

IOPW Steering Committee Meeting November 8, 2015
Gaylord Hotel, National Harbor, MD
(Merging contributed notes by Hueso, Steffl, Roe, Corlies, Rathbun)

Permanent Members in attendance:

Heidi Hammel, Imke de Pater, Chris Russell, Glenn Orton, Bob West

Subcommittee Chairs or their proxies in attendance:

Andy Steffl, Paul Corlies, Julie Rathbun, Paul Steffes, Ricardo Hueso

Rotating Members:

Pat Irwin, Sarah Horst, Kunio Sayanagi

IOPW Atmospheres sub-discipline: Ricardo Hueso

1. Summarizing group work: we are building a new amateur observation database. The current PVOL was originally built by students 10 years ago. The Bilbao group (Grupo Ciencias Planetarias, GCP) has joined the European Research Infrastructure (Europlanets) which will provide funds for improvements on the online database of amateur observations of the Giant Planets (PVOL). This will be integrated in VESPA (Virtual European Solar and Planetary Access), a large part of the Research infrastructure projected to develop a fully virtual observatory of Solar System objects. PVOL will grow to contributions of other planets atmospheres too. The Bilbao group will also have some money to develop open source software for amateurs to examine their video recordings and look for impacts. This will grow from existing software platforms (Bilbao software, Marc Delcroix's software). These developments should start around early 2016 to be finished early 2017.
2. We are currently putting together a workshop for amateur astronomers, in Nice, France. Europlanets devotes part of its money to the organization of activities with amateur astronomers and Ricardo Hueso with Marc Delcroix (French amateur) will apply for funds to organize an Amateur Juno Support Workshop on Europe (possibly in France) to be hold around late March 2016. Europlanets runs until August 2019 and every year, European researchers will have similar be opportunities for networking with amateurs.
3. The PlanetCam instrument is finished and able to observe from 400 nm to 1.7 microns at high spatial resolution (0.1'' effective spatial resolution or better). It can be used in the 1.2 and 2.2m telescopes in Calar Alto Observatory in Spain. Besides regular observing campaigns it can be used quickly if unexpected events are found in Jupiter-Neptune (impacts, large-scale storms, etc ...).

4. The PlanetCam instrument is finished and able to observe from 400 nm to 1.7 microns at high spatial resolution (0.1'' effective spatial resolution or better). It can be used in the 1.2 and 2.2m telescopes in Calar Alto Observatory in Spain. Besides regular observing campaigns it can be used quickly if unexpected events are found in Jupiter-Neptune (impacts, large-scale storms, etc ...).
5. Separate small reports for different planets...

Jupiter: The 2014-2015 Jupiter apparition contains 1900 observations of different quality. This is a lower number than in previous years due to the efforts by many amateurs to try more difficult objects like Uranus and Neptune. There are enough observations of very high quality to track most interesting atmospheric features and the observed phenomenology over this year. Many efforts were devoted to studies of Jupiter satellites mutual events (transits, eclipses, etc..). The IMCEE (Institute de Mécanique Celeste et de Calcul des Ephemerides) in France coordinates the observations and analysis.

Saturn: Amateurs have been very successful this year in observations of a polar perturbation in Saturn around the 72° jet, close to the hexagon, and in a singular long-enduring white spot first at Equator (both phenomena presented by our team in the meeting). The GCP team in collaboration with many USA colleagues obtained three HST orbits in June-July 2015 from DDT to observe both phenomena with the WFC3, also tracked from the ground with GCP instruments. Working on the final report now.

Uranus: Lots of amateur observations of Uranus with improved quality from the last year. None of them has found any particularly new atmospheric feature but the South Polar hazes are generally resolved and some amateurs have been able to show realistic bands in the planet. If a large atmospheric feature like that of 2014 would have appeared in the planet, amateurs would have been well equipped to track that feature and provide ephemeris.

Neptune: Many good observations of Neptune this year. For the first time, amateurs are interested in tracking features in Neptune. Many amateurs have contributed to tracking a long-lived large feature at -40°. This is the third year amateurs observe features at this latitude but in this case the number of observations has at least tripled from previous years and the quality has improved. Some observers have been able to find real features at +20° and at -70° that compare well with Keck II and HST observations on close dates. Similar to what we have for Uranus, amateur observation quality is improving, we should be able to see any significant outbreak if they happen. Neptune is now getting low in the sky, but Uranus is still observable for a bit longer.

Discussion:

There is a high-precision Uranus photometry campaign coming up with K2 (Kepler 2), so we should encourage more amateurs to look for Uranus features.

