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Taurus Hill Observatory Scientific Observations for Pulkova Observatory during the 2016-2017 Season

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Abstract

Taurus Hill Observatory (THO) [1], observatory code A95, is an amateur observatory located in Varkaus, Finland. The observatory is maintained by the local astronomical association Warkauden Kassiopeia. THO research team has observed and measured various stellar objects and phenomena. Observatory has mainly focused on exoplanet light curve measurements, observing the gamma rays burst, supernova discoveries and monitoring [2]. We also do long term monitoring projects [3].

1. Exoplanet observations during the season 2016-2017 for Pulkova Observatory

During the winter 2016 - 2017 Taurus Hill Observatory [1] has been actively involved with the Pulkova Observatory, Russia, in a project to look for new exoplanets. During the winter, the brightness variations and the abnormalities of few selected stars have been closely monitored at Taurus Hill Observatory. The aim of the observation campaign is to find out about the orbiting times of potential exoplanets around their central star and the magnitude of brightness change in the central star caused by them.

2. Variable star discoveries during the exoplanet campaign

In these exoplanet observations made in THO four completely new variable stars, some of which appear to be WUMa-type variables and one HADS-type variable, have been unexpectedly discovered among the comparison stars used to determine the change in brightness of the exoplanets. For determining the type of the one remaining variable star requires more additional observations, which will be made during the next observation season 2017-2018. These variable stars were detected when various unexpected changes occurred in the mutual brightness of the observed exoplanet candidate or the reference stars that were observed.

3. Asteroid 3169 Ostro observations

In addition, during the spring 2017, asteroid 3169 Ostro has been observed for the Pulkova Observatory. Ostro has a regular period in the light curve and this regularity of the period may indicate that the asteroid is very concise or interrelated double-asteroid.

Summary and Conclusions

The discoveries regarding the four completely new variable stars needs more observations during the next observation season, especially the fourth one that has not been yet categorized and identified. Also the asteroid 3169 Ostro requires more observations for determining the nature of the asteroid. Exoplanet observations campaign for Pulkova Observatory continues on the observation season 2017-2018.

Acknowledgements

The Taurus Hill Observatory will acknowledge the cooperation partners, Pulkova Observatory, Finnish Meteorological Institute and all financial supporters of the observatory.

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Bright features on Uranus and Neptune

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1. Abstract

In the past 10 years, we have studied the atmospheres of Uranus and Neptune using telescopes with apertures ranging from 28 to 50 cm. Our focus was on the detection of bright features on these planets. In 2015, we have imaged a long-living bright storm on Neptune, which existed for at least 5 months. This storm showed a westward drift of 24.0º/day, which fitted quite well with the know local wind speeds. Other spots were also detected.
In 2016 a bright spot was detected on Uranus. In general, the occurrence of bright features on Uranus seems to be rarer than on Neptune. This study illustrates the potentials of amateurs to contribute to studies of the distant ice giants.

2. Introduction

For amateur astronomers, the distant planets Uranus and Neptune are quite a challenge. With their angular size of maximal 3.6” and 2.4”, respectively, it is not easy to detect atmospheric details. However, the recent development of digital cameras with increased sensitivity in the near-infrared, including the methane bands at 616, 727, 862 and 889 nm, has opened new possibilities.

3. Results

3.1 Uranus

Our studies of Uranus started in 2006 [1]. At that time, no atmospheric details could be detected. In 2007 the Earth crossed the equatorial plane of Uranus and its satellites allowing the observation of the partial occultation of Umbriel by Ariel on 7 August 2007.

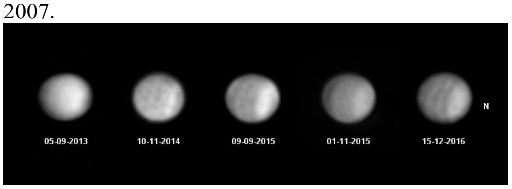

Fig.1: Uranus from 5 Sep. 2013 till 15 Dec. 2016. C14 and different types of cameras. Red long pass (>610nm) or IR filters

In the following years, the atmosphere of Uranus showed increased formation of darker and brighter bands (Fig. 1). In addition, brightening of the North Polar region could be detected. These changes might be seasonal effects.
An exceptional activity occurred in 2014, leading to several observations of a major storm by some amateurs [2] (Fig.2).

