Komeetta 17P/Holmesin vuoden 2007 purkauksen mallintaminen

Cygnus 2025, Tähtitieteellinen yhdistys Ursa ry

Markku Nissinen 2.8.2025

Komeetta 17P/Holmes

- Edwin Holmes löysi tämän komeetan marraskuun 6 päivänä 1892 vastaavanlaisen purkauksen ansiosta, mitä esiintyi vuonna 2007 lokakuussa.
- Kiertoaika 6,9 vuotta.
- Radan inklinaatio 19,1 astetta.
- Aphelin etäisyys Auringosta 5,18 AU
- Perihelin etäisyys Auringosta 2,05 AU
- Ainoa tunnettu komeetta, joka purkautuu vuoden 2007 purkausta vastaavasti. Purkauksia on ollut ainakin 3 kappaletta. Marraskuussa 1892, tammikuussa 1893 sekä lokakuussa 2007.

Jupiter-perheen komeetat

Komeetta 17P/Holmes kuuluu Jupiter-perheen komeettoihin

- Kiertoajat vähemmän yleensä kuin 20 vuotta. Määrittely alle 200 vuotta.
- Jupiterin gravitaatio määrittää nykyiset radat. Radat eivät ulotu paljon kauemmaksi Jupiterin radasta.
- Alkuperä on ajateltu olevan Kuiperin vyöhykkeellä.
- Inklinaatiot usein varsin pieniä.
- Tisserandin invariantti $T_j > 2$.
- Tässä luokittelussa on tällä hetkellä 672 komeettaa.

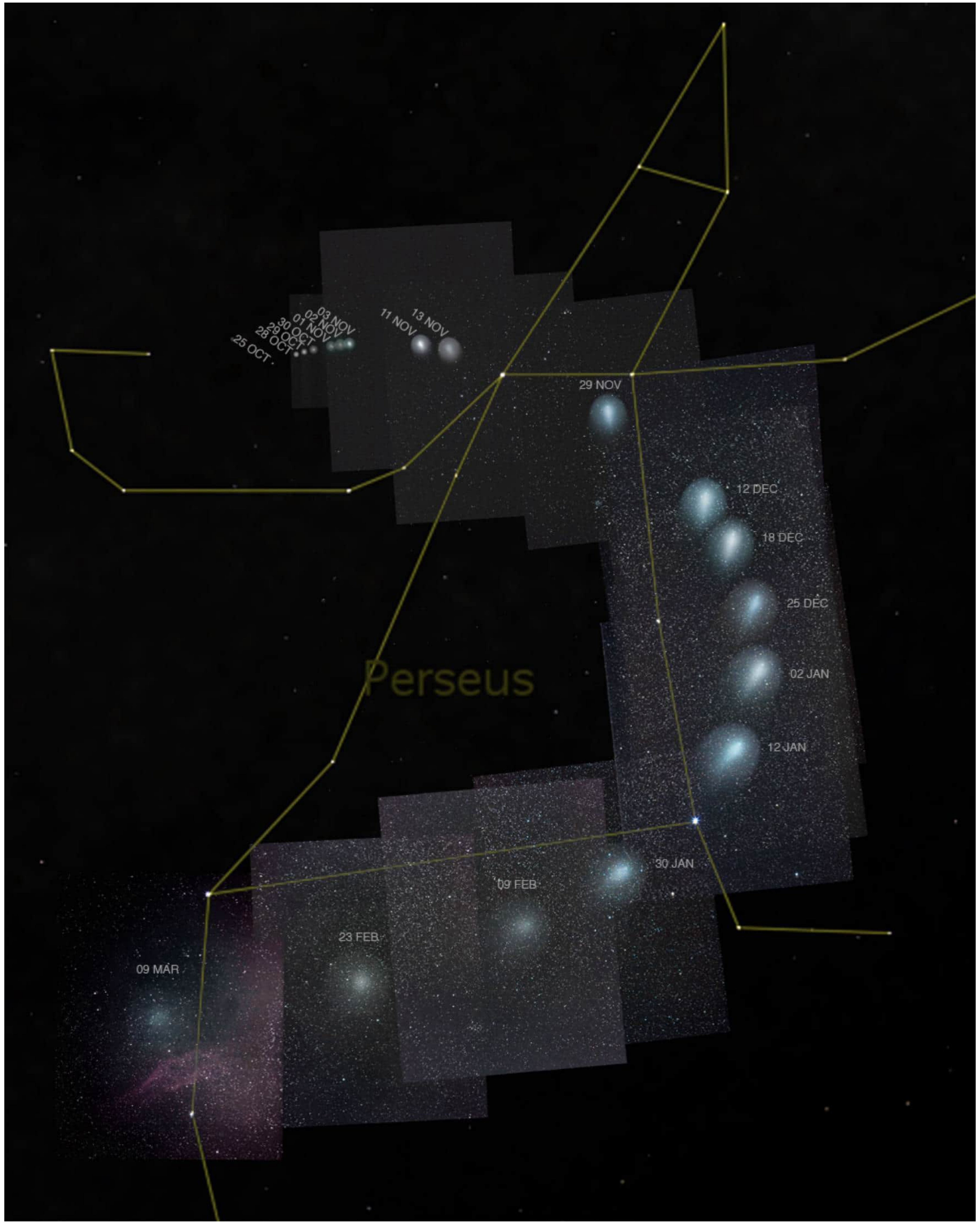
Vuoden 2007 lokakuun purkaus

- Kirkkaus ennen purkausta noin 17 mag 23,1 (desimaalipäivä) lokakuussa 2007.
- Purkaus 23 ja 24 lokakuuta 2007 välillä.
- Kirkkaus 2 mag 25,1 (desimaalipäivä) lokakuussa 2007.
- Kirkkaus nousi siis miljoonakertaisesti näiden mittausten välillä.
- Myöhemmin pölykuvion koko kasvoi suuremmaksi, kuin Auringon näennäinen koko taivaalla.

2007 purkaus

Kuva: John Pane

- Komeetta 17P/Holmes 19-yön yhdistelmäkuva.
- 2007-10-25 - 2008-03-09
-
-
- Kuva John Pane



31.10/1.11.2007

Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Värikuva
- Härkämäen observatorio
- Kamera: Canon 350D

2.11/3.11.2007

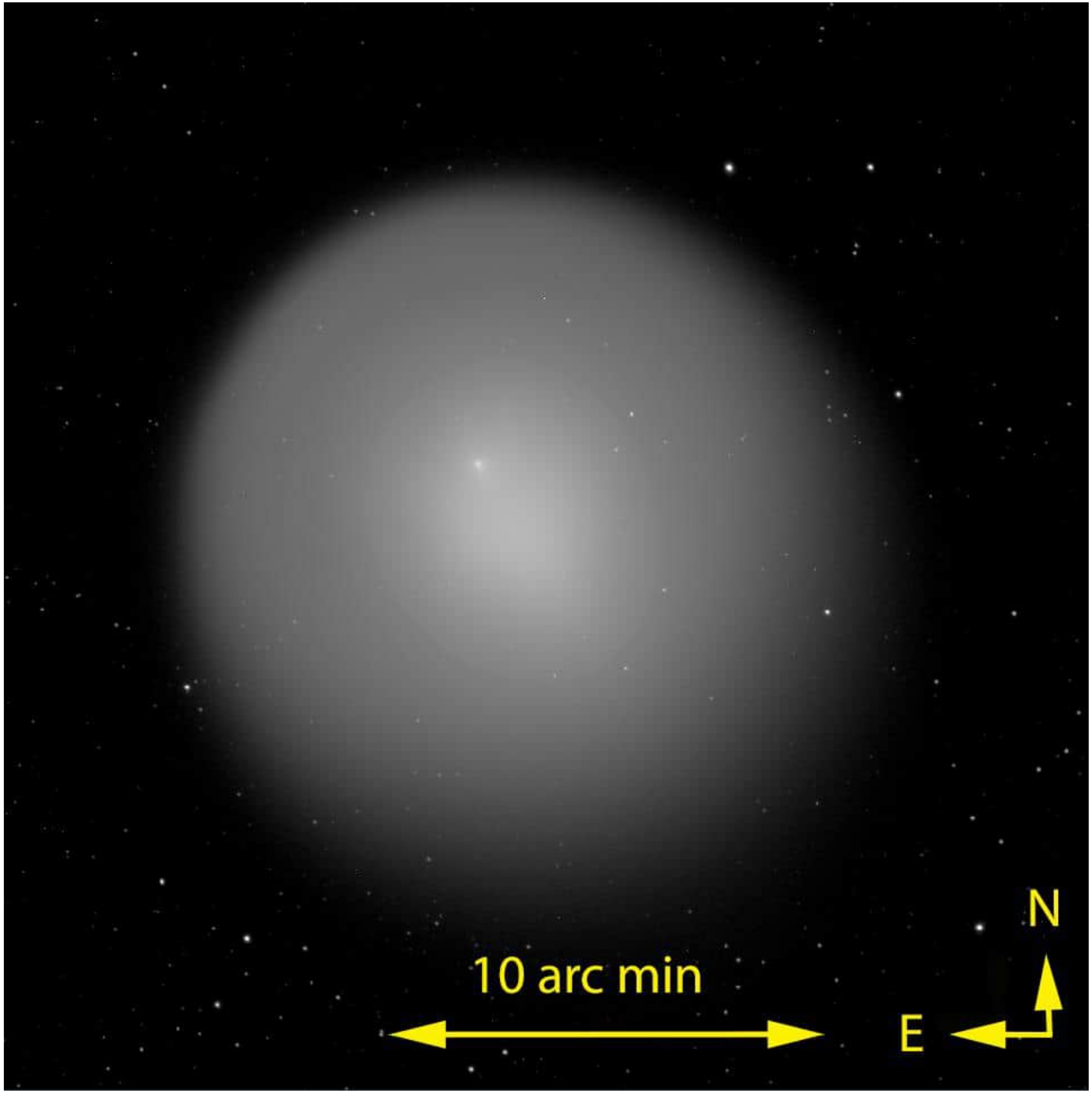
Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Värikuva
- Härkämäen observatorio
- Kamera: Canon 350D

4.11.2007

Kuva: Arto Oksanen

- 2007 Nov 4 16:30:06 UT
- Hankasalmi Observatory
- Valotus: 60 sekuntia
- SBIG STL-1001 CCD kamera



4/5.11.2007

Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Värikuva
- Härkämäen observatorio
- Kamera: Canon 350D

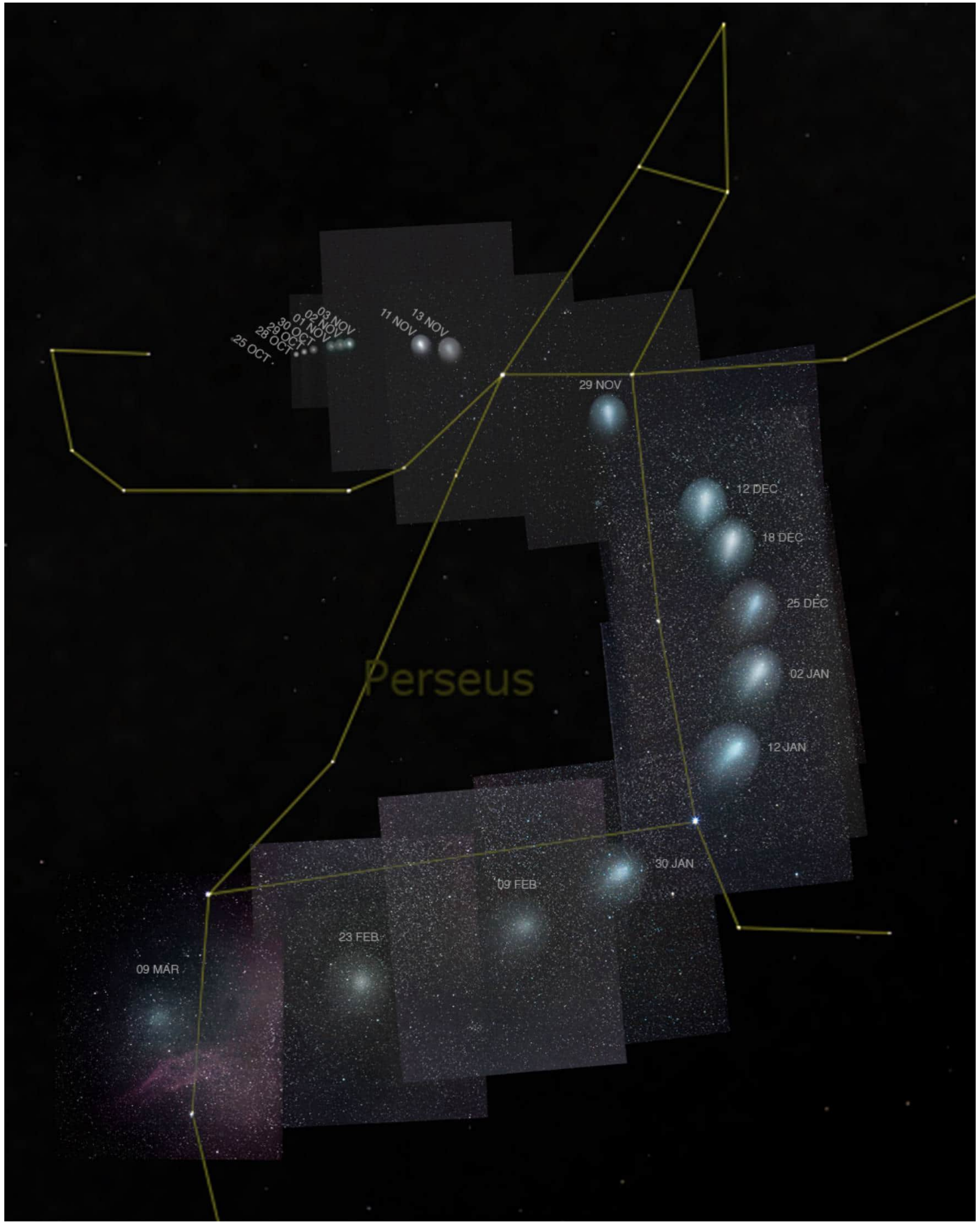
4/5.11.2007

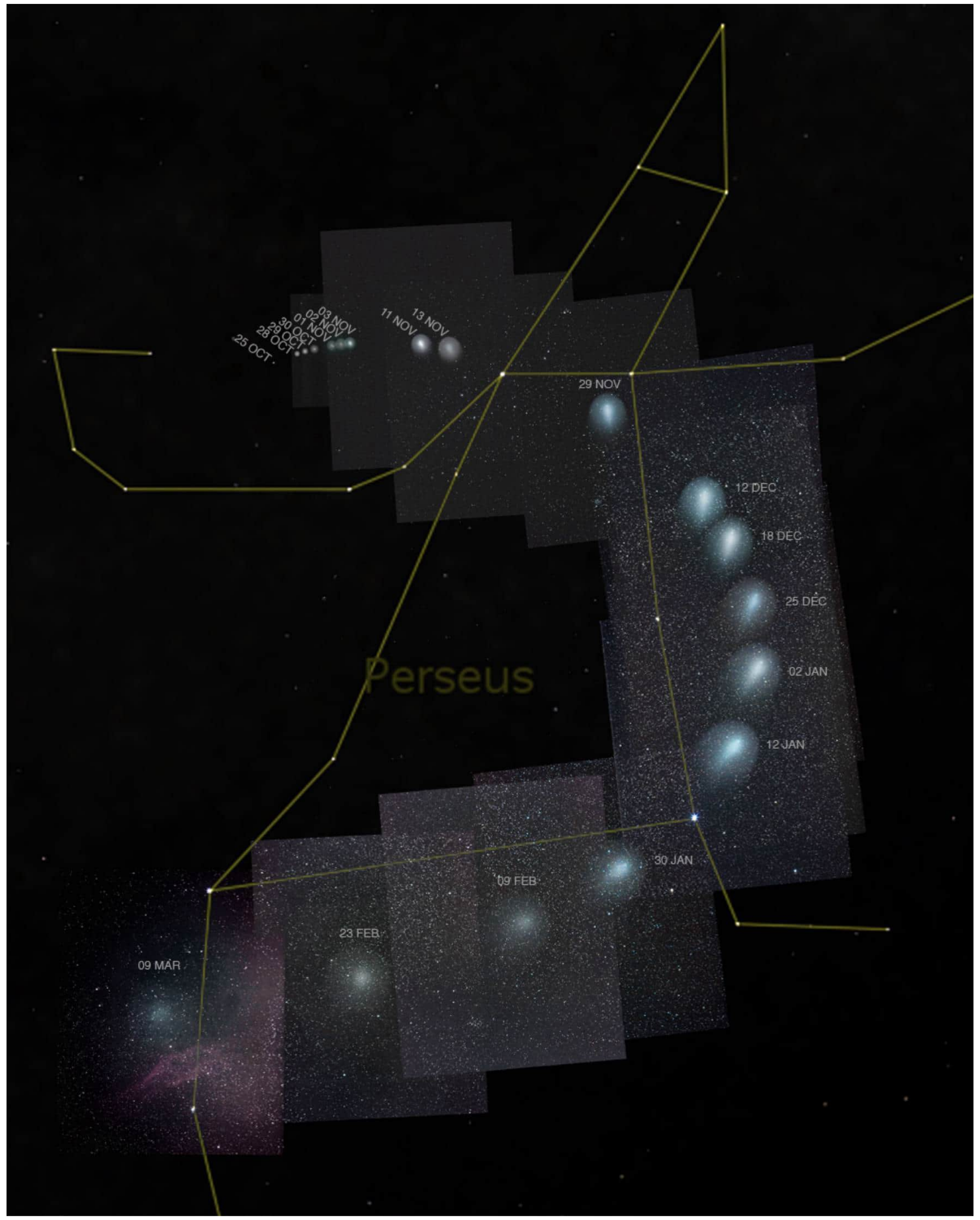
Kuva: Markku Nissinen ja Veli-Pekka Hentunen

Havaitsimme 17P/Holmes komeettaa Härkämäellä 4.11/5.11.2007 välisenä yönä tornin laitteistolla ja Canon EOS 350D kameralla. Vaikka pakkanen paukkui Härkämäen tähtitornin nurkissa, komeetta Holmes ei jättänyt havaitsijoitaan kylmäksi. Ytimestä valokuvissamme näkyviin tulleet kirkkaat suihkut, moneen suuntaan osoittavat eriväriset pyrstöt ja koman ulkopuolinen valtava kaasupallo, sekä koman yksityiskohdat, olivat meille suuri yllätys ja ihmetyksen aihe. Kangaslammin aarniometsissä elävien villieläinten kaukaiset huudot säestivät havaintojemme tekoa. Pitkästä aikaa taivas oli tähtiharrastajan toiveet täyttävä Linnunradan erottuessa yksityiskohtineen läpi taivaankannen. Pystytimme torniin pihalle linssikaukoputken, jolla komeetta näkyi lähes ottamiemme valokuvien veroisesti. Totesimme, että Holmes on myös kiikareilla katsottuna yksi vaikuttavimmista koskaan näkemistämme yötaivaan kohteista. Pohdimme eri mahdollisuuksia, jotka olisivat voineet aiheuttaa komeetan valtavan kirkastumisen, mutta mitään aukotonta yksittäistä selitystä emme keksineet. Päätimme koota yleistajuisen katsauksen Holmes –komeetasta ja siitä tehdyistä havainnoista seuraavaan jäseniltaamme Varkaudessa.