De Pater: Multifrequency VLA observations have been taken of all 4 giant planets to map the brightness distribution below the clouds (team: de Pater, Sault, Butler, deBoer).

Chris Russell: Is the decrease in the image submission a concern?

Ricardo: it's not a saturation issue, but many users are now choosing to share on their own website or facebook rather than the organized astronomy repository.

Heidi+Glenn: Isn't that a problem for the Juno support campaign? Let's make sure to disseminate the information so that people participate.

IOPW Satellite sub-discipline: Julie Rathbun

1. I've been concentrating on Io – looking at what's been going on with volcano observations.
2. Support of the JAXA Hisaki mission have waned, but data reduction is continuing and some new observations have been made.
3. IRTF Observations

In Spring 2015 Robert Howell (with Spencer, Rathbun, and Goguen) observed mutual satellite occultations of Io in order to determine precise locations and brightnesses of active volcanoes.

In fall 2015, Constantine Tsang at SwRI (with Spencer and Greathouse) continued his observations of Io's atmosphere.

4. Keck Observations

Imke de Pater continued observations of Io's volcanoes, with observations in March through May.

5. Gemini

Katherine de Kleer continued observations of Io's volcanoes, with many observations over the year.

6. Several observations of Io's volcanoes were obtained in Jan-March 2015 at LBTI (PI: Al Conrad).

7. Recent results:

A major eruption at Pillan Patera was observed at IRTF, Keck and LBTI. Loki continues to be active.

8. Future events:

With the Juno spacecraft reaching Jupiter next year, more ground-based observations will likely occur.

9. Observations of other satellites: Europa.

Two groups have recently begun groundbased observations of Europa's surface:

N.Ligier, F. Poulet, and others from IAS in Orsay, France obtained good spatial resolution spectra of Europa's surface using SINFONI at the VLT in Chile from October 2011-January 2012.

P.D. Fischer, M. Brown, and K. Hand have obtained similar spectra of Europa using NIRSPEC and adaptive optics at Keck.

Discussion

Julie Rathbun – I haven't been putting in a lot of IRTF proposals, but I should.

Glenn + Chris – we should keep continuous records of observation. Are there gaps?

Julie – there are giant gaps – gaps tend to open up when a major space mission comes online.

Glenn – during Jupiter Galileo campaign, there were lots of observations during that timeframe.

Julie – more people are interested in Io-Jupiter connections, we did observations during Galileo, but it became too hard since around 2004, 2005.

Imke: we also got time on ALMA, but I don't think we will get data. The proposal was to observe Io in eclipse – don't expect to have it executed because it is too time critical, and I think they are just going to miss the observation. We have to re-propose when they miss the observation.

Sarah: there was also a Enceladus plume observation selected by ALMA.

Heidi: Is anybody keeping track of Europa plume development? One of the things this group could do effectively is to coordinate support observations better so that missions can be better planned. Organize ideas on what we can actually do better from space missions than from the ground.

Julie: one idea would be to bring on someone like Kurt Retherford, who would be more familiar with UV observation. I haven't paid too much attention to Icy Satellites lately ... I do pay attention to geophysics but not atmosphere/plumes. Josh Emery was doing ground-based Europa observations.

Heidi: In terms of coordinating IOPW focus, in 3 years, we will have JWST coming online.

Io Taurus – Andrew Steffl

1. The JAXA Hisaki mission continues to observe the Io plasma torus and Jovian aurora. The spacecraft is in good health and generating a wealth of great data. Hisaki has completed its primary mission and is now into its first extended mission, which will run through the end of 2017, so as to make coordinated observations of the Jupiter system with the JUNO spacecraft. There is an effort to create a “participating scientist” program with NASA to obtain funding to work with the Hisaki team and increase the science return of the mission.
2. Ground-based observations of the Io torus were made by Carl Schmidt (CNRS: LATMOS) on the Apache Peak 3.5m and Andrew Steffl (SwRI-Boulder) and Masato Kagitani (Tohoku University, Japan) in early 2014 in support of the Hisaki prime mission. Analysis of this data is ongoing.
3. Fran Bagenal (Univ. Colorado/LASP) and a few students have restored the Steffl torus spectral model for use in analyzing/verifying Hisaki data. They have also worked to reduce Galileo UVS observations of the Io torus.
4. Peter Delamere and Matt Copper (Univ. Alaska-Fairbanks) continue to develop their 2.5-D physical chemistry model of the Io/Europa torus

Discussion:

Linked to Hisaki mission, we have been getting data, but they have been very slow to publish. Their mission has been extended to 2017 to support Juno. We have a meeting coming up in Japan – Plasmas workshop, end of November. Considering of how to push participating scientist setup etc, but it's just in conceptualizing stage.