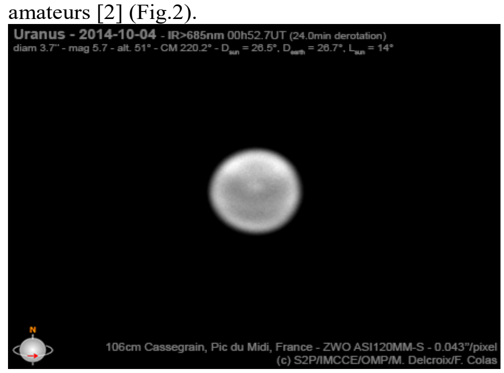

Fig.2: Uranus in Oct. 2014 from Pic du Midi 1m telescope in infrared, showing storm K1 at meridian.

However, the occurrence of bright spots detectable for amateurs turns out to be very rare. On 15 August 2016 nonetheless, a bright spot could be detected at coordinates longitude 241.9 º, latitude +56.7º (Fig.3).

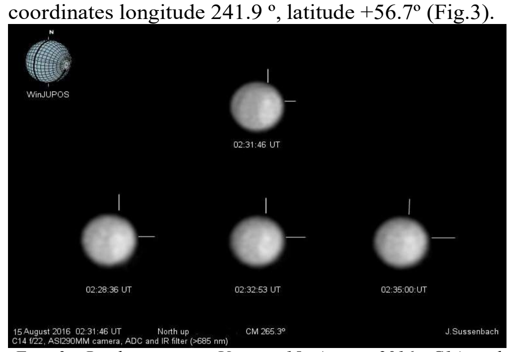

Fig. 3: Bright spot on Uranus 15 August 2016. C14 and ASI290MM camera and IR filter. At the top the combination of the three lower images. In the left upper corner a WinJUPOS simulation.

Unfortunately, prolonged poor weather conditions hampered to observe the development of this spot (only a few observations by other amateurs showed also possible activity in that zone). In the coming years, the declination of Uranus will increase steadily, which will give observers at the Northern hemisphere the opportunity to perform extensive studies of the atmosphere of Uranus by amateurs.

3.2 Neptune

After several sparse amateur observations of bright features on Neptune since 2013 [3], the frequent observation of Neptune by amateurs started in July 2015, when Ricardo Hueso from the Universidad del Pais Vasco, Bilbao, Spain did an appeal to the amateur world [4]. He requested amateurs to investigate whether a bright spot at -41º professionals discovered on Neptune on 13 July 2015 was also detectable with amateur instruments. This was indeed the case and we followed this feature (Spot A) till December 2015 (Fig.4).

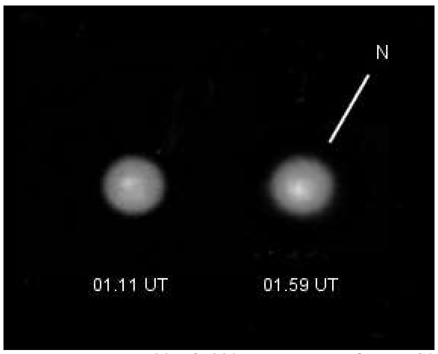

Fig. 4: Neptune on 20 July 2015. Imaging conditions: C14 f/22, QHY5LII camera and a 610 nm red long pass filter. North is up.

Later, also a second bright spot was detected, this time in the Northern hemisphere. We measured the drift of this Spot A and found a value of 24.0º/day westward in longitude (Fig.5) [5]. This fits quite well with the results of professional measurements showing a westward drift of 24.27º/day [4].

4. Conclusion

The bright features detected in the atmospheres of Uranus and Neptune represent high-altitude atmospheric disturbances. Interestingly, these features are less frequently present on Uranus than on the more distant planet Neptune. The appearance of atmospheric features deserves a longer period of observation to establish seasonal effects. This study illustrates that with the current equipment available to amateurs valuable information can be obtained about the atmospheric processes on Uranus and Neptune.

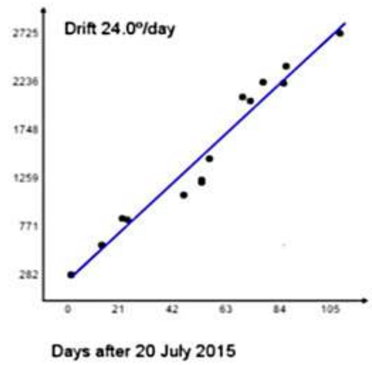

Fig. 5: Drift of Spot A on Neptune in 2015

5. Acknowledgements

We gratefully acknowledge the support of Dr. Ricardo Hueso Alonso who immediately informed the amateur astronomers about the discovery of spot A on Neptune on 13 July 2016 and stimulated them to detect and to observe its development. We thank him for his assistance.

