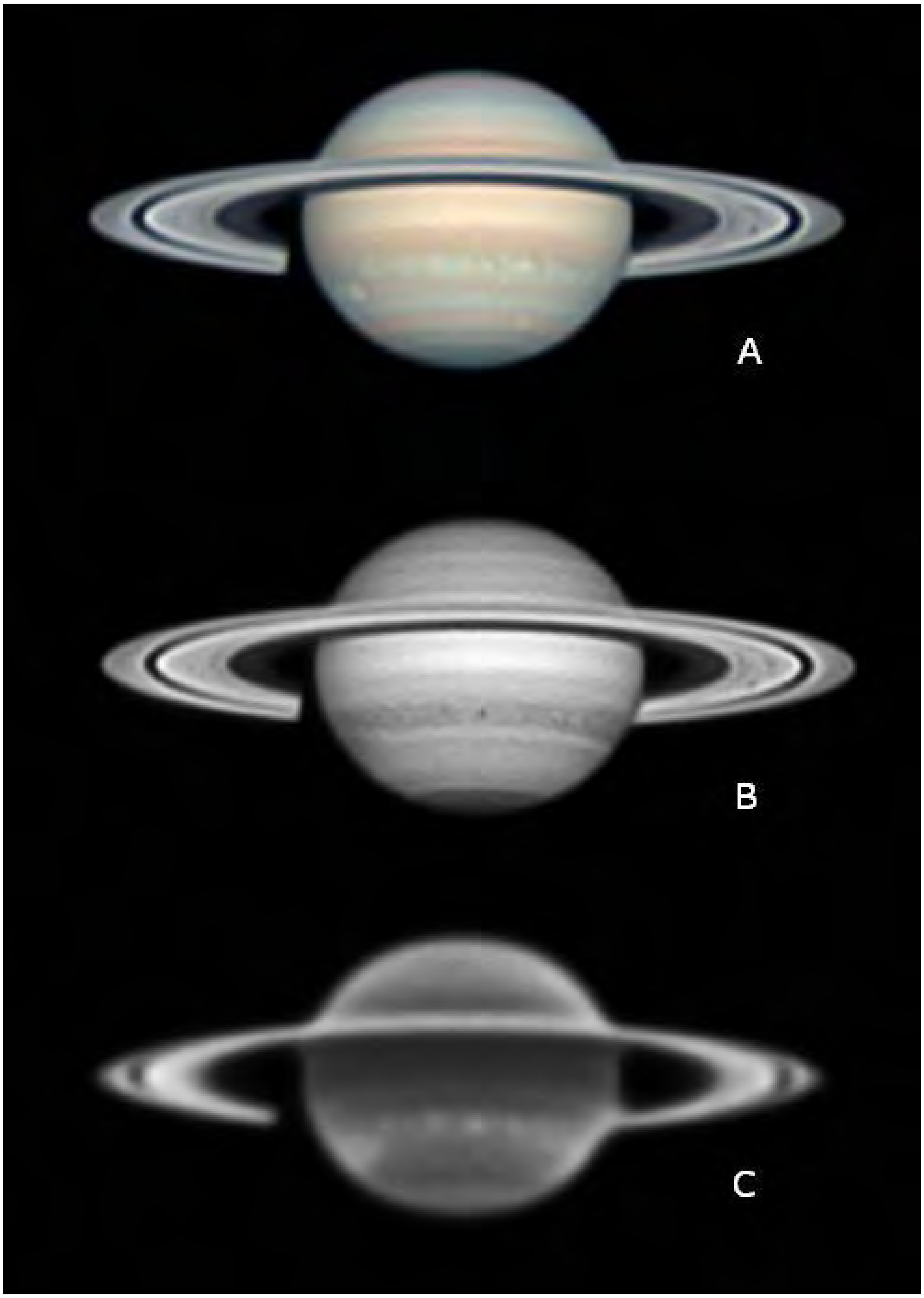


Illustration 022. Comparative Wavelength Images
2011 Feb 22 08:18 UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with RGB filters. S = 8.0, Tr = 3.5. CMI = 270.3°, CMII = 93.5°, CMIII = 159.1°, B = +9.7°, B´ = +8.2°.
2011 Feb 22 08:18 UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with Near-IR 715nm filter. S = 8.0, Tr = 3.5. CMI = 261.5°, CMII = 85.1°, CMIII = 150.6°, B = +9.7°, B´ = +8.2°.
2011 Feb 22 07:56 UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with 380nm UV filter. S = 8.0, Tr = 3.5. CMI = 257.4°, CMII = 81.1°, CMIII = 146.7°, B = +9.7°, B´ = +8.2°.
Compare the prominence and morphology of the NTrZ white storm in these three images taken in visible (RGB), IR, and UV wavelengths.

Methods (The Saturn Handbook). Savannah, GA: Review Publishing Company, 1996 (8th Revised Edition - now available also in pdf format).

________ (2008). *ALPO Observations of Saturn During the 2004-2005 Apparition*, Journal of the Assn of Lunar & Planetary Observers, 50, 1: 30-54.

________(2009). *ALPO Observations of Saturn During the 2005-2006 Apparition*, Journal of the Assn of Lunar & Planetary Observers, 51, 1: 32-62.

________ (2010a). *ALPO Observations of Saturn During the 2006-2007 Apparition*, Journal of the Assn of Lunar & Planetary Observers, 52, 1: 20-50.