Kunio – Last year, at Japan Geoscience Union meeting in Chiba, Japan, Linda Spilker invited Japanese scientists to apply to Cassini PS – but at the end, it was revealed that NASA and JAXA lack some sort of agreement to have Japanese scientists participate in Cassini. Might affect Hisaki -- Linda Spilker should remember the details on that incident.

Looking at sodium cloud from the ground – ref. Mizuki Yoneda.

Titan sub-discipline: Paul Corlies (representing Alex Hayes)

Update on Past and Upcoming Titan Observations

A. Cassini Observations

- 1) ISS – as part of the Titan meteorological campaign, ISS has made 55 cloud/8 haze observations in 2014 and 26 cloud/32 haze observations in 2015 searching for clouds. However, since 2010 only a few clouds have been observed on Titan (predominantly in the North Pole). These observations are made over any range from Titan (up to 2 million km).
- 2) VIMS – has also only observed a few clouds on Titan, include a few at the South Pole indicative of the possible onset of a large polar hood as was observed at the North Pole. Additionally, the first dust storm is believed to have been observed on Titan – making it one of only three bodies for which this has been observed. Sebastien Rodriguez have been leading the effort.
- 3) VIMS is also being used for radiative transfer modeling to retrieve haze population, spectral surface albedo on a global scale, and cloud characteristics. Additional works is also being one in VIMS, in combination with RADAR/SAR to characterize dunes on Titan.
- 4) RADAR -- Alex has been working with a postdoc – new super resolution techniques are being tried, originally developed for Mars -- it looks for return from the bottom of the lakes, and see compositional gradient of the lakes.
- 5) The dust/tholin distribution could be distinguished from the colors (Dr. Horst is skeptical). (Kunio post-meeting note – is it this paper?
<http://adsabs.harvard.edu/abs/2014AGUFM.P23D4019L>)

B. Ground Based Observations

- 1) A slew of ground-based observations have been made at a variety of observatories and, in agreement with Cassini observations, large scale clouds that would be visible from the ground have yet to be observed. This is contradictory to Global Circulation Models, however, new models suggest the onset of larger cloud systems within the next year. There is >50 hours of observations and >125 epochs in the past year on instruments including:
 - NIRI (G. North) – H2 1-0 S(1) narrow band imaging – 3 epochs
 - NIFS (G. North) – K band IFU spectroscopy – 3 epochs
 - SINFONI (VLT) – HK band IFU spectroscopy – 90 epochs in 2014/19 epochs in 2015
 - ARCoIRIS (Cerro Tololo) - .8-2.5um whole disk spectroscopy – 6 epochs
 - SPeX (IRTF) - .8-2.5um whole disk spectroscopy – 17 epochs

- GPI (G. South) – K band IFU spectroscopy – 3 epochs
- 2) Fractionation measurements of methane isotopes in Titan's atmosphere to determine the global distribution of CH₃D/CH₄ on Titan to be uniform to within 10%. Observations were made with the Keck NIRSPA0 instrument in conjunction with VLT SINFONI measurements.
 - 3) ALMA observations were made in Cycle 0/1 and Cycle 1/2 to generate spatially resolved distribution of HCN and HC₃N on Titan.
 - 4) Observations were also made during the commissioning period of GPI in polarization mode of Titan that remain to be analyzed.

C. Upcoming Observations

- 1) ALMA observations are currently planned for 2016 to continue the search for the distributions of molecular species on Titan
- 2) Ground based observations have been proposed on a variety of telescope for the upcoming observing season to cover the first half of 2016.
- 3) Continued observations of Titan are planned in the upcoming flybys of Titan by Cassini with the VIMS and ISS instruments.
- 4) Efforts have been made to suggest potential points of interest in Titan science that can be achieved with JWST, though these observations are still several years from first light.
- 5) Significant efforts are being made to start a collaborative network of ground based amateur observing to compliment professional observatories in meteorological observations of Titan

Additional Discussion:

We are using VLT and IRTF, Gemini N/S – observing Titan from pretty much every telescope we can get hold of. No cloud has been seen from the ground, and only small ones from Cassini. More observations coming in this November, we will update.