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PVOL2 (The Planetary Virtual Observatory and Laboratory): An improved database of amateur observations of Solar system planets

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Abstract

The Planetary Virtual Observatory and Laboratory (PVOL) stores and serves publicly through its web site a large database of amateur observations of solar system planets [1, 2]. These images are regularly used for research on solar system astronomy [3] empowering collaborations between amateur and professional astronomers in planetary science in a wide range of topics that extend from studies of the atmospheres of the Giant planets, Venus and Mars to the motions of their satellites. We here document recent major advances in the PVOL database, now called PVOL2 and available since the second half of 2016. PVOL2 contains amateur observations from Mercury to Neptune including the Moon and the Galilean satellites. PVOL2 is also integrated in the VESPA portal (Virtual European Space and Planetary Access) as one general service in VESPA. PVOL can be consulted in http://pvol2.ehu.eus or through the VESPA portal in: http://vespa.obspm.fr/

1. Introduction

The original PVOL website and the current PVOL2 have been built as a database of amateur observations contributed by a few hundredths of observers. The PVOL2 website offers different searching tools that allow retrieving observations from a particular range of dates, a given observer, particular locations in a planet, movies and animations instead of original images, map projections and many others searching options. Data can be uploaded by amateur astronomers with a personal username and password or can be submitted by e-mail to pvol@ehu.eus. The webpage includes relevant news to amateur astronomers, short reports, links to major image sources such as ALPO-Japan among others (http://alpo-j.asahikawa-med.ac.jp/indexE.htm) and links to relevant websites in pro-am collaborations in Solar System astronomy like the websites of the Juno mission to Jupiter and the Akatsuki mission to Venus. Additionally PVOL2 can be consulted externally from other platforms popular among professional astronomers (like TOPCAT). A very important characteristic of PVOL2 is that it is now fully integrated in the VESPA portal which offers different services to the professional community. VESPA aims to build a Virtual Observatory for Planetary Science, connecting all sorts of data in the field and providing modern tools to retrieve, cross-correlate, and display data and results of scientific analyses. For instance, queries on VESPA of spectra of a particular planet would also show images of that planet in PVOL2 obtained in the time range of the spectra.

2. Data in PVOL2

PVOL2 contains amateur observations of Jupiter since the year 2000 and has been expanding ever since then. It now contains more than 32,300 image registries contributed by about 320 observers. Most of the images are Jupiter observations (72%) followed by Saturn observations (23%). Mercury, Mars and Venus images are available since 2016 and Uranus and Neptune observations, although a minority of the data, are also stored and used for scientific research of these planets [4]. Observations of the Galilean satellites and the Moon are also available and can be used for teaching projects. One new characteristic in PVOL2 is that most of the images uploaded since 2017 are "tagged" so that it becomes easy to find images containing a particular detail like Jupiter's Great Red Spot or a particular crater on the Moon. We continue to work to include data of more and more amateur observers to make PVOL2 as complete as possible.

3. Science

Advances over the last decade in electronic cameras, image processing software and the popularization of fast-imaging techniques have resulted in a golden era of amateur observations of the Solar System. Planetary observations by amateur astronomers reach a high spatial resolution and the combination of data from many different observers allows a nearly continuous monitoring of these planets. This is particularly important for the study of the atmosphere of Jupiter or the giant planets in general but it is also relevant in the study of other planetary atmospheres like that of Venus. PVOL2 contains a list of scientific publications that have used or are based in amateur data. About 30 scientific publications are listed in PVOL2, including publications in major scientific journals such as Nature, Science, The Astrophysical Journal or Astronomy & Astrophysics. These publications cover the following most relevant topics among many others:

- Jovian atmospheric dynamics [5, 6].

- Impacts in Jupiter [7, 8].

- Saturn atmospheric dynamics [9, 10].

- Uranus and Neptune atmospheric dynamics [4, 11].

- Venus global winds [12].

- Atmospheric features in Mars [13].

The current version of PVOL is indented to boost new professional and amateur collaborations in these and other related fields. The PVOL website also hosts a particular project related to the searches of fireball impacts in Jupiter [7, 8].

Acknowledgements

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Digital amateur observations of Venus at ~0.9μm

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Abstract

Venus atmosphere is extremely dynamic, though it is very difficult to observe any features on it in the visible and even in the near-IR range.

Digital observations with planetary cameras in recent years routinely produce high-quality images, especially in the near-infrared (0.7-1μm), since IR wavelengths are less influenced by Earth's atmosphere and Venus's atmosphere is partially transparent in this spectral region.

