RECENT OBSERVATIONS OF THE 17P/HOLMES DUST TRAIL. M. Nissinen[1], M. Gritsevich[2,3,1], J. Ryske[4], [1]Finnish Fireball Network, Ursa Astronomical Association, Kopernikuksentie 1, 00130 Helsinki, Finland, E-mail: markku.nissinen@protonmail.com, [2]Finnish Geospatial Research Institute, Vuorimiehentie 5, FI-02150 Espoo, 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]Ursa Astronomical Association, Kopernikuksentie 1, 00130 Helsinki, Finland.

Introduction: In the recent study [1] we have introduced a comprehensive Dust Trail kit model capable of describing the evolution of a cometary dust trail. The model is based on the Monte Carlo multi-particle approach and it accounts for solar radiation pressure effects, as well as for gravitational disturbance caused by major planets. Simulations are performed with Orekit Open Source Library for Operational Flight Dynamics. Particle populations are simulated with sizes from 0.001 mm to 1 mm with spherically symmetric ejection velocity distribution and towards the Sun outburst modeling [1].

Based on this model we have further developed a set of Python scripts to calculate position of the dust trail produced by the massive outburst of comet 17P/Holmes in October 2007 for observatory topographical location coordinates [2]. The Python script calculates RA and DEC to narrowest part of the trail using Skyfield library. The script takes into account corrections also for the light time and for the atmospheric refraction. The script is suitable for calculations predicting the trail until March 2023. After March 2023 current trail positions must be calculated using the full Orekit model to retain accuracy. The coordinates are calculated for the dust particles occurring in the model close to the narrowest point of the trail [2].

In this study, using these predictions, we present and discuss new, made in 2022, observations of the dust trail produced by the massive outburst of comet 17P/Holmes in October 2007.

New 2022 observations of the 17P/Holmes trail: The dust trail was observed on 26 February 18:26 UT and 28 February 18:31 UT. 40 x 90 seconds exposures were obtained at both nights with 305 mm aperture telescope and clear filter using CCD bin2x2 mode and sidereal tracking (**Figure 1**).

The dust trail was also observed on 1 March 18:25 UT and 2 March 18:35 UT. 50 x 45 seconds exposures were obtained at both nights with 305 mm aperture telescope and clear filter CCD bin3 mode (**Figure 2**).

Images were stacked, plate solved and subtracted. Comparison shows a good match between the model calculations [1,2] and these observations (**Fig. 3**) [3].

The dust trail was again observed in the fall 2022, on 30 October 21:33 UT and 31 October 01:36 UT. Two separate 3 h exposures were obtained with a 305 mm aperture telescope and a clear filter. The dust trail moved 16 arc seconds at right angle direction during each 3 hour exposure. Stacking was done using dust trail movement compensated stacking method (**Fig. 4**).

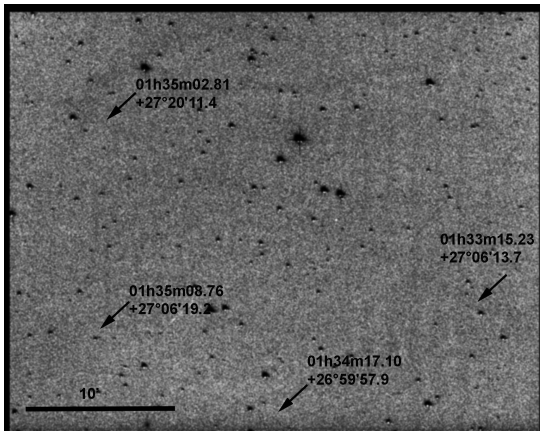

Figure 1: Subtracted image. Upper trail 26 February and lower trail 28 February.

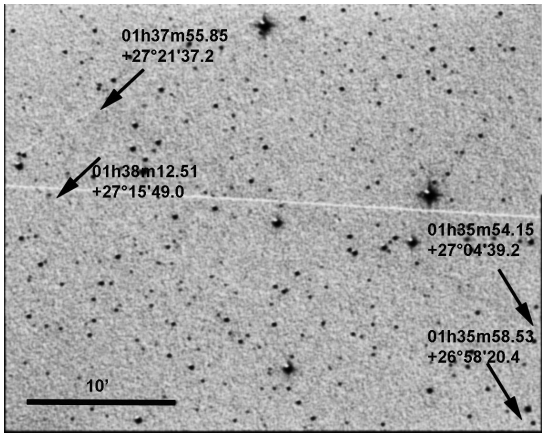

Figure 2: Subtracted image of dust trails with measured positions. Upper trail observed on 1st March and lower trail on 2nd March 2022.

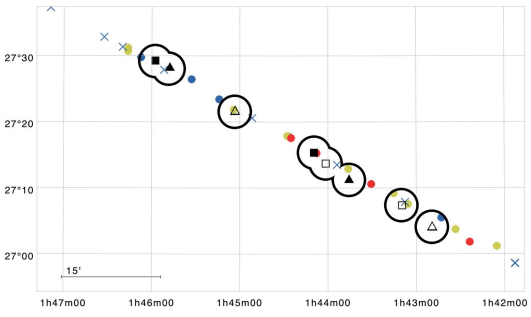

Figure 3: Observed trail positions are marked with circled squares and triangles. Filled circles are modeled particles and crosses are towards the Sun modeled particles. Blue are small particles, yellow are medium sized particles and red are big particles; see [1] for mass and size definitions within these groups.