Varkaudessa,

Markku Nissinen ja Veli-Pekka Hentunen
Warkauden Kassiopeia ry


25 OCT
28 OCT
29 OCT
30 OCT
01 NOV
02 NOV
03 NOV
11 NOV
13 NOV
29 NOV
12 DEC
18 DEC
25 DEC
02 JAN
12 JAN
Perseus
30 JAN
09 FEB
23 FEB
09 MAR


25 OCT
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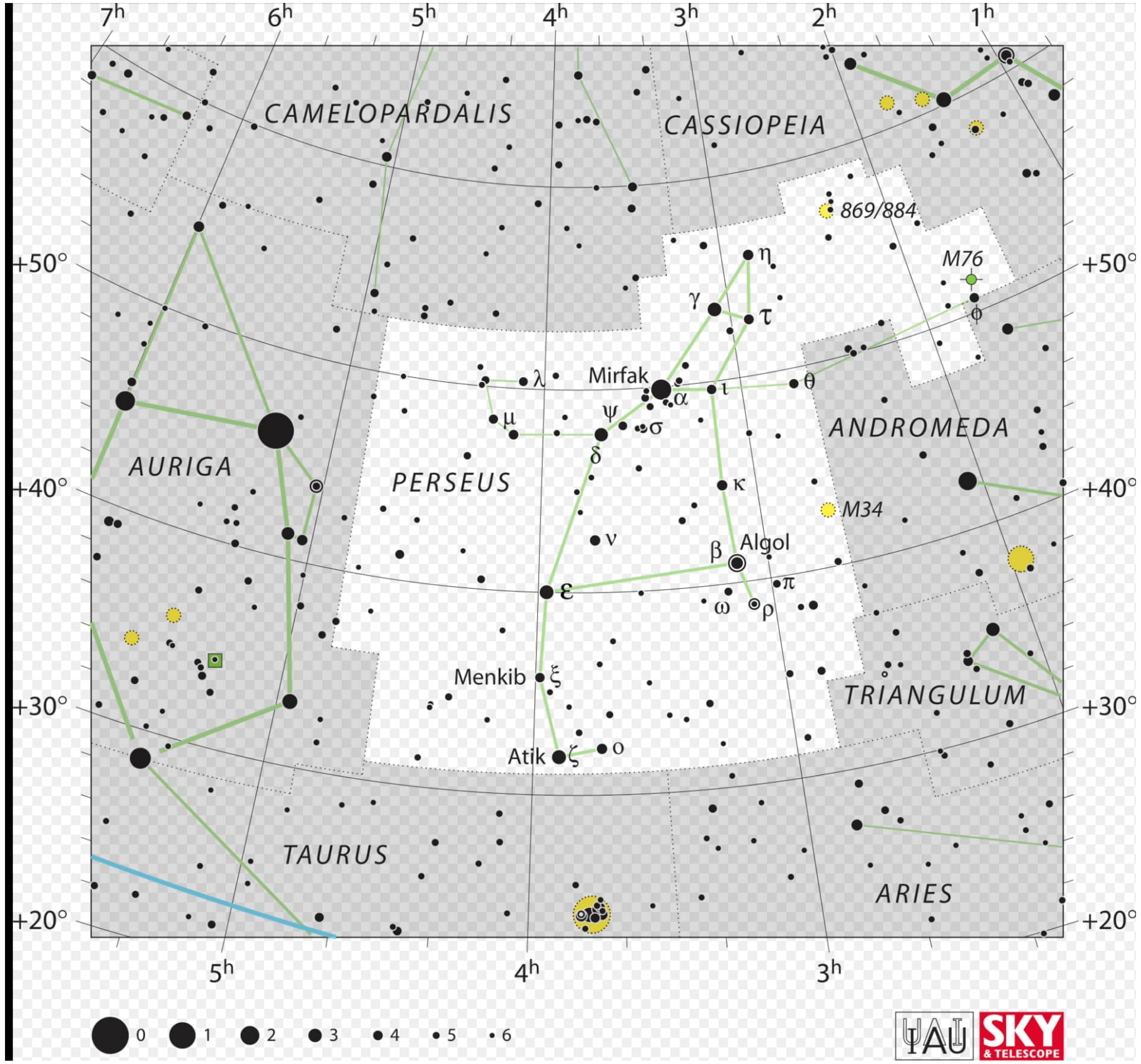
12 DEC
18 DEC
25 DEC
02 JAN
12 JAN
30 JAN
09 FEB
23 FEB
09 MAR
Perseus


7h 6h 5h 4h 3h 2h 1h
+50° +40° +30° +20°
5h 4h 3h
CAMELOPARDALIS
CASSIOPEIA
869/884
M76
η γ τ θ φ
Mirfak α ι
λ μ ψ σ δ
ANDROMEDA
AURIGA
PERSEUS
κ
M34
ν
β Algol
ε π ω ρ
Menkib ξ
TRIANGULUM
Atik ζ ο
TAURUS
ARIES
0 1 2 3 4 5 6
IAU
SKY & TELESCOPE

T+A 7/2007 kansikuva

Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Härkämäen observatorio
- Värikuva
- Kamera: Canon 350D

12/13.12.2007

Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Värikuva
- Härkämäen observatorio
- Kamera: Canon 350D

16/17.12.2007

Kuva: Markku Nissinen ja Veli-Pekka Hentunen

- Värikuva
- Härkämäen observatorio
- Kamera: Canon 350D

Vuoden 2007 purkauksen sublimaatiomallinnus

Pidän esityksen EPSC-DPS 2025 konferenssissa Helsingissä Finlandia talossa syyskuussa (7.9-12.9.2025) europlanet

Division for Planetary Sciences of the AMERICAN ASTRONOMICAL SOCIETY

EPSC-DPS Joint Meeting 2025
Finlandia Hall Helsinki, Finland
7–12 September 2025

Welcome to the EPSC-DPS Joint Meeting 2025

The EPSC-DPS Joint Meeting 2025 will be held at Finlandia Hall, Helsinki, Finland on 7–12 September 2025.

The programme has been launched

Browse the session programme

Register now

Find all details on the registration fees here.

Register here

Scope & Aims

The Scientific Organizing Committee of the EPSC-DPS 2025 invites all planetary scientists to participate in the congress, submit contributions to the topical sessions and share their research with their colleagues. The congress will offer virtual elements to access oral and poster sessions.

Orals TUE-OB6: Tue, 9 Sep, 16:30–18:00 | Room Uranus

Chairpersons: Olena Shubina, Ludmilla Kolokolova

16:30–16:45 | EPSC-DPS2025-388 | ECP | solicited | On-site presentation

Combined Long-term Orbital and Thermal Evolution Simulations of Oort Cloud Comets

Adam Parhi and Dina Prialnik

16:45–17:00 | EPSC-DPS2025-702 | ECP | On-site presentation

Short-term color changes in comets at large heliocentric distances

Anhelina Voitko and Oleksandra Ivanova

17:00–17:12 | EPSC-DPS2025-1419 | On-site presentation

JWST observations of distant long period comet C/2024 E1 (Wierzchos)

Colin Snodgrass, Carrie E. Holt, Michael S. P. Kelley, Cyrielle Opitom, Aurélie Guilbert-Lepoutre, Matthew M. Knight, Rosita Kokotanekova, Emmanuel Jehin, Elena Mazzotta Epifani, Alessandra Migliorini, Cecilia Tubiana, Marco Micheli, and Davide Farnocchia

17:12–17:24 | EPSC-DPS2025-2 | On-site presentation

The volatile content of giant Oort cloud comet C/2014 UN271 during its return to the planetary region

Bryce Bolin

17:24–17:36 | EPSC-DPS2025-17 | On-site presentation

Modeling Sublimation Dynamics and Dust Propagation of Comet 17P/Holmes During its 2007 Outburst

Markku Nissinen, Maria Gritsevich, Marcin Wesołowski, Jorma Ryske, and Alberto J. Castro-Tirado

17:36–17:48 | EPSC-DPS2025-930 | ECP | On-site presentation

Emission of decimetre-sized debris from comet 67P

Dar Dahlen, Pablo Lemos, Marius Pfeifer, Nicholas Attree, Raphael Marschall, and Jessica Agarwal

17:48–18:00 | EPSC-DPS2025-1059 | Virtual presentation

The Orbit and Size of the Active Jupiter Co-Orbital P/2023 V6 (PANSTARRS)

Theodore Kareta and John Noonan

Purkauksen sublimaatiomallinnus

Lähtökohtana fotometriset mittaukset
Kolme erilaista skenaariota

- Pölyn peittämät huokoiset materiaalit.
- Huokoiset materiaalit.
- Materiaalit, joilla on poikkeava haihtumiskerroin.

Purkauksen sublimaatiomallinnus

Lähtökohtana fotometriset mittaukset

- Pogsonin laki.
- Mallinnetaan purkauksessa vapautunut kokonaismassa.

Purkauksen sublimaatiomallinnus

Lähtökohtana fotometriset mittaukset

- Purkauksessa vapautuu kaasua ja pölyä.
- Pöly dominoi sironnan mittauksen signaalia.

Purkauksen sublimaatiomallinnus

Lähtökohtana fotometriset mittaukset

- Huokoinen jää.
- Orgaaniset materiaalit.
- Pöly.
- Näillä kullakin 50% aktiivinen pinta-alan osuus.

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **538,** 470–479 (2025) https://doi.org/10.1093/mnras/staf219
Advance Access publication 2025 February 20

Mass of particles released by comet 12P/Pons–Brooks during 2023–2024 outbursts

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Accepted 2025 January 31. Received 2025 January 26; in original form 2024 October 21

sublimation flux occurring through the porous structure of the nucleus of comet 12P. Estimating the mass ejected as a result of an outburst is a complex problem that depends on many parameters. In this study, we rely on Pogson's law, which can be defined as

$$\Delta m = -2.512 \log \frac{p(\theta)_\mathrm{N} A_\mathrm{N} S_\mathrm{N} + p(\theta)_2 \left(C(t_2) + C_\mathrm{ej}\right)}{p(\theta)_\mathrm{N} A_\mathrm{N} S_\mathrm{N} + p(\theta)_1 C(t_1)}. \quad (1)$$

In equation (1) $p(\theta)_1$ represents the phase function of the cometary nucleus, $p(\theta)_2$ is the phase function of the cometary agglomerates, A_N is the albedo, S_N is the total area of the comet, $C(t_1)$ is the scattering cross-section of the cometary agglomerates raised into a coma during the quiet sublimation phase (t_1), $C(t_2)$ is the scattering cross-section of the cometary agglomerates raised into a coma during the outburst phase (t_2), C_{ej} is the scattering cross-section of agglomerates originating from the destroyed and ejected layer of the nucleus. The individual scattering cross-sections that appear in equation (1) can be expressed as (Wesołowski 2022a)

$$C(t_1) = \eta_1 \xi \frac{\int_{r_{\min}}^{r_{\max}} Q_{\mathrm{scat}}(r) r^{2-q} \mathrm{d}r}{\int_{r_{\min}}^{r_{\max}} r^{3-q} \mathrm{d}r}, \tag{2}$$

$$C(t_2) = (\eta_1 + \Delta\eta)\, \xi \frac{\int_{r_{\min}}^{r_{\max}} Q_{\mathrm{scat}}(r) r^{2-q} \mathrm{d}r}{\int_{r_{\min}}^{r_{\max}} r^{3-q} \mathrm{d}r}, \tag{3}$$

and

$$C_{\mathrm{ej}} = \frac{3 M_{\mathrm{ej}} \int_{r_{\min}}^{r_{\max}} Q_{\mathrm{scat}}(r) r^{2-q} dr}{4 \rho_{\mathrm{gr}} (1-\psi) \int_{r_{\min}}^{r_{\max}} r^{3-q} dr}. \tag{4}$$

In equations (2)–(4), η_1 is the active surface during quiet sublimation, $\Delta\eta$ is a correction related to the ejection of a fragment of the cometary nucleus surface during the outburst, ξ is a factor related to thermodynamic parameters, r is the radius of porous particles on which the incident sunlight scatters, $Q_{scat}(r)$ is the scattering coefficient, q is an index in the power law, M_{ej} is the mass ejection, ρ_{gr} is the density of particles, and ψ is the porosity of particles.

equations (2)–(3) contain two parameters that can be expressed as:

$$\xi = \frac{3 S_{\mathrm{N}} \gamma_{\mathrm{j}} \psi F_{\mathrm{i}} R_{\mathrm{c}}}{v_{\mathrm{g}} \rho_{\mathrm{agg}}}, \tag{5}$$

and

$$\Delta\eta = \frac{M_{\mathrm{ej}}}{4 S_{\mathrm{N}} h \rho_{\mathrm{gr}} (1 - \psi)}. \tag{6}$$

In equations (5)–(6), γ_{j} is the dust-gas mass ratio (if $\mathrm{j} = 1$ then comet activity occurs in the quiet sublimation phase and if $\mathrm{j} = 2$ then comet activity occurs in the outburst phase), F_{i} is the sublimation flux (if $\mathrm{i} = 1$, this sublimation activity is controlled by ice H_2O, and when $\mathrm{i} = 2$, this sublimation activity is controlled by ice CO_2), $\mathrm{R_c}$ is radius of the cometary coma, ρ_{agg} is the density of agglomerates, $\mathrm{v_g}$

is the gas velocity, and h is the thickness of the destroyed layer. The parameter $\eta(t_1)$ defines the fraction of the nucleus surface actively sublimating during periods of quiet activity, relative to its total surface area. In our calculations, we consider a broad range for this parameter, extending up to 50 per cent, reflecting observations from comet 67P/Churyumov–Gerasimenko where water ice sublimation predominantly occurred on sunlit areas of the nucleus (Gicquel et al. 2016). To determine the value of the mass expelled during the outburst, we also need to ascertain individual thermodynamic parameters such as gas velocity and sublimation flux. This requires resolving the energy balance equation, which can be represented as follows:

$$\frac{S_{\odot}(1 - A_{\mathrm{N}})}{r_{\mathrm{h}}^2} \max(\cos\Theta_{\mathrm{Sun}}, 0) = \epsilon\, \sigma_{\mathrm{B}}\, T_{\mathrm{i}}^4 + H_{\mathrm{k}}\, F_{\mathrm{i}}, \tag{7}$$

where $S_{\odot}$ is the solar constant at 1 au, Θ_{Sun} is the solar zenithal angle, r_{h} is the heliocentric distance at which the comet outburst was observed, ϵ is the emissivity, σ_{B} is the Stefan Boltzmann constant, T is the temperature, and H_{k} is the latent heat of sublimation (if $\mathrm{k} = 1$ then we take into account the latent heat of sublimation of ice H_2O, and if $\mathrm{k} = 2$ then we take into account the latent heat of sublimation of ice CO_2). Let us explain that correctly describing the sublimation of cometary ice is not a simple task. Using thermodynamic models, one can determine the temperature, but this requires adopting certain values in the model that are poorly defined. An example of such a parameter is the thermal conductivity of the surface layer of the core and the changes occurring in this layer under the influence of the sublimation flux. Therefore, in order not to underestimate or overestimate the temperature value due to the uncertainty of thermal conductivity in the energy balance equation, this factor was omitted.

Additionally, the gas velocity and sublimation flux are calculated using the following relationships:

$$v_{\mathrm{g}} = \sqrt{\frac{\pi k_{\mathrm{B}} T_{\mathrm{i}}}{2 m_{\mathrm{g,i}}}}, \tag{8}$$

and

$$F_{\mathrm{i}} = \beta \psi p_{\mathrm{sat,i}} \sqrt{\frac{\pi m_{\mathrm{g,i}}}{2 k_{\mathrm{B}} T_{\mathrm{i}}}}, \tag{9}$$

where k_B is the Boltzmann constant, $m_{g,i}$ is the mass of a gas molecule, β is the sticking coefficient of the gas molecules on to the surface (the value of this coefficient is in the range $0< \beta <1$), and $p_{sat,i}$ is the pressure of the phase equilibrium.

4 RESULTS

To determine the actual ejected mass responsible for the outburst, equation (1) needs to be solved numerically. Put simply, we are seeking the mass ejected value corresponding to a specific outburst amplitude. Equation (1) is a complex logarithmic function of the individual scattering cross-sections. Hence, we utilized an algorithmic approach for numerical solution. This involved iteratively refining the mass ejected value until convergence criteria were met. In our context, this iterative process identifies the mass ejected value for the observed outburst occurring at a particular heliocentric distance.

Holmesin vuoden 2007 purkauksen pölyvana

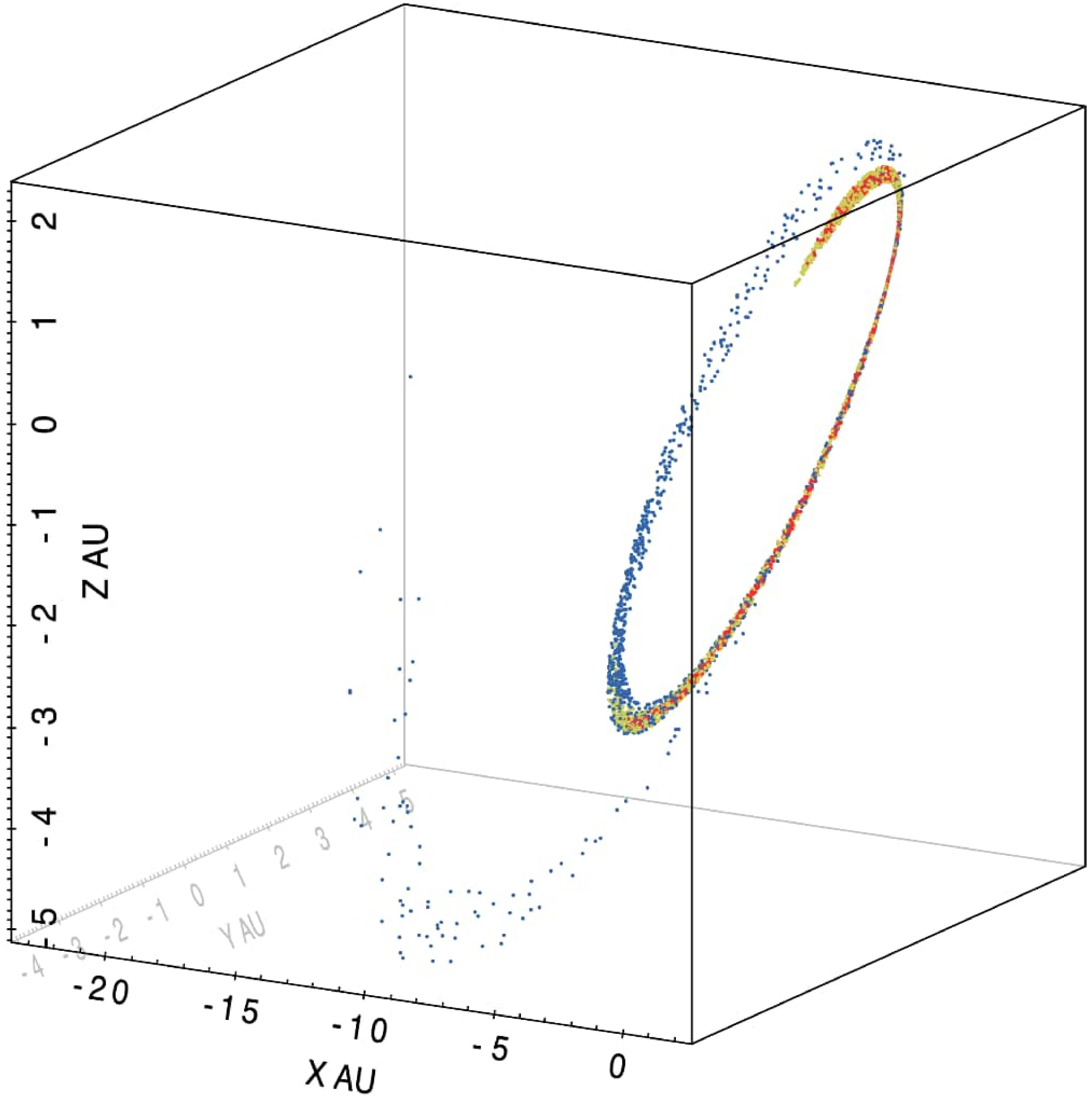
Havaittavissa eteläisellä ja pohjoisella taivaalla solmupisteissä

- Pölypartikkelien ratojen solmupisteet ovat pohjoisella taivaalla räjähdyspisteen tienoilla ja eteläisellä taivaalla vastapuolella räjähdyspistettä.
- Pohjoisella taivaalla pölyvanan pölypartikkelit konvergoituvat kaikissa suunnissa.
- Eteläisellä taivaalla pölyvanan pölypartikkelit ovat havaittavissa parhaiten silloin, kun Maa kulkee Holmes komeetan ratatason läpi. Tämä tapahtuu elokuussa ja helmikuussa vuosittain.
- Pölypartikkeleiden tiheys havaintopisteessä tietysti myös muuttuu ajan funktiona, joten läheskään aina ei pölyvana ole havaittavissa.