Continuous observations over a few hours may track dark atmospheric features in the dayside and determine their motion. In this work we will present such observations and some dark-feature motion measurements at ~0.9μm.

Ground-based observations at this wavelength are rare and are complementary to *in situ* observations by JAXA's Akatsuki orbiter, that studies the atmospheric dynamics of Venus also in this band with the IR1 camera [1,2].

1. Introduction

The dayside 0.90 μm images visualize the distribution of clouds illuminated by sunlight. Any features captured are considered to originate in the middle and lower cloud layers [3]. But, as with the visual band, the dayside disk appears almost featureless at this wavelength. Ground-based observations at this wavelength are very rare and moreover there are no image pairs to make measurements of the feature motion. Observations are very useful especially now that spacecraft Akatsuki is in orbit and takes images at this band with the onboard IR1 camera [4]. In this work we will briefly review the near-IR ~0.9μm imaging methodology, the observational results and some wind measurements.

2. Methodology

All observations were obtained with a 0.35m telescope and a DMK21AU618 camera along the 2016-7 eastern elongation of Venus. A Hutech IDAS 884-900nm bandpass filter was used. The observing method is based on image pairs or triplets separated by a temporal interval of ~1-2 hours [5]. Since observations were obtained from one observer, in order to achieve the typical observing window of ~2 hr with Venus in higher altitude we used Digital Daylight Observation (DDO) methodology [6] to capture the planet with the Sun above the horizon. When Venus is low in the horizon it is impossible to capture any useful details. Near-IR observations provide better resolution (suffers less from earth's atmospheric disturbance) and are less influenced by daylight radiation. Furthermore, it's quite hard to detect any low-contrast features in the bright Venus disk without special processing by using software like *Registax* and *Photoshop*.

3. Observations & Results

Some set of observations will be presented like the one in Fig.1.The complete set of observations can be found at [7]. The ~0.9μm images obtained were used for cloud tracking. *WinJupos* [8] was used to retrieve the velocity of individual features in different latitudes.

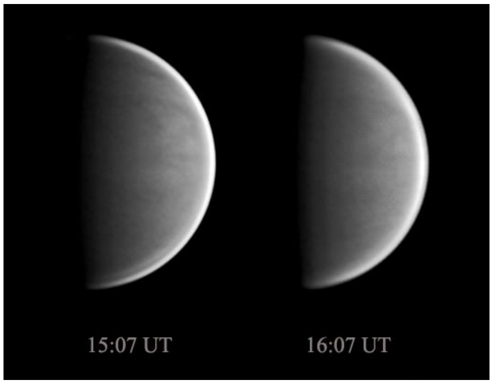

Figure 1. *Venus observations separated by one hour on Jan. 2nd, 2017 at 0.9μm showing movement of dark features [North is up]*

4. Summary and Conclusions

Modern technology and equipment allow planetary observations by amateurs in the ~0.9µm band. We presented the methodology, some observations and preliminary results that may be useful. Our data provide the first wind measurements in 0.9µm from a single ground-based observer.

Acknowledgements

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Europlanet 2020: Fostering the collaboration between professional scientists and amateur astronomers

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Abstract

The Horizon 2020 advanced research infrastructure project *Europlanet 2020* aims to strengthen the collaboration in European planetary sciences. One of the major goals of the project's Work Package NA1 Task 12.5 "Coordination of ground-based observations" is to foster the cooperation between professional planetary scientists and amateur astronomers in Europe. This presentation will give an overview on Europlanet 2020 and will summarize the major activities of NA1-Task 12.5, focusing on how the project supports the activities of amateur astronomers and their collaboration with professional scientists in Europe. This will also include an overview on funding possibilities for amateur astronomers.

1. Introduction

Europlanet 2020 (http://www.europlanet-2020-ri.eu/) is an advanced research infrastructure project of the European Commission's funding scheme Horizon 2020. Its main goals are the provision of access to planetary field sites and European laboratories, the development of Virtual Observatories for planetary sciences, the support for scientific workshops and summer schools, as well as the provision of a high-quality Public Outreach Media Centre. As the follow-up project of two other highly-successful Europlanet-projects it started operation in September 2015 and will be active until August 2019. It is divided into several different Work Packages (WPs), of which one of them is *WP12: Networking Activity 1 (NA1) "Innovation through Science Networking"*. One of its tasks – *Task 12.5 "Coordination of ground-based observations"* – will be presented in more detail within this presentation. One of its major goals is to foster the collaboration between professional scientists and amateur astronomers.