________ (2010b). *ALPO Observations of Saturn During the 2007-2008 Apparition*, Journal of the Assn of Lunar & Planetary Observers*, 52,* 3: 29-58.

--------------- (2012) *ALPO Observations of Saturn During the 2008-2009 Apparition*, *JALPO, 54,* 2: 29-70.

Gehrels, T. and Matthews, M.S., Saturn. Tucson: University of Arizona Press, 1984.

Spilker, Linda J., Editor. (1997). *Passage to A Ringed World: The Cassini-Huygens Mission to Saturn and Titan* (NASA SP-533). Washington: U.S. Government Printing Office.

Rothery, D.A., et al, *An Introduction to the Solar System*. Cambridge: Cambridge University Press, 2011 (Revised Edition).

United States Naval Observatory, *The Astronomical Almanac*. Washington: U.S. Government Printing Office. (Annual Publication; the 2010 and 2011 editions, which were published in 2009 and 2010, respectively, were used for this report).

Illustration 023. 2011 Apr 11 00:14 UT. Drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250 to 312X. S = 6.0, Tr = 4.0 (interpolated). CMI = 197.0°, CMII = 280.6°, CMIII = 288.7°, B = +8.3°, B´ = +8.9°. NTrZ white storm details are apparent in this superbly detailed drawing.

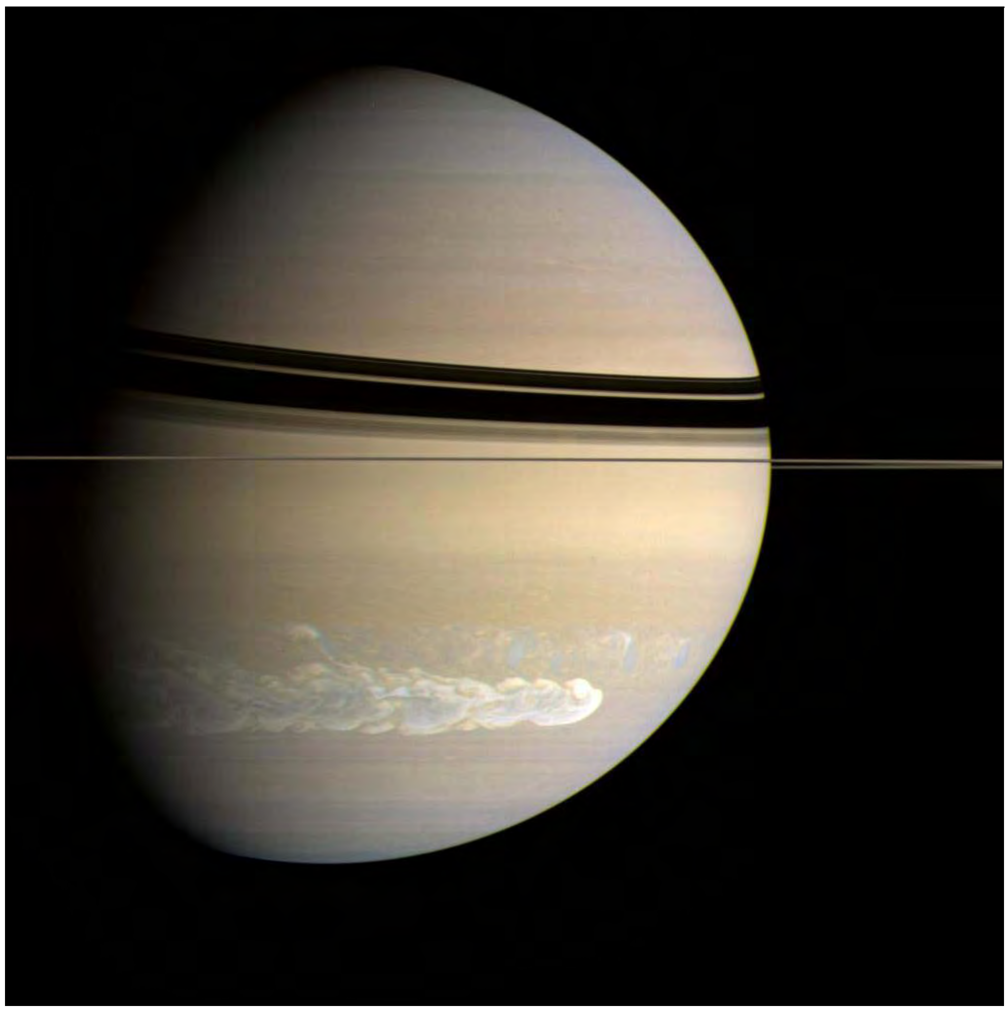


Illustration 024. 2011 Feb 25 RGB composite of images taken by the *Cassini* spacecraft on February 25, 2011 from a distance of 2.1 million km. Leading W edge of the massive storm in Saturn's atmosphere can be seen clearly in this image. Image credits: NASA / JPL / Space Sciences Institute / Mike Malaska.

