Aurinkokuntatapaaminen 2022

Harrastajapostereita tiedekokouksiin

Veikko Mäkelä, Markku Nissinen, Jorma Ryske

Mikä on posteri?

- Posteri on julistemuotoinen tapa esittää tutkimustuloksia
- Posteri ovat tieteellisten esitelmien ohella olennainen osa tieteellisiä kokouksia
- Posterit ovat näytteillä kokoustiloissa ja ohjelmaan voi kuulua erityinen aika, jolloin tekijät esittelevät omaa posteriaan kokousyleisön kiertäessä posterialueella
- Perinteinen posteri tyypillisesti A0-kokoinen pysty- tai vaakasuuntainen juliste (kokousten järjestäjät usein ohjeistavat koosta ja muodosta)
- Virtuaalisissa konferensseissa (ainakin EPSC, *Europlanet Science Congress*) on lanseerattu virtuaalinen eli verkkoposteri, se voi olla esimerkiksi muutaman PowerPoint-kalvon setti, joka on helpommin ruutuluettavassa muodossa

Harrastajat tiedekokouksissa

- Muutamissa tiedekokouksissa, muun muassa EPSC:ssä, on harrastajille varattu oma ohjelmalinja proam-tyyppisille aiheille, näissä on sekä esitelmiä että postereita
- Harrastajat voivat olla myös mukana yhteistyökumppaneina ammattitutkijoiden postereissa ja harrastajaposterit voivat olla mukana muissakin ohjelmalinjoissa
- Posteri on harrastajalle ehkä helpompi tapa päästä esittelemään tuloksiaan kuin esitelmä, vaikka hyvä posteri vaatiikin vähintään saman verran työtä

Esimerkkejä

- Seuraavassa esimerkkejä muutamista viimeaikaisissa konferensseissa olleista sekä perinteisistä että virtuaalisista postereista

Veikko Mäkelä ja Paula Wirtanen:

Diminishing of Martian Southern Polar Cap in Apparition 2020–2021

Europlanet Science Congress (EPSC) 2021

Verkkoposteri

Diminishing of Martian Southern Polar Cap in Apparition 2020–2021

Veikko Mäkelä[1], Paula-Christiina Wirtanen[1]

[1] **Ursa Astronomical Association / Lunar and Planetary group**, Helsinki, Finland; **(kuuplaneetat@ursa.fi)**

Abstract

We present some results of diminishing of Martian Southern Polar Cap (SPC) during the apparition 2020–2021 by Finnish amateur data. We have selected a sample from ca 150 images and converted them into a polar projections using the WinJUPOS software. Then we have measured the northernmost latitude of SPC from each image.

The diminishing rate is consistent with to the data from earlier apparitions, e.g. by British Astronomical Association and American Lunar and Planetary Observers.

The SPC asymmetry and misplacement from the Martian South Pole is clearly visible.

Novus Mons feature was observable as a separated icy fragment near the edge of the SPC during the period 14–21 Aug 2020.

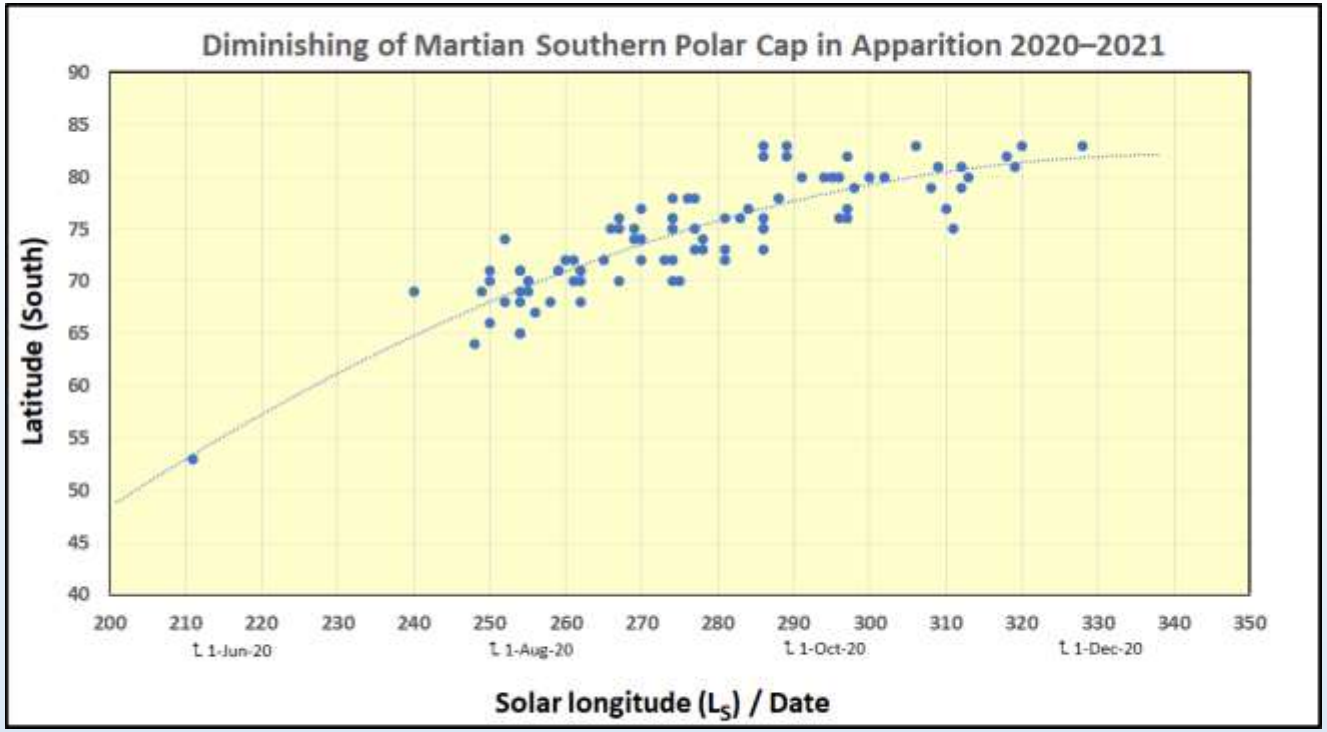


Figure 1. The northernmost latitude of the SPC edge by Finnish observational data. The dotted line shows a 2nd order polynomial fitting of the data points. The X-axis shows the solar longitude (L_S) and corresponding date.

Diminishing of Martian Southern Polar Cap in Apparition 2020–2021

Veikko Mäkelä[1], Paula-Christiina Wirtanen[1]

[1] **Ursa Astronomical Association / Lunar and Planetary group**, Helsinki, Finland; **(kuuplaneetat@ursa.fi)**

Abstract

We present some results of diminishing of Martian Southern Polar Cap (SPC) during the apparition 2020–2021 by Finnish amateur data. We have selected a sample from ca 150 images and converted them into a polar projections using the WinJUPOS software. Then we have measured the northernmost latitude of SPC from each image.

The diminishing rate is consistent with to the data from earlier apparitions, e.g. by British Astronomical Association and American Lunar and Planetary Observers.
The SPC asymmetry and misplacement from the Martian South Pole is clearly visible.

Novus Mons feature was observable as a separated icy fragment near the edge of the SPC during the period 14–21 Aug 2020.

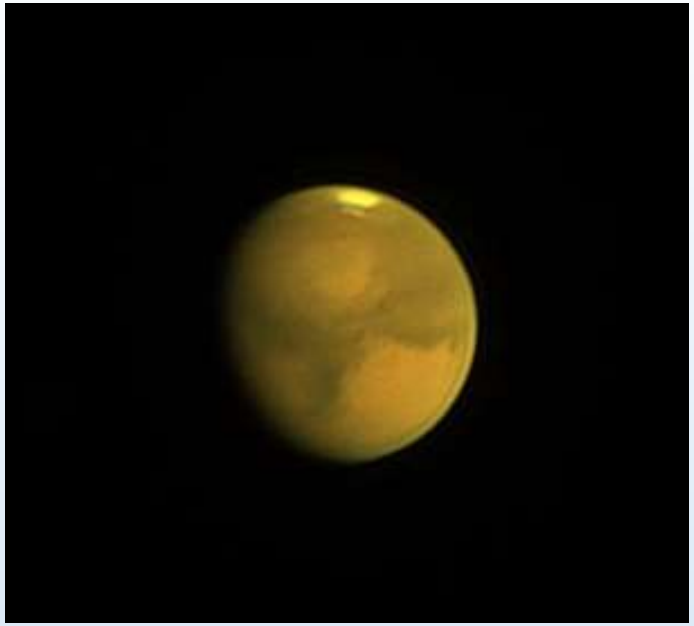


Figure 1. Image by J. Jantunen 19 Aug 2020 at 22:58–23:01 UT (CM = 294°) with 0.28-m SCT and QHY5III224 planet imaging camera.

Introduction and Observations

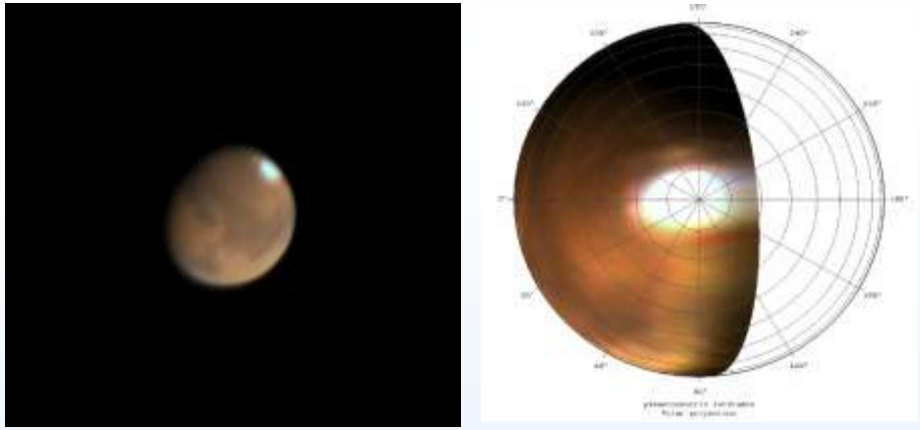
Background

The Martian apparition 2010–2011 was the best for the high latitude observers for almost 15 years. The perihelion on 3 Aug 2020, just two months before the opposition, offered a large angular diameter of the planetary disc and the axial position of the planet made possible to study the southern polar cap (SPC).

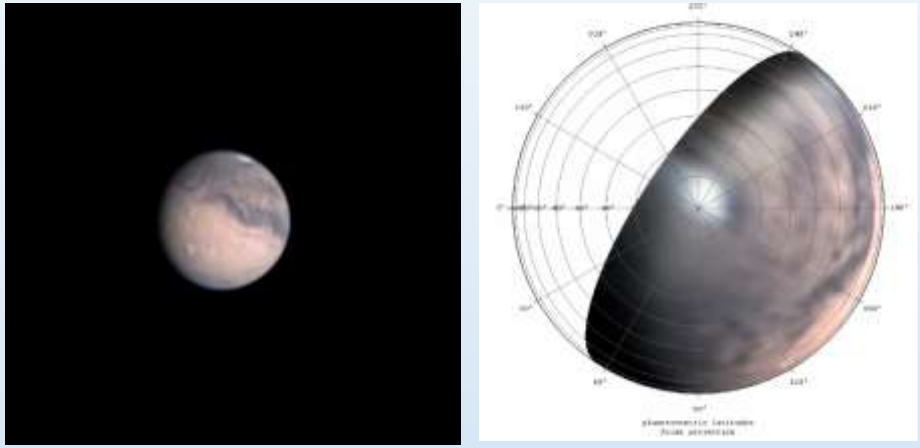
Observations and Measurements

We had ca 150 images taken by the members of the Lunar and Planetary group of Ursa Astronomical Association. Observations were made with 0.10-m up to 0.40-m telescopes mainly with planet imaging cameras. Image data cover the period from May 2020 to May 2021 [1].