2. NA1-Task 5: Collaboration between professionals and amateurs

NA1- Task 12.5 "Coordination of ground-based observations" is centered on three main goals: (i) the organization of scientific workshops for the coordination of observation campaigns, (ii) the organization of amateur training workshops and summer schools, and (iii) the establishment of an observatory database, in which amateurs can build up their own system to share their observational data with the scientific community.

During the first two years of the project several workshops with its focus on the coordination of amateur campaigns were funded and organized within the frame of NA1-Task 5. As an example, the "Workshop on Juno Ground-Based Support from Amateurs: Science and Public Impact", which took place from May 12-13, 2017, in Nice, France, marked one of the by now most successful amateur oriented workshops of the first project-half. In addition, NA1-Task 5 also is organizing amateur training workshops /summer schools, of which some of them are taking place on a yearly basis at the Moletai Observatory in Lithuania. Besides presenting some of those workshops and summer schools, the presentation will also give an insight on how you can apply for workshop support.

NA1-Task 5 is also upgrading the so-called *"NA1-Matrix of Ground-based Facilities and Space Missions"* (http://iwf.oeaw.ac.at/matrix/), which was already developed during the predecessor of Europlanet 2020, i.e. during Europlanet-RI (2009-2012). Within the new project it will be extended, so that amateur astronomers will be able to share their observational data with the community via the Virtual Observatory VESPA.

3. Summary and Conclusions

Via the funding of dedicated workshops for the coordination of amateur observation campaigns, as well as of dedicated amateur training workshops, Europlanet 2020 provides a strong tool for fostering the collaboration between professional scientists and amateur astronomers. Since amateur astronomers provide a strong benefit for the European community, this presentation wants not only to advertise the need of such collaboration, but also to invite the community to apply for workshop funding. Amateur astronomers often do not have the possibility to attend scientific workshops and to meet each other at conferences. Hence, NA1-Task 5 for the first time provides a scheme, which very much facilitates such collaborations and which funds the attendance of amateur astronomers at scientific workshops or even at conferences such as this year's EPSC.

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Amateur observations of exoplanets in Finland: History and recent activities

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Abstract

Exoplanets have been observed by Finnish amateur astronomers already 17 years. Recently there are two active observers, but the interest to photometric observations on exoplanet transits is increasing in Finland.

1. History

The first exoplanet transit observation in Finland was made by Jyväskylän Sirius observing group: Marko Moilanen, Jalo Ojanperä, Jouni Sorvari, Aki Id and Arto Oksanen on 16 September, 2000 [1]. The observation of HD 209458 exoplanet transit was made with 16-inch Meade telescope and SBIG ST7E CCD camera in Nyröla Observatory in Central Finland. The observation was confirmed by Geoffrey Marcy from University of California at Berkeley.

This was also the first amateur observation of exoplanet transits in the world. It started the rising interest on exoplanet observing among Finnish amateurs.

The observation was also one reason why NASA and Berkeley scientists founded Transitserach.org netowork [2] for coordinating amateur exoplanet observations. Sirius group continued collaboration with newly founded Transitsearch.org.

Taurus Hill Observatory (THO) began the scientific research campaigns by observing supernovae and making the first amateur supernova discoveries in Finland. After success in supernova discoveries, THO concentrated mailnly on the light curve measurements, especially exoplanets. First contacts between THO and the scientific community were with Gregory Laughlin [7] and his research partners in 2007. As the light curve measurements were in the high scientific level, THO further initiated research partnerships e.g. with TRESCA [5] and latest with the Pulkovo Observatory (Russia) [6]. Nowadays THO has observed and measured over 50 exoplanet light curves.

2. Recent activities

Currently there are 2–3 amateur groups observing exoplanet transits in Finland.

Petri Kehusmaa is collaborating with KELT (Kilodegree Extremely Little Telescope) observation system [3]. The main goals for this cooperation are:

- multiband photometric observations of exoplanet candidates found by KELT wide field cameras and contributing light curve data to research team
- find new exoplanets

Kehusmaa is also working as support astronomer in CONTRAST team [4] which is collaboration of several projects on planetary science. Kehusmaa id observing two known exoplanet system to analyze their full period cycle. Kehusmaa is using remote controlled telescope in Chile.

During the winter 2016 – 2017 Taurus Hill Observatory has focused on the Pulkovo Observatory exoplanet research campaign by observing the carefully pre-selected stars. The aim of the observation campaign is to find out about the orbiting times of potential exoplanets around their central star and the magnitude of brightness change in the central star caused by them. This campaign will continue on the next observing seasons.

