Validation of the ‘Dust Trail kit’ model with the recent observations of the comet 17P/Holmes dust trail (February – March 2022)

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ABSTRACT

The comet 17P/Holmes underwent an enormous outburst in October 2007 leaving vast amount of dust particles, which spread into elliptic orbits around the Sun [1, 2]. During February-March 2022 dust trail observations were forecasted to be possible with amateur sized telescope when outburst dust particles were in second revolution orbiting the Sun [1]. Observations were compared to the new dust trail particle model ‘Dust Trail kit’ implemented in Orekit.

INTRODUCTION

Cometary Dust Trail kit model was developed between 1999-2013 and latest dust trail observations were referenced to model at 2015 [1]. More recent observations were needed to ensure and validate model accuracy and these new observations were part of the announced comet 17P dust trail observation campaign that started in 2013 [1].

OBSERVATIONS of 17P/Holmes dust trail February 26th and 28th 2022

The 17P/Holmes dust trail was observed 26.2.2022 18:26UT and 28.2.2022 18:31UT based to the modeled position reported in [1]. 40 x 90 second exposures were taken at both nights with 305mm aperture telescope and clear filter using CCD bin2 mode and tracking stars. Star registration method was used when stacking images. Stacked images were astrometrically plate solved, then subtracted and inverted to highlight the dust trails. Figure 1 shows the dust trails with their positions. The upper dark dust trail was observed on 26.2.2022 and lower light dust trail on 28.2.2022.

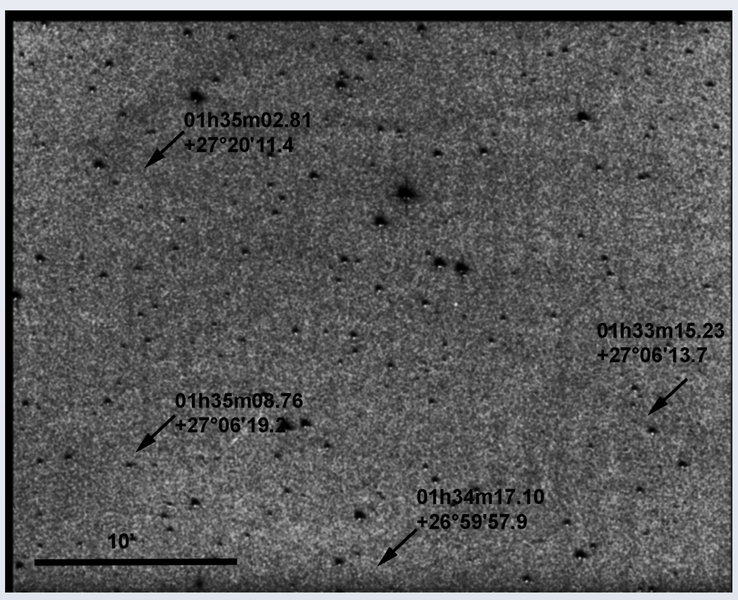

Figure 1: Subtracted image of 17P/Holmes dust trails with measured positions, upper dark dust trail 26.2.2022, lower light trail 28.2.2022, Jorma Ryske. Observations separation is 48 hours.

March 1st and 2nd 2022

The 17P/Holmes dust trail was observed on 1.3.2022 18:25UT and 2.3.2022 18:35UT based to the model position. CCD bin3 mode was used to get more sensitivity with exposure times 50 x 45 second at both nights. Star registration image stacking method was used in Figure 2a, dust trail registration method in Figure 2b. Figure 2a shows dust trails with positions, the upper dark dust trail is an observation made on 1.3.2022 and the lower light dust trail on 2.3.2022.

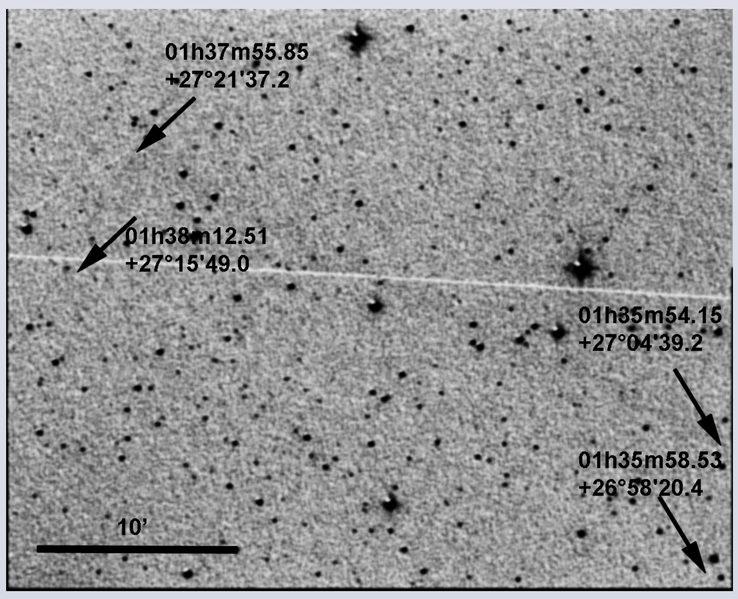

Figure 2a: Subtracted star registered stacked image of 17P/Holmes dust trails with measured positions, upper dark dust trail 1.3.2022, lower light dust trail 2.3.2022, Jorma Ryske. Observations separation is 24 hours. Two satellite tracks in image.