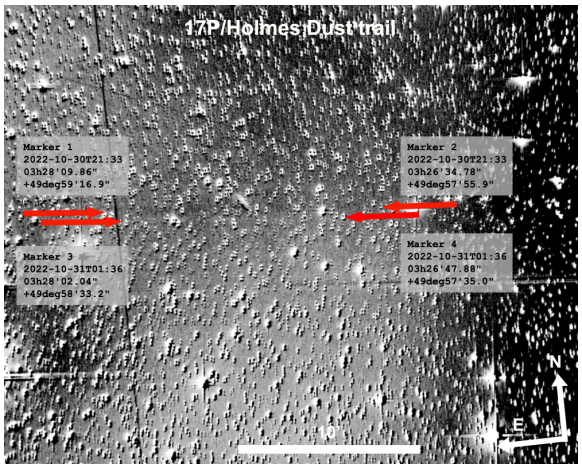

Figure 4: Subtracted image with trail movement compensated stacking. The upper trail is mid exposure on 30 October 21:33 UT and the lower trail is mid exposure on 31 October 01:36 UT.

A comparison was made to the Python script calculated particle positions. A good agreement was obtained between Python script calculations and these two observations (**Figure 5**).

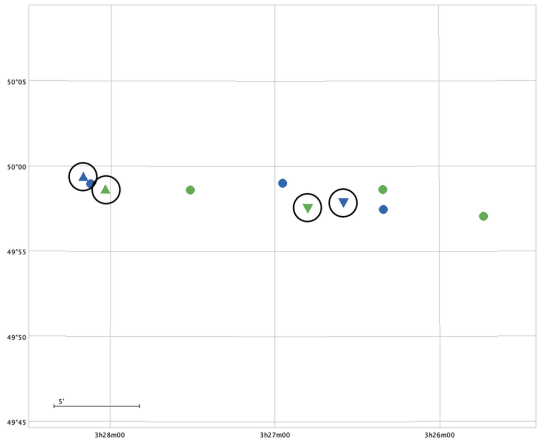

Figure 5: Observed positions are marked with circled triangles and Python script positions are dots.

The telescope was 305 mm aperture and 1205 mm focal length F4 Newton with a coma corrector. Mount was an iOptron CEM60 with an auto guider. The CCD camera was QSI690wsg. A Baader Clear filter was used. Image processing software was PixInsight. Plate solving and astrometric analysis was made using ASTAP software. The Remote Controlled Observatory used for the observations is located at Viestikallio at Artjärvi, Finland, with Bortle 3 rural sky conditions.

We observed the dust trail once again on 27 December 02:25 UT. 17 x 300 seconds exposures were obtained with 510 mm aperture telescope and a luminance filter using CCD bin1x1 mode and sidereal tracking. Images were stacked using both, sum stacking and average stacking. Stacks of 8 and 9 exposures were subtracted.

A comparison was made to the Python script calculated 5 modeled particle positions. The observed trail and the Python calculated trail cross at the narrowest point showing a good match between our calculations and this observation (**Figure 6**).

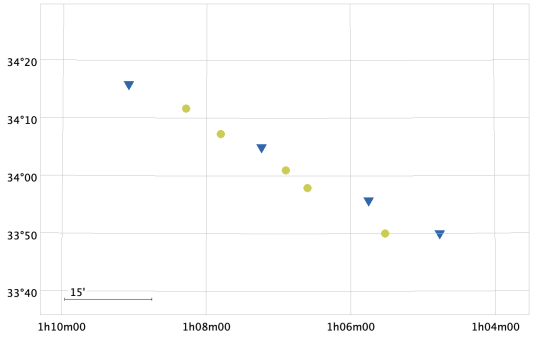

Figure 6: Observed trail positions on 27 December 2022 02:25 UT are marked with triangles and the Python script calculated 5 positions are marked with yellow circles.

The telescope was 510 mm aperture iTelescope T11 f/6.8 reflector with f/4.5 focal reducer. The CCD camera was FLI ProLine PL11002M. Mount is Ascension 200HR. An AstroDon luminance filter was used. The telescope is located in Mayhill, New Mexico, USA, and it is remotely controlled.

Results: The trail produced by the outburst of comet 17P/Holmes in October 2007 was the most massive outburst event documented to date and it is still an intriguing subject of investigation. The trail is still observable by using even moderate ground-based telescopes. Both, the surface brightness and the position of the dust trail are within the limits of the published predictions provided by the Dust Trail kit model [1]. The new observational results reported here can facilitate further adjustment of the otherwise poorly unknown start outburst parameters in the model [1] as well as the Python script [2].

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References: [1] Gritsevich M. et al. (2022) *MNRAS, 513,* 2201-2214. [2] Nissinen M., Gritsevich M. (2022) https://doi.org/10.5281/zenodo.6977358 [3] Ryske J. et al. (2022) *EPSC,* Vol 16, EPSC2022-60.