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Comprehensive amateur coverage of the Mars 2015-2017 apparition from the Southern Hemisphere

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Abstract

Although there are current, active scientific assets orbiting and on the surface of Mars, comprehensive amateur monitoring of the planet can still add value. With latest technology and improved high resolution imaging techniques, amateurs are still in a position to observe and report in real time on any significant atmospheric activity on the planet. The author was able to follow the 2015-2017 Mars apparition comprehensively from December 2015 through until February 2017. The planet was imaged on 198 nights by the author during this period, and although no major(non-regional) dust storms occurred during the apparition, a number of atmospheric phenomena were noted and imaged. Orographic cloud formations, Northern and southern polar hood development, high latitude weather systems and the changing weather systems and conditions in and around the Hellas basin were observed and recorded.

1. Introduction

The author, based at a southern latitude of 25 deg 53 min and a longitude of 28deg 09min East was ideally located to monitor the planet over the duration of the apparition. Although there were some periods of unsettled weather, conditions on the South African Highveld were generally favourable, with variable seeing conditions. This location also assists with filling the observational gap between the observers of the far eastern and western hemispheres. The first observation was made on 5 December 2015 with Mars at an angular diameter of 4.8" and the last of the apparition was captured on 19 February 2017 at and an angular size of 4.7".

1.1 Observatory and equipment

The author's backyard observatory is located at his home in Centurion, Gauteng, South Africa. It is a motorized roll-off roof design and houses a pier mounted Celestron 14" Edge HD Schmidt-Cassegrain telescope. A range of ZWO cameras are used, although the major portion of the apparition was covered using the ZWO ASI290MC camera with Baader L filter. IR imaging was also undertaken. Processing was done with Autostakkert 2!, Registax 6 and Photoshop.

1.2 Observing programme

This section will summarise the statistical record of observations made during the course of the apparition

2. Main Features and Highlights noted during the apparition

2.1 Orographic Cloud formations over the Tharsis plateau during the Martian Southern Spring season.

Extensive orographic cloud formations developed and were observed during the northern late summer/autumn period.

2.2 The Polar Hoods and other high latitude cloud and weather systems

The normal cycle of Polar hood formation and dissipation was observed, with a number of interesting high latitude weather formations being recorded.

2.3 Hellas

The Hellas Basin underwent a number of interesting changes as the seasons progressed. Of particular note was the development of what appears to be south easterly jet streams which carried mixed cloud and dust from the basin.

2.4 Dust activity

Although there was no global dust storm activity during the apparition, a number of regional dust events were observed

3. Figures

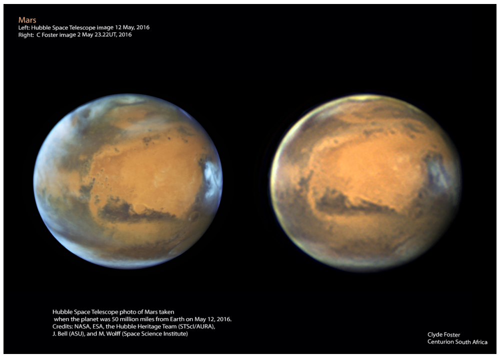

Figure 1: Hubble comparison image.

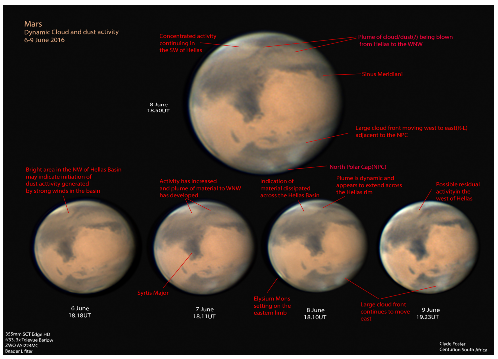

Figure 2: atmospheric activity close to opposition.