Mallinnettu pölyvana

28.10.2021

Alkuperäisessä purkauspaikassa oleva tiimalasikuvio näkyy vanan alkupuolella. Eteläisellä taivaalla pölyhiukkasten ratojen solmupisteessä oleva tiimalasikuvio näkyy vanan loppupuolella. Pölyhiukkasten koordinaatit on esitetty ICRF koordinaatistossa. Pienet pölyhiukkaset on esitetty sinisellä värillä, keskikokoiset pölyhiukkaset on esitetty keltaisella värillä ja suuret pölyhiukkaset on esitetty punaisella värillä.



Pölyvana eteläisellä taivaalla

17.2.2013 ja 19.2.2013 (kuvanvähennys)

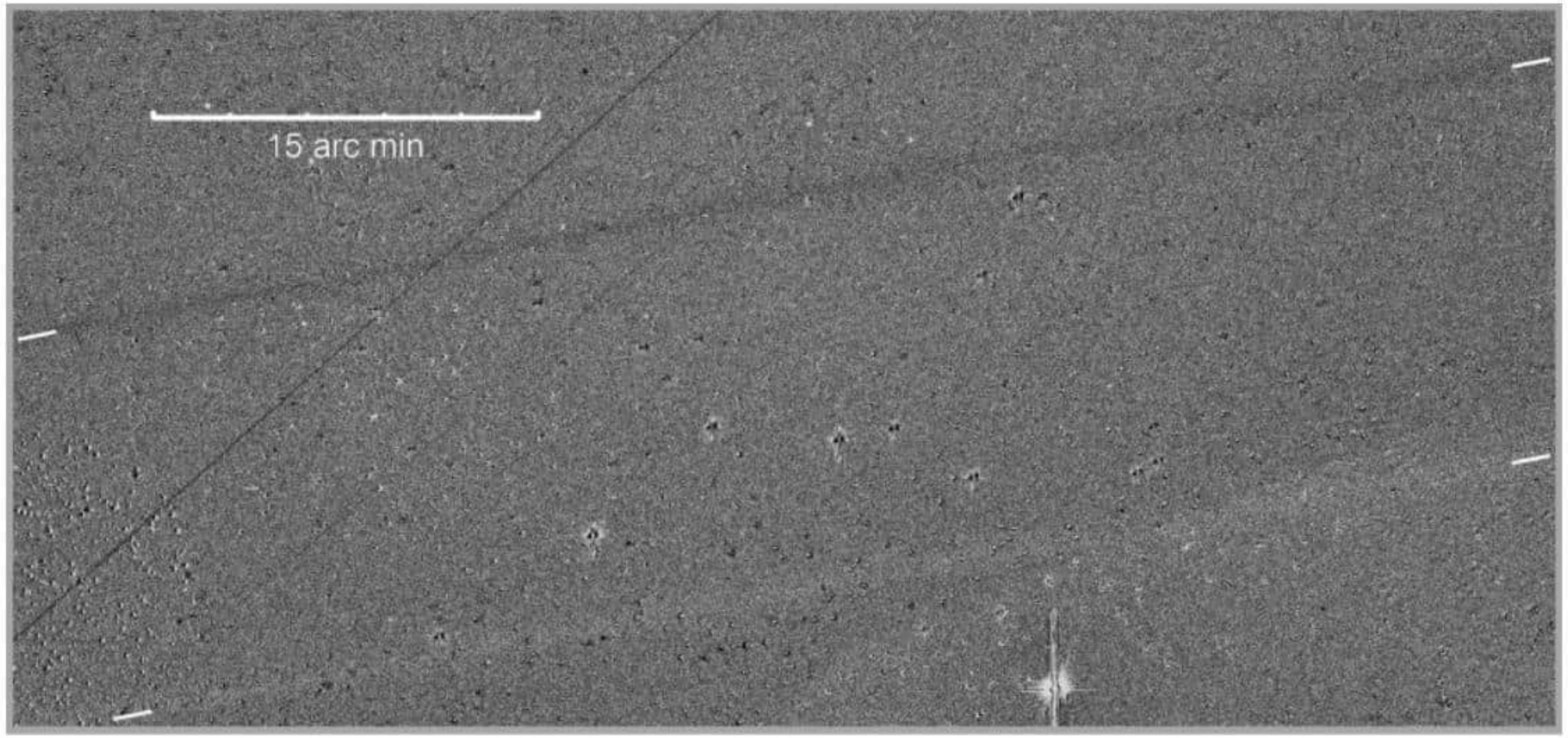
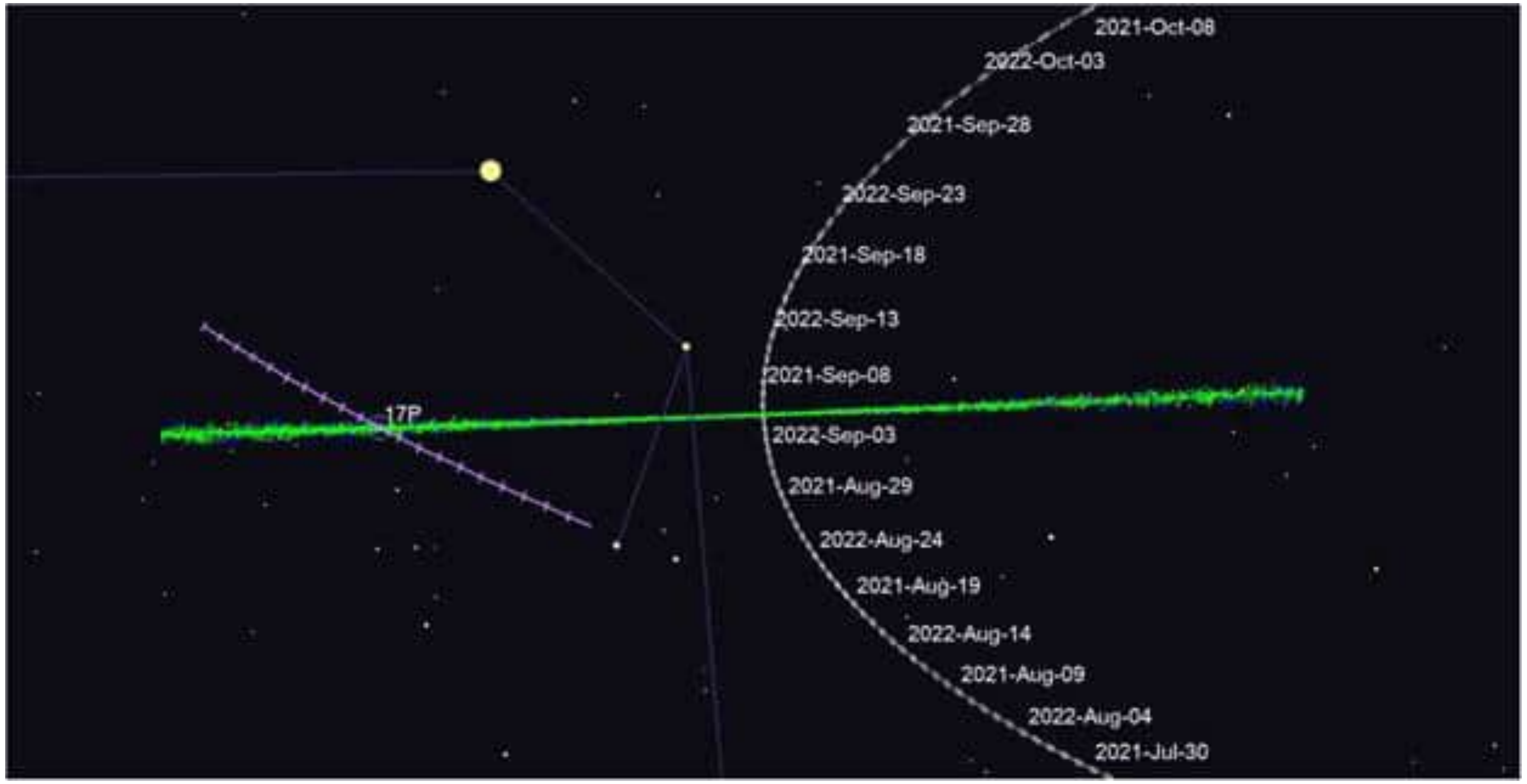


Figure 5. Observation made on 2013 February (M2). Darker trail is 17 February observation. Lighter trail is 19 February observation. Adopted from Lyytinen et al. (2013).

Mallinnettu pölyvana

6.9.2021

Komeetta 17P/Holmes mallinnetun vanan kohdalla 6.9.2021. Alkuperäisen purkauspaikan näennäinen liike yötaivaalla on myös esitetty kuvassa.



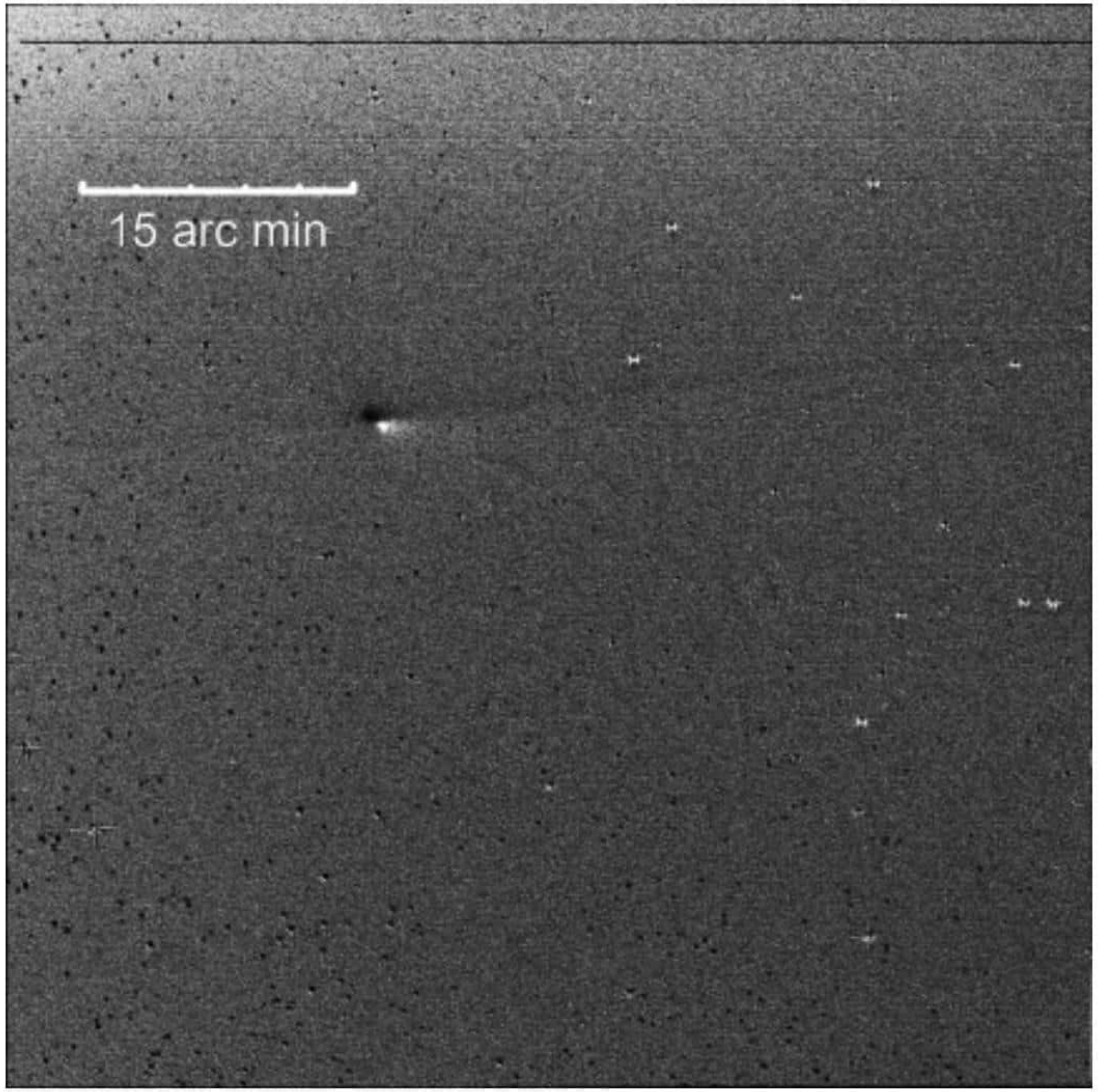
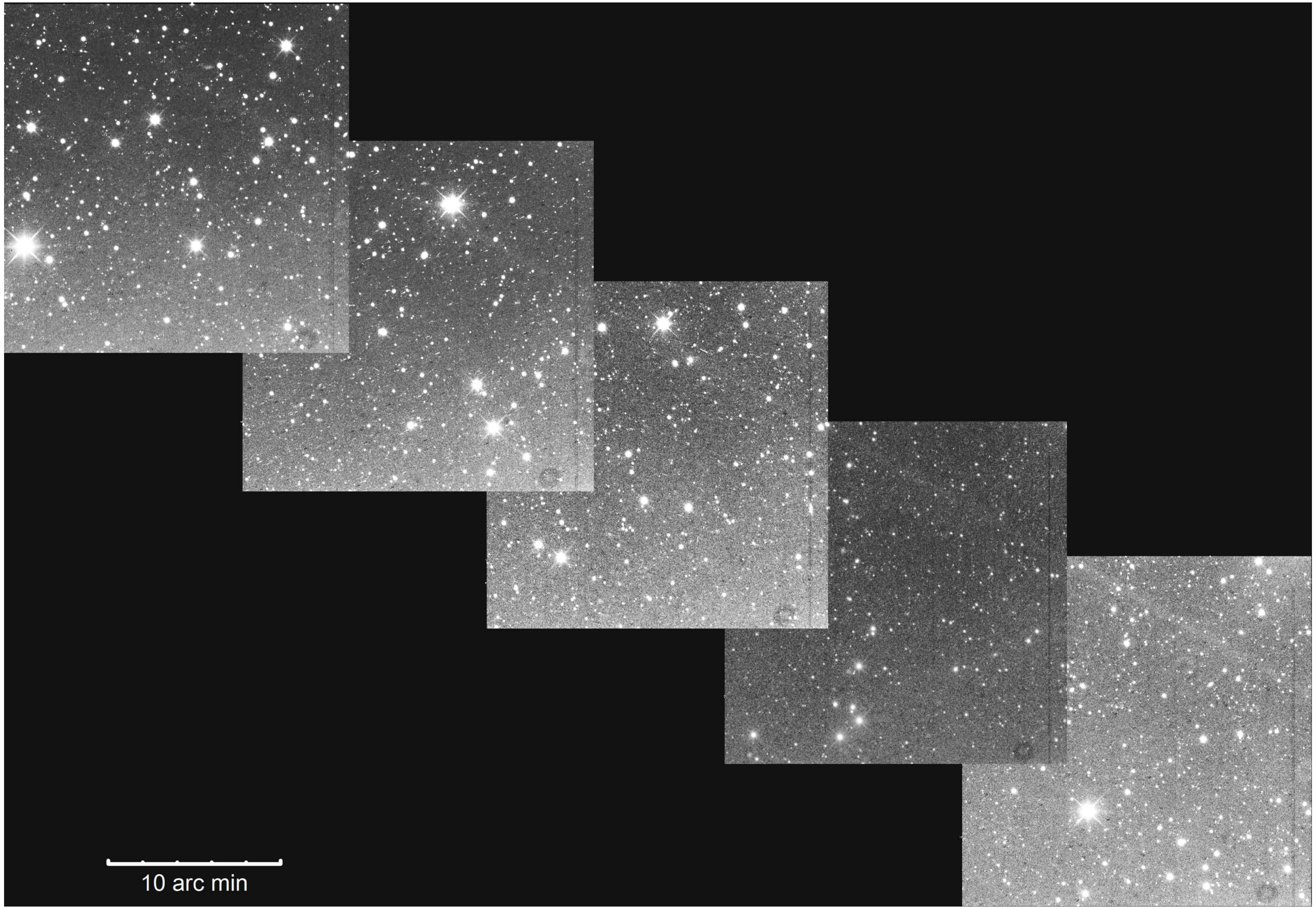


Figure 13. Image taken with the T24 telescope obtained when 17P/Holmes was aligned with the dust trail. The observation was made in 2014 September 16 (M6). Image subtraction. The darker trail is M6.

Pölyvana

Kuva: Arto Oksanen

- Kuva otettu Hankasalmen observatoriossa
- Kuva on otettu 2015 helmikuun 14 päivänä.
- Kuva on yhdistelmäkuva viidestä CCD kameralla otetusta yksittäiskuvasta.



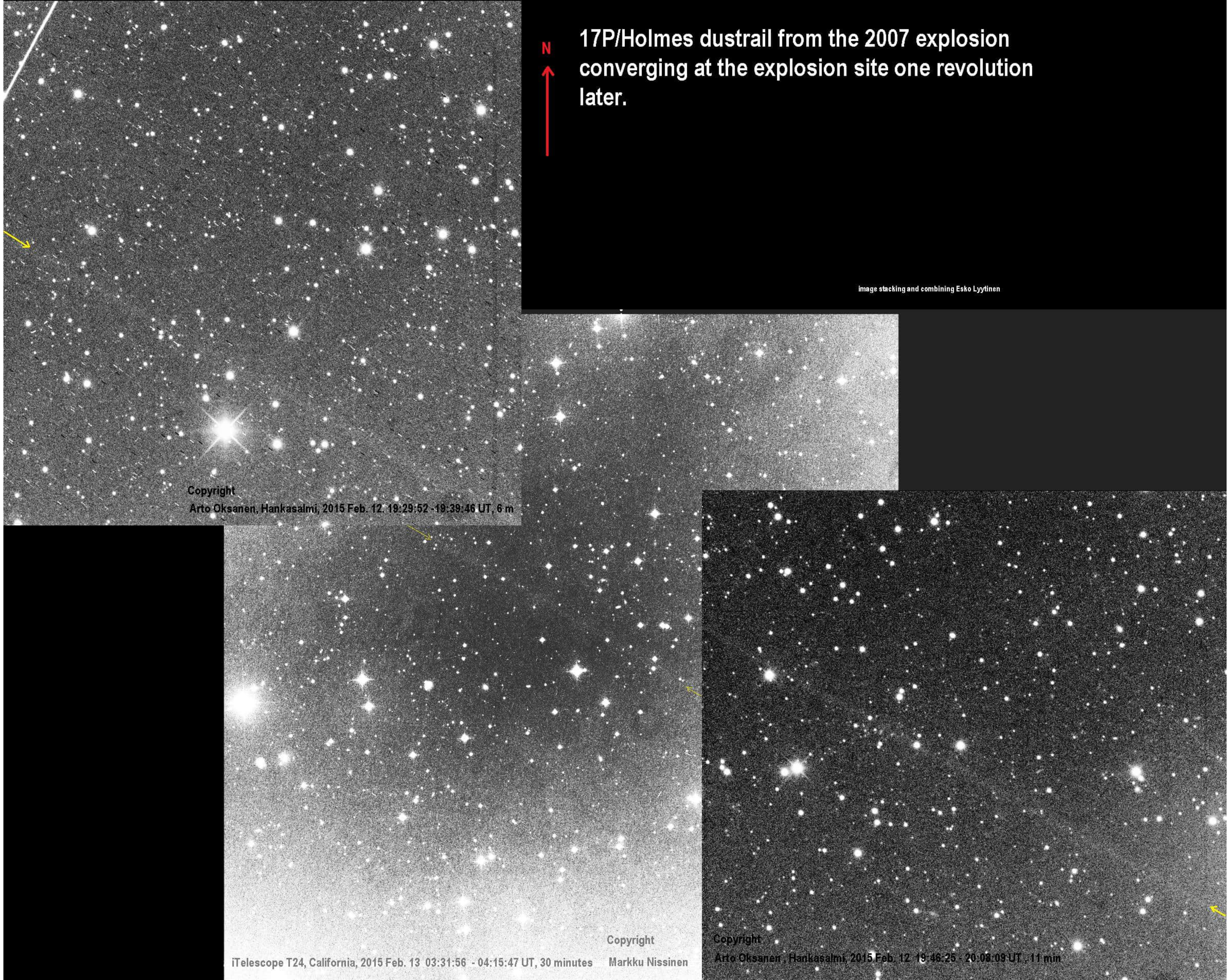

N
17P/Holmes dustrail from the 2007 explosion converging at the explosion site one revolution later.
image stacking and combining Esko Lyytinen
Copyright
Arto Oksanen, Hankasalmi, 2015 Feb. 12. 19:29:52 -19:39:46 UT, 6 m
Copyright
iTelescope T24, California, 2015 Feb. 13 03:31:56 - 04:15:47 UT, 30 minutes
Markku Nissinen
Copyright
Arto Oksanen , Hankasalmi, 2015 Feb. 12 19:46:25 - 20:08:09 UT , 11 min

Figure 4: Observation of the trail on February 15, 2015, without image subtraction, observations A. Oksanen. Adopted from [1].