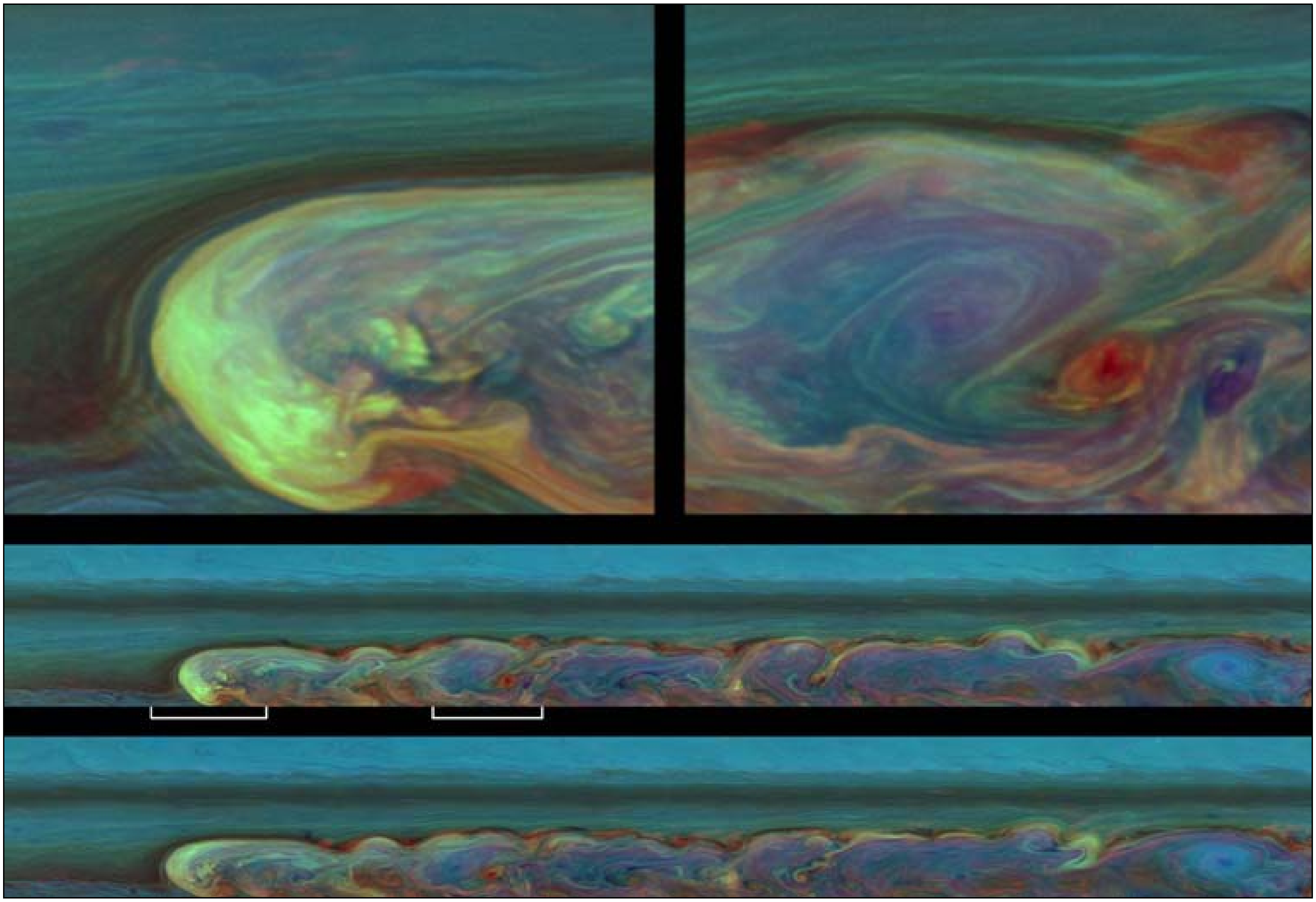


Illustration 025. 2011 Feb 26. False-color images from *Cassini*, assembled into a mosaic to chronicle development of the massive NTrZ white storm, show clouds at different altitudes within Saturn's atmosphere. Yellow and white clouds are optically thick, situated at high altitude above greenish intermediate level clouds, underlain by reddish-brown clouds at low altitude. The base of the clouds, where lightning is generated, probably lies within the water cloud layer. The NTrZ storm clouds are likely composed of water-ice covered by crystallized ammonia.
Note: The "white line brackets" beneath the middle mosaic identify the two close-up enlargements at the top. Image credit: NASA/JPL-Caltech/Space Sciences Institute.