4. Summary and Conclusions

Although the much anticipated Martian global dust storm event was not observed on this apparition, amateur, high resolution earth based imaging permitted comprehensive monitoring of various atmospheric conditions and events over the duration of the apparition. Despite the fact that relatively few amateur astronomical alerts were published, the amateur astronomical community remains in a strong position to support the professional planetary scientific community

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The 19th of July 2016 Multi-Chord Stellar Occultation by Pluto - A European PRO-AM cooperation

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Abstract

The occultation of the 14th mag star UCAC4 345-180315 by Pluto on the evening of the 19th of July, 2016 could be observed from large parts of Europe, middle east and northern Africa as well. A campaign had been organized with many observers and observatories throughout Europe and other countries. Professional as well as amateur observatories and observers shared in a PRO-AM cooperation to achieve the highest possible coverage. The scientific goal was the ongoing monitoring of Pluto's atmosphere, waiting for a possible shrinking of its pressure due to the increasing distance of Pluto from the sun. The astrometric predictions were largely done by the RIO team and Bruno Sicardy's. An occultation of a fainter star 5 days before (14th of July) was successfully observed and used as a "pathfinder" for the main occultation on the 19th. In an unprecedented action, the GAIA team released the star position of the target star 2 months before the GAIA DR1 catalogue was made public. This helped to determine the occultation track for the 19th with extremly high precision (pre- versus post occultation calculation only differed in less than 100 km).

Because of relative good weather conditions for the event, observations of about 30 stations could be recorded and analyzed. This report will describe the observations, the lightcurve analysis and will give some insights in the atmospheric situation in the year after the New Horizons flyby.

1. Introduction

Because a space probe flyby can only determine conditions in the atmosphere for one single time point, a continuous monitoring of the status of the atmosphere of Pluto using stellar occultations has to be performed. Occultation astronomy is the only precise way to evaluate these data. The increasing solar distance of Pluto since 1988 leads to a decrease in solar flux down to 79.5% up to now and down to 47% for the next aphelion in about 100 years.

2. Observations

Observing stations with telescopes ranging from 0.20m to 3.58m diameter took part in the campaign. One of the main obstacles for many observatories was the close proximity of the target to the full moon. The angular distance was only about 10 degrees. Furthermore, the event took place for central Europe only low in the sky, the elevations were only between 10 and 20 degrees.

Images were recorded either using analogue video cameras or fully digital cameras with 12 or more bit A/D . In most cases timing was provided by GPS receivers or NTP connections, either implementing the time directly into the analogue videosignal or inserting it in the FITS images digitally. Video data files (avi files) were transferred to single FITS image files using ffmpeg software (Linux). All images were analyzed using a batch job written in MIDAS [5] image analysis software using varying aperture sizes dependent on the quality of the images. Plots and statistical analysis were mainly done using DATAPLOT software from NIST [4].

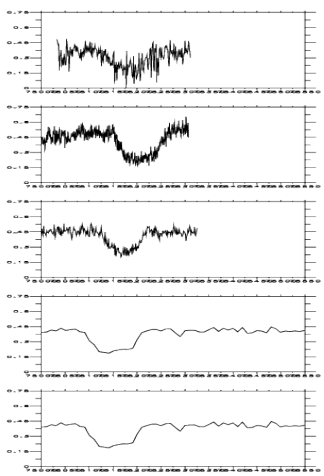

Figure. 1 Some lightcurves for instruments larger then 42 cm diameter

Nearly 30 light curves had been acquired with highly varying quality. This causes some problems in data fitting for further atmospheric analysis.

3. Main results

Getting all light curves together, the status of the atmosphere could be determined using fitting procedures as described in [3] and [4]. The post-occultation astrometry, derived from the observed light curves was in perfect agreement with the pre-occultation prediction. The knowledge of the GAIA position of the target star together with the Pluto astrometry from the "pathfinder" occultation 5 days before was a perfect prediction scheme.

The atmosphere has still not collapsed and did not undergo big changes in the year since 2016. A more detailed analysis will follow.

In terms of information of observers this campaign had shown, that in central Europe it is possible to motivate very different observers and observatories to take part in a true multinational observation campaign for professional and amateur observers.

4. Acknowledgements

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DeTeCt planetary impact detection project - frequency estimations and big data set secondary results

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Abstract

The DeTeCt project has been running for 5 years, aiming at not only detecting impact flashes on Jupiter (and Saturn), but also estimating their frequency. Although no impact has been detected yet, a frequency of 4.7 impacts per year on Jupiter could be estimated (as of 2017.05.08), thanks to continuing participations of amateurs to the project and refinement of the processing. Additionally, analysis of the large data set from the 67 thousands of videos analysis brought some information about amateur astronomers habits in planetary imaging. This can even help improving the impact frequency estimation.

1. Introduction

A software was developed by the UPV/EHU Bilbao team to automatically detect impacts (http://pvol2.ehu.eus/psws/jovian_impacts/, [1], [2]), on Jupiter amateur videos. Based on it, the DeTeCt project was launched by the author (http://www.astrosurf.com/planetessaf/doc/project_detect.shtml). By logging date information of the videos analyzed and collecting them, it aims at estimating the impact frequency on Jupiter and Saturn, using negative as well as positive detections ([3], [4]). Work has been done to improve the quality of this estimation in the post processing phase by improving the date information.