WGN julkaisu 2013

WGN, THE JOURNAL OF THE IMO 41:3 (2013) 77

Ongoing meteor work

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

Esko Lyytinen[1], *Markku Nissinen*[2], *Harry J. Lehto*[3]

Stella Arcti kunniamainninta vuonna 2014

Inarissa palkittiin poissaolevina myös **Markku Nissinen** (Kuvansi), **Esko Lyytinen** (Helsinki) sekä **Harry Lehto** (Kaarina) havainnoista, joita he tekivät komeetta 17P/Holmesin räjähdysmäisen purkauksen jälkeensä jättämästä pölyvanasta. Havainnoista löytyi aiemmin havaitsematon ilmiö, joka saa komeetasta irronneet kappaleet kerääntymään räjähdyspisteestä katsottuna vastakkaiselle puolelle aurinkoa. Tämä tunnetaan konvergenssi-ilmiönä. Aiemmin palkitut Nissinen ja Lyytinen sekä ammattitähtitieteilijä Harry Lehto saivat havainnostaan Stella Arcti -kunniamaininnan.

- Esko Lyytinen ja minä Asteroids, Comets and Meteors konferenssissa Helsingissä 2014

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **513,** 2201–2214 (2022) https://doi.org/10.1093/mnras/stac822
Advance Access publication 2022 March 29

Evolution of the dust trail of comet 17P/Holmes

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Accepted 2022 March 20. Received 2022 March 17; in original form 2021 June 11

MNRAS artikkeli

Lähtökohdat ja tehdyt mallinnukset ja lisäykset

- Esko Lyytisen visio purkauksesta ja pölyvanan käyttäytymisestä hyvin tärkeässä osassa!
- Havaintoja vuodesta 2013 asti tehty säännöllisesti partikkelien ratojen molemmissa solmupisteissä eteläisellä ja pohjoisella taivaalla.
- Yhdistettyä mallinnusta, joka olisi riittävän korkealla tieteellisellä tasolla, ei ollut olemassa, vaan se piti itse tehdä.
- MNRAS artikkeli on Open Access artikkeli!

- Yhdistimme elementtejä Spitzer avaruusteleskoopin avulla (Reach W. T., Vaubaillon J., Lisse C. M., Holloway M., Rho J., 2010, Icarus, 208, 276) tehdystä purkauksen malllinnuksesta meillä jo olleisiin malleihin.
- Malleja oli tehty Excelillä ja Excel solverilla sekä käytettävissä oli meteoriparvien partikkelimallinnusohjelmistot, joissa olin itse mukana kehityksessä ja mallinnuksessa esimerkiksi Leonidien meteoriparven mallinnuksessa.
- Mallinnus tehtiin uudelleen alusta asti käyttäen Orekit kirjastoa ja Javaa. Koordinaatisto muuttui moderniin ICRF koordinaatistoon. Integraattoriksi valittiin Runge-Kutta pohjainen integraattori, jolla tarkkuus erittäin hyväksi.
- Käytettävissä oli myös Jari Suomelan tekemä PHP ohjelma koordinaattien laskemiseen, jota oli käytetty jo 2013 WGN artikkelissa. Sillä laskettiin uudelleen ennusteen koordinaatit, jotka on supplementary materiaalissa.

Table 1. Particle radius in mm, ejection velocity in m s^{-1} after (Reach et al. 2010) and the ratio of radiation pressure to gravity β after (Burns et al. 1979; Landgraf et al. 2000).

r, mm	Ejection velocity (m s^{-1})	β
1	330	0.0002
0.1	515	0.0022
0.01	610	0.022
0.001	640	0.280

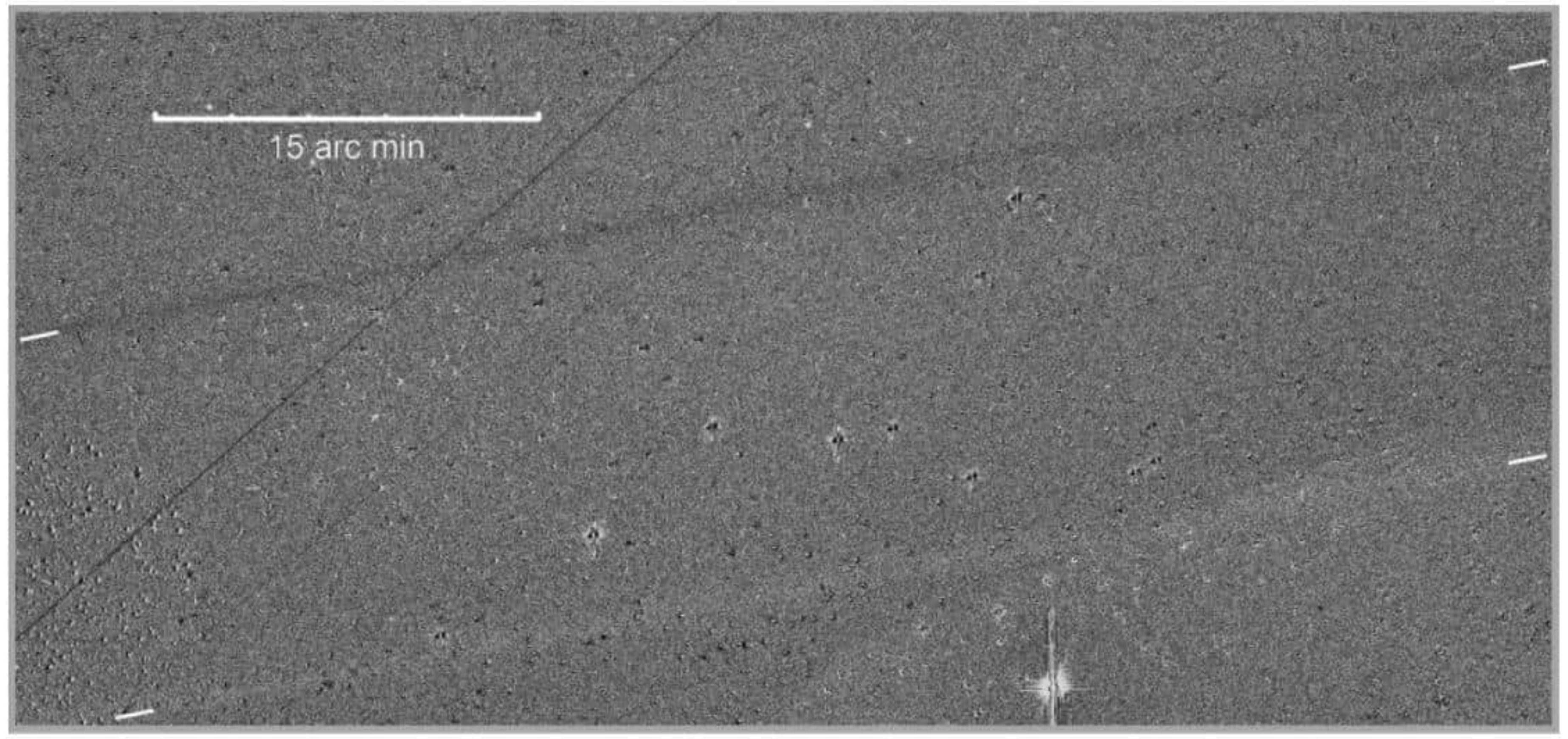


Figure 5. Observation made on 2013 February (M2). Darker trail is 17 February observation. Lighter trail is 19 February observation. Adopted from Lyytinen et al. (2013).

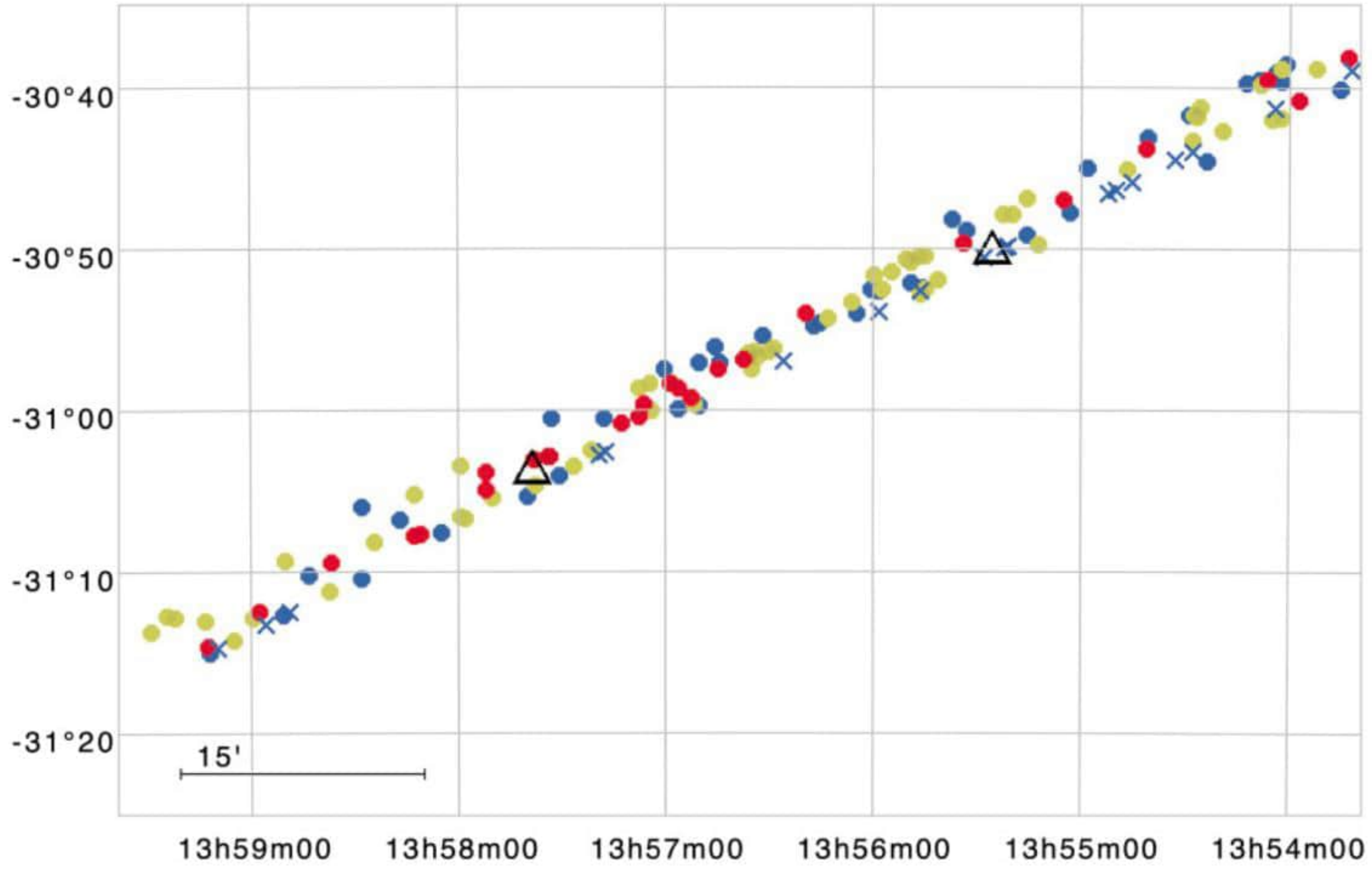


Figure 6. The 'Dust Trail kit' modelling for 2013 August 24 output is consistent with the observations of (M3). X-axis shows RA and Y-axis DEC. The colour coding is used to illustrate different size particles. Blue: SPs. Yellow: MPs. Red: BPs. Black triangles: the observed start and end positions of the trail. Particles ejected towards the Sun are marked with crosses.

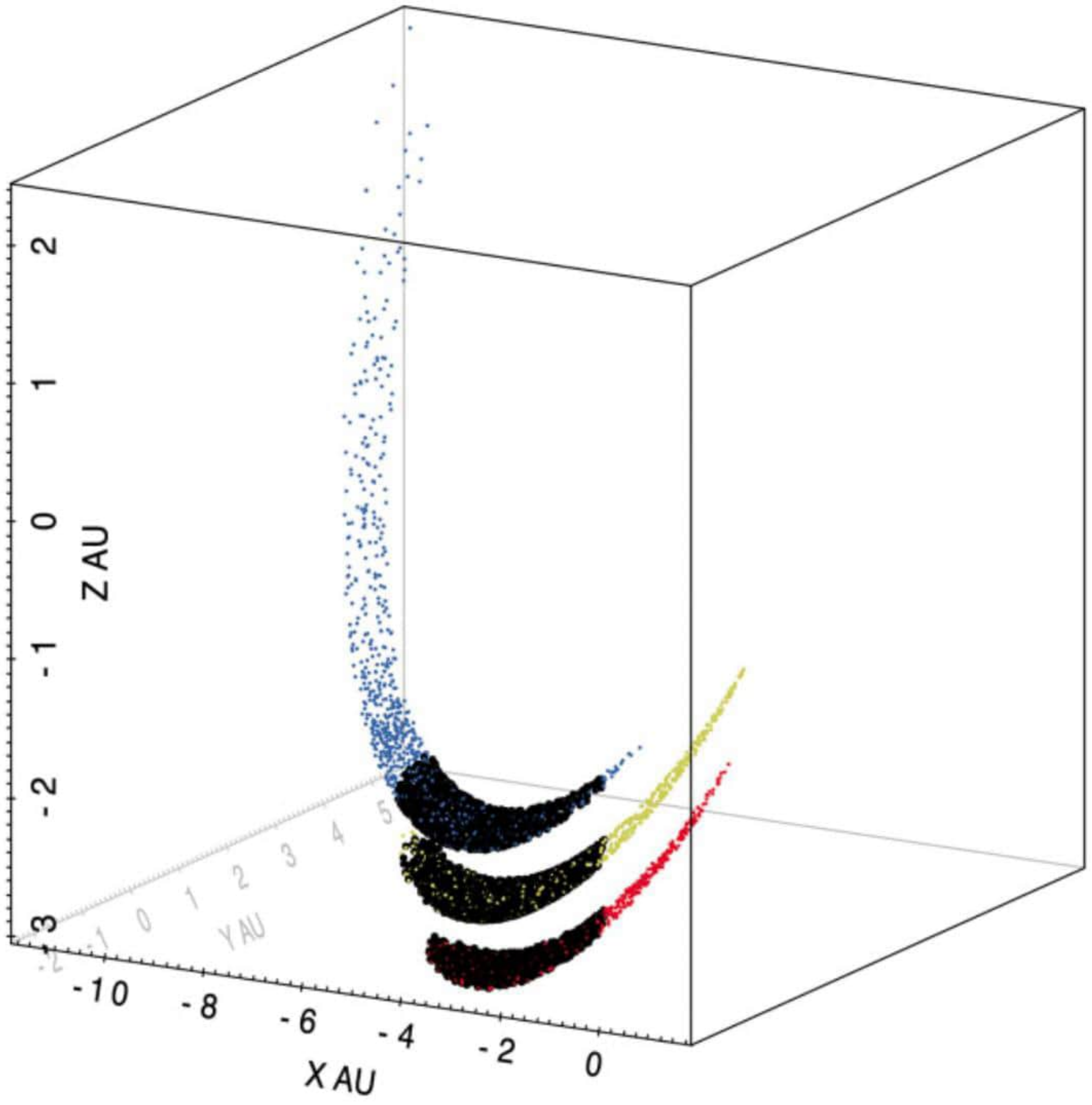


Figure 4. Modelling results for 2013 February 17 (at the time of observation M2). The particles are shown in ICRF coordinates XYZ. The colour code used reflects the size of the modelled particles: Blue: SPs. Yellow: MPs. Red: BPs. In order to fully demonstrate all particle populations, we have applied offset Z = 0.5 to the blue particles and offset Z = −0.5 to the red particles. Black circles: particles in the 40° RA window.

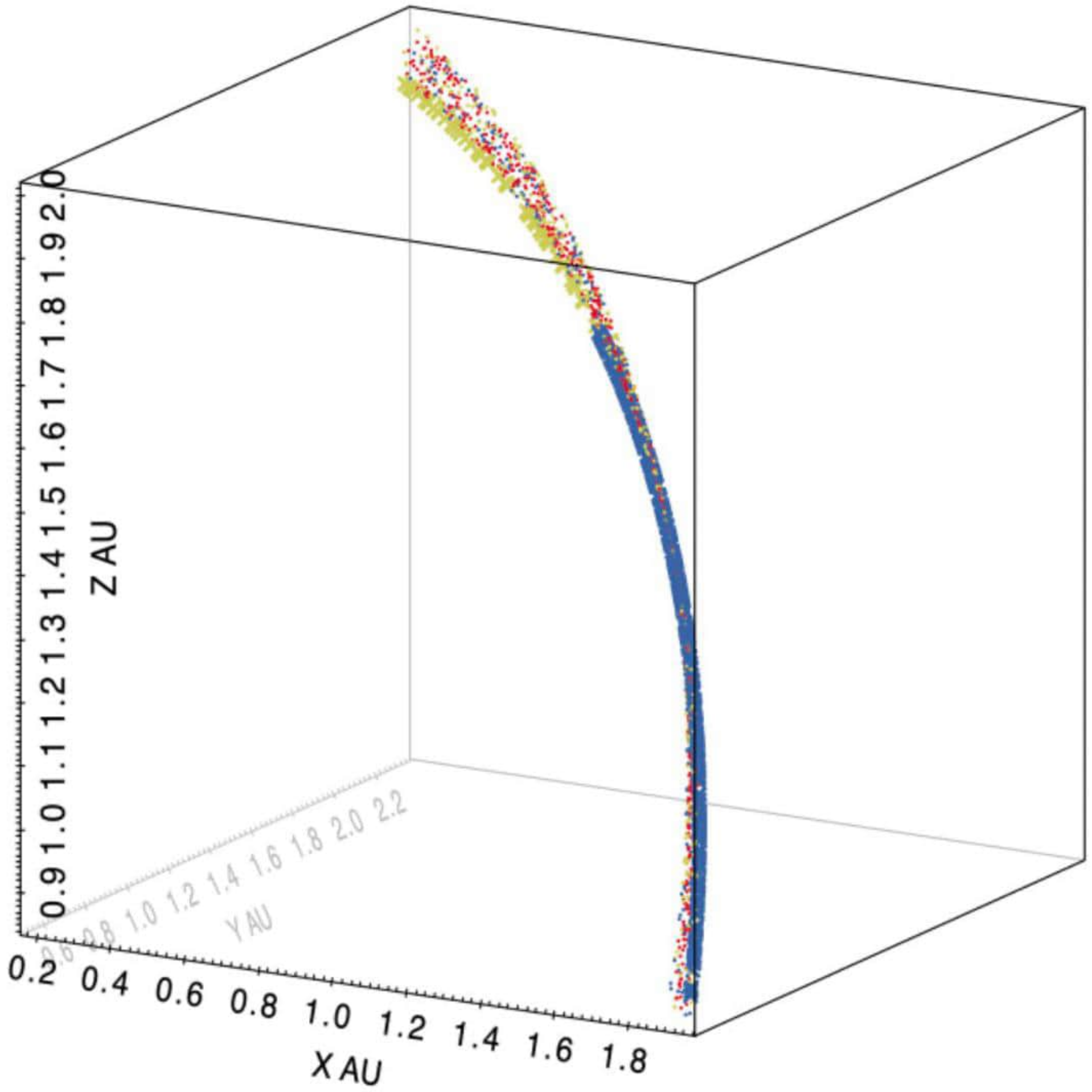


Figure 17. Modelling results versus observation made in the northern node in 2015 February 14 (M13). The particles are shown in the ICRF coordinates XYZ. Colour code stands for particle size. Blue: SPs. Yellow: MPs. Red: BPs.