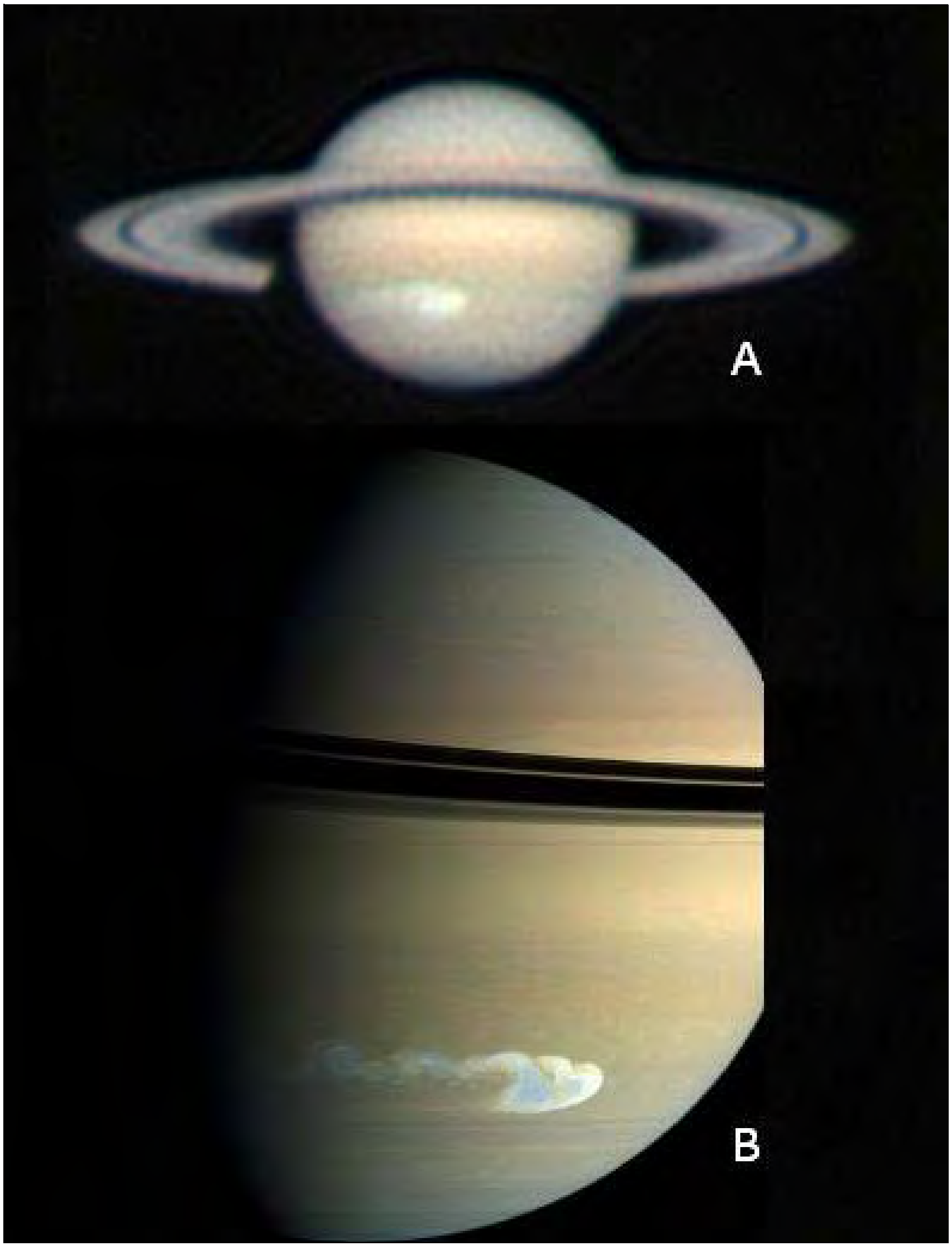


Illustration 026. Comparison near-simultaneous images (ALPO vs Cassini)
2010 Dec 24 13:53 UT. Digital image by Paul Maxson. 25.4 cm (10.0 in.) DAL with RGB filters. S and Tr not specified. CMI = 204.7°, CMII = 158.5°, CMIII = 296.2°, B = +9.9°, B´ = +7.3°. NTrZ white storm is prominent.
2010 Dec 24 Composite near-true-color view by *Cassini* of the huge NTrZ storm churning through Saturn's atmosphere. Image credit: NASA/JPL-Caltech/ Space Sciences Institute.

Illustration 027. Comparison near-simultaneous images (ALPO vs Cassini)
2011 Jan 02 11:29 UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with RGB filters. S = 7.5, Tr = 3.5. CMI = 159.2°, CMII = 185.6°, CMIII = 312.5°, B = +10.0°, B´ = +7.5°. Brilliant NTrZ is crossing CM.
2011 Jan 02 Composite near-true-color view of the NTrZ storm from *Cassini*. Image credit: NASA/JPL-Caltech/ Space Sciences Institute.