Additional ground-based observations ... Mate Adamkovics will be presenting on different isotopic measurements. Imke: we typically observe once a year with OSIRIS, and with NIRSPEC before OSIRIS was on the telescope. We usually don't see any clouds; we are monitoring the aerosol distribution – with long timescale, we are starting to see changes.

Heidi – when is the next flip going to happen? Sarah: we think we are seeing it now, with some formations that might be the beginning of south polar hood.

Patricio Rojo is collecting polarization data using Gemini.

Imke – is the polarization data public? Heidi: I don't think it's public.

Glen: Palomar uses Titan as a calibrator

Sarah: there are a few ALMA observations of Titan coming up.

Pluto sub-discipline: Henry Roe

In 2015 with the high interest generated by the New Horizons encounter, numerous observers undertook Pluto campaigns with Earth-based facilities. (It's difficult to quantify for sure, but seems likely that Pluto was more heavily observed in 2015 than any previous year.) Many of these observations are listed on a website maintained by the New Horizons Observation Team (<http://guinan.space.swri.edu/nhcs/observations>). They range from ultraviolet wavelengths with HST to millimeter wavelengths with ALMA, and include spectral resolutions from broadband photometry to high-resolution spectroscopy.

Laboratory Experiments Sub-discipline: Paul Steffes

Written report:

- Steffes and Bellotti (Georgia Tech): Centimeter-wavelength measurement of ammonia and water vapor at temperatures up to 600 K to support Juno Microwave Radiometer (MWR) observations of deep Jovian atmosphere.
- David Goldsby (Univ. of Penn): Laboratory investigation of the effects of particulates on the flow of ice (Titan/Pluto)
- Murthy Gudipati (JPL): Photochemistry in Titan's lower atmosphere.
- Robert Hodyss (JPL): Titan surface crystals
- Peter Bernath (Old Dominion Univ.): Laboratory measurements of IR constituent spectra related to exoplanets (hot methane, ammonia, hydrocarbon)
- Ryan Leib (SRI International): Laboratory measurements of phosphine photochemistry kinetics.
- Keeyoon Sung (JPL): Mid IR spectroscopy of propane (Titan) and methane in near IR
- Tim Zwier (Purdue Univ.): Laboratory studies of Titan photochemistry.

Verbal presentation:

Lab Work – mostly focused on icy satellites – lots of work for Titan currently going on, still doing cm waves, high-temp, high-pressure work. Most of the work that's going on right now is on photochemistry on organics, (Sarah is still in that game) – there was a space station experiment, AMINO: tholin chemistry experiment.

No traditional spectroscopy work going on much. Linda Brown is retiring,

Tim Zwier at Purdue is still doing photochemistry.

Most of the lab work is focused on Titan... ice flows, particulates, etc. I don't know anybody working on neutral atmosphere of giant planets.

Malathy Devi at NASA Langley continues her lab spectroscopy work.

Peter Bernath at Old Dominion University was working on exoplanet atmospheric chemistry but he has been busy with the Canadian ACE (Atmospheric Chemistry Experiment) satellite mission lately.

Sarah: Exoplanet hot atmosphere chemistry work just got funded

Sarah: what's coming active – Pluto experimental work. With people in Flagstaff, we will start some results soon...

IOPW Aurora and Magnetosphere sub-Discipline: John Clarke

The concentration of effort in the past year has again been at Saturn, owing to the continuing Cassini mission and concentration of data taking. The Japanese EXCEED instrument on the HISAKI mission is also operating, and returning observations of the Io plasma torus and jovian aurora. The first science results from EXCEED have also now been published.

The status of the discipline was reported at the July 2015 Magnetospheres of the Outer Planets conference, held in Atlanta GA (<http://mop.gatech.edu/>). The next MOP meeting will be over 12-16 June 2017 in Uppsala Sweden.

The main results from the past year are best summarized by the many new publications that have come out, listed below. A good overview of the areas of effort can be gleaned simply from the paper titles.

New Publications:

“Mapping the Electron Energy in Jupiter's Aurora: Hubble Spectral Observations”, J.-C. Gérard et al., *J. Geophys. Res.*, 119, 9072-9088, doi:10.1002/2014JA020514 (2014).

“Survey of Saturn Auroral Storms Observed by the Hubble Space Telescope: Implications for Storm Time Scales”, J. Geophys. Res., 119, 9624-9642, doi:10.1002/2014JA020601 (2014).

“Jupiter’s Equatorward Auroral Features: Possible Signatures of Magnetospheric Injections”, M. Dumont et al., J. Geophys. Res., 119, 10,068 - 10,077, doi: 10.1002/2014JA020527 (2014).