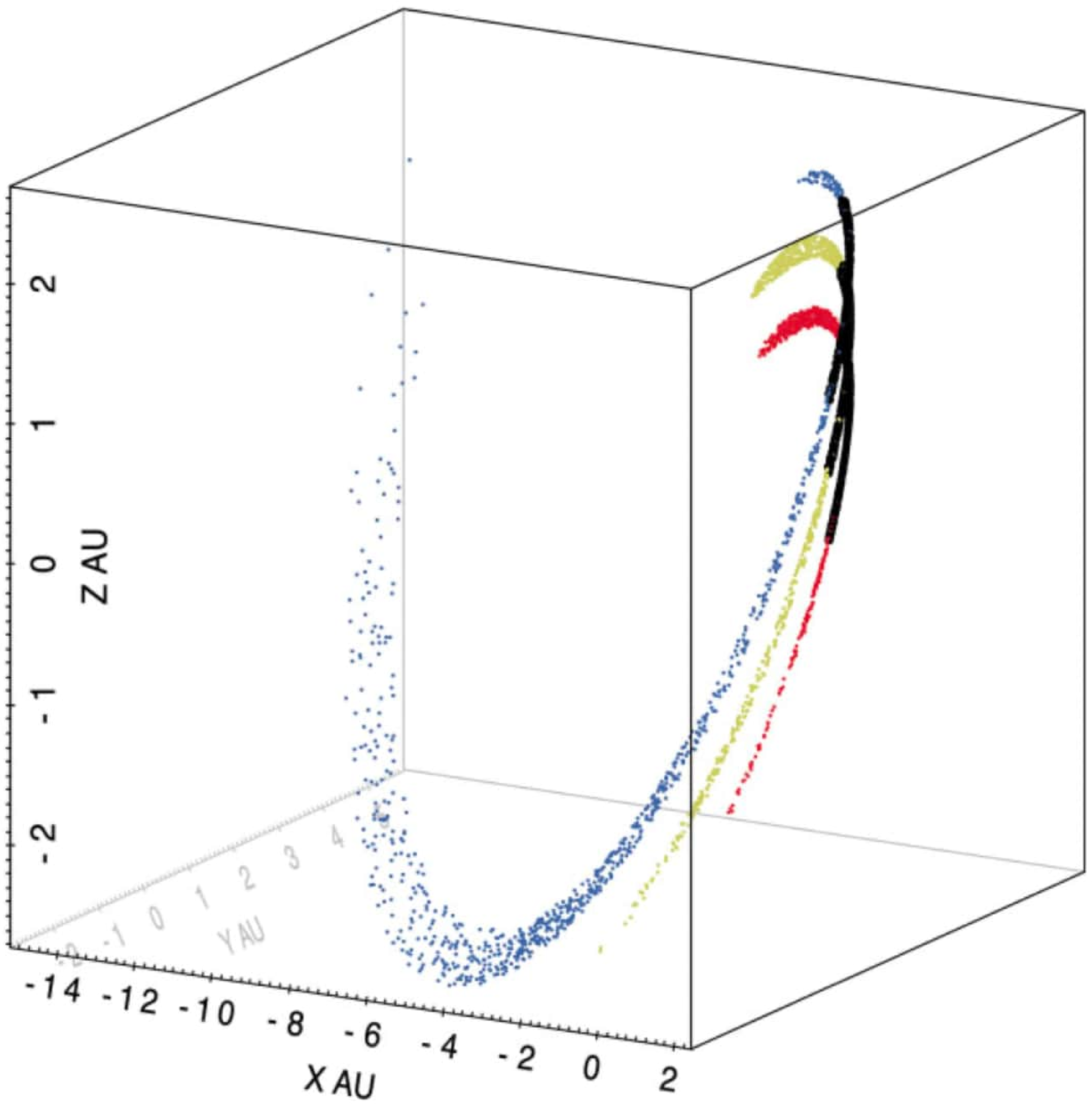


Figure 21. Modelling results for the time of the observation made in 2015 February 15 (M14). Here we show a complete modelled dust trail. The 40° RA sections of the trail are coloured here by black. The particles are shown in the ICRF coordinates XYZ. Blue: SPs. Yellow: MPs. Red: BPs. In order to fully demonstrate all particle populations, we have applied offset Z = 0.5 to the blue particles and offset Z = −0.5 to the red particles.

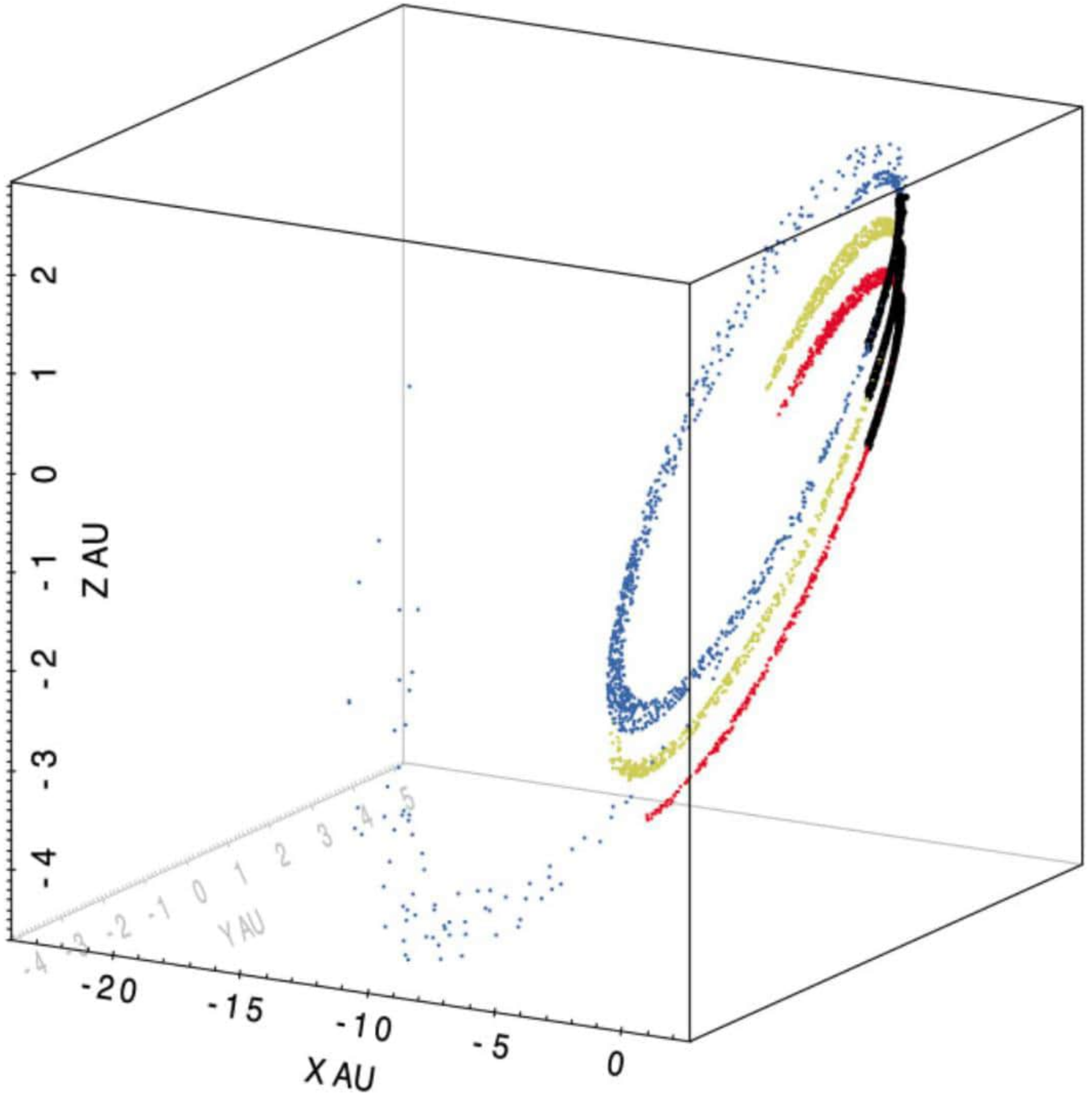


Figure 26. Modelling of the predicted trail for 2022 February (2022–02-15T12:00:00) (F7). The section highlighted is modelled in more detail near the 2007 outburst point. Blue: SPs. Yellow: MPs. Red: BPs. Black circles: 2007 outburst point centered 40° RA window. Particles are shown in the ICRF coordinates XYZ. In order to fully demonstrate all particle populations, we have applied offset Z = 0.5 to the blue particles and offset Z = −0.5 to the red particles.

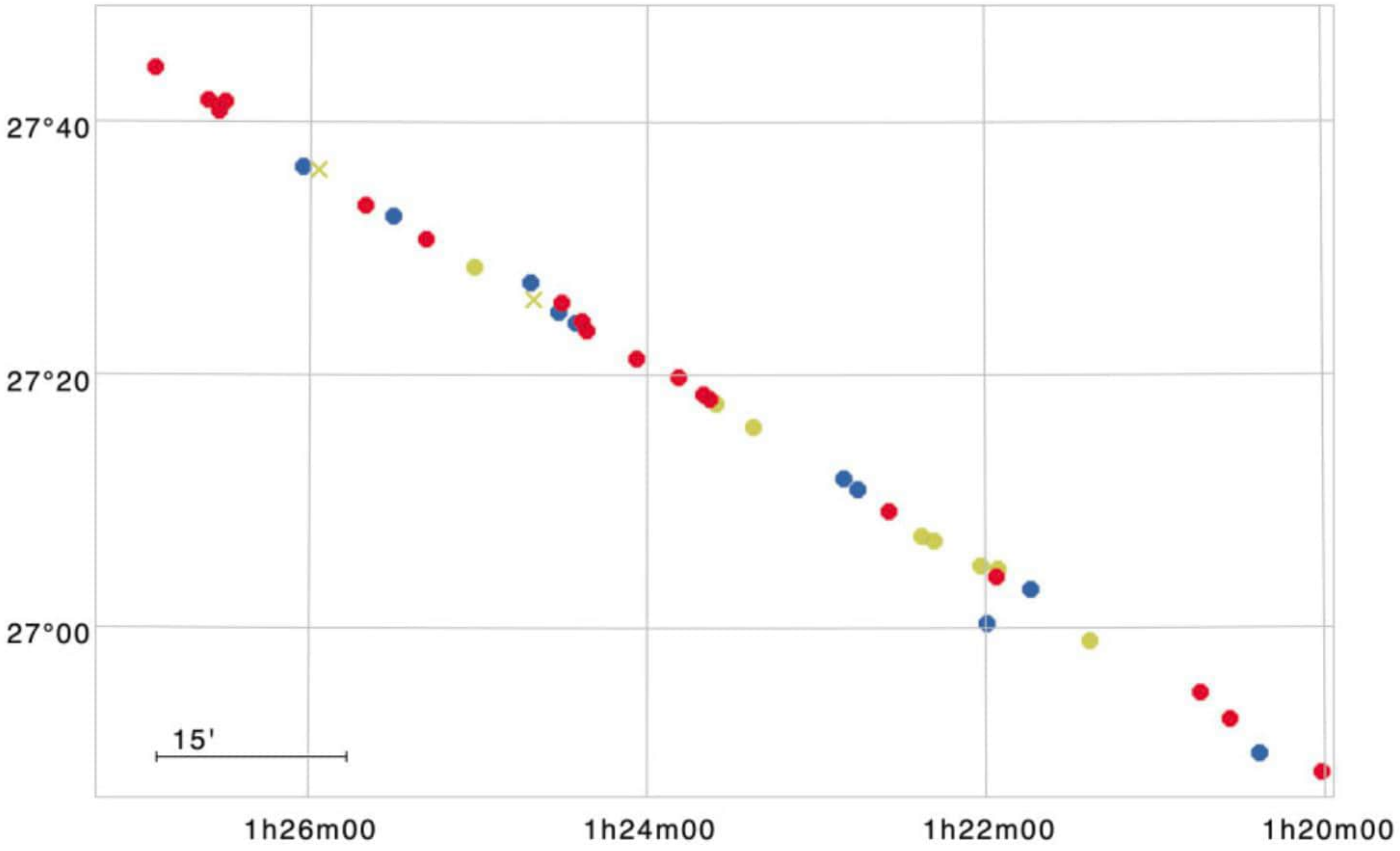


Figure 28. Modelling of the dust trail in 2022 February (2022–02-15T12:00:00) (F7). The X-axis shows RA and the Y-axis DEC. Blue: SPs. Yellow: MPs. Red: BPs. Particles ejected towards the Sun are marked with crosses.

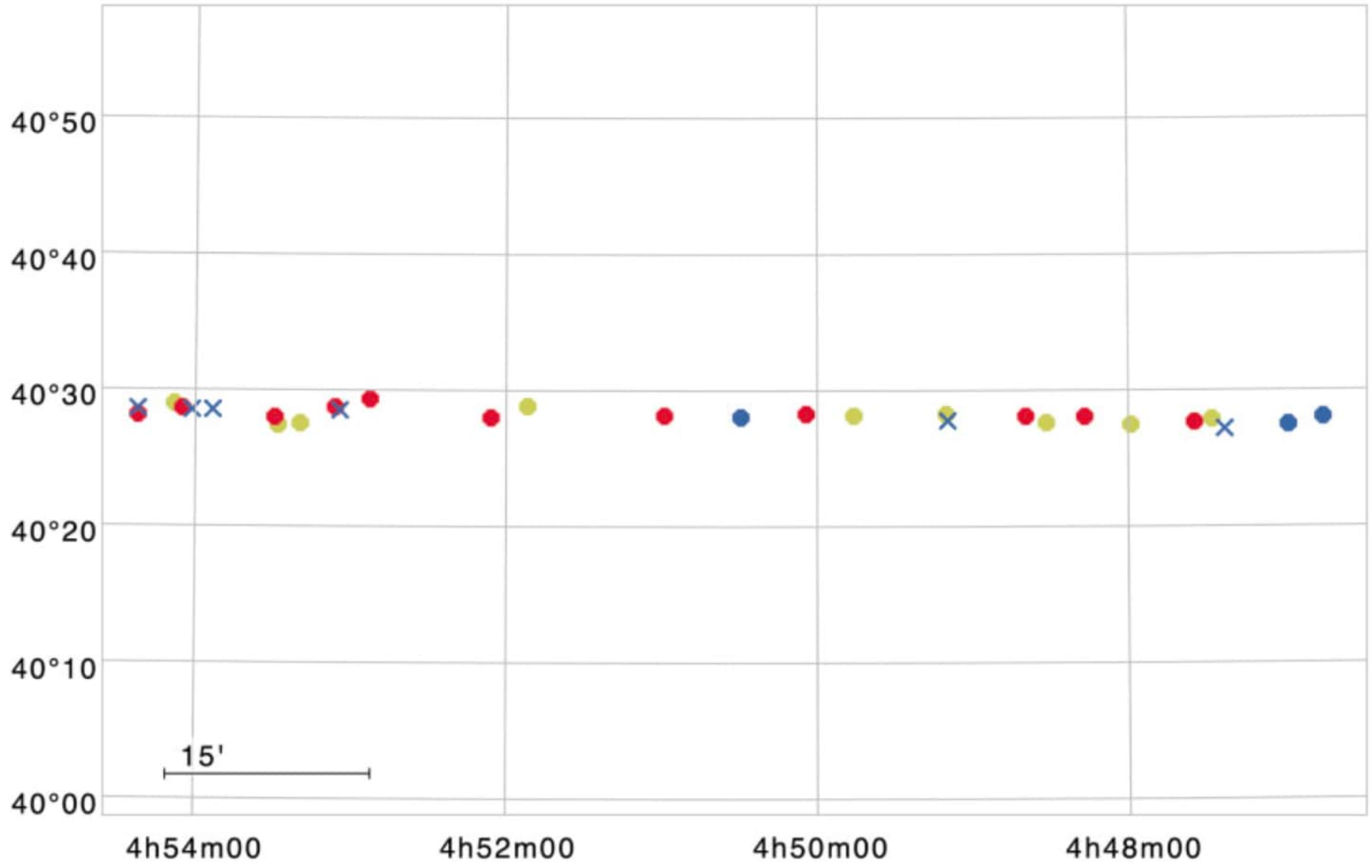


Figure 29. Modelling of the dust trail in 2022 August (2022–08-18T12:00:00) (F9). The X axis shows RA and the Y axis DEC. Blue: SPs. Yellow: MPs. Red: BPs. Particles ejected towards the Sun are marked with crosses.

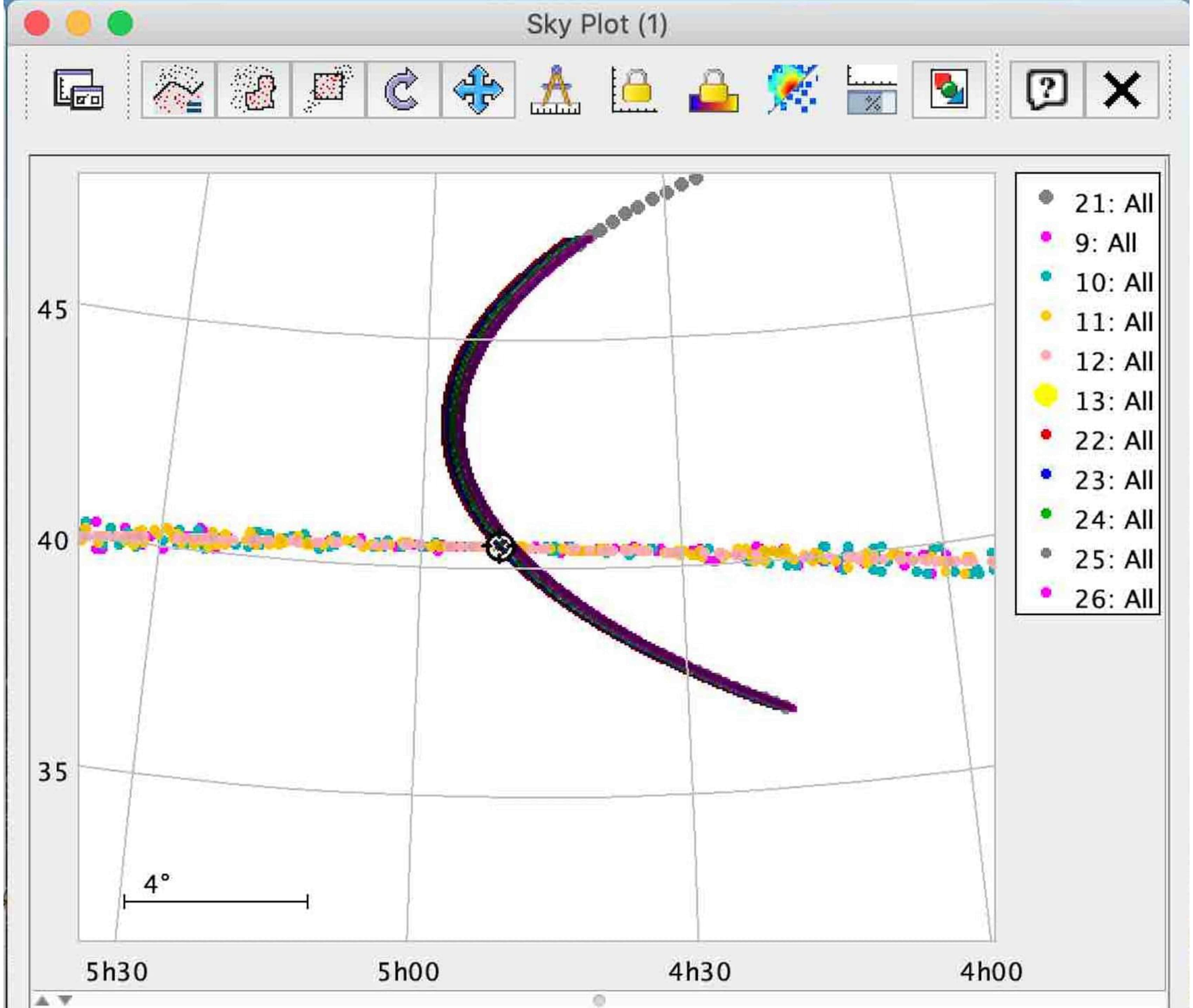
Tarkat pölyvanan koordinaatit tunnin välein