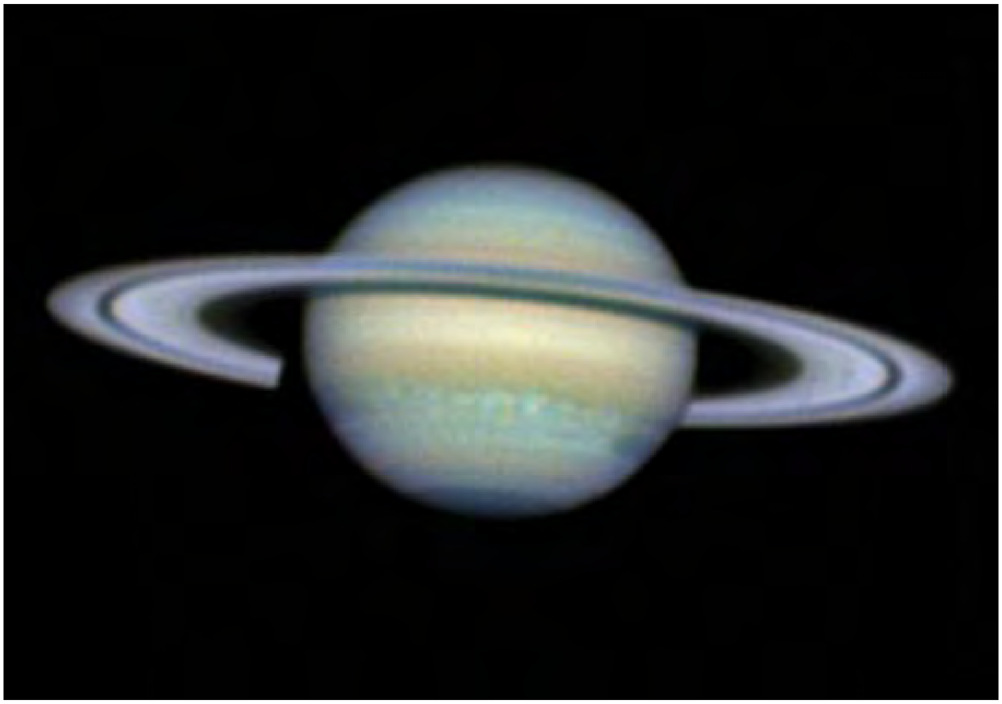


Illustration 028. 2011 Feb 24 07:00 UT Digital image by Wayne Jaeschke. 35.6 cm (14.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 113.4°, CMII = 233.7°, CMIII = 296.9°, B = +9.7°, B´ = +8.2°. Considerable differentiation is occurring within the elongated and widening NTrZ storm as it encircles the planet.

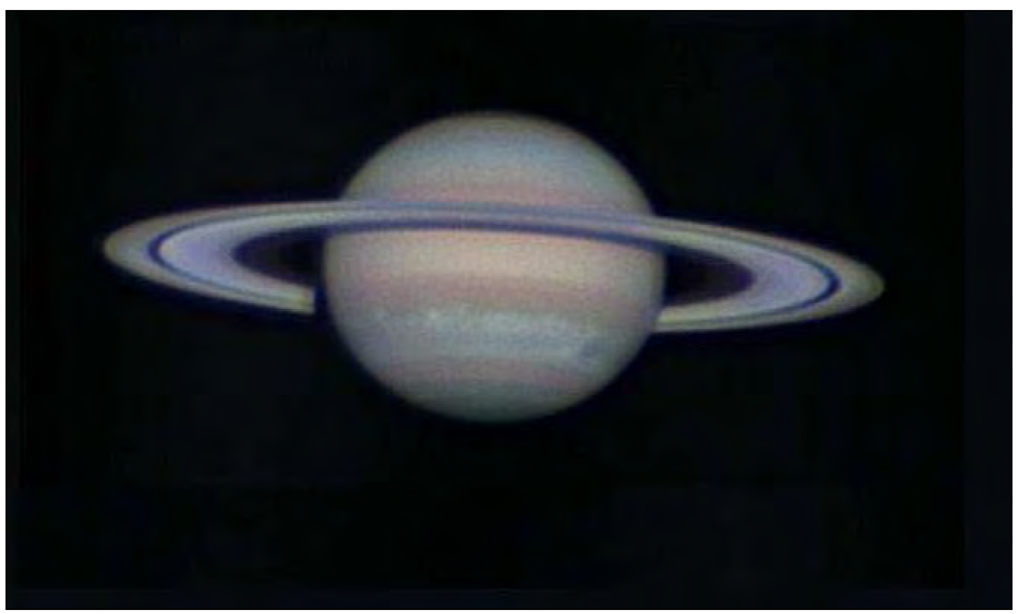


Illustration 029. 2011 Mar 12 07:14 UT. Digital image by Brian Combs. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S and Tr not specified. CMI = 311.9°, CMII = 275.1°, CMIII = 319.0°, B = +9.3°, B´ = +8.4°. Beautiful image showing continued growth and evolution of the NTrZ white storm in both latitude and longitude.

Illustration 030. 2011 Apr 19 23:01 UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 193.4°, CMII = 347.9°, CMIII = 345.2°, B = +8.0°, B´ = +9.0°. The NTrZ storm encircling the globe of Saturn shows further changes in morphology since March.

Illustration 031. 2011 May 17 01:45 UT. Digital image by Efrain Morales. 30.5 cm (12.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 46.0°, CMII = 44.8°, CMIII = 9.4°, B = +7.3°, B´ = +9.4°. The NTrZ storm is evolving as the apparition progresses continuing to exhibit higher, brighter clouds at its edges, with darker, lower cloud structure in between.

Illustration 032. 2011 Jun 09 01:08 UT. Digital image by Wayne Jaeschke. 35.6 cm (14.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 113.4°, CMII = 233.7°, CMIII = 296.9°, B = +9.7°, B´ = +8.2°. The NTrZ storm exhibits analogous features as seen during May as it continues to evolve this apparition.