“Vertical Emissivity Profiles of Jupiter’s Northern H3+ and H2 Infrared Auroras Observed by Subaru/IRCS”, T. Uno et al., J. Geophys. Res., 119, 10,219 - 10,241, doi: 10.1002/2014JA020454 (2014).

“Transient Internally-driven Aurora at Jupiter Discovered by Hisaki and the Hubble Space Telescope”, T. Kimura et al., Geophys. Res. Lett., doi:10.1002/2015GL063272 (2015).

“Saturn’s Northern Auroras as Observed Using the Hubble Space Telescope”, J.D. Nichols, S. Badman, E. Bunce, J.T. Clarke, S. Cowley, G. Hunt, and G. Provan, Icarus, 263, 17-31, doi: 10.1016/j.icarus.2015.09.008 (2015).

“Cassini VIMS Observations of H3+ Emission on the Nightside of Jupiter”, T. Stallard et al., J. Geophys. Res., 120, 6948-6973, doi:10.1002/2015JA021097 (2015).

“Down-tail Mass Loss by Plasmoids in Jupiter’s and Saturn’s Magnetospheres”, S. Cowley, J. Nichols, and C. Jackman, J. Geophys. Res., 120, 6347-6356, doi:10.1002/2015JA021500 (2015).

“Giant Planet Magnetodiscs and Aurorae - an Introduction”, K. Szego et al., Sp. Sci. Rev., 187, 1-3, doi:10.1007/s11214-014-0131-x (2015).

“Solar Wind and Internally Driven Dynamics: Influences on Magnetodiscs and Auroral Responses”, P. Delamere et al., Sp. Sci. Rev., 187, 51-97, doi:10.1007/s11214-014-0075-x (2015).

“Auroral Processes at the Giant Planets: Energy Deposition, Emission Mechanisms, Morphology, and Spectra”, S. Badman et al., Sp. Sci. Rev., 187, 99-179, doi:10.1007/s11214-014-0042-x (2015).

A special issue of Icarus in early 2015 will feature a suite of papers about Saturn’s magnetosphere based on Cassini data.

Open Discussion:

Julie: Q: Does SSO give preference to observation that supports missions? A: yes.

Imke: Certain projects like Jupiter SL9 were a big deal that drew a lot of funding.

Heidi: we can't tell NASA what to spend their funding on, but we can suggest specific languages in the program calls to encourage timely proposals. If we can make a convincing case that there are observations that enhance NASA's missions in the short term through missions or time-critical phenomena, we can advocate for those observations and ask for specific languages in the calls. It's too late for Juno – but we should start advocating for JWST.

Glenn: Juno's first science orbit is November 16th. It's the right time now actually.

By the way, there's a new program PDART – which can be used to analyze data and archive, and make new higher-order data products.

It might be too late for SSO, but is there a list of critical observations that need to be made?

Glenn: there are categories of “significant enhancement” of missions for SSO

Heidi: Do you want to try to make a list of critical observations for Juno, end of Cassini, etc? Those are the kind of things we should work on and write to NASA about.

Imke: we did write a letter to ALMA (ASAC) to request a change in their policy with regard to several of their policies, such as simultaneous use of 7m- and 12m- arrays, and timing constraints. Fletcher wrote a white paper about it too.

Glenn: SSO lists missions that need to be supported.

Action item: Kunio has had discussion on what type of languages could be suggested to be included in program calls, so Kunio will draft the type of language that could be submitted to NASA PO's, give it to Heidi, and then wordsmithed to be handed to Glenn.

Paul Corlies: two years left for Cassini, so this is our chance to build the ground-based observation.

Before we drift too far away from SSO ... it's not too late to suggest languages before February.

Glenn: we are starting to see a dark spot form on Neptune.

Imke: we want to see how deep it extends... Question is whether it's forming – it wouldn't be surprising given the bright spot. The behavior is similar to what Heidi got during Voyager cruise

For SSO – Juno, Titan clouds ... Cassini end of mission? What else do we have that are timely?

West: Cassini observations are very sparse – if you make a very good case to provide contexts to the observation sequences, that should be encouraged...

Ricardo: end of Cassini could be supported by HST, when Cassini is too close to see the entire Saturn.

Heidi: I am urging this steering committee to find important time-critical opportunities and encourage NASA and observatories to give priorities – tell them that there are time-critical observations, and ask them if there is any way to give priorities to those observation.

Chris – it was 30 years ago that I wrote a letter to ask money to have this group supported ... we haven't spent any money in 29 years. International Halley Watch is how this group started.