Furthermore, all these analysis logs from the big number of 67 198 videos can be analysed to derive interesting information about participating amateurs' habits.

2. Improvement of analysis

The log files generated by the DeTeCt software and collected include start and end date information, duration, fps (frames per seconds) of the videos, filename, detect software version, and capture software version if the acquisition log generated by the capture software is available. Unfortunately, in a certain number of logs, the date information is not standardized, exact, or accurate. The processing log analysis algorithm has hence been improved:
- to transform all local times into universal times (from observer location information, or from cross-checking different date information)
- using the filename of the file to derive date information if missing from the logs
- using a default duration for the videos (set-up at 20s initially) when it is not known
- correcting duration when it is incoherent
- correcting simultaneous acquisition dates for the same observer.

This allowed a more accurate estimation of the total duration of videos analysed, changing the value from 71.905 days of Jupiter videos analysed to 77.258 days (7.4% increase), bringing the frequency estimation from 5.08/year down to 4.73/year.

3. Log data set analysis for identifying amateur habits or trends

The number of amateurs and videos analyzed growing steadily over the years built a large set of data (36100 videos from 48 different observers since 2015 – limited to analyze only the most recent information). This can be used to derive other results about planetary amateur astronomers' usages.

3.1 Duration of acquisitions

Using the duration of the videos for each observer, we get an average duration of 98s per observer for acquisitions. This stays below the admitted limit of 120s per video to have the rotation of the planet compensated by the multipoint alignment method use by Autostakkert, the standard stacking software used by all amateurs (http://www.autostakkert.com/). Only 4 observers (8%) have an average video length between 200 and 600s, showing as they use the video derotation function implemented in the WinJupos software (http://www.grischa-hahn.homepage.t-online.de/index.htm).

This showed that the previous assumption of setting to 20s the duration of DeTeCt processed videos which duration was not known was really underestimated. Correcting that value to 98s refines the frequency estimation from 4.73/year to 4.69/year.

3.2 Acquisition formats

DeTeCt support multiple acquisition formats (ser, avi, fit, jpg, png, etc.). Out of those, the fit format was hardly used since 2015, the avi format used by 35% of the observers and the ser format, created for planetary imaging, is used by 65% of the amateurs.

3.3 Capture softwares

For the 40 observers whose acquisition software could be identified, 3% use PLXcapture (dedicated for one brand of camera), 3% SharpCap, 13% Genika (software under license/provided with cameras bought from the Airylab company https://airylab.com/genika-astro/ , with a version existing also for the professional market) but the vast majority (83%) use FireCapture (http://firecapture.de/), clearly the leader of acquisition software.

This confirm that would we work on implementing a detect functionality in capture softwares, we should concentrate on FireCapture, as discussed during a workshop in January 2017 in Toulouse about the future possible DeTeCt improvements.

In 2017, only 10% of the FireCapture users used not the latest version of the software available, which proposes to update itself when a new version is available (usually once a year). Still, for 43% of the observers, the acquisition software logs are not available. This is a way for improvement as having them would greatly increase the accuracy of the date and duration information from the videos

3.4 DeTeCt software

In 2017, for the first 15 observers who participated to the project, 21% did not use the latest version 2.0.4 (they used earlier versions 2.0.1, 2.0.0 or even 1.2.2 which is 4 years old). DeTeCt version usage is clearly fragmented, probably due to the fact that the software does not detect itself that it is not up-to-date and hence do not propose, like FireCapture, to update itself.

This confirm the interest of this possible functionality identified during the January 2017 DeTeCt workshop.

4. Future improvements

On top of the improvements identified above, a DeTeCt users survey conducted by the author identified the strengths and weaknesses of the software, and possible improvements.

The robustness of the automatic detection algorithm as well as a friendly graphical user interface were hence developed in a new DeTeCt version 3 ([5]).

5. Conclusion

Through this project and software, science results are obtained from amateur’s data to estimate the rate of impacts on Jupiter (4.7/year in May 2017) and on Saturn (7.1 days of videos analyzed without any flashes). These science results could be improved by bigger participation of amateurs in analyzing their Jupiter and Saturn videos, thanks to an improved software and a better usage of capture software.

Additionally, the data obtained permits to understand the trends and usages of planetary amateur astronomers, hence potentially taking this into account for scientific projects.

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