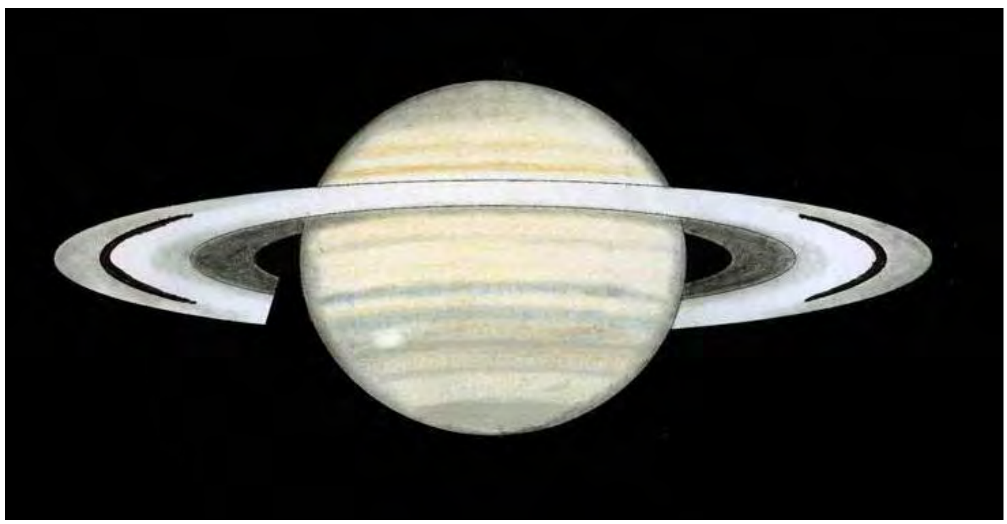


Illustration 033. 2010 Dec 17 04:49 UT. Drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 200 to 250X. S = 6.0, Tr = 4.0 (interpolated). CMI = 95.5°, CMII = 287.7°, CMIII = 74.7°, B = +9.7°, B´ = +7.2°. NTeB is visible in this detailed drawing in favorable seeing; the NTrZ white spot is also noticeable near the E limb.

Illustration 034. 2011 Jan 14 09:51 UT. Digital image by Dan Llewellyn. 35.6 cm (14.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 154.0°, CMII = 154.9°, CMIII = 267.4°, B = +10.1°, B´ = +7.6°. The NTeZ is seen in this image along with nearby prominent white NTrZ storm.

Illustration 035. 2011 Jun 02 20:43 UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 181.4°, CMII = 358.0°, CMIII = 302.3°, B = +7.2°, B´ = +9.6°. NNTeZ is apparent in this exquisitely detailed image, including considerable structure in the NTrZ white storm complex. The dark gray NPR is seen at the northern limb of Saturn. The major ring components, as well as Cassini's (A0 or B10), Encke's (A5), and Keeler's (A8) divisions are visible.

Illustration 036. 2011 Apr 01 23:53 UT. Digital image by Jean-Pierre Prost. 25.4 cm (10.0 in.) DAL and RGB filters. S and Tr not specified. CMI = 145.4°, CMII = 160.2°, CMIII = 179.1°, B = +8.6°, B´ = +8.7°. The main ring components, as well as Cassini's (A0 or B10), Encke's (A5), and Keeler's (A8) divisions are well seen.

Illustration 037. 2011 Mar 07 03:18 UT. Digital image by Mark Delcroix using a 25.4 cm (10.0-in.) SCT with R + IR 610nm filters. S = 6.0, Tr = 3.0. CMI = 297.6°, CMII = 257.3°, CMIII = 233.9°, B = +7.5°, B´ = +9.2°. Dusky "spokes" within Ring B are possibly present at the W ansae in this near-IR image.

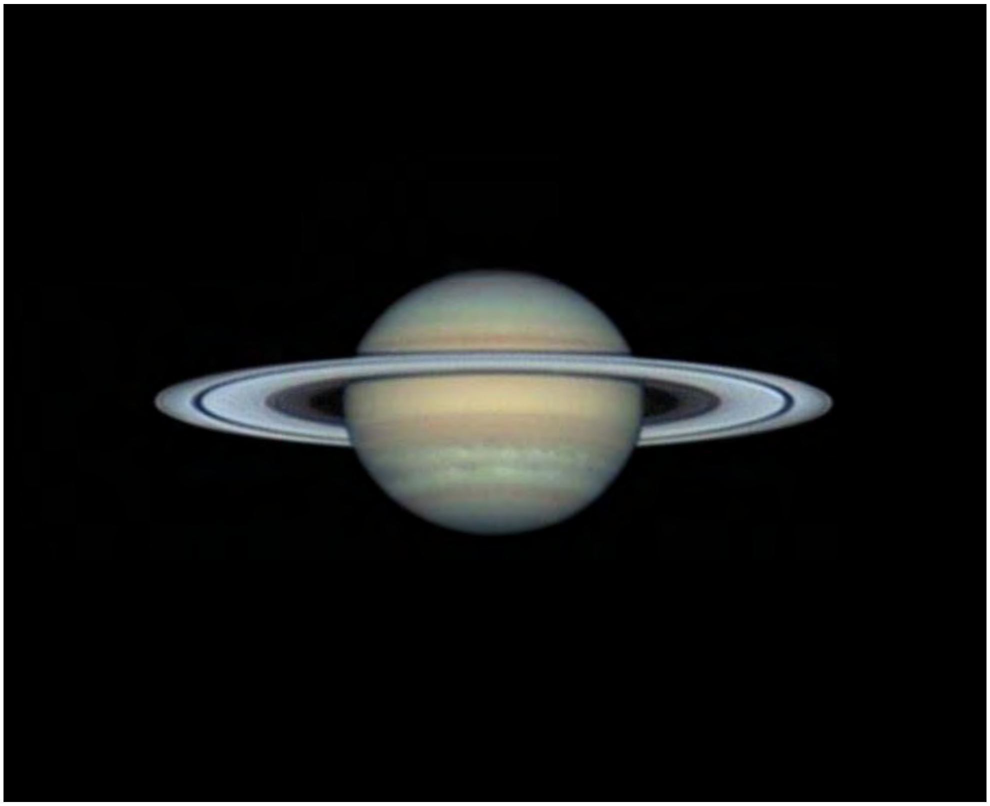


Illustration 038. 2011 Apr 08 23:47 UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 292.5°, CMII = 81.3°, CMIII = 91.8°, B = +8.3°, B´ = +8.8°. All of the major ring components, plus Cassini's (A0 or B10), Encke's complex (A5), and Keeler's (A8) divisions, along with hints of "intensity minima" within Ring B, are quite apparent in the superb, large-scale image. The Seeliger Opposition Effect, a brightening of Saturn's rings by coherent back-scattering of sunlight by their constituent μ-sized icy particles is quite noticeable.