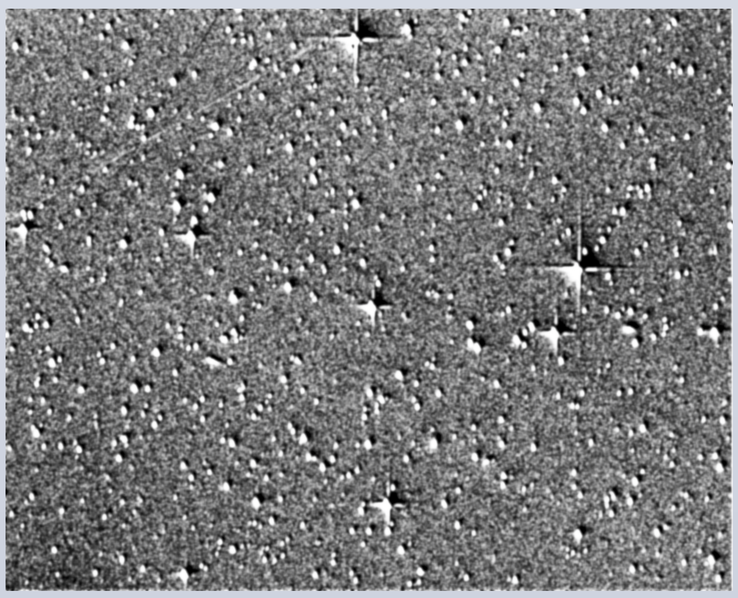

Figure 2b: Subtracted dust trail registered stacked image. During 50x45s exposures at both nights 1&2.3.2022 the dust trail moved 16” in trail right angle direction which was compensated during image stacking process.

Comparison to the model

Observations 26.2. & 28.2.2022 and 1.3. & 2.3.2022 were compared with the results of the ‘Dust Trail kit’ model implemented in Orekit by Markku Nissinen. Figure 3 show a good correlation between the model calculations and the four observations.

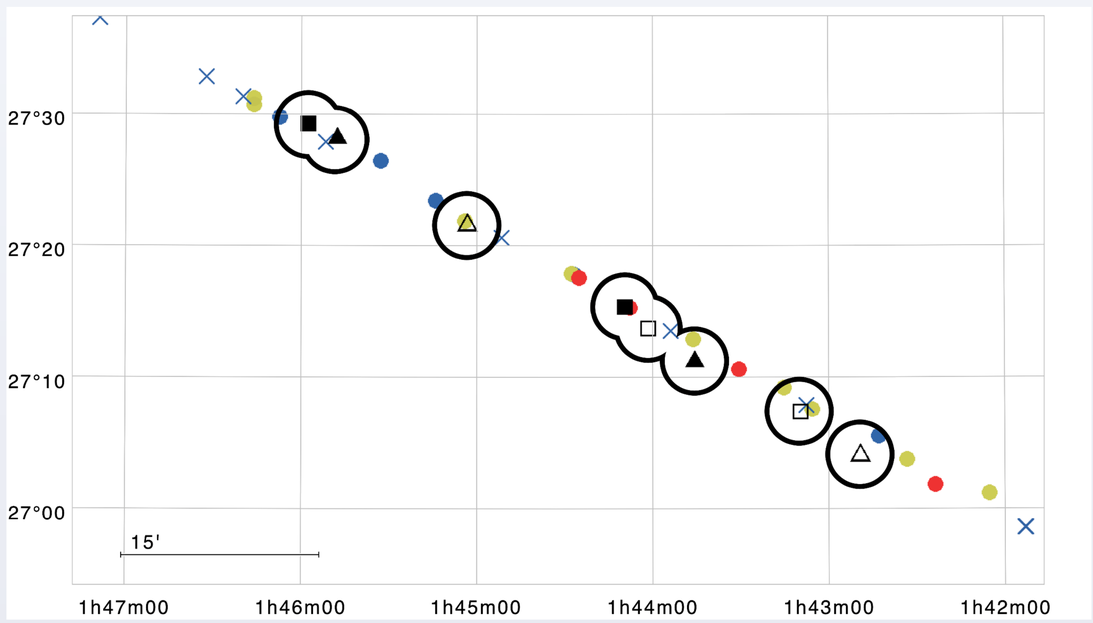

Figure 3: 17P Dust Trail kit model positions (markers with no circles as small, medium, big and toward the Sun particles) [1] and observations positions (square and triangle markers with circles) for