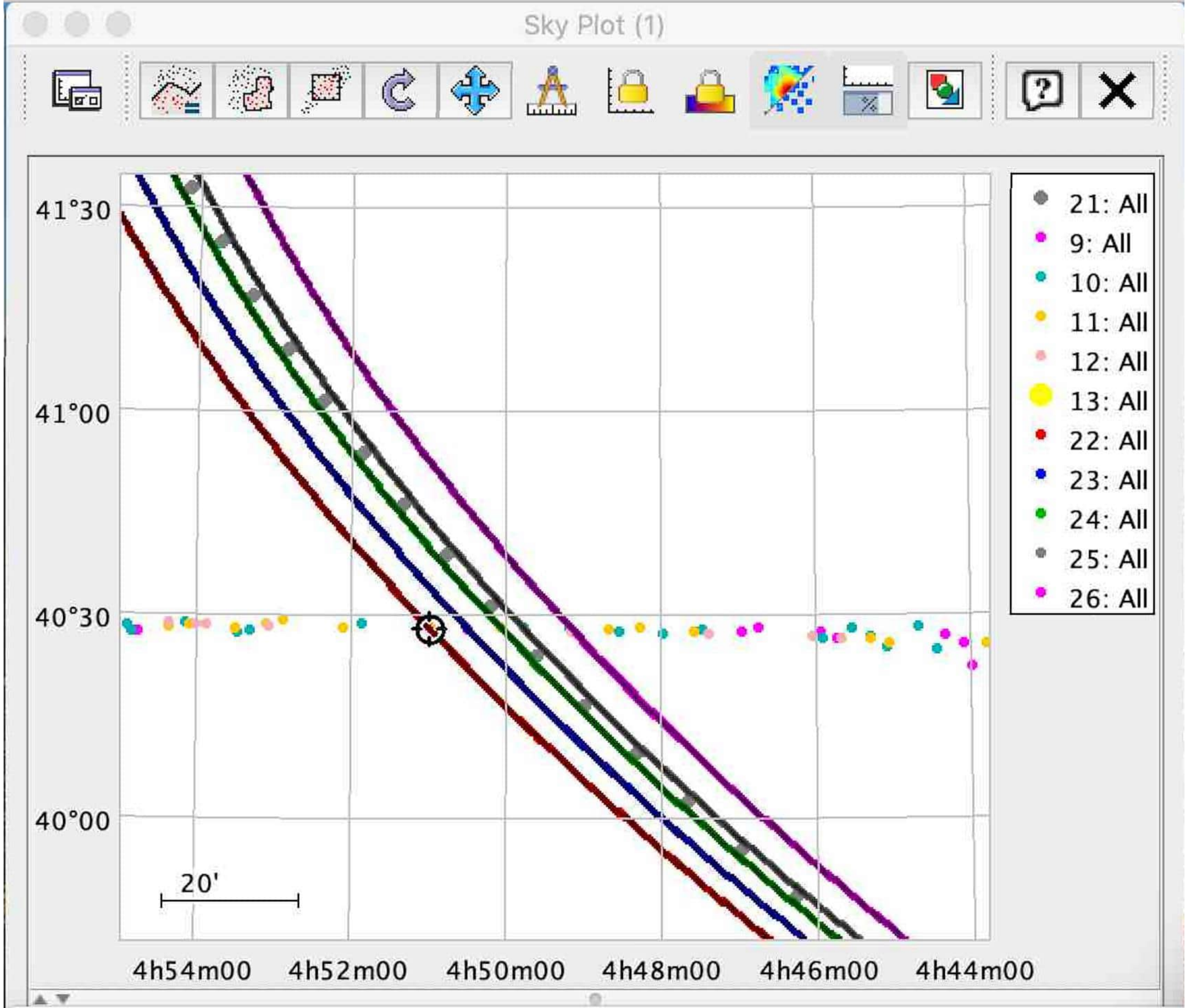
Tarkat koordinaatit tunnin välein on laskettu Python Skyfield ohjelmalla

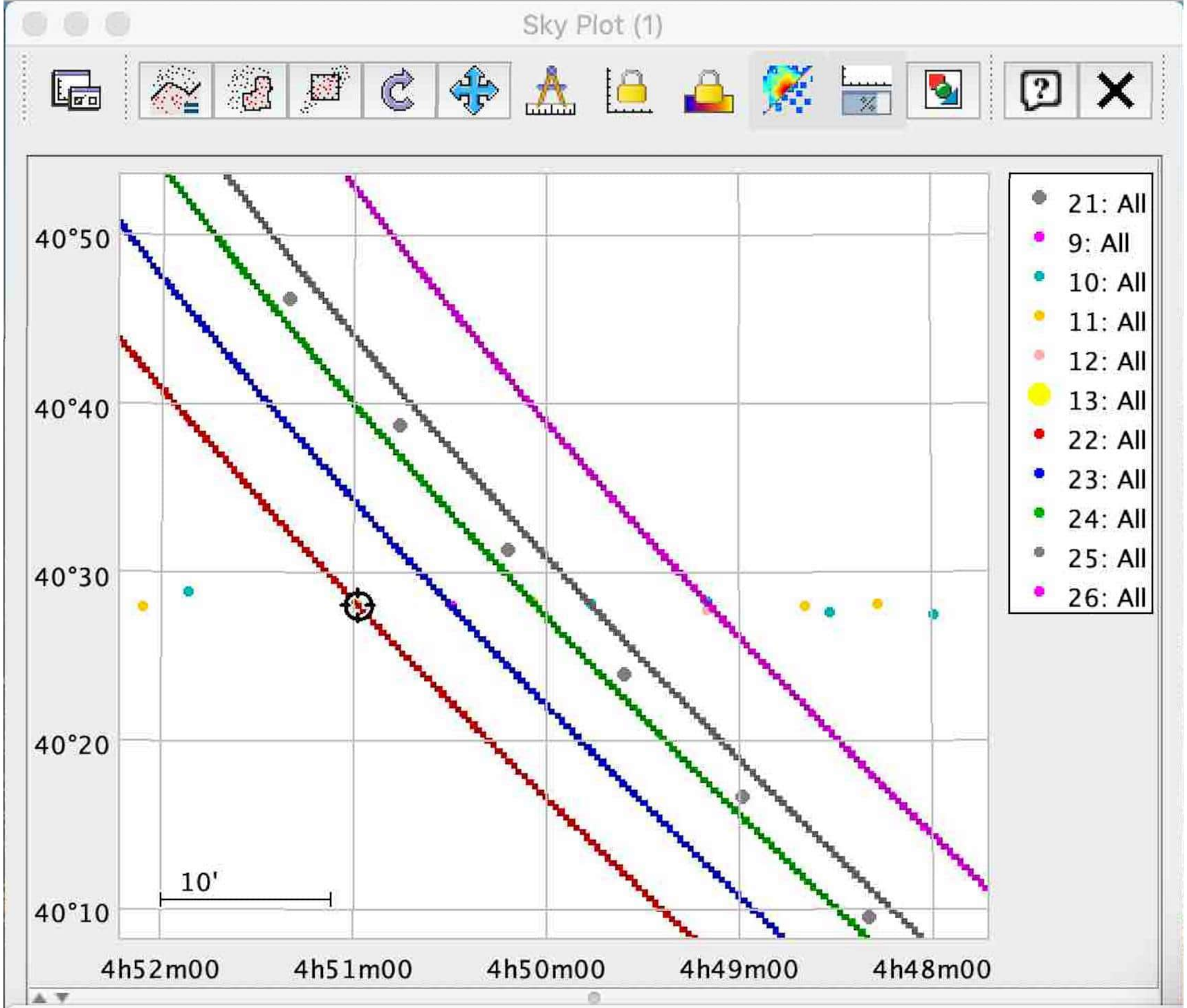
- Koordinaatit laskettiin observatoriokoodin mukaan tunnin välein. Koordinaateissa on otettu huomioon ns. light time, observatorion sijainti maapallolla sekä ilmakehän refraktion vaikutus. Suomessa koordinaatit on nyt laskettu Kouvolalle.

- Lähtökohtana tarkkojen koordinaattien laskennalle on Orekitillä tehty pölyvanan partikkelimallinnus, joka on tehty elokuun 18 päivälle 2022 MNRAS artikkelin teon yhteydessä. Myös Orekitillä on laskettu koordinaatit, mutta niissä ei ole näitä kaikkia vaikutuksia mukana. Ero Orekit ja tältä osalta tarkemman Python Skyfield koordinaattien laskennan välillä on ainoastaan 10 kaarisekuntia.

- Koordinaatit on laskettu viidelle Orekitillä mallinnetulle partikkelille pölyvanan kapeimmassa kohdassa.


Sky Plot (1)
45
40
35
4°
5h30
5h00
4h30
4h00
21: All
9: All
10: All
11: All
12: All
13: All
22: All
23: All
24: All
25: All
26: All


Sky Plot (1)
41°30
41°00
40°30
40°00
20'
4h54m00
4h52m00
4h50m00
4h48m00
4h46m00
4h44m00
21: All
9: All
10: All
11: All
12: All
13: All
22: All
23: All
24: All
25: All
26: All


Sky Plot (1)
40°50
40°40
40°30
40°20
40°10
4h52m00
4h51m00
4h50m00
4h49m00
4h48m00
10'
21: All
9: All
10: All
11: All
12: All
13: All
22: All
23: All
24: All
25: All
26: All

Esimerkki-koordinaattitaulukon selitykset

- Observatorion nimi
- Partikkelin ”nimi”
- Aika JPL formaatissa
- Aika JD
- RA ja DEC desimaalisena
- RA ja DEC normaalissa muodossa
- Alt ja Az

Kouvola_middle2 A.D. 2022-Aug-12 00:00:00.0000 UTC JD: 2459803.4999993294 RADEC: 71.42055617 DeclDEC: 39.69033877 RA: 04h 45m 40.93s Decl: +39deg 41' 25.2" Alt: 36deg 23' 42.0" Az: 71deg 59' 39.3"
Kouvola_middle2 A.D. 2022-Aug-12 01:00:00.0000 UTC JD: 2459803.5416659964 RADEC: 71.42821910 DeclDEC: 39.69525704 RA: 04h 45m 42.77s Decl: +39deg 41' 42.9" Alt: 43deg 32' 10.5" Az: 83deg 51' 30.9"
Kouvola_middle2 A.D. 2022-Aug-12 02:00:00.0000 UTC JD: 2459803.5833326634 RADEC: 71.43583576 DeclDEC: 39.70017211 RA: 04h 45m 44.60s Decl: +39deg 42' 00.6" Alt: 50deg 50' 20.2" Az: 97deg 04' 01.7"
Kouvola_middle2 A.D. 2022-Aug-12 03:00:00.0000 UTC JD: 2459803.6249993304 RADEC: 71.44341006 DeclDEC: 39.70507926 RA: 04h 45m 46.42s Decl: +39deg 42' 18.3" Alt: 57deg 53' 52.4" Az: 112deg 50' 36.6"
Kouvola_middle2 A.D. 2022-Aug-12 04:00:00.0000 UTC JD: 2459803.6666659974 RADEC: 71.45094826 DeclDEC: 39.70997444 RA: 04h 45m 48.23s Decl: +39deg 42' 35.9" Alt: 64deg 02' 19.3" Az: 133deg 09' 59.7"
Kouvola_middle2 A.D. 2022-Aug-12 05:00:00.0000 UTC JD: 2459803.7083326643 RADEC: 71.45845857 DeclDEC: 39.71485452 RA: 04h 45m 50.03s Decl: +39deg 42' 53.5" Alt: 68deg 05' 29.6" Az: 160deg 06' 00.8"
Kouvola_middle2 A.D. 2022-Aug-12 06:00:00.0000 UTC JD: 2459803.7499993313 RADEC: 71.46595055 DeclDEC: 39.71971756 RA: 04h 45m 51.83s Decl: +39deg 43' 11.0" Alt: 68deg 37' 31.9" Az: 191deg 42' 25.3"
Kouvola_middle2 A.D. 2022-Aug-12 07:00:00.0000 UTC JD: 2459803.7916659983 RADEC: 71.47343448 DeclDEC: 39.72456288 RA: 04h 45m 53.62s Decl: +39deg 43' 28.4" Alt: 65deg 23' 28.7" Az: 220deg 23' 12.8"
Kouvola_middle2 A.D. 2022-Aug-12 08:00:00.0000 UTC JD: 2459803.8333326653 RADEC: 71.48092067 DeclDEC: 39.72939114 RA: 04h 45m 55.42s Decl: +39deg 43' 45.8" Alt: 59deg 40' 24.8" Az: 242deg 19' 52.2"
Kouvola_middle2 A.D. 2022-Aug-12 09:00:00.0000 UTC JD: 2459803.8749993322 RADEC: 71.48841871 DeclDEC: 39.73420431 RA: 04h 45m 57.22s Decl: +39deg 44' 03.1" Alt: 52deg 46' 57.5" Az: 259deg 05' 48.1"
Kouvola_middle2 A.D. 2022-Aug-12 10:00:00.0000 UTC JD: 2459803.9166659992 RADEC: 71.49593684 DeclDEC: 39.73900552 RA: 04h 45m 59.02s Decl: +39deg 44' 20.4" Alt: 45deg 30' 17.6" Az: 272deg 50' 40.6"
Kouvola_middle2 A.D. 2022-Aug-12 11:00:00.0000 UTC JD: 2459803.9583326662 RADEC: 71.50348139 DeclDEC: 39.74379881 RA: 04h 46m 00.84s Decl: +39deg 44' 37.7" Alt: 38deg 17' 52.3" Az: 284deg 58' 55.2"
Kouvola_middle2 A.D. 2022-Aug-12 12:00:00.0000 UTC JD: 2459803.9999993332 RADEC: 71.51105634 DeclDEC: 39.74858894 RA: 04h 46m 02.65s Decl: +39deg 44' 54.9" Alt: 31deg 28' 20.1" Az: 296deg 20' 14.7"
Kouvola_middle2 A.D. 2022-Aug-12 13:00:00.0000 UTC JD: 2459804.0416659997 RADEC: 71.51866301 DeclDEC: 39.75338097 RA: 04h 46m 04.48s Decl: +39deg 45' 12.2" Alt: 25deg 16' 43.2" Az: 307deg 24' 23.5"
Kouvola_middle2 A.D. 2022-Aug-12 14:00:00.0000 UTC JD: 2459804.0833326667 RADEC: 71.52630004 DeclDEC: 39.75817998 RA: 04h 46m 06.31s Decl: +39deg 45' 29.4" Alt: 19deg 56' 34.6" Az: 318deg 29' 13.4"
Kouvola_middle2 A.D. 2022-Aug-12 15:00:00.0000 UTC JD: 2459804.1249993336 RADEC: 71.53396341 DeclDEC: 39.76299071 RA: 04h 46m 08.15s Decl: +39deg 45' 46.8" Alt: 15deg 40' 28.3" Az: 329deg 44' 26.2"
Kouvola_middle2 A.D. 2022-Aug-12 16:00:00.0000 UTC JD: 2459804.1666660006 RADEC: 71.54164674 DeclDEC: 39.76781720 RA: 04h 46m 10.00s Decl: +39deg 46' 04.1" Alt: 12deg 39' 28.3" Az: 341deg 13' 10.2"
Kouvola_middle2 A.D. 2022-Aug-12 17:00:00.0000 UTC JD: 2459804.2083326676 RADEC: 71.54934176 DeclDEC: 39.77266255 RA: 04h 46m 11.84s Decl: +39deg 46' 21.6" Alt: 11deg 02' 01.8" Az: 352deg 53' 03.1"
Kouvola_middle2 A.D. 2022-Aug-12 18:00:00.0000 UTC JD: 2459804.2499993346 RADEC: 71.55703880 DeclDEC: 39.77752871 RA: 04h 46m 13.69s Decl: +39deg 46' 39.1" Alt: 10deg 52' 51.7" Az: 04deg 37' 42.7"
Kouvola_middle2 A.D. 2022-Aug-12 19:00:00.0000 UTC JD: 2459804.2916660015 RADEC: 71.56472753 DeclDEC: 39.78241630 RA: 04h 46m 15.53s Decl: +39deg 46' 56.7" Alt: 12deg 12' 24.8" Az: 16deg 19' 06.1"
Kouvola_middle2 A.D. 2022-Aug-12 20:00:00.0000 UTC JD: 2459804.3333326685 RADEC: 71.57239760 DeclDEC: 39.78732463 RA: 04h 46m 17.38s Decl: +39deg 47' 14.4" Alt: 14deg 56' 49.7" Az: 27deg 50' 16.8"
Kouvola_middle2 A.D. 2022-Aug-12 21:00:00.0000 UTC JD: 2459804.3749993355 RADEC: 71.58003940 DeclDEC: 39.79225169 RA: 04h 46m 19.21s Decl: +39deg 47' 32.1" Alt: 18deg 58' 21.1" Az: 39deg 07' 53.5"
Kouvola_middle2 A.D. 2022-Aug-12 22:00:00.0000 UTC JD: 2459804.4166660025 RADEC: 71.58764467 DeclDEC: 39.79719434 RA: 04h 46m 21.03s Decl: +39deg 47' 49.9" Alt: 24deg 06' 21.5" Az: 50deg 13' 49.4"
Kouvola_middle2 A.D. 2022-Aug-12 23:00:00.0000 UTC JD: 2459804.4583326695 RADEC: 71.59520710 DeclDEC: 39.80214848 RA: 04h 46m 22.85s Decl: +39deg 48' 07.7" Alt: 30deg 08' 32.6" Az: 61deg 16' 17.0"

Kouvola_middle2 A.D. 2022-Sep-12 00:00:00.0000 UTC JD: 2459834.4999995860 RADEC: 74.08188220 DeclDEC: 43.89586285 RA: 04h 56m 19.65s Decl: +43deg 53' 45.1" Alt: 52deg 57' 01.5" Az: 90deg 37' 53.9"
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Kouvola_middle2 A.D. 2022-Sep-12 02:00:00.0000 UTC JD: 2459834.5833329195 RADEC: 74.07762940 DeclDEC: 43.90907575 RA: 04h 56m 18.63s Decl: +43deg 54' 32.7" Alt: 66deg 49' 39.4" Az: 124deg 40' 22.6"
Kouvola_middle2 A.D. 2022-Sep-12 03:00:00.0000 UTC JD: 2459834.6249995860 RADEC: 74.07542794 DeclDEC: 43.91565464 RA: 04h 56m 18.10s Decl: +43deg 54' 56.4" Alt: 71deg 42' 58.7" Az: 152deg 20' 26.7"
Kouvola_middle2 A.D. 2022-Sep-12 04:00:00.0000 UTC JD: 2459834.6666662530 RADEC: 74.07319224 DeclDEC: 43.92221103 RA: 04h 56m 17.57s Decl: +43deg 55' 20.0" Alt: 72deg 58' 38.1" Az: 188deg 18' 23.0"
Kouvola_middle2 A.D. 2022-Sep-12 05:00:00.0000 UTC JD: 2459834.7083329195 RADEC: 74.07093566 DeclDEC: 43.92874388 RA: 04h 56m 17.02s Decl: +43deg 55' 43.5" Alt: 69deg 52' 02.9" Az: 221deg 19' 29.4"
Kouvola_middle2 A.D. 2022-Sep-12 06:00:00.0000 UTC JD: 2459834.7499995865 RADEC: 74.06867160 DeclDEC: 43.93525392 RA: 04h 56m 16.48s Decl: +43deg 56' 06.9" Alt: 64deg 00' 22.5" Az: 244deg 49' 38.1"
Kouvola_middle2 A.D. 2022-Sep-12 07:00:00.0000 UTC JD: 2459834.7916662530 RADEC: 74.06641266 DeclDEC: 43.94174361 RA: 04h 56m 15.94s Decl: +43deg 56' 30.3" Alt: 57deg 00' 39.2" Az: 261deg 43' 01.3"
Kouvola_middle2 A.D. 2022-Sep-12 08:00:00.0000 UTC JD: 2459834.8333329200 RADEC: 74.06416973 DeclDEC: 43.94821696 RA: 04h 56m 15.40s Decl: +43deg 56' 53.6" Alt: 49deg 42' 50.0" Az: 275deg 09' 04.0"
Kouvola_middle2 A.D. 2022-Sep-12 09:00:00.0000 UTC JD: 2459834.8749995865 RADEC: 74.06195125 DeclDEC: 43.95467926 RA: 04h 56m 14.87s Decl: +43deg 57' 16.8" Alt: 42deg 32' 54.4" Az: 286deg 51' 45.5"
Kouvola_middle2 A.D. 2022-Sep-12 10:00:00.0000 UTC JD: 2459834.9166662535 RADEC: 74.05976264 DeclDEC: 43.96113672 RA: 04h 56m 14.34s Decl: +43deg 57' 40.1" Alt: 35deg 47' 42.4" Az: 297deg 45' 49.2"
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Kouvola_middle2 A.D. 2022-Sep-12 12:00:00.0000 UTC JD: 2459834.9999995865 RADEC: 74.05547949 DeclDEC: 43.97406394 RA: 04h 56m 13.32s Decl: +43deg 58' 26.6" Alt: 24deg 23' 55.5" Az: 318deg 56' 54.1"
Kouvola_middle2 A.D. 2022-Sep-12 13:00:00.0000 UTC JD: 2459835.0416662535 RADEC: 74.05337843 DeclDEC: 43.98054673 RA: 04h 56m 12.81s Decl: +43deg 58' 50.0" Alt: 20deg 08' 42.6" Az: 329deg 40' 45.7"
Kouvola_middle2 A.D. 2022-Sep-12 14:00:00.0000 UTC JD: 2459835.0833329200 RADEC: 74.05129461 DeclDEC: 43.98704985 RA: 04h 56m 12.31s Decl: +43deg 59' 13.4" Alt: 17deg 05' 01.7" Az: 340deg 36' 31.5"
Kouvola_middle2 A.D. 2022-Sep-12 15:00:00.0000 UTC JD: 2459835.1249995870 RADEC: 74.04921737 DeclDEC: 43.99357751 RA: 04h 56m 11.81s Decl: +43deg 59' 36.9" Alt: 15deg 20' 43.5" Az: 351deg 42' 31.3"
Kouvola_middle2 A.D. 2022-Sep-12 16:00:00.0000 UTC JD: 2459835.1666662535 RADEC: 74.04713425 DeclDEC: 44.00013239 RA: 04h 56m 11.31s Decl: +44deg 00' 00.5" Alt: 15deg 00' 30.8" Az: 02deg 53' 30.5"
Kouvola_middle2 A.D. 2022-Sep-12 17:00:00.0000 UTC JD: 2459835.2083329204 RADEC: 74.04503176 DeclDEC: 44.00671546 RA: 04h 56m 10.81s Decl: +44deg 00' 24.2" Alt: 16deg 05' 19.6" Az: 14deg 02' 33.9"
Kouvola_middle2 A.D. 2022-Sep-12 18:00:00.0000 UTC JD: 2459835.2499995870 RADEC: 74.04289639 DeclDEC: 44.01332591 RA: 04h 56m 10.30s Decl: +44deg 00' 48.0" Alt: 18deg 32' 11.5" Az: 25deg 03' 22.4"
Kouvola_middle2 A.D. 2022-Sep-12 19:00:00.0000 UTC JD: 2459835.2916662539 RADEC: 74.04071548 DeclDEC: 44.01996120 RA: 04h 56m 09.77s Decl: +44deg 01' 11.9" Alt: 22deg 14' 38.4" Az: 35deg 52' 20.9"
Kouvola_middle2 A.D. 2022-Sep-12 20:00:00.0000 UTC JD: 2459835.3333329204 RADEC: 74.03847812 DeclDEC: 44.02661726 RA: 04h 56m 09.23s Decl: +44deg 01' 35.8" Alt: 27deg 03' 34.6" Az: 46deg 30' 13.7"
Kouvola_middle2 A.D. 2022-Sep-12 21:00:00.0000 UTC JD: 2459835.3749995870 RADEC: 74.03617587 DeclDEC: 44.03328872 RA: 04h 56m 08.68s Decl: +44deg 01' 59.8" Alt: 32deg 48' 16.1" Az: 57deg 03' 13.5"
Kouvola_middle2 A.D. 2022-Sep-12 22:00:00.0000 UTC JD: 2459835.4166662539 RADEC: 74.03380335 DeclDEC: 44.03996931 RA: 04h 56m 08.11s Decl: +44deg 02' 23.9" Alt: 39deg 17' 02.5" Az: 67deg 44' 29.0"
Kouvola_middle2 A.D. 2022-Sep-12 23:00:00.0000 UTC JD: 2459835.4583329204 RADEC: 74.03135863 DeclDEC: 44.04665230 RA: 04h 56m 07.53s Decl: +44deg 02' 47.9" Alt: 46deg 17' 16.7" Az: 78deg 57' 14.0"

Published August 9, 2022 | Version v1

Software Open

Instructions on where and how to observe the comet 17P/Holmes dust trail

Nissinen, Markku[1]; Gritsevich, Maria[2]

Show affiliations

The attached coordinates list comprises the calculated comet 17P/Holmes dust trail coordinates. The predictions hold for the two-revolution dust trail behavior near the comet 17P/Holmes 2007 outburst point. The calculations were performed as detailed in Gritsevich et al. 2022. The coordinate list columns are Observatory name and particle position in the narrowest part of the trail, JPL date time, JD, RA and DEC in decimal notation, RA and DEC in normal notation, Altitude from horizon, and Azimuth. The attached list coordinates are calculated for Boston, as the observatory position, but the list can be used for any telescope location on Earth.

The trail is expected to be detectable by using ground-based telescopes in August-September 2022 and during the winter. The attached Python code has 3D position of the trail, which can be used even for a space-based telescope. The Python program uses Skyfield library. The Python program uses topographical location on Earth for the calculations. It corrects for the light time, for the topographical location, and for the atmospheric refraction. The coordinates are calculated for the 5 dust particles occurring in the model closest to the narrowest point of the trail.

The image subtraction is suggested to be made from CCD images taken at two nights. The filter is suggested to be as luminance of unfiltered.

Earlier this year Ryske et al. 2022 and Nissinen et al. 2022 have additionally confirmed the correctness of the predicted position of the trail by reporting the first 2022 dust trail observations in the specified location.

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Name	Size	Download all
boston_left.rtf md5:631f23ac4f33700c5c60ee62888bd70e	374.1 kB	Download
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boston_left.rtf md5:631f23ac4f33700c5c60ee62888bd70e	374.1 kB	Download
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Resource type
Software

Publisher
Zenodo

Rights

Citation

Nissinen, M., & Gritsevich, M. (2022). Instructions on where and how to observe the comet 17P/Holmes dust trail. Zenodo. https://doi.org/10.5281/zenodo.6977358

Style APA

Published September 5, 2023 | Version v1

Software Open

Instructions for Ongoing Observations of the Dust Trail from the 2007 Outburst of Comet 17P/Holmes

Nissinen, Markku[1]; Gritsevich, Maria[2]

Show affiliations

These instructions provide guidance for the continuous observation of the dust trail resulting from the 2007 outburst of Comet 17P/Holmes.

1. Software and Access

To facilitate data collection and analysis the software is open-access.

2. Coordinate Data

The attached coordinate lists contain calculated coordinates for the dust trail of Comet 17P/Holmes. These coordinates are based on predictions for the behavior of the dust trail near the comet's 2007 outburst point (referred to as the northern node) and also at the southern node. The calculations were conducted according to the methodology detailed in Gritsevich et al. 2022.

3. Coordinate List Columns

The coordinate list includes the following columns:

- Observatory name
- Particle position in the narrowest part of the trail
- JPL date-time
- Julian Date (JD)
- Right Ascension (RA) and Declination (DEC) in decimal notation
- RA and DEC in normal notation
- Altitude from the horizon
- Azimuth
- Distance to the trail from Earth in Astronomical Units (AU)

These coordinates are initially calculated for observatories in Kouvola, Utah, and Siding Spring, but they are adaptable for use with telescopes at any location on Earth.

4. Observation Period

Versions

Version v1 Sep 5, 2023

10.5281/zenodo.8319474

Cite all versions? You can cite all versions by using the DOI 10.5281/zenodo.8319473. This DOI represents all versions, and will always resolve to the latest one. Read more.

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The dust trail is expected to be observable using ground-based telescopes from September 2023 to March 2025, both at the northern and southern nodes.

5. Python Code

An attached Python code provides 3D positions of the dust trail. This code can be utilized with both ground-based and space-based telescopes. The Python program employs the Skyfield library and takes into account the topographical location of Earth, correcting for light time and atmospheric refraction.

6. Dust Particle Positions

The coordinates are calculated for five dust particles located closest to the narrowest point of the trail. These particles are named as follows: FarLeft, Left, Middle, Right, and FarRight particles. It is recommended to align your telescope with the Middle particle's position, as this provides the most accurate trail orientation. The other particles offer guidance on the trail's orientation within your telescopic field of view.

7. Trail Positions

Trail positions are based on the findings of Gritsevich et al. 2022 and are provided for various months, including September 2023, November 2023, January 2024, July 2024, and October 2024. All scripts included in the package are designed to calculate position data for the entire period from September 2023 to March 2025. To achieve the highest accuracy, select the script that corresponds to the nearest trail position relative to your specific observing date and time.

8. Image Subtraction

For image subtraction, it is recommended to use CCD images taken over two consecutive nights. Employ an unfiltered luminance filter for this purpose.

9. Brightness and Visibility

The most recent observations of the dust trail, to the best of our knowledge, were conducted by Jorma Ryske in February 2023. These observations confirmed the positioning of the dust trail as predicted. It is expected that the dust trail will maintain for some time a nearly consistent brightness level starting from September 2023. Further research is needed to assess the brightness of the dust trail at the southern node.

10. Particle Sizes

Particle sizes vary at the northern node, with larger particles present starting in September 2023 and finer dust particles predominant by October 2024. At the southern node, fine dust particles are found at the narrowest point of the trail. Additionally, there is a second, extremely dim trail view that is not expected to be observable. By October 2024, the head mass of the trail, consisting mainly of larger particles with an abundance of middle-sized particles, approaches the vicinity of the southern node.

11. Dust Trail Width and Comet's Orbital Plane

Our previous findings highlighted the hourglass shape of the dust trail, indicating that the trail's width varies along its path. Trail width at the northern node is estimated to be in September 2023 approximately 40 arc seconds. The trail is wider at the southern node than at the northern node. In our trail positions, the southern trail measures approximately 2 arc minutes in width at its narrowest point when Earth is not in the comet's orbital plane. This width naturally fluctuates depending on Earth's alignment with the comet's orbital plane. A narrower width of the trail results in a higher particle density, which in turn increases the trail's surface brightness. For ground-based observations, the most favorable geometry occurs when Earth crosses the comet's orbital plane. Earth intersects Holmes' orbital plane twice a year, in February and August.

12. Collaboration Opportunities

For additional in-depth information and references, please refer to the provided resources. We would be delighted to receive updates from your observing campaigns. We eagerly anticipate the possibility of collaborating on joint publications and the dissemination of research findings. In Gritsevich et al. 2022, we have identified open research questions that could be addressed with the help of additional observations. Your contributions are invaluable for advancing the current understanding of cometary outbursts and the subsequent evolution of dust trails. Together, we can explore new horizons in planetary science and share our discoveries with the scientific community and beyond!

Files

Details

DOI

DOI 10.5281/zenodo.8319474

Resource type

Software

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Citation

Nissinen, M., & Gritsevich, M. (2023). Instructions for Ongoing Observations of the Dust Trail from the 2007 Outburst of Comet 17P/Holmes. Zenodo. https://doi.org/10.5281/zenodo.8319474

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Modified September 6, 2023

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Files

holmes_2023_2025_kouvola_january2024.txt

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Files (279.6 MB)

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Pölyvanan kuvaaminen onnistui myös 2022 ja 2023

- Pölyvana oli hyvin havaittavissa Suomesta syksyllä 2022. Sen piti olla mallinnuksen mukaan riittävän kirkas, jotta sen voisi havaita harrastajien välineillä. Havaintoja pystyttiinkin tekemään.
- Pölyvanan kuvaamisessa käytettiin kuvanvähennysmenetelmää. Kuvaus vähintään kahtena yönä ja kuvanvähennys. Tämä vaati kärsivällisyyttä kuvaamiseen ja laitteiston parametrien oli pysyttävä samana öiden välillä.
- Suodattimena luminance tai no filter. Pölyvana oli niin himmeä, että se ei ollut harrastajien ulottuvilla kuvattuna suodattimella.

Posteri oli esillä heinäkuussa 2025 Australiassa Metsoc konferenssissa

LONG-TERM EVOLUTION OF THE DUST TRAIL FROM 2007 OUTBURST OF COMET 17P/HOLMES

Markku Nissinen[1], Maria Gritsevich[2,3], Marcin Wesołowski[4], Jorma Ryske[1], Alberto Javier Castro-Tirado[5,6]

[1]Ursa Astronomical Association, Kopernikuksentie 1, 00130 Helsinki, Finland. [2]Faculty of Science, University of Helsinki, Gustaf Hallströmin katu 2, 00014 Helsinki, Finland. [3]Institute of Physics and Technology, Ural Federal University, Mira St. 19, 620002 Ekaterinburg. [4]University of Rzeszów, Faculty of Exact and Technical Sciences, Institute of Physics, Pigonia 1, 35-310 Rzeszów, Poland. [5]Instituto de Astrofísica de Andalucía (IAA-CSIC), Glorieta de la Astronomía s/n, E-18008 Granada, Spain. [6]Ingeniería de Sistemas y Automática, Universidad de Málaga, Unidad Asociada al CSIC por el IAA, Escuela de Ingenierías Industriales, Málaga, Spain.

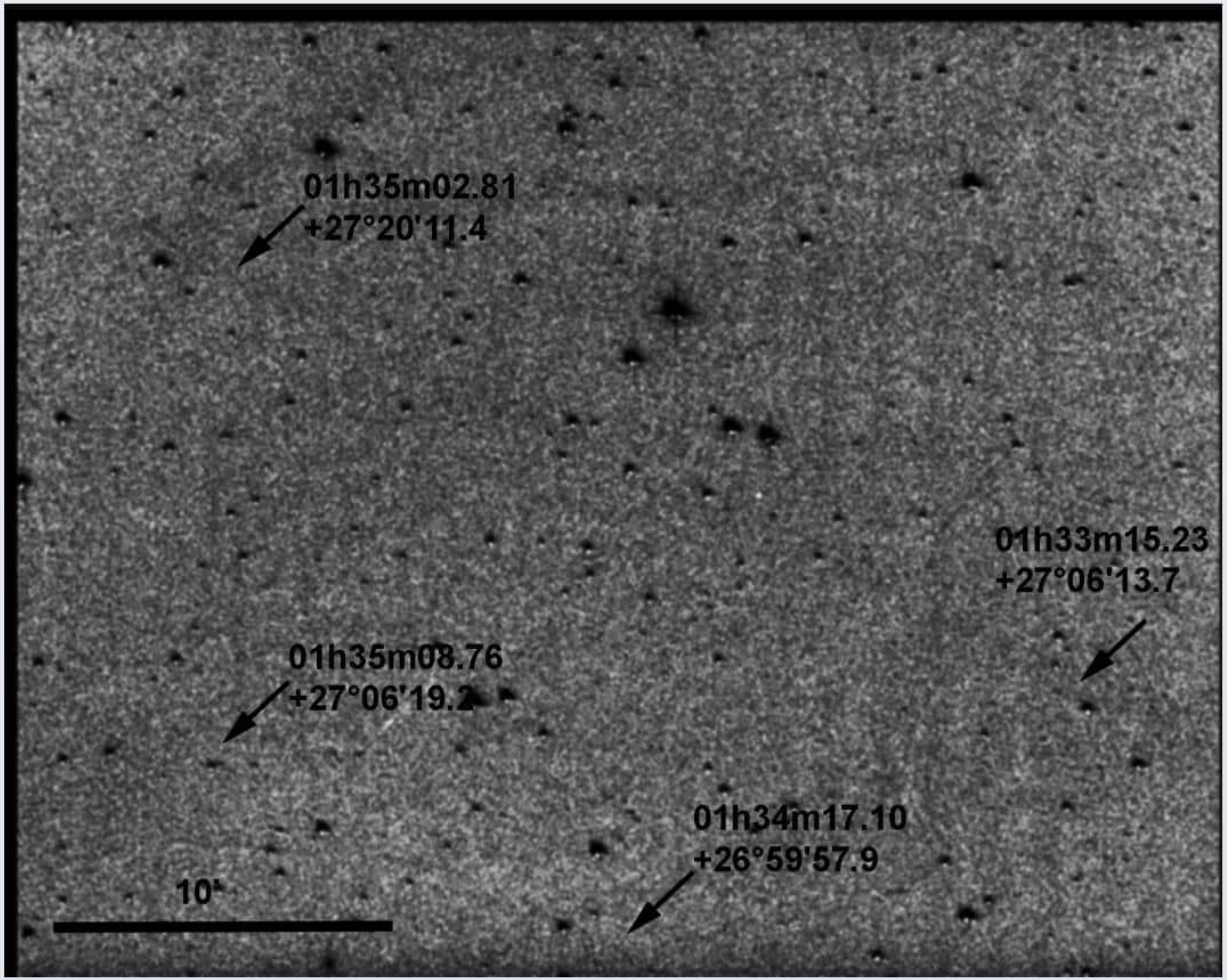


Figure 1: Subtracted image of 17P/Holmes dust trails with measured positions, upper dark dust trail 26.2.2022, lower light trail 28.2.2022, Jorma Ryske. Observations separation is 48 hours.

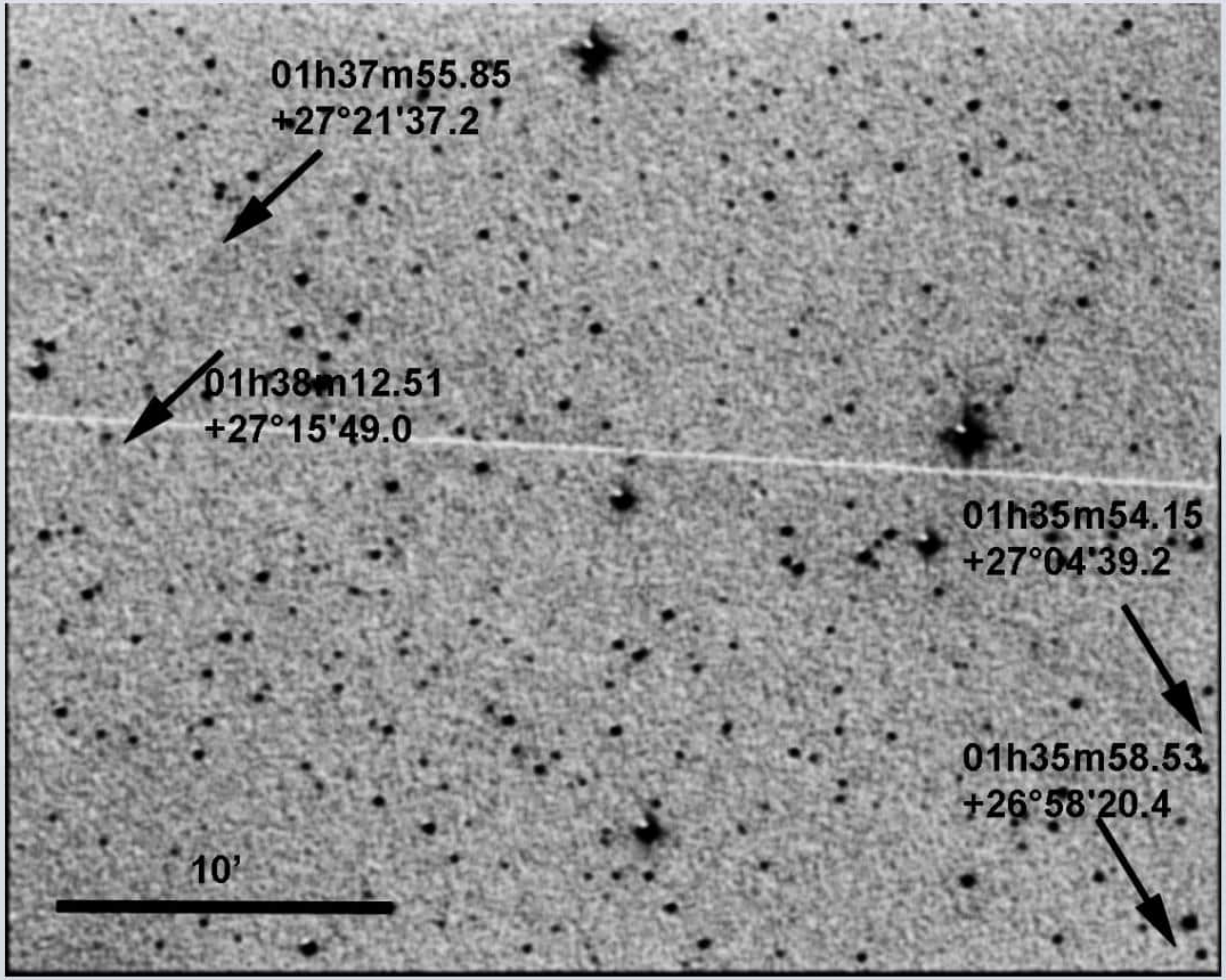


Figure 2a: Subtracted <u>star registered</u> stacked image of 17P/Holmes dust trails with measured positions, upper dark dust trail 1.3.2022, lower light dust trail 2.3.2022, Jorma Ryske. Observations separation is 24 hours. Two satellite tracks in image.