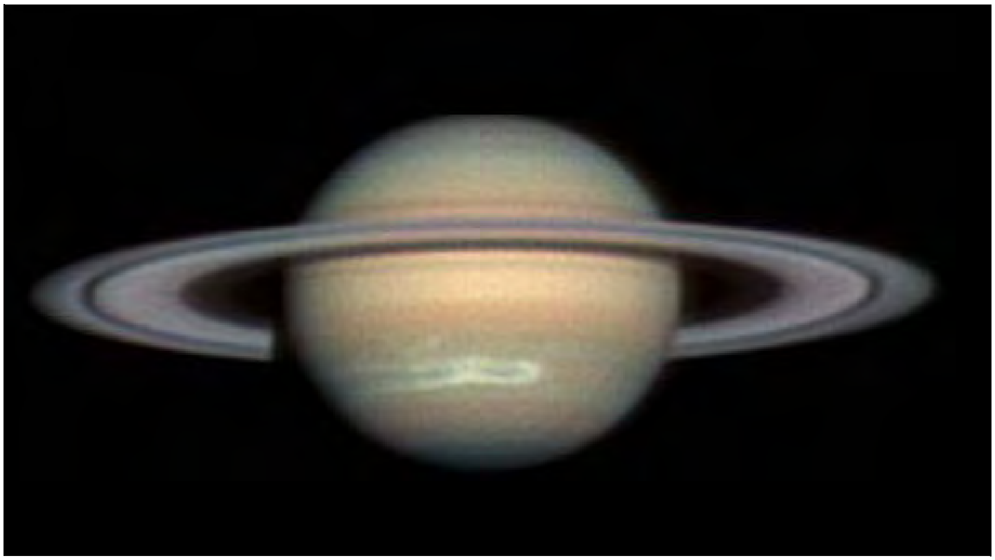


Illustration 039. 2011 Mar 02 17:19 UT UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 7.0, Tr = 3.0. CMI = 142.7°, CMII = 55.4°, CMIII = 110.8°, B = +9.5°, B´ = +8.3°. When **B** and **B'** are both positive, and the value of **B** is greater than that of **B'**, the ring shadow is to the north of the projected rings, as depicted in this image.

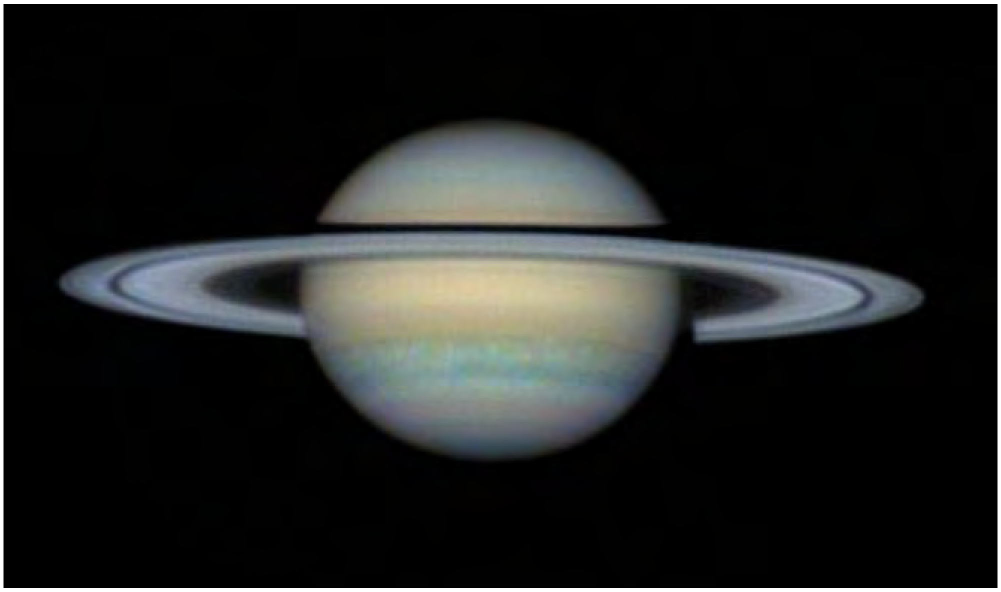


Illustration 040. 2011 May 19 20:55 UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 248.8°, CMII = 157.3°, CMIII = 118.4°, B = +7.3°, B´ = +9.4°. When **B** and **B’** are both positive, and the value of **B** is less than of **B’**, the dark shadow of the rings on the globe is cast to their south, as shown here.