We selected a large sample of images where the polar cap is clearly visible. Then we converted the sample images into a polar projection with planetocentric latitudes using the WinJUPOS software [2]. We measured the northernmost latitude of SPC from each projected image.



Figures 2–3. Image by M. Ankelo 16 Aug 2020 at 01:15 UT (CM = 4°) and corresponding polar projection.



Figures 4–5. Image by L. Ekblom 7 Sep 2020 at 00:18 UT (CM = 273°) and corresponding polar projection.

Results: The Diminishing Rate

We were able to monitor the diminishing rate of Martian SPC by detecting its northernmost latitude from May to December 2020. The results are show in the Figure 6. The polynomial fitting of the diminishing rate is consistent with the data from earlier apparitions, e.g. by British Astronomical Association and American Lunar and Planetary Observers [3, 4].

Due to poor weather conditions in midwinter 2020–2021 the disappearance of the SPC is unsolved. In January 2021, the SPC is not detectable in the Finnish data, albeit there are some reports of its visibility in the observations of British Astronomical Association [5].

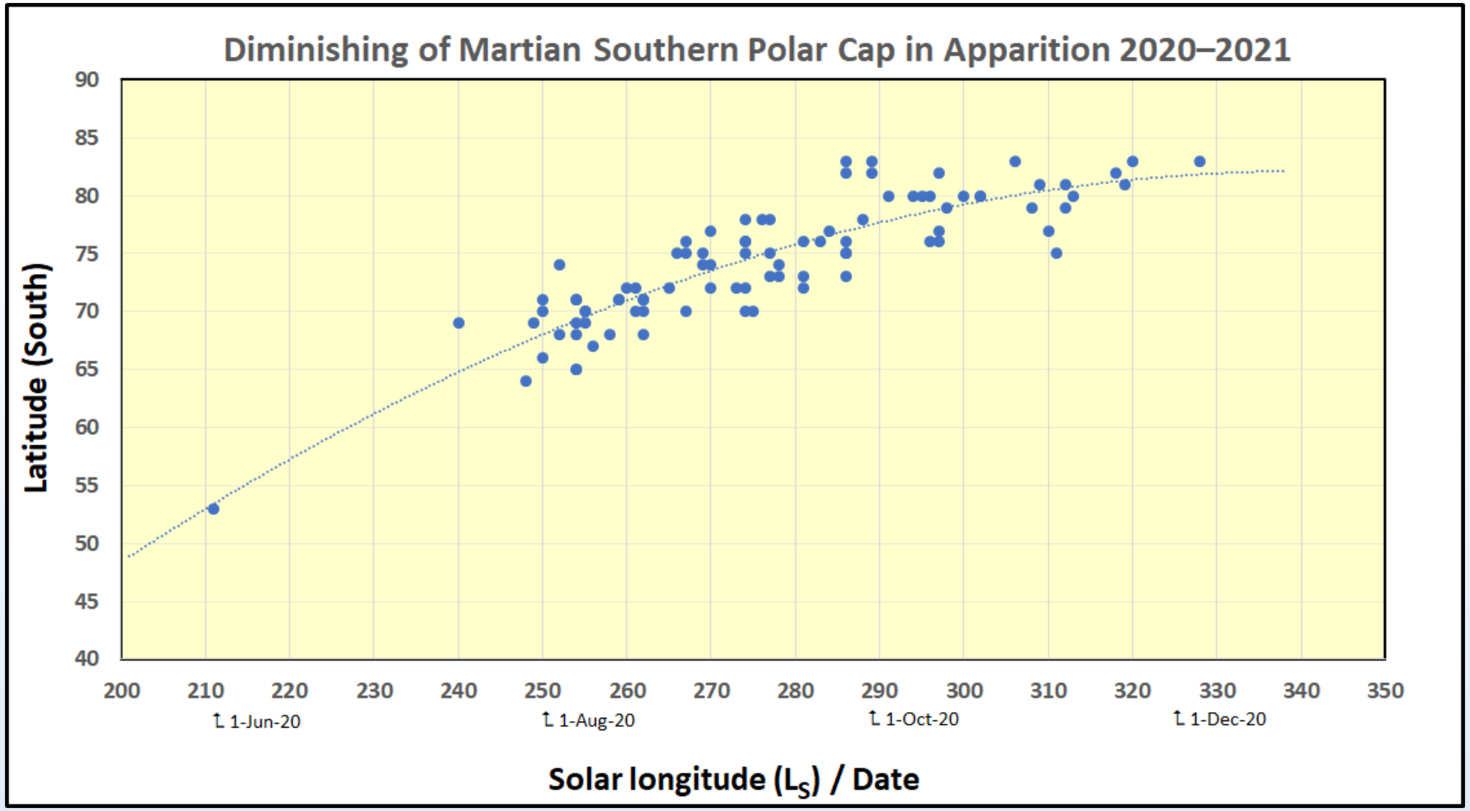


Figure 6. The northernmost latitude of the SPC edge by Finnish observational data. The dotted line shows a 2nd order polynomial fitting of the data points. The X-axis shows the solar longitude (L_S) and corresponding date.

Results: Shape and features of SPC

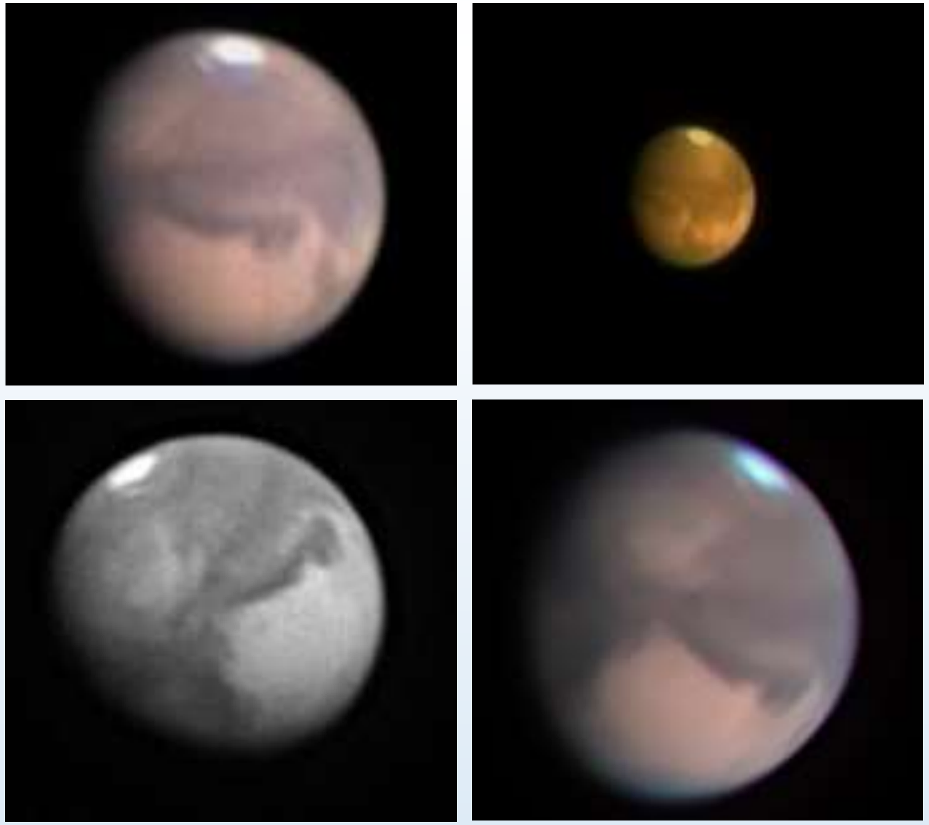
In the early phases of the diminishing process the SPC was more or less oval-shaped. Especially in the August 2020 observations the shape was clearly non-circular.

The SPC asymmetry is clearly visible. The centre of the polar cap was misplaced from the Martian South Pole. The northern edge of SPC extended towards 330–60° longitudes. The midpoint was located around the 80–85° latitudes.

Novus Mons feature

Novus Mons, aka "Mountains of Mitchel" area was visible in late August 2020 observations. In the early August observations it was observable as a "bump" in the edge of SPC. As a separated icy fragment near the edge it was visible during the period 14–21 Aug 2020 (L_S = 258–262°).

The areographic location of the feature was around 300–330° W and 70–75° S.



Figures 7–10. Images with Novus Mons feature. From upper left: by L. Ekblom 16 Aug 2020 at 23:58 UT (CM = 336°), by J. Kankaanpää 16 Aug 2020 at 23:04 UT (CM = 7°), by M. Koskimo 19 Aug 2020 at 23:59 UT (CM = 308°) and by A. Haavisto 21 Aug 2020 at 0:41 UT (CM = 310°).

Discussion and Conclusions

The results are consistent with earlier studies e.g. by British Astronomical Association and American Lunar and Planetary Observers [3, 4]. The polar projection method proved useful to study the polar cap evolution and features.

Three main factors compromising the latitude measurements accuracy are:

- Due to asymmetry of SPC, observations made from the opposite direction of the extend edge easily produce too high latitude values
- The quality of observations, e.g. poor seeing conditions, small aperture telescopes and image process weaknesses decreases the accuracy
- Manual positioning of the images in the JUPOS software, e.g. adjusting planet disc and axis direction, cause some deviation to the results

The asymmetry and the misplacement of the polar cap centre from the planetary pole are clearly detectable from the amateur data. Asymmetry have been noticed by Huygens already in 1672. Maraldi noticed the misplacement from the pole in 1719 [6]. Later these are confirmed by e.g. Mars missions data [7]. These phenomena have been explained by topographic and climatic features in Martian western hemisphere near the southern polar region [8, 9]. The large and deep impact basins Hellas Planitia and Argyre Planitia are assumed to change climatic conditions on the Martian southern hemisphere.

The Novus Mons feature is discovered by O. M. Mitchel in 1845 [4]. The mountain region keeps shortly its ice cover when the SPC is melting and the edge is shrinking southwards.

References

[1] Taivaanvahti database, Ursa Astronomical Association, *https://www.taivaanvahti.fi/observations/browse/pics/3869010/observation_start_time*.
[2] WinJUPOS project, *http://winjupos.org*.
[3] McKim R. (2021), British Astronomical Association, *personal communication*.
[4] Beish J. (2020). "The South Polar Region", Association of Lunar and Planetary Observers, http://www.alpo-astronomy.org/jbeish/SPR.htm.
[5] McKim R., (2021). "BAA: The 2020 Mars Opposition blog, part 2", *https://britastro.org/node/24324*.
[6] Schmude R. W. Jr. (2019). "The South Polar Region of Mars: A Review". Georgia Journal of Science, Vol. 77 No. 2, *https://digitalcommons.gaacademy.org/cgi/viewcontent.cgi?article=1919&context=gjs*.
[7] Schenk P. M. and Moore J. M. "Mars Polar Lander resources". Lunar and Planetary Institute, *https://www.lpi.usra.edu/resources/msp/msp.html*.
[8] Colaprete A., Barnes J. R., Haberle R. M., Hollingsworth J. L., Kieffer H. H. and Titus T. N. (2005). "Albedo of the south pole of Mars determined by topographic forcing of atmosphere dynamics". Nature 435:184-188.
[9] M. Giuranna, D. Grassi, V. Formisano, L. Montabone, F. Forget & L. Zasova (2008). "PFS/MEX observations of the condensing CO2 south polar cap of Mars". Icarus 197(2):386-402.

Markku Nissinen, Maria Gritsevich,
Arto Oksanen, Jari Suomela:

Modeling of Cometary Dust Trails

84th Annual Meeting of Meteoritical Society (MetSoc) 2021

Verkkoposteri

MODELING OF COMETARY DUST TRAILS

M. Nissinen[1], M. Gritsevich[1,2,3,4], A. Oksanen[5], J. Suomela[6]

[1]Finnish Fireball Network, Ursa Astronomical Association, Kopernikuksentie 1, 00130 Helsinki, Finland. E-mail: markku.nissinen@pp.inet.fi, [2]Finnish Geospatial Research Institute, Geodeetinrinne 2, 02430 Masala, Finland, [3]Department of Physics, University of Helsinki, Gustaf Hällströmin katu 2a, P.O. 64, 00014 Helsinki, Finland. E-mail: maria.gritsevich@helsinki.fi, [4]Institute of Physics and Technology, Ural Federal University, Mira str. 19., 620002 Ekaterinburg, Russia, [5]Hankasalmi observatory, Jyväskylän Sirius ry, Verkkoniementie 30, 40950 Muurame, Finland, [6]Clayhole observatory, Jokela, Finland.

Introduction

The aim of this work is to present the 'Dust Trail kit' model describing the evolution of cometary dust trails. Besides the model description, as a case study, we demonstrate our analysis of the physical and spatial characteristics of the dust trail produced by the 2007 explosion of comet 17P/Holmes. Comet 17P/Holmes experienced a big outburst on 2007 October 23-24 leading to a large amount of dust particles and gas ejecting from the comet [1].

The dust particles started orbiting the Sun in different elliptic orbits. Solar radiation pressure and Jupiter's gravitational disturbance cause the particles' orbits to differ from the orbit implied by the pure gravitational model. The dust particles converge in two common nodes of their orbits making it possible, in addition to the modeling, to directly observe the dust in the visible light spectrum using ground-based telescopes [6]. One of the aims of our work is to study the populations of different sized particles ejected during the 2007 outburst [2] from the coma of 17P/Holmes by developing and applying the dust trail particle model.

Methods

The dust trail particle model (Fig. 1) comprises multiparticle Monte Carlo modeling including the solar radiation pressure effects, gravitational disturbance caused by Jupiter, and also gravitational interaction of the dust particles with the parent comet itself. The model is validated using the observational data obtained by us [3] [4] [5]. The obtained results allow us to make predictions for the future dust trail behavior when it comes close to the 2007 explosion point. According to the earlier proposal, the particle size is modeled using the β parameter, which generates non-gravitational solar radiation pressure disturbance to the particle [6]. Ejection speed was different for the different sized particles [7]. Smaller particles attained greater maximum speed than larger particles.

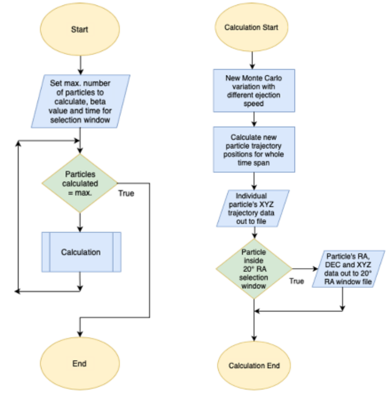


Figure 1: Flowchart of the dust trail particle model.

Solar radiation pressure effect β is effectively particle size (Eq. 1). Particle size is linked to maximum ejection velocity v. Model calculates particle locations in heliocentric ecliptic coordinate-system (Egs. 2, 3). When sampling particle in observation window and calculating RA and DEC Earth's location is subtracted (Eq. 4).

$$g_p = \frac{1}{1-\beta} g_s \quad (1)$$

$$\begin{bmatrix} x_{eq} \\ y_{eq} \\ z_{eq} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\varepsilon & -\sin\varepsilon \\ 0 & \sin\varepsilon & \cos\varepsilon \end{bmatrix} \cdot \begin{bmatrix} x_{ec} \\ y_{ec} \\ z_{ec} \end{bmatrix} \quad (2)$$

$$\begin{bmatrix} x_2 \\ y_2 \\ z_2 \end{bmatrix} = \begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix} + \begin{bmatrix} v_x \\ v_y \\ v_z \end{bmatrix} \quad (3)$$

$$\begin{bmatrix} x_{gw} \\ y_{gw} \\ z_{gw} \end{bmatrix} = \begin{bmatrix} x_p \\ y_p \\ z_p \end{bmatrix} - \begin{bmatrix} x_{earth} \\ y_{earth} \\ z_{earth} \end{bmatrix} \quad (4)$$

Results

We have observed dust particles in the trail of comet 17P/Holmes starting from 2013 February until 2015 October in the southern common node and in the northern common node close to the year 2007 explosion point [3] [4] [5]. We have developed the model describing the evolution of cometary dust trails and have successfully used these observations to validate the modeling accuracy using the prominent example of comet 17P/Holmes. We have made predictions of future observability of dust particles near the comet's 17P/Holmes explosion point in the Northern Hemisphere.

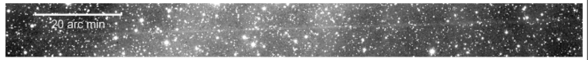


Figure 2: Observation of the trail as seen in 2015 February 15 in Hankasalmi Observatory. Without image subtraction.

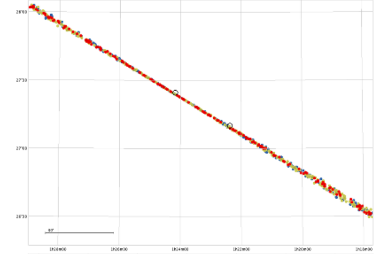


Figure 3: Dust Trail kit modeling results vs observation made in 2015 February 15. X axis shows RA and Y axis DEC. Blue: β = 0.03 (particle radius 0.03 mm). Yellow: β = 0.01 (particle radius 0.1 mm). Red: β = 0.001 (particle radius 1 mm). Observed dust trail positions from the middle of Figure 2 are marked as black circles. Observed positions show full width of telescopic field of one CCD-image.

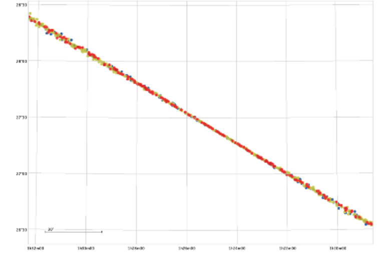


Figure 4: Dust Trail kit modeling results for prediction of dust trail for February 2022 (2022-02-15T18:55:03). X axis shows RA and Y axis DEC. Blue: β = 0.03 (particle radius 0.03 mm). Yellow: β = 0.01 (particle radius 0.1 mm). Red: β = 0.001 (particle radius 1 mm).

Conclusions

Our modeling and its comparison to the observations show that the developed model describes well the evolution of cometary dust trails (Fig. 3). By applying the model to the dust trail of comet 17P/Holmes we observe the following. The trail will be visible in 2021 and 2022 even by using modest aperture telescopic systems, but it may require image subtraction to enhance particle detectability (Fig. 4). The surface brightness of the dust trail in 2021-2022 will be similar or greater to that of 2013-2014 in the southern node of the orbit [6] in the Southern Hemisphere, but it will be less than it was observed in February 2015 near the explosion point in the Northern Hemisphere [3] (Fig 2). This kind of interplanetary dust is likely to be observable also using mid infrared spectroscopy.

Acknowledgements

We express deep gratitude to Esko Lyytinen for initiating this research and for putting in place effective collaboration under the umbrella of the Ursa Astronomical Association and the Finnish Fireball Network. We thank Salli and Olli Lyytinen for sharing the material for this research from Esko Lyytinen's personal archive and computers. We believe this allowed us to provide a comprehensive representation of the dust trail evolution research ideas that were earlier described to us by Esko in the form of personal communications, emails and notes. We are grateful to Pekka Lehtikoski for his contribution to the programming of the mathematical model. This work was supported, in part, by the Academy of Finland project no. 325806 (PlanetS).

Dedication

This presentation is dedicated to the memory of mastermind Esko Lyytinen who did a tremendous amount of original research, modeling, and meteor showers predictions for the scientific community.

References

[1] Lin Z. Y. et al. (2009). "The Outburst of Comet 17P/Holmes". AJ, 138(2). [2] Sekanina Z. (2009). "Comet 17P/Holmes: A Megaburst Survivor", International Comet Quarterly, pp. 5-23. [3] Lyytinen E., Nissinen M. and Oksanen A. (2015). "Dust Trail of Comet 17P/Holmes". ATel 7062. [4] Lyytinen E., Nissinen M., Lehto H. J. and Suomela J. (2014). "Dust Trail of Comet 17P/Holmes". CBET 3969. [5] Lyytinen E., Lehto H. J., Nissinen M., Jenniskens P. and Suomela J. (2013). "Comet 17P/Holmes Dust Trail". CBET 3633 #1. [6] Lyytinen E., Nissinen M. and Lehto H. J. (2013). "Comet 17P/Holmes: originally widely spreading dust particles from the 2007 explosion converge into an observable dust trail near the common nodes of the meteoroids' orbits". WGN, Journal of the International Meteor Organization, 41(3), pp. 77–83. [7] Reach W. T. et al. (2010). "Explosion of Comet 17P/Holmes as revealed by the Spitzer Space Telescope". Icarus 208(1), pp. 276-292.

Markku Nissinen, Maria Gritsevich,
Arto Oksanen, Jari Suomela:

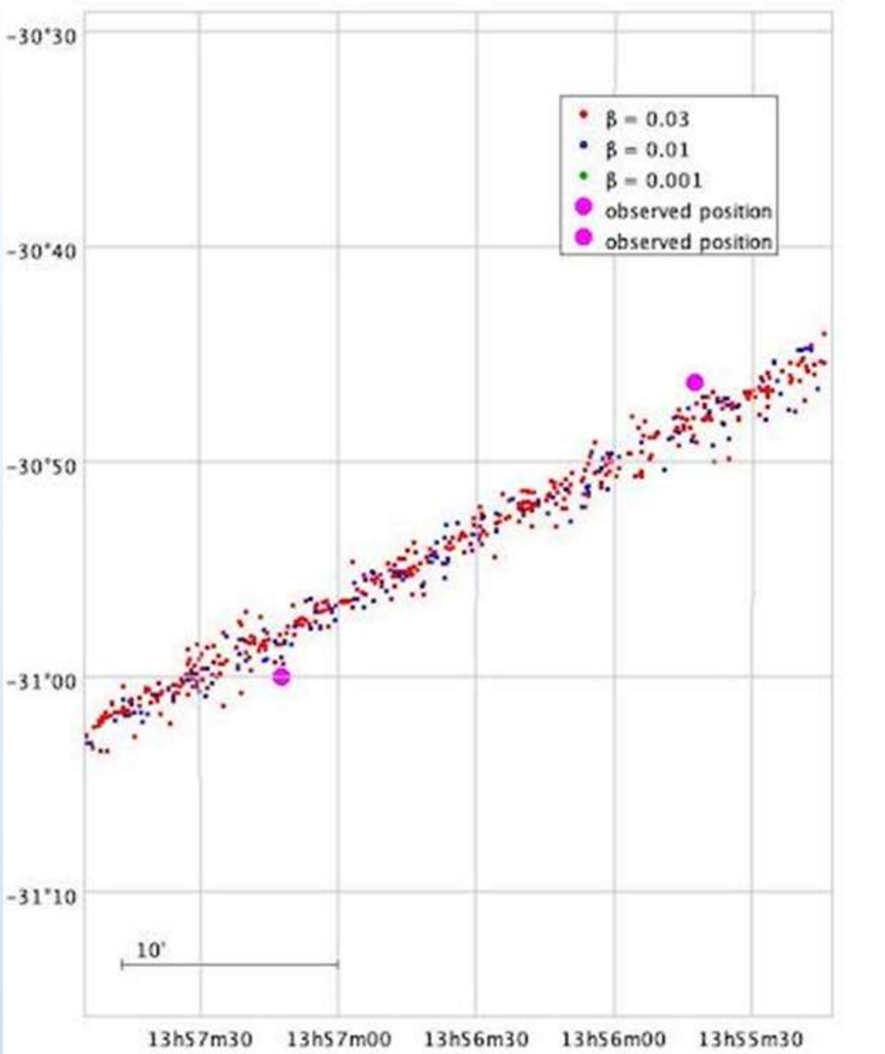
Dust Trail Observations of Comet 17P/Holmes and Predictions for 2021–2022

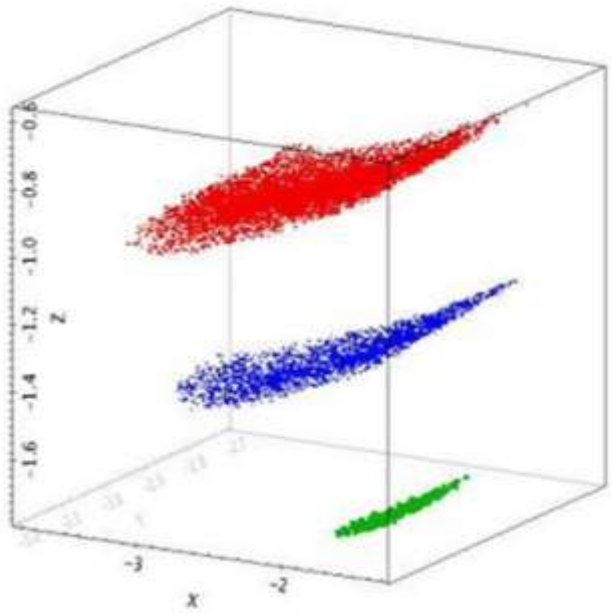
Europlanet Science Congress (EPSC) 2021

Verkkoposteri

Dust Trail Observations of Comet 17P/Holmes and Predictions for 2021-2022

M. Nissinen, M. Gritsevich, A. Oksanen, J. Suomela





β = 0.03 (particle r = 0.03 mm). β = 0.01 (r = 0.1 mm). β = 0.001 (r = 1 mm).

Fig. 1 & 2. Modeling of observation made in 2013 August 24.

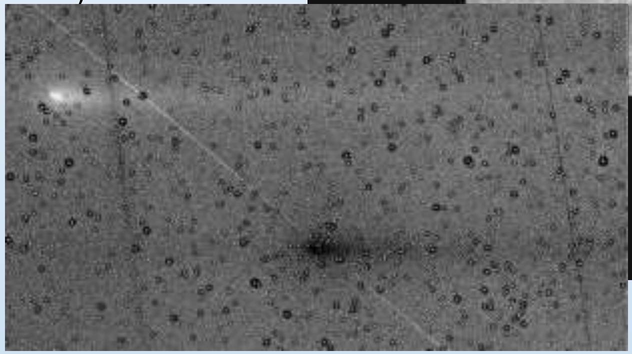


Fig 3. 17P/Holmes pictured on top of the dust trail on 2014 September 3-4.

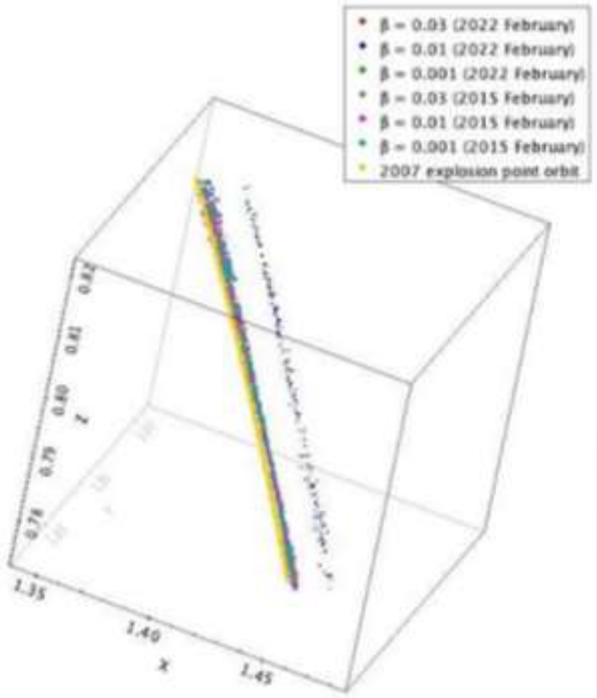


Fig. 4. Prediction of the dust trail in February 2022 near the 2007 outburst point. Marked in the picture is 17P/Holmes orbit at the time of outburst event, modeled 2015 February trail and 0.01 AU further away modeled 2022 February trail.

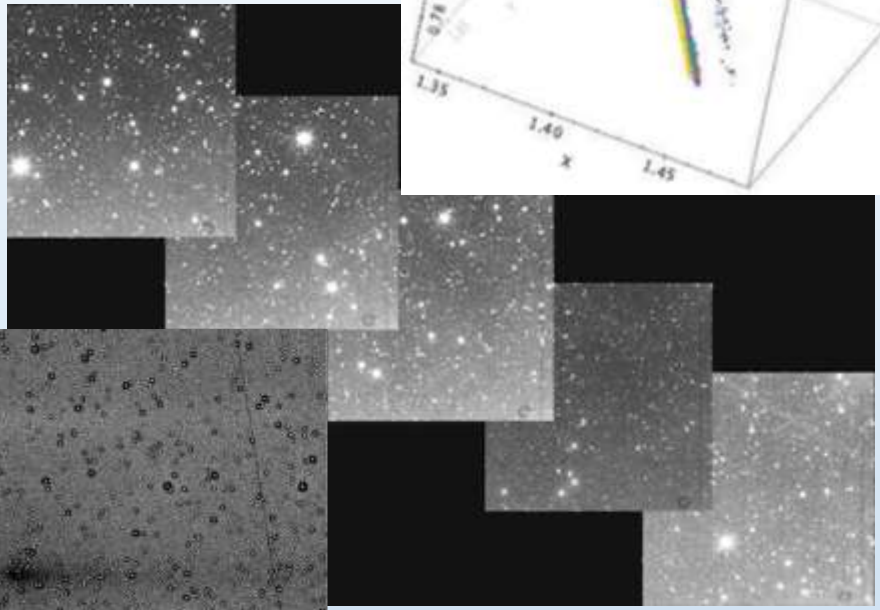


Fig. 5. Observation obtained in 2015 February 14 from Hankasalmi observatory.

Dust Trail Observations of Comet 17P/Holmes and Predictions for 2021-2022

M. Nissinen[1], M. Gritsevich[1,2,3,4], A. Oksanen[5], J. Suomela[6]

[1] **Finnish Fireball Network, Ursa Astronomical Association, Kopernikuksentie 1, FI-00130 Helsinki, Finland (markku.nissinen@pp.inet.fi)**

[2] Finnish Geospatial Research Institute (FGI), Geodeetinrinne 2, FI-02430 Masala, Finland

[3] Department of Physics, University of Helsinki, Gustaf Hällströmin katu 2a, P.O. Box 64, FI-00014 Helsinki, Finland. (maria.gritsevich@helsinki.fi)

[4] Institute of Physics and Technology, Ural Federal University, Mira str. 19., 620002 Ekaterinburg, Russia

[5] Hankasalmi observatory, Jyväskylän Sirius ry, Verkkoniementie 30, 40950 Muurame, Finland. (arto.oksanen@jklsirius.fi)

[6] Clayhole observatory, Jokela, Finland. (suomela20@gmail.com)

Presentation highlights

- *A comprehensive model capable of describing the evolution of the dust trails produced by the 2007 outburst of comet 17P/Holmes.*
- *Continuous observations of the dust trails in common nodes for 0.5 and 1 revolutions.*
- *Predictions for the two-revolution dust trail behavior near the explosion point for the years 2021 and 2022.*

Background

Comet 17P/Holmes’ outburst

When the comet 17P/Holmes' outburst took place on 2007 October 23-24 a large amount of dust particles and gas were ejected from the comet [1][7]. Comet was a rare spectacle to the observers (Fig. 1).

The dust particles ended up on elliptic orbits around the Sun and seemingly vanished. However, there are two common nodes of their orbits, where dust particles converge and form the possibility to directly observe the dust telescopically in the visible light spectrum [2].

Individual dust particle orbits are affected mainly by solar radiation pressure effects and Jupiter gravitational disturbance.
We made predictions of dust observability in visible light, when the dust converges near the outburst point in the future, starting from fall 2021.

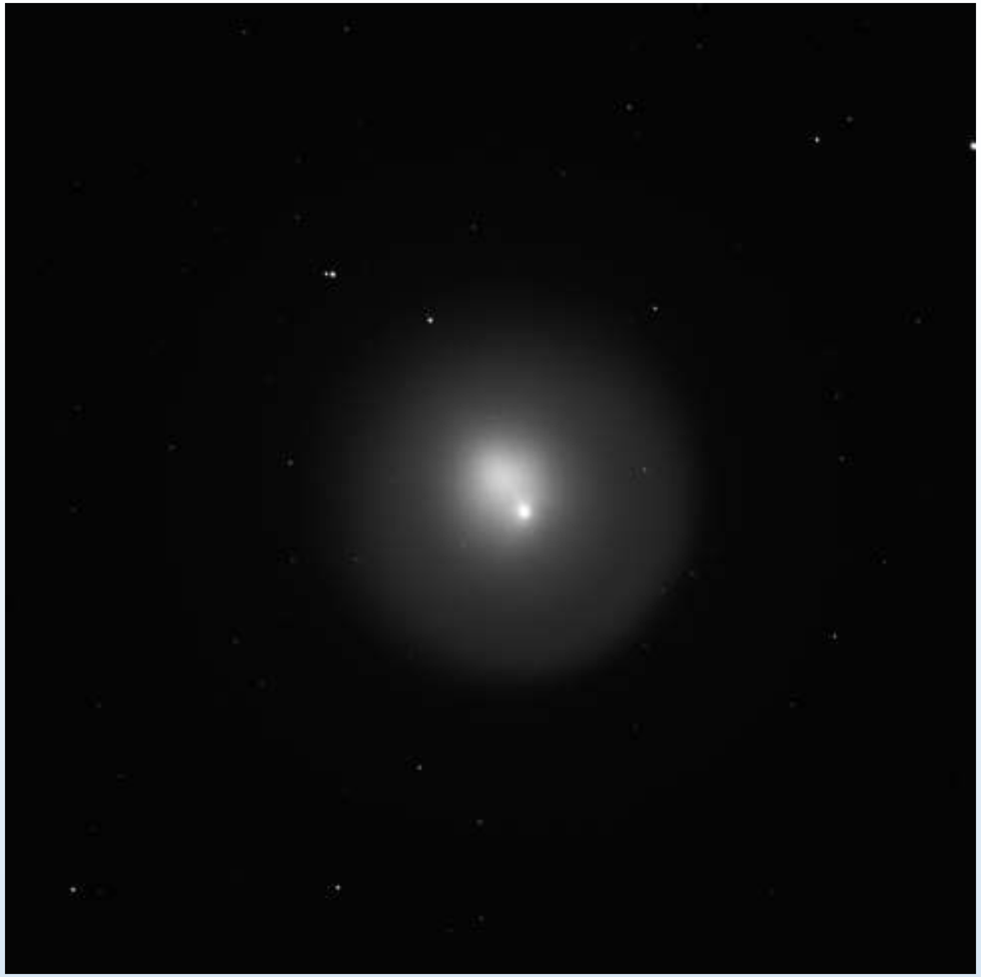


Figure 1. Comet 17P/Holmes observed in Hankasalmi Observatory 2007 November 4.

First Trail Observations (February 2013)

Our first observations of the dust were made at the Siding Spring Observatory. The modeling results show that all particle sizes (correlating with the parameter β) modeled were still present in the dust trail. The observed part of the dust trail was situated already towards the end part of the trail. The second observation made in August 2013 showed a dust trail, which had small and middle sized particles, but not any more big particles (Fig. 2 & 3).

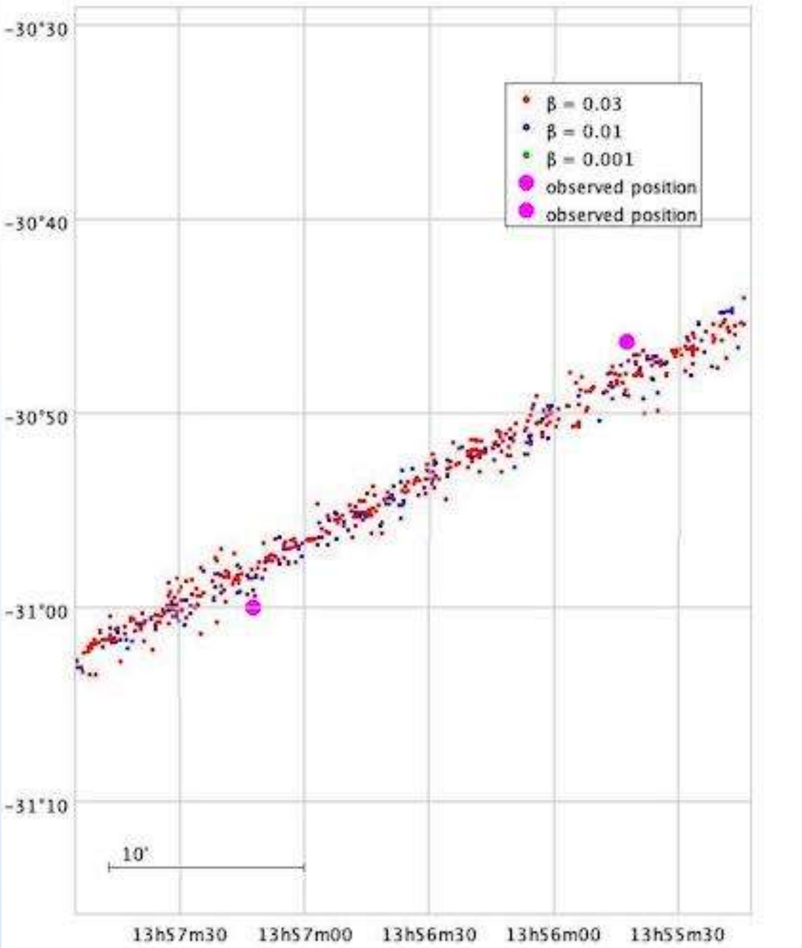


Figure 2. Modeling of observation 2013 August 24. Plotted in the figure are also the observed position points, which are corrected by adjusting time of the observation to match the timestamp used in the model using a coordinate list [6]. Sky coordinates.

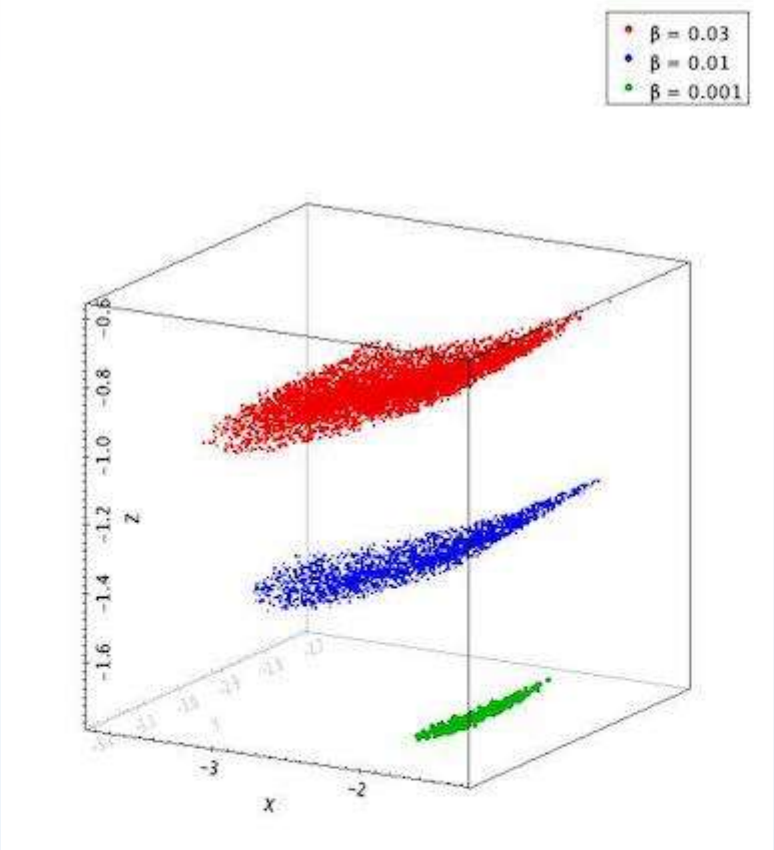


Figure 3. Modeling of observation 2013 August 24. Cartesian coordinates.

Trail in September 2014

Observations were continued in the Northern Hemisphere at the Auberry Sierra Remote Observatory and at the New Mexico Skies observatory in September 2014, when the comet itself was located on top of the dust trail as seen from Earth. All particle sizes were present during the observation with the comet itself (Fig. 4). Observations continued in Hankasalmi Observatory, Finland. In February 2015 dust trail was visible without image subtraction [3][4][5](Fig. 5).

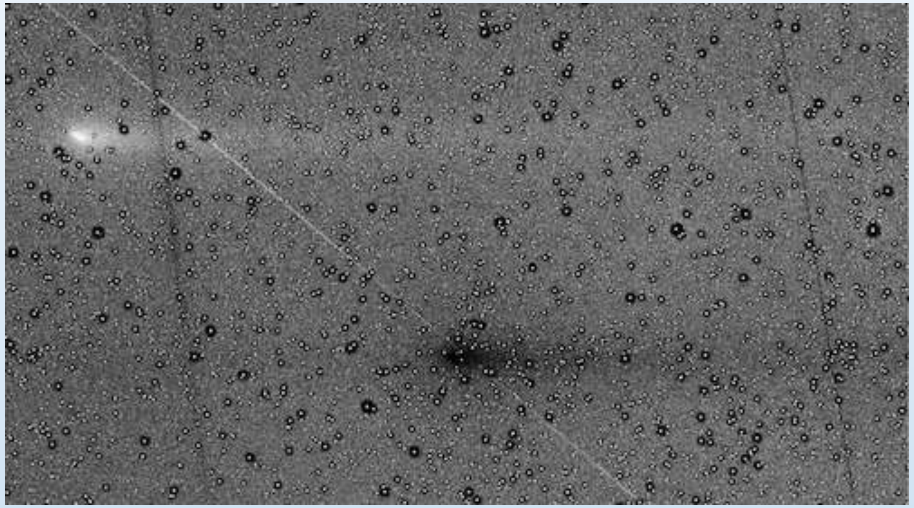


Figure 4. Comet 17P/Holmes pictured when traveling on top of the dust trail. Image subtraction. 2014 September 3-4.

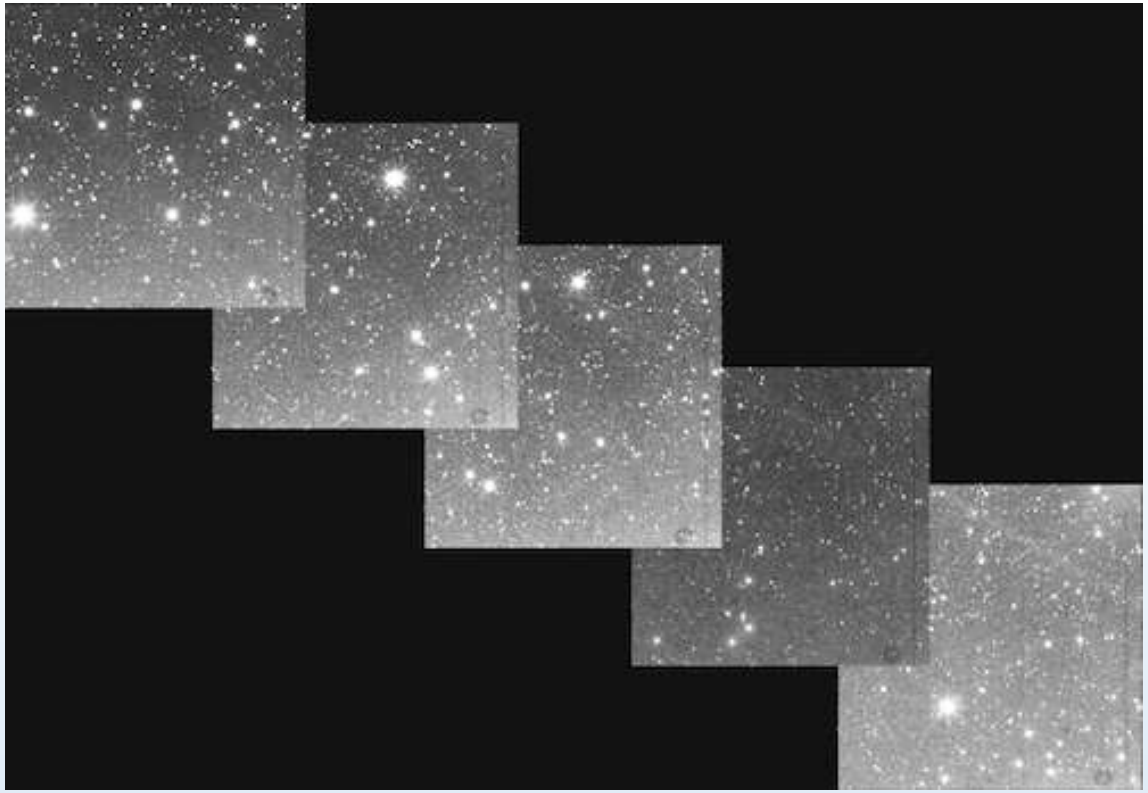


Figure 5. Observation 2015 February 14 in Hankasalmi Observatory. Without image subtraction. Dust trail is several telescopic fields at length.

Summary

The dust trail particle is modelled using our software named the 'Dust Trail kit' that comprises multiparticle Monte Carlo modeling including the solar radiation pressure effects, gravitational disturbance caused by Jupiter, and also gravitational interaction of the dust particles with the parent comet itself. This model can be used also for calculating predictions for meteor streams that hit Earth's atmosphere [8].

According to our theoretical results the dust trail will be detectable in visible light even when observed by modest aperture telescopes, although it may require the use of image subtraction. Interplanetary dust at the predicted time and coordinates will also be bright in mid infrared (Fig. 6 & 7).

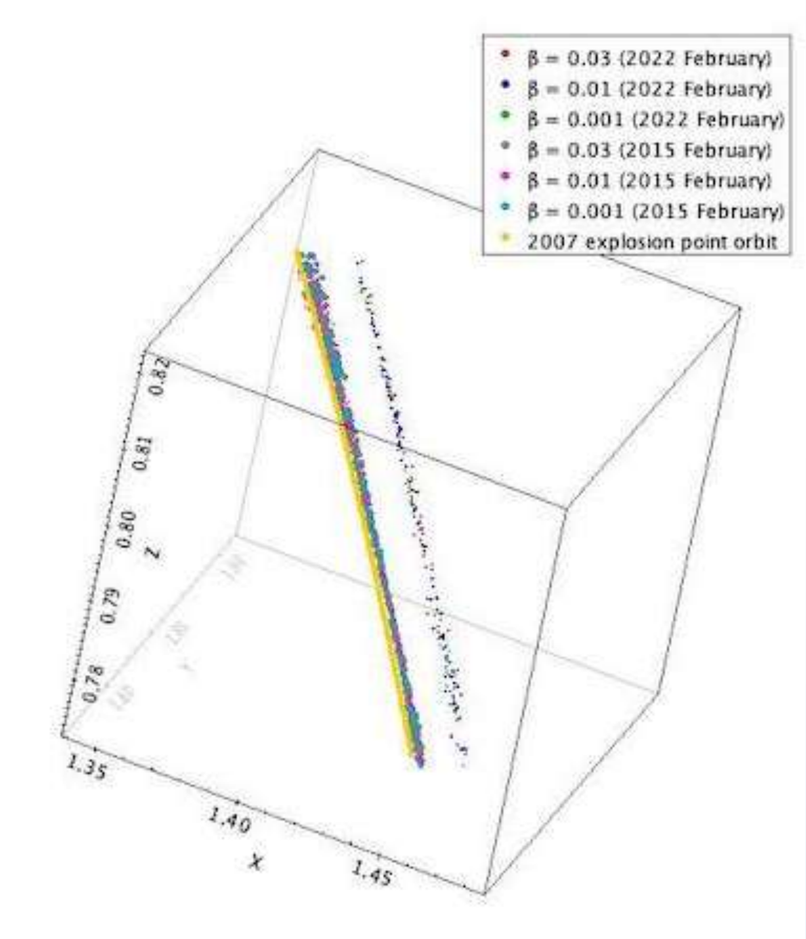


Figure 7. Prediction of the dust trail in February 2022 near the outburst point. Marked in the picture is 17P/Holmes orbit at outburst event, modeled 2015 February trail and 0.01 AU further away modeled 2022 February trail. Density in the model is 15000 particles for each beta for 2015 and 4000 particles for each beta for 2022.

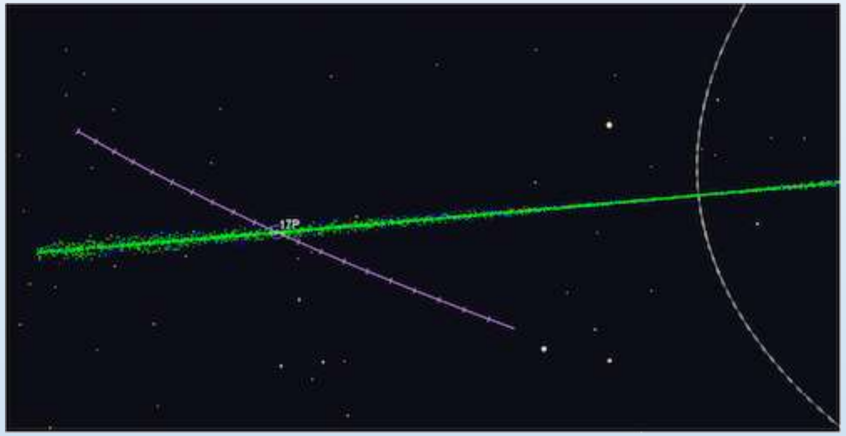


Figure 6. Comet 17P/Holmes plotted on top of the modeled trail for 2021 September 6. Also convergence point location movement in the sky is shown in the picture.

Acknowledgements and References

This presentation is dedicated to the memory of mastermind Esko Lyytinen who did a tremendous amount of original research, modeling, and predictions of meteor streams for the scientific community. We express deep gratitude to Esko for initiating this research and for putting in place effective collaboration under the umbrella of the Ursa Astronomical Association and the Finnish Fireball Network. We thank Salli and Olli Lyytinen for sharing the additional material for this research from Esko Lyytinen's personal archive and computers. We are grateful to Pekka Lehtikoski for his contribution to the programming of the mathematical model. This work was supported, in part, by the Academy of Finland project no. 325806 (PlanetS).

[1] Lin Z. Y., Lin C. S., Ip W. H. and Lara L. M. (2009). "The Outburst of Comet 17P/Holmes". The Astronomical Journal, Volume 138, Number 2.
[2] Sekanina Z. (2009). "Comet 17P/Holmes: A Megaburst Survivor", International Comet Quarterly, pp. 5-23.
[3] Lyytinen E., Nissinen M. and Oksanen A. (2015). "Dust Trail of Comet 17P/Holmes". ATel 7062.
[4] Lyytinen E., Nissinen M., Lehto H. J. and Suomela J. (2014). "Dust Trail of Comet 17P/Holmes". CBET 3969.
[5] Lyytinen E., Lehto H. J., Nissinen M., Jenniskens P. and Suomela J. (2013). "Comet 17P/Holmes Dust Trail". CBET 3633 #1.
[6] Lyytinen E., Nissinen M. and Lehto H. J. (2013). "Comet 17P/Holmes: originally widely spreading dust particles from the 2007 explosion converge into an observable dust trail near the common nodes of the meteoroids' orbits". WGN, Journal of the International Meteor Organization, vol. 41, no. 3, pp. 77–83.
[7] Reach W. T., Vaubaillon J., Lisse C. M., Holloway M. and Rho J. (2010). "Explosion of Comet 17P/Holmes as revealed by the Spitzer Space Telescope". Icarus 208, Issue 1, pp. 276-292.
[8] Lyytinen E., Nissinen M. and Van Flandern T. (2001). "Improved 2001 Leonid Storm Predictions from a Refined Model". WGN, Journal of the International Meteor Organization, vol. 29, no. 4, pp. 110–118.

Jorma Ryske:

Cometary CN Cyanogen Jet Observation Using Small Telescopes with Narrow Band UV Filter

Europlanet Science Congress (EPSC) 2019, Geneve

Julisteposteri

Cometary CN cyanogen jet observations using small telescopes with narrowband UV filter

Jorma Ryske
Ursa Astronomical Association, Finland (jorma.ryske@iki.fi)

21P/Giacobini-Zinner
Broadband image, 3.9.2018

ABSTRACT

CN cyanogen radical rotating gas jets was first found and directly imaged in comet P1/Halley during 1986 post-perihelion [1]. Development and pricing of high quantum efficiency CCD-cameras, filter technologies and image processing software's has made it possible to amateur astronomers with relatively small telescopes to image CN jets, spirals and other features in medium bright comets at ultraviolet wavelengths. This presentation describes CN jet observations and used equipment of comets 21P/Giacobini-Zinner, 46P/Wirtanen and C/2018 Y1 (Iwamoto).

INTRODUCTION

Three comets were observed with 12inch telescope, CCD camera and commercial 387nm narrowband CN filter to get possible CN cyanogen gas jets visible. Observations were also part of 4*P Coma Morphology Campaign organized by the Planetary Science Institute and images have been verified by the campaign professionals.

OBSERVATIONS

Comet 21P/Giacobini-Zinner

21P/Giacobini-Zinner was observed several nights at August and September 2018. Images taken with 12inch telescope and commercial CN filter show two gas jets onwards of comets optocenter and broadband filter image show dust tail [Figure 1]. 4*P Coma Morphology Campaign professionals compared the 12inch images taken at same time with Lowell Observatory 42inch RC John S. Hall Telescope using HB CN and HB R filter verifying that the observed CN jets and dust tail were practically identical [Figure 2].

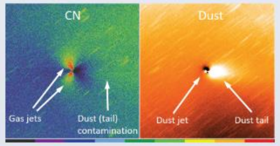


Figure 1: 21P/Giacobini-Zinner with 12inch/Ryske, 21.8.2018. Left image with commercial CN filter showing CN jets with minor dust contamination, right image with broadband filter showing dust tail. Image processing by M Knight, University of Maryland. N up, E left.

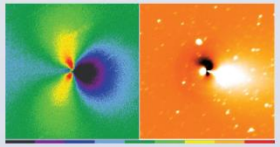


Figure 2: 21P/Giacobini-Zinner with 42inch/Lowell, 21.8.2018. Left image HB CN filter, right image HB R filter. Image processing by M Knight, University of Maryland. N up, E left.

Comet 46P/Wirtanen

46P/Wirtanen was observed with the 12inch equipment several nights at December 2018 and January 2019. At night 11/12.1.2019 continuous observing time was 11 hours and totally 120 images each 5 minutes exposures through CN filter was taken. Processed images [Figure 3a] and 10 frame animation [Figure/link 3b] show CN jet full rotation and pinwheel effect around 46P/Wirtanen optocenter during 11 hours of observation period. 46P/Wirtanen was a main target of Planetary Science Institute 4*P Coma Morphology Campaign during 2018/2019.

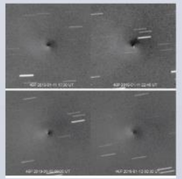


Figure 3a: 46P/Wirtanen, CN jet rotation and pinwheel effect during 11 hours of observing time, CometCIEF azimuthal median image enhancement, 12inch. 11/12.1.2019.

Figure/link 3b/Spaceweather image gallery: 46P/Wirtanen, 10 frame animation of CN jet rotation and pinwheel effect during 11 hours of observing time, 12inch. 11/12.1.2019.

Comet C/2018 Y1 (Iwamoto)

C/2018 Y1 (Iwamoto) was observed several nights at February 2019. Processed images show CN jet morphology around comet optocenter during 3 hours of observing time, [Figure 4].

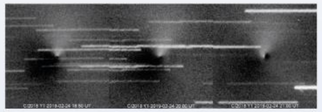


Figure 4: C/2018 Y1 (Iwamoto) CN jet morphology, 12inch. 24.2.2019

EQUIPMENT

Telescope was 305mm aperture and 1200mm focal length F4 Newton. Combined coma corrector and focal length reducer was used so that the effective focal length was 905mm/F2.9. Mount was iOptron CEM60 and autoguider was configured to track comet during each exposure. Telescope was placed in Helsinki, Finland under area of severe light pollution.

Narrowband ultraviolet filter was commercially available Semrock FF01-387/11-27. Center wavelength of the filter is 387nm and measured bandwidth is 15nm.

CCD-camera was cooled QSI690wsg. CCD-chip in the camera is Sony ICX814 and at 387nm wavelength absolute quantum efficiency is ~60%. Typically 5 minutes exposures were used through Semrock 387nm filter with CCD binning 2x2, giving 1.68 arcsec/px resolution.

SOFTWARE

Image processing software was PixInsight (PI) and images were registered and stacked with PI Comet Registration and PI Integration functions.
Image enhancing software was CometCIEF Cometary Coma Image Enhancement Facility [2].
Enhancement technique used in CometCIEF was "Division by Azimuthal Median".

SUMMARY AND CONCLUSIONS

Cometary narrowband UV imaging is possible with relatively small aperture amateur sized telescopes using modern CCD-camera technology. Fast changing and rotating CN cyanogen radical gas jets emitting at 3883Å can be resolved in comet coma morphology using commercially available narrowband filter giving useful research data by amateur astronomers.

REFERENCES

[1] A'Hearn Michael F. et al.: Cyanogen jets in comet Halley, Nature vol. 324 18/25, pp 649-651, December 1986.
[2] Samarasinha, N. H., Martin, M. P., Larson, S. M. CometCIEF: A web-based image enhancement facility to digitally enhance images of cometary comae, Planetary and Space Science 118, July 2015.

ACKNOWLEDGEMENTS

Farnham, Tony, University of Maryland
- Semrock 387nm CN filter analysis and tests

Knight, Matthew, University of Maryland
- CN image verifications of comets

Samarasinha, Nalin, Planetary Science Institute
- CN morphology and image analysis of comets

Harri Haukka, Veli-Pekka Hentunen, Markku Nissinen,
Tuomo Salmi, Hannu Aartolahti, Jari Juutilainen,
Esa Heikkinen ja Harri Vilokki:

Taurus Hill Observatory season 2020/2021 exoplanet review. HAT-P-38b (Hiisi) and secondary eclipse of the HAT-P-32b exoplanet

Europlanet Science Congress (EPSC) 2020

Verkkoposteri

Taurus Hill Observatory season 2020/2021 exoplanet review. HATP-38b (Hiisi) and secondary eclipse of the HAT-P-32b exoplanet.

Vol. 15, EPSC2021-107, 2021

H. Haukka[1,2], V-P. Hentunen[1], M. Nissinen[1], T. Salmi[1], H. Aartolahti[1], J. Juutilainen[1], E. Heikkinen[1] and H. Vilokki[1]

(1) **Taurus Hill Observatory, Varkaus, Finland (veli-pekka.hentunen@kassiopeia.net),**

(1) **Finnish Meteorological Institute, Space Research and Observation Technologies, Helsinki, Finland**

Drone images by Esa Heikkinen.

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 (over 170 measurements so far) [4], observing the gamma rays burst, supernova discoveries and monitoring [2]. We also do long term monitoring projects [3].

The results and publications that pro-am based observatories, like THO, have contributed, clearly demonstrates that pro-amateurs are a significant resource for the professional astronomers now and even more in the future.

HAT-P-38 and HAT-P-38b (Horna and Hiisi)

The object is located in RA 2h 21min 32s and DE + 32 ° 14 ’46”. From Finland, the object is high in the southern sky only in autumn. In addition, the transit time of the object is such that transit occur quite rarely at night. Considering the uncertain autumn weather in Finland, the probability of detecting a complete transit is quite uncertain in Finland.

Taurus Hill Observatory detected the HAT-P-38b first time on 18 September 2020 and for the second time on 8 November 2020. Based on our observations, the timing of the transit deviated from the forecast by almost an hour. The transit took place clearly ahead of schedule. It is an indication that the rotation time of the exoplanet is possibly slightly shorter than recorded in the original catalog values. In this case, the transit catalog times are no longer valid. Observations made by other observers also confirm this. It is therefore worth monitoring the object to see if such an observed change is indeed regular.

In the first observation the dimming was 13.6 mmag and in the second it was clearly less, only 6.8 mmag. The length of the transit also varied slightly, from 178 minutes on the first occasion to 185 minutes on the second occasion.

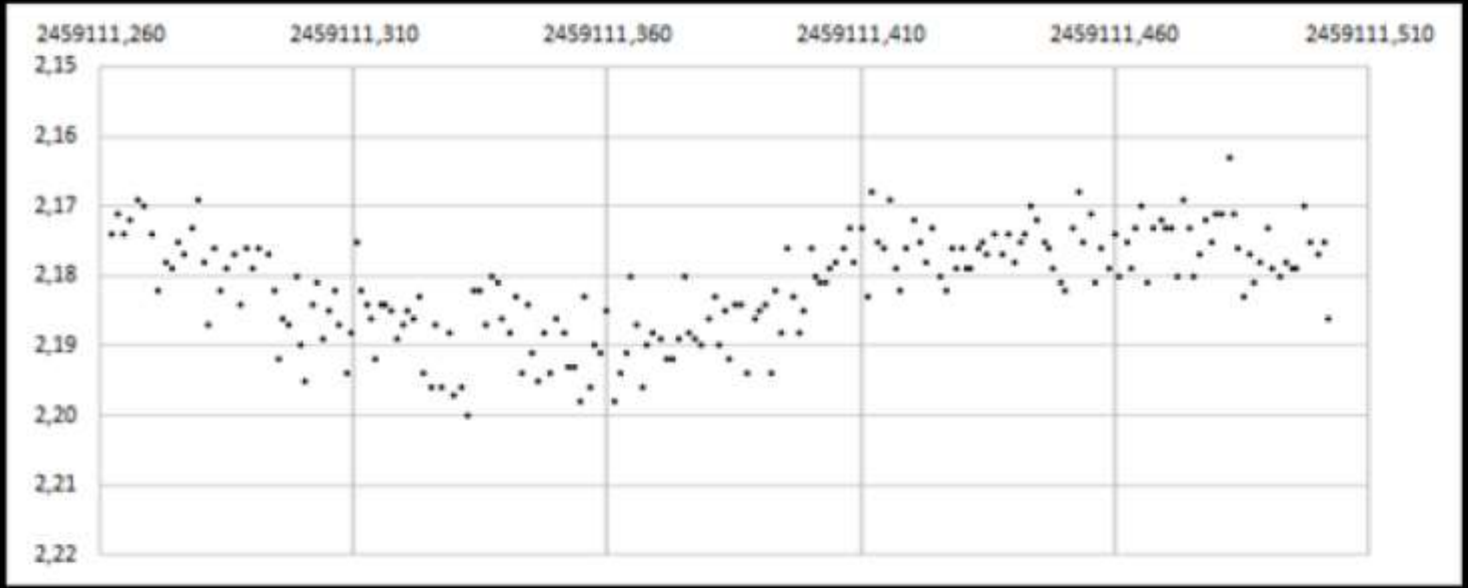


Figure 1: HAT-P-38b transit observed at THO; C-14, Paramount MEII, SBIG ST-8XME. Credit: Taurus Hill Observatory.

Secondary eclipse caused by the HAT-P-32b exoplanet

Last winter, for the first time in Taurus Hill Observatory, a rather challenging exoplanet was observed to transit behind its own parent star. Such an observation was made in Taurus Hill Observatory on February 17, 2021 from the exoplanet HAT-P-32b. Normal transit of a similar object had been observed in Taurus Hill Observatory a few times before. After an observation tip from the Pulkova Observatory, an attempt was made to observe this secondary eclipse in Taurus Hill Observatory. According to forecasts, the subject would have to dim about 3-4 mmag and the duration of the blackout would be about 120 minutes. The fading according to the forecasts was barely visible in the measurements of the Taurus Hill Observatory. Although the detection of a “behind transit” of a star would require better accuracy, at least the measurement results obtained from the light curve, the timing, and the intensity of the dimming were fully consistent with the predictions. Thus, there is strong evidence that the first observation of secondary blackout in Taurus Hill Observatory was real.

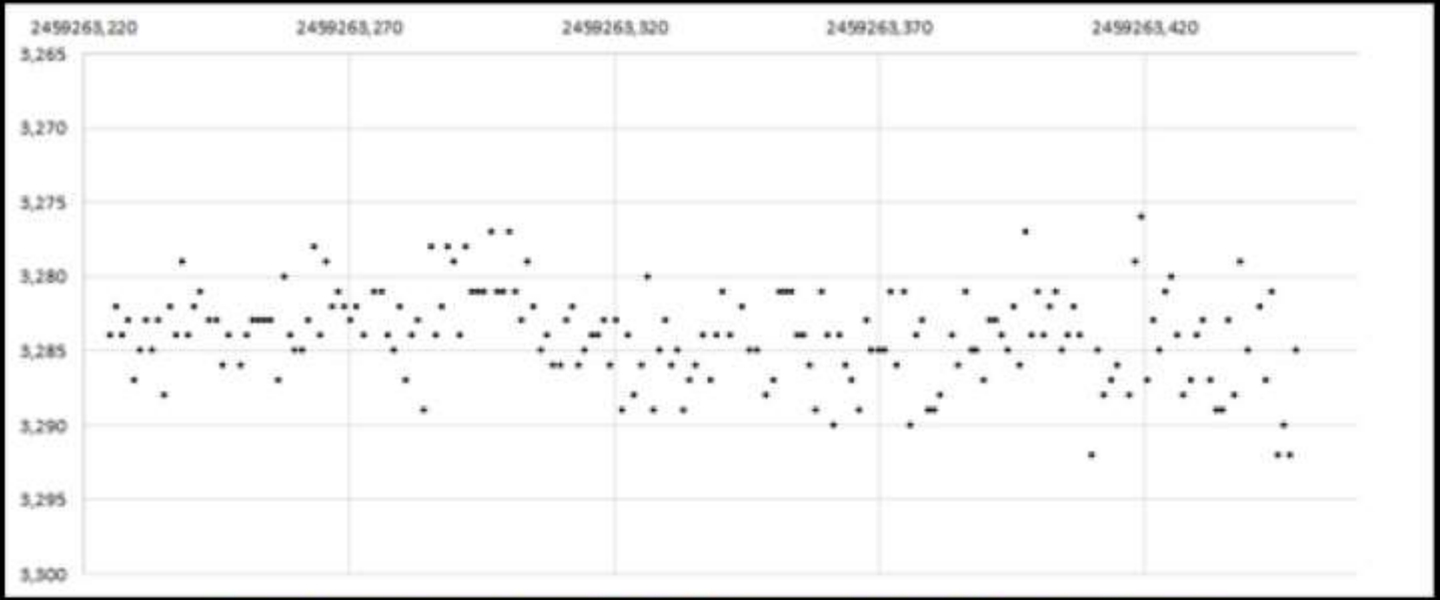


Figure 2: Secondary eclipse caused by the HAT-P-32b observed at THO. Credit: Taurus Hill Observatory.

TESS candidates have joined as new targets

The Taurus Hill Observatory began observing TESS candidates, or TOI objects, in the autumn of 2020. In total, these objects have now been observed 21 times in Taurus Hill Observatory. There have been seven different TESS candidates on the list. These selected targets have been fairly easy to detect, with a change in brightness caused by transits in between 7 and 20 mmag. The findings have been uploaded to the TRESCA ETD database. Although transits have been clearly observable in all observations, the timing of transits or the magnitude of dimming in most of them have been somewhat different from the catalog values, according to measurements by the Taurus Hill Observatory. This is probably mainly due to the huge number of observations of new uncertain objects and the rather modest resolution equipment of the TESS satellite itself. It is very possible that not nearly all of the observed TESS candidates will be confirmed as new exoplanets.

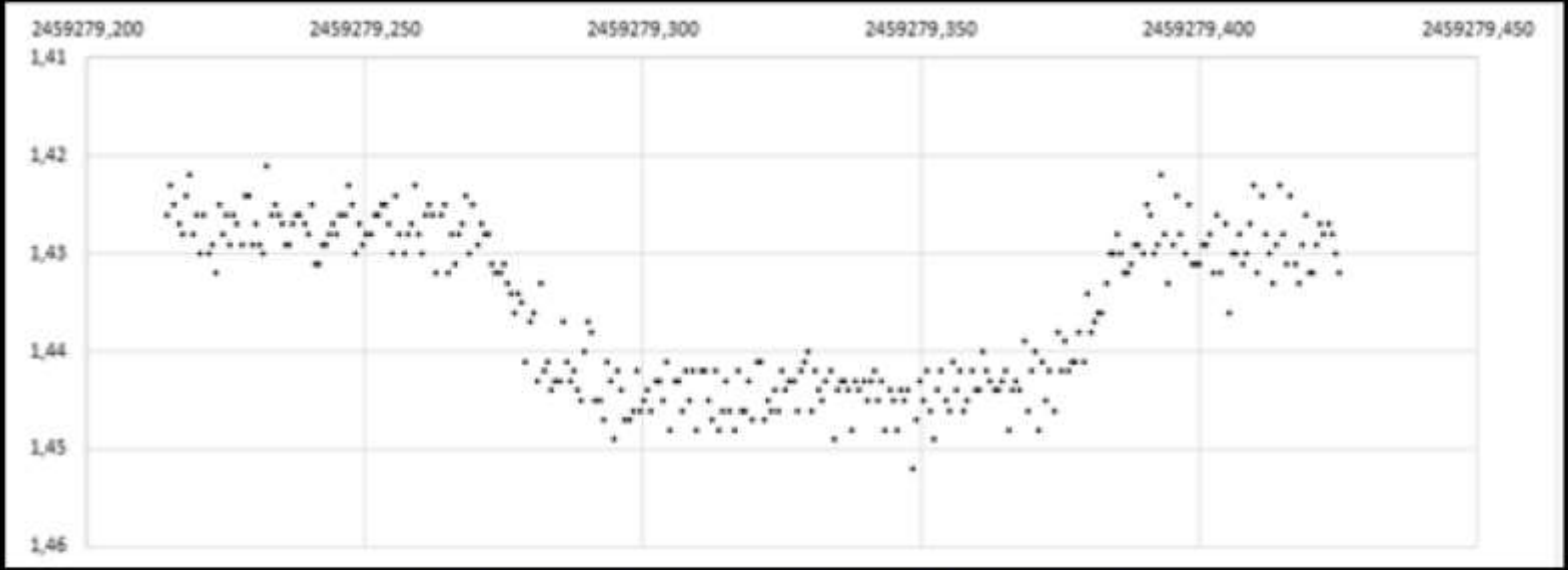


Figure 3: TOI1516.01b transit observed at THO.. Credit: Taurus Hill Observatory.

Summary and Conclusions

Taurus Hill Observatory and other similar pro-amateur based observatories have a good record in field of astronomy and especially in the light curve measurements and photometric monitoring.

The research teams have the knowledge for making a good and high quality photometric light curve measurements. The publication records are one of the good examples from this knowledge. In the future the THO research team aims for more challenging astronomical research projects with professional astronomers and observatories, so please **contact us if you have a measuring campaign or project you would like to include us**.

As a conclusion it can be stated that it is possible to do high quality astronomical research with pro-amateur astronomy equipment if you just have the enthusiasm and knowledge to use your equipment in the right way.

Our Main Contacts and Cooperation Partners

- *Prof. Gregory Laughlin,* Santa Cruz, CA 2006 - 2007
- Amateur astronomer *Bruce Gary*, Hereford (G95), AZ 2007 - 2009
- TRESCA 2009 -
- *Prof. Sergio Messina*, Catania, Italy 2013 - 2014
- *Prof. Eugene Sokov*, Pulkovo (St. Petersburg), Russia 2013 -
- Amateur astronomer *Paul Benni*, Acton, MA, 2017 -

On 2021 Warkauden Kassiopeia celebrates its 20 years birthdays.

Acknowledgements

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

References and Links

[1] **Taurus Hill Observatory website** (http://www.taurushill.net)

[2] **A low-energy core-collapse supernova without a hydrogen envelope**; S. Valenti, A. Pastorello, E. Cappellaro, S. Benetti, P. A. Mazzali, J. Manteca, S. Taubenberger, N. Elias-Rosa, R. Ferrando, A. Harutyunyan, V.-P. Hentunen, M. Nissinen, E. Pian, M. Turatto, L. Zampieri and S. J. Smartt; Nature 459, 674-677 (4 June 2009); Nature Publishing Group; 2009.

[3] **A massive binary black-hole system in OJ 287 and a test of general relativity**; M. J. Valtonen, H. J. Lehto, K. Nilsson, J. Heidt, L. O. Takalo, A. Sillanpää, C. Villforth, M. Kidger, G. Poyner, T. Pursimo, S. Zola, J.-H. Wu, X. Zhou, K. Sadakane, M. Drozdz, D. Koziel, D. Marchev, W. Ogloza, C. Porowski, M. Siwak, G. Stachowski, M. Winiarski, V.-P. Hentunen, M. Nissinen, A. Liakos & S. Dogru; Nature - Volume 452 Number 7189 pp781-912; Nature Publishing Group; 2008

[4] **Transit timing analysis of the exoplanet TrES-5 b. Possible existence of the exoplanet TrES-5 c**; Eugene N Sokov, Iraida A Sokova, Vladimir V Dyachenko, Denis A Rastegaev, Artem Burdanov, Sergey A Rusov, Paul Benni, Stan Shadick, Veli-Pekka Hentunen, Mark Salisbury, Nicolas Esseiva, Joe Garlitz, Marc Bretton, Yenal Ogmen, Yuri Karavaev,Anthony Ayiomamitis, Oleg Mazurenko, David Alonso, Sergey F Velichko; Monthly Notices of the Royal Astronomical Society, Volume 480, Issue 1, October 2018, Pages 291–301, https://doi.org/10.1093/mnras/ sty1615

Links

[1] https://www.kassiopeia.net

[2] TRESCA: http://var2.astro.cz/EN/tresca/transits.php?pozor=Veli-Pekka+Hentunen (*Exoplanet lightcurves of this presentation*)

[3] https://www.ursa.fi/proam/yleista-ryhmasta.html (*general information about pro-amateur activitivites in Finland, pages in Finnish*)

[4] GRB 200829A OA. GCN circular 28318: https://gcn.gsfc.nasa.gov/gcn3/28318.gcn3

Veli-Pekka Hentunen, Harri Haukka, Esa Heikkinen,
Tuomo Salmi ja Jari Juutilainen:

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

Europlanet Science Congress (EPSC) 2017, Riika

Julisteposteri

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

V-P. Hentunen, H. Haukka, E.Heikkinen, T. Salmi and J. Juutilainen

Taurus Hill Observatory, Finland (harri.haukka@kassiopeia.net / Tel: +358-443406510)

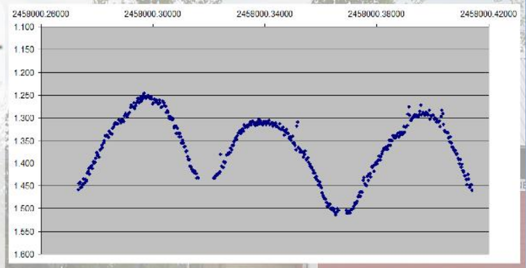
http://www.taurushill.net

Taurus Hill Observatory (THO), 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 asteroid [1] and exoplanet light curve measurements, observing the gamma rays burst, supernova discoveries and monitoring [2]. We also do long term monitoring projects [3]. THO research team has presented its research work on previous EPSC meetings [4], [5], [6] and [7] and got very supportive reactions from the European planetary science community.

Exoplanet observations during the season 2016-2017 for Pulkova Observatory

During the winter 2016 - 2017 Taurus Hill Observatory 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.



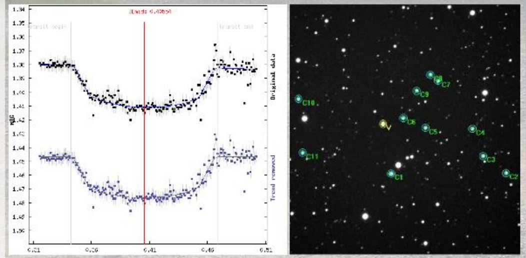
Asteroid 3122 Florence light curve measured at Taurus Hill Observatory 3.-4.9.2017. Credit: Taurus Hill Observatory.

Variable star observations during the exoplanet campaign

In these exoplanet observations made in THO also variable stars, some of which appear to be WUMa-type and HADS-type variables, have been observed 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.

Asteroid observations

In addition, during the spring 2017, asteroids have been observed for the Pulkova Observatory.



Exoplanet HAT-P-32b light curve measured at Taurus Hill Observatory (C-14, Paramount MEII, SBIG ST-8XME). Credit: TRESCA / Taurus Hill Observatory.

Summary and Conclusions

The discoveries regarding variable stars needs more observations during the next observation season. Also the asteroid observations requires more observations for determining the natures (e.g. shape, orbits and rotation period) of the asteroids. 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.

References

[1] *Lightcurve inversion for asteroid spins and shapes*; J. Torppa; University of Helsinki, Faculty of Science, Department of Astronomy; Doctoral dissertation; 2007

[2] *A low-energy core-collapse supernova without a hydrogen envelope*; S. Valenti, A. Pastorello, E. Cappellaro, S. Benetti, P. A. Mazzali, J. Manteca, S. Taubenberger, N. Elias-Rosa, R. Ferrando, A. Harutyunyan, V.-P. Hentunen, M. Nissinen, E. Pian, M. Turatto, L. Zampieri and S. J. Smartt; Nature 459, 674-677 (4 June 2009); Nature Publishing Group: 2009.

[3] *A massive binary black-hole system in OJ 287 and a test of general relativity*; M. J. Valtonen, H. J. Lehto, K. Nilsson, J. Heidt, L. O. Takalo, A. Sillanpää, C. Villforth, M. Kidger, G. Poyner, T. Pursimo, S. Zola, J.-H. Wu, X. Zhou, K. Sadakane, M. Drozdz, D. Koziel, D. Marchev, W. Ogloza, C. Porowski, M. Siwak, G. Stachowski, M. Winiarski, V.-P. Hentunen, M. Nissinen, A. Liakos & S. Dogru; Nature - Volume 452 Number 7189 pp781-912; Nature Publishing Group; 2008.

[4] *Small Telescope Exoplanet Observations in Taurus Hill Observatory*; V.-P. Hentunen, M. Nissinen, H. Haukka and H. Aartolahti; Vol. 4, EPSC2009-119, 2009; European Planetary Science Congress 2009

[5] *Small telescope stellar object light curve measurements*; H. Haukka, V.-P. Hentunen, M. Nissinen, T. Salmi, and H. Aartolahti; Vol. 5, EPSC2010-170, 2010; European Planetary Science Congress 2010

[6] *Ground Based Support for Exoplanet Space Missions*; H. Haukka, V-P. Hentunen, M. Nissinen, T. Salmi, H. Aartolahti, J. Juutilainen and H. Vilokki; Vol. 6, EPSC-DPS2011-683, 2011; EPSC-DPS Joint Meeting 2011

[7] Transit Observations in Taurus Hill Observatory; H. Haukka, V-P. Hentunen, M. Nissinen, T. Salmi, H. Aartolahti, J. Juutilainen and H. Vilokki; Vol. 7 EPSC2012-169; European Planetary Science Congress 2012

More information about the Taurus Hill Observatory research

If You would like to get more information about the research work made at the THO, please visit our website in the address ***http://www.taurushill.net***. We recommend that You also visit the Transitsearch (*http://www.transitsearch.org/*) and AXA (*http://brucegary.net/AXA/x.htm*) websites. We are grateful to the Finnish Meteorological Institute who sponsored this poster.

Poster design: Harri Haukka *Background image: Esa Heikkinen*