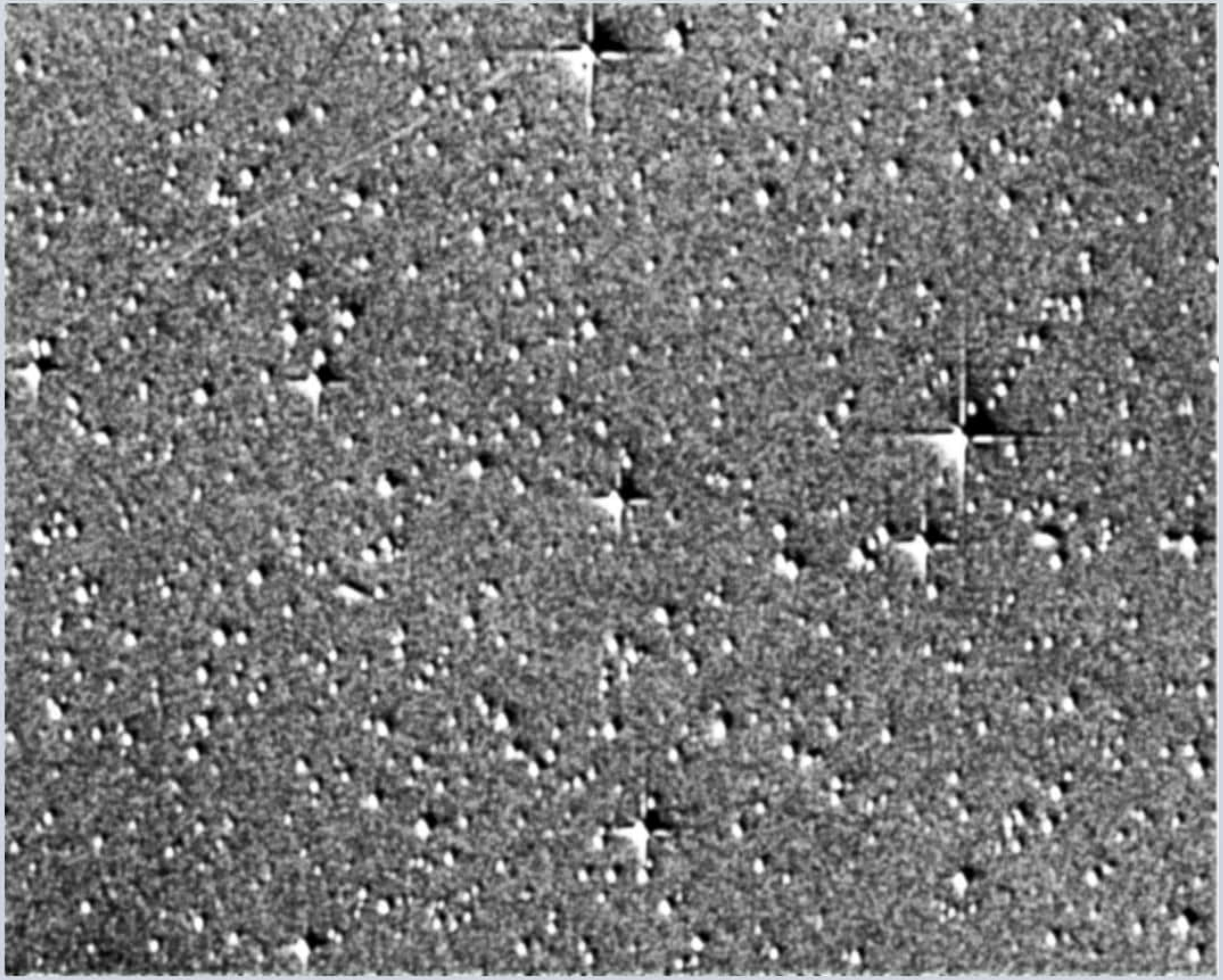


Figure 2b: Subtracted <u>dust trail</u> registered stacked image. During 50x45s exposures at both nights 1&2.3.2022 the dust trail moved 16" in trail right angle direction which was compensated during image stacking process.

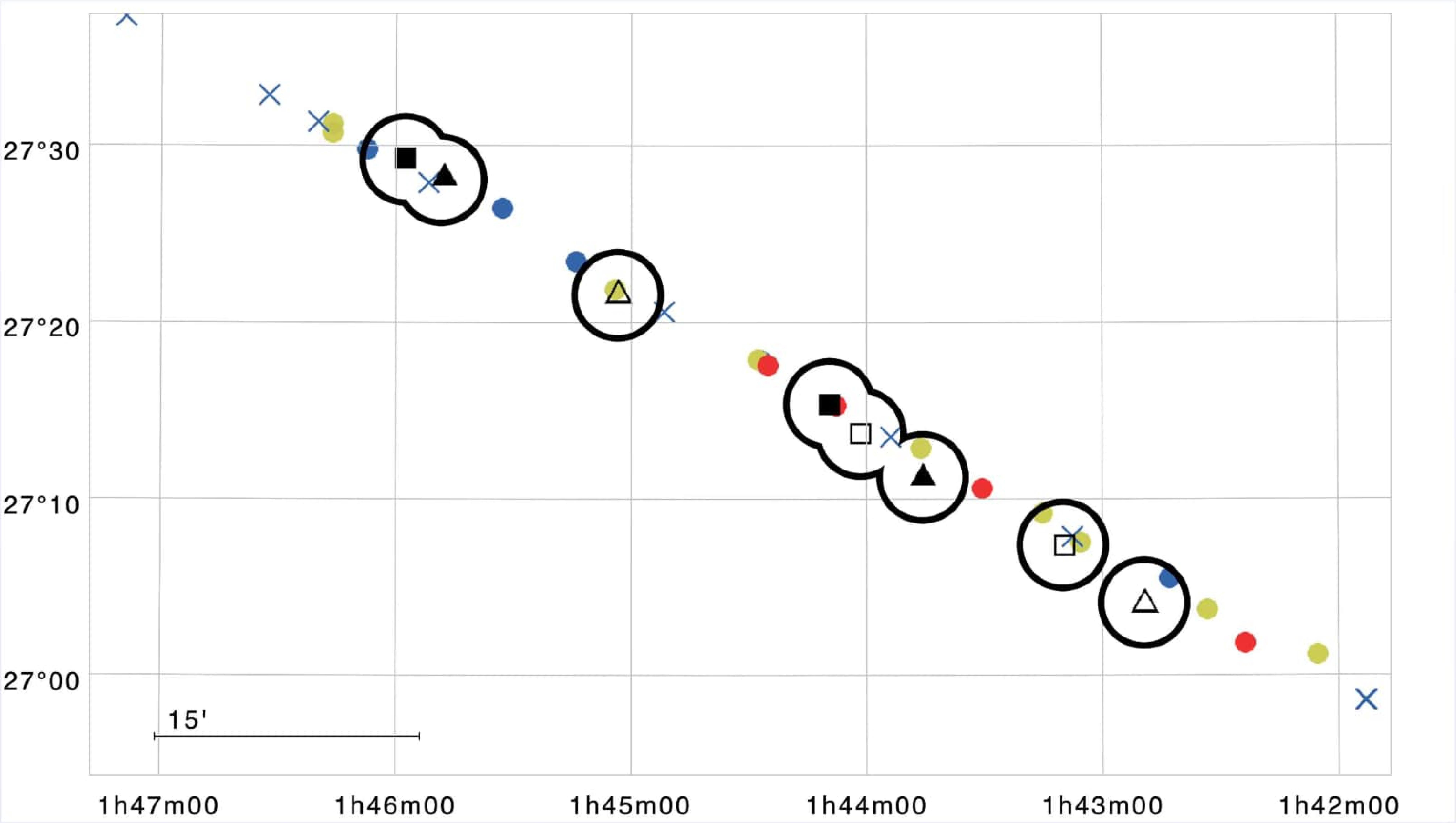


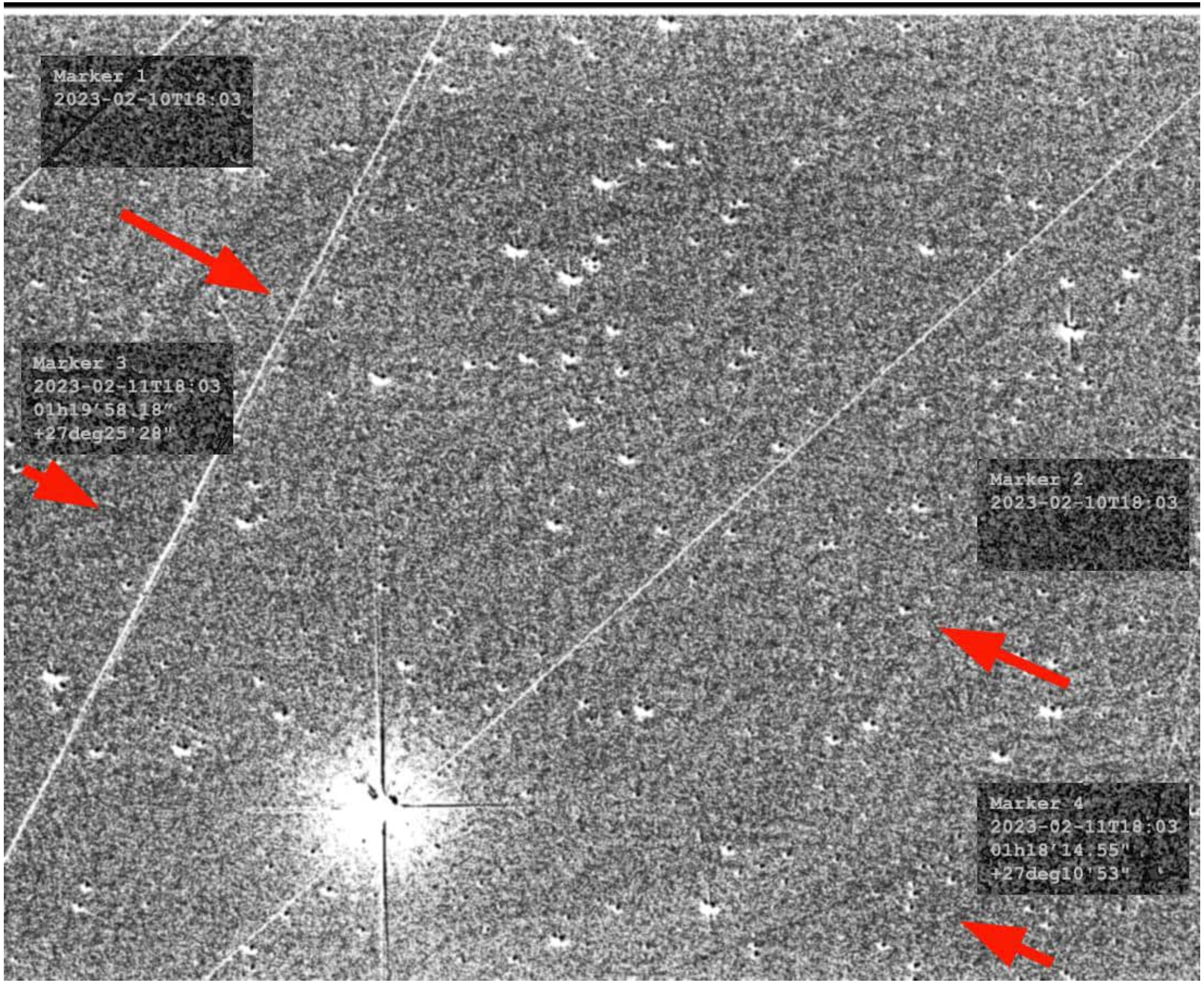
Figure 3: 17P Dust Trail kit model positions (markers with no circles as small, medium, big and toward the Sun particles) [1] and observations positions (square and triangle markers with circles) for dates 26.2. & 28.2.2022 and 1.3. & 2.3.2022. The X-axis shows RA and the Y-axis DEC. Model calculations M. Nissinen, M. Gritsevich, observations J. Ryske.

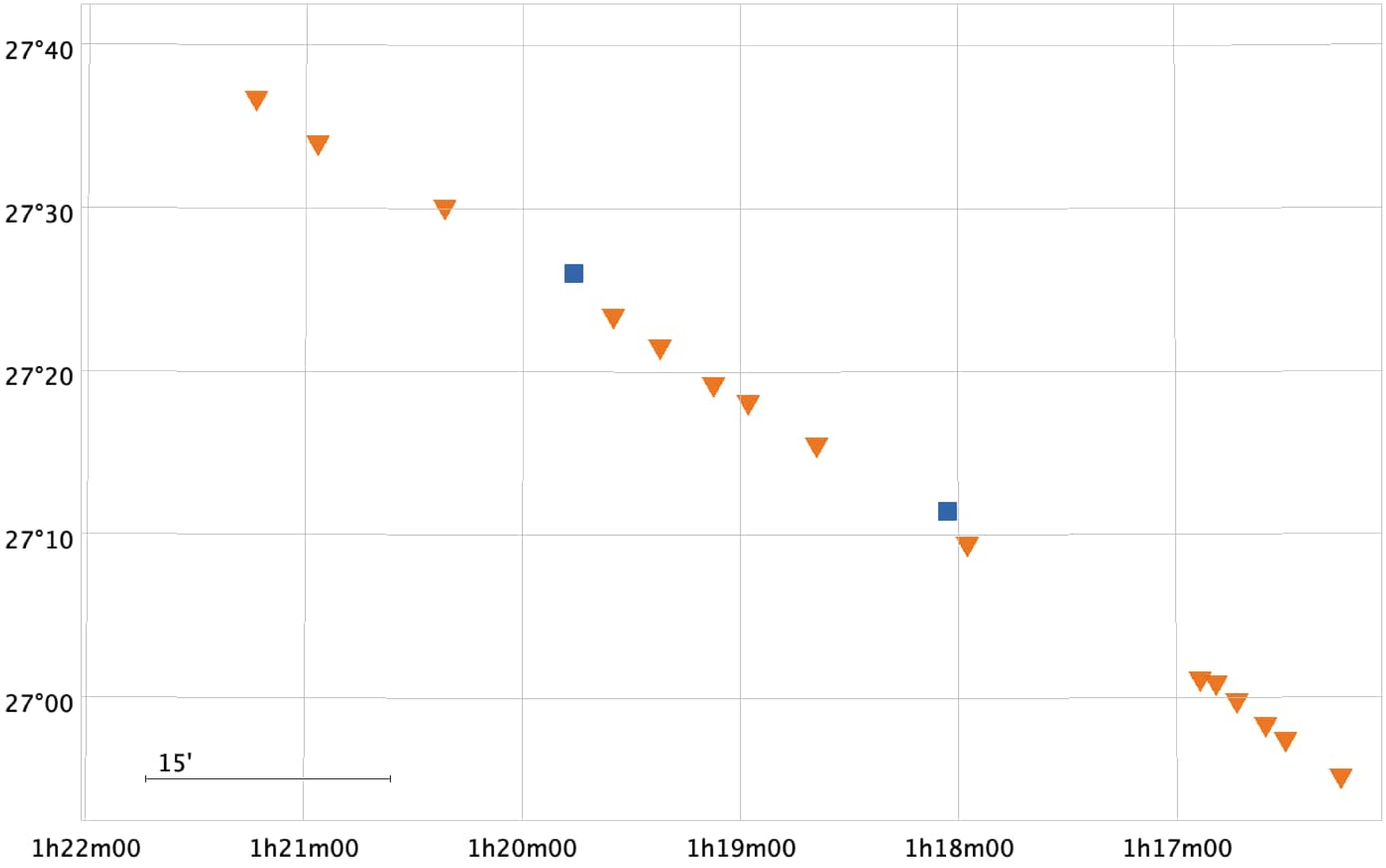
Tässä vielä tällä hetkellä viimeisin havainto pölyvanasta, tehty 10.2. / 11.2.2023 (kuvanvähennysmenetelmällä)

Pölyvana

Kuva: Jorma Ryske

- Kuvanvähennys
- 10.2.2023 ja 11.2.2023 kuvat vähennetty toisistaan.
- Pölyvana näkyy juuri ja juuri.




27°40
27°30
27°20
27°10
27°00
15'
1h22m00
1h21m00
1h20m00
1h19m00
1h18m00
1h17m00

Observational efforts began in 2013, with the first successful detection of the trail near the southern node [3]. Subsequent observations at the northern node between 2014 and 2015 confirmed the trail's persistence (Fig. 4). Our ongoing monitoring campaigns have continued to detect the trail in recent years 2022-2023 using differential photometry and image subtraction techniques (Fig. 1&2), [4], [6]. Last weak positive dust trail observation was made at 11.2.2023, after it 2023-2025 only negative observations using 0.3m aperture telescopes. While most observations have been conducted in visible wavelengths using ground-based telescopes, complementary infrared observations are encouraged to further constrain particle sizes and thermal properties.

Meteoroids 2022 ja EPSC 2022 posterit

- M. Nissinen, M. Gritsevich, E. A. Silber, A. Oksanen, J. Suomela, J. Ryske (2022). Fates of the Particles Released in the 2007 Outburst of the Comet 17P/Holmes. Poster session C. https://fireballs.ndc.nasa.gov/meteoroids2022/ Meteoroids 2022 Conference

- Jorma Ryske, Maria Gritsevich and Markku Nissinen. Validation of the Dust Trail kit model with the recent observations of the comet 17P/Holmes dust trail (February – March 2022). EPSC Abstracts. Vol. 16, EPSC2022-60, 2022. https://doi.org/10.5194/epsc2022-60 Europlanet Science Congress 2022

Lehdistötiedotteita ja uutisartikkeleita

- https://www.helsinki.fi/fi/uutiset/avaruus/uudet-mallit-kuvaavat-komeettojen-polyvanojen-kayttaytymista-ja-muotoa
- https://www.sttinfo.fi/tiedote/69942125/komeetan-jattimaisen-purkauksen-jaljet-havaittavissa-kesalla?publisherId=69817990
- Mediassa on ollut paljon uutisia tästä tutkimuksesta ja kiinnostusta on ollut paljon. Poimittuja uutisartikkeleita lehdistötiedotteen perusteella:
- https://www.livescience.com/comet-17p-holmes-dust-trail
- https://www.space.com/comet-17p-outburst-debris-visible-from-earth

Kiitos!

Referenssit

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