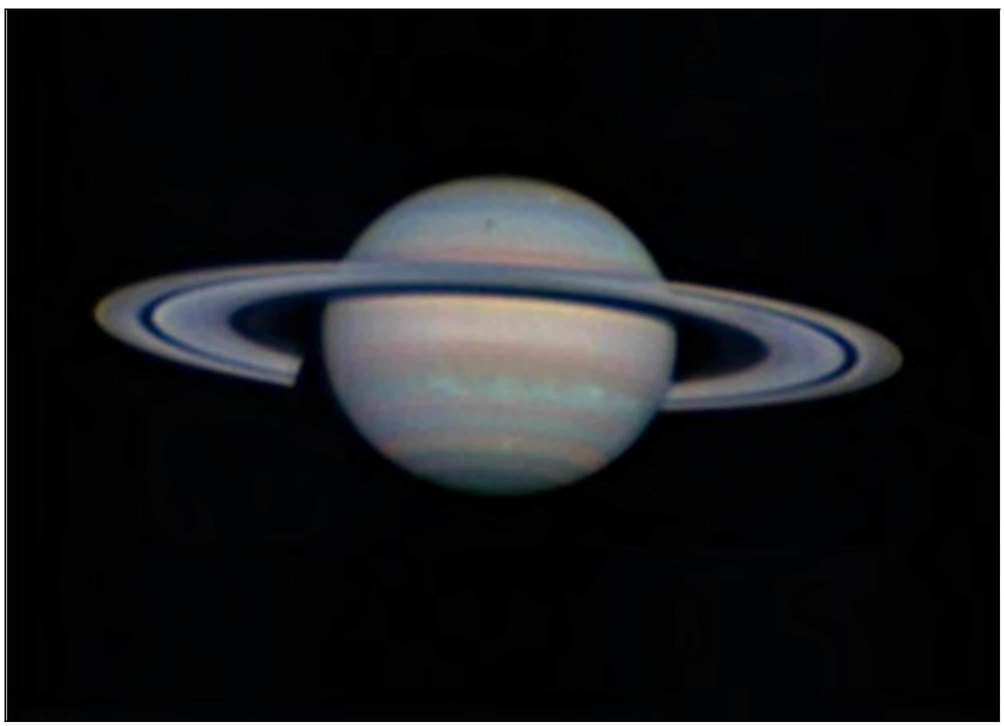


Illustration 041. 2011 Jan 29 09:27 UT. Digital image by Brian Combs. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S and Tr not specified. CMI = 205.4°, CMII = 82.4°, CMIII = 176.8°, B = +10.1°, B´ = +7.8°. Tethys and its shadow are easily seen transiting the southern hemisphere of the globe.

Illustration 042. 2011 Feb 09 17:41 UT. Digital image by Tomio Akutsu. 35.6 cm (14.0 in.) SCT with RGB filters. S = 7.5, Tr = 4.0. CMI = 63.3°, CMII = 293.9°, CMIII = 14.6°, **B** = +10.0°, **B´** = +8.0°. Tethys and its shadow appear transiting the southern hemisphere of the globe.

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http://moon.scopesandscapes.com/ALPO_Lunar_Program.htm

Smart-Impact Webpage

http://www.zone-vx.com/alpo-smartimpact.html

The Lunar Observer

http://moon.scopesandscapes.com/tlo.pdf

Lunar Selected Areas Program

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There is NO CHARGE for any of the ALPO monographs.

- **Monograph No. 1.** *Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993. 77* pages. File size approx. 5.2 mb.

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

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

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

- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.* By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Hard copy $10 for the United States, Canada, and Mexico; $15 elsewhere. File size approx. 2.6 mb.

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

- **Monograph No. 7.** *Proceedings of the 48th Convention of the Association of*

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Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76 pages. Hard copy $12 for the United States, Canada, and Mexico; $16 elsewhere.File size approx. 2.6 mb.

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

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

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

- **Monograph No. 11**. *The Charte des Gebirge des Mondes* (Chart of the Mountains of the Moon) by J. F. Julius Schmidt, this monograph edited by John Westfall. Nine files including an accompanying guidebook in German. Note files sizes:
Schmidt0001.pdf, approx. 20.1 mb;
Schmidt0204.pdf, approx. 32.6 mb;
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Order the following directly from the appropriate ALPO section recorders; use the address in the listings pages which appeared earlier in this booklet unless another address is given.

- **Solar:** *Guidelines for the Observation of White Light Solar Phenomena*, *Guidelines for the Observing Monochromatic Solar Phenomena* plus various drawing and report forms available for free as pdf file downloads at http://www.alpo-astronomy.org/solarblog.

- **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

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- **Lunar (Bailey):** (1) *The ALPO Lunar Selected Areas Program (*$17.50). Includes full set of observing forms for the assigned or chosen lunar area or feature, along with a copy of the *Lunar Selected Areas Program Manual.* (2) *observing forms,* free at http://moon.scopesandscapes.com/alpo-sap.html, or $10 for a packet of forms by regular mail. Specify *Lunar Forms*. 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 $1.25 per hard copy: send SASE with payment (check or money order) to: Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080.

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

- **Venus (Benton):** Introductory information for observing Venus, including observing forms, can be downloaded for free as pdf files at http://www.alpo-astronomy.org/venus. The *ALPO Venus Handbook* with observing forms included is available as the *ALPO Venus Kit* for $17.50 U.S., and may be obtained by sending a check or money order made payable to “Julius L. Benton” for delivery in approximately 7 to 10 days for U.S. mailings. The *ALPO Venus Handbook* may also be obtained for $10 as a pdf file by contacting the ALPO Venus Section. All foreign orders should include $5 additional for postage and handling; p/h is included in price for domestic orders. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO Venus section. Observers should make copies using high-quality paper.

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

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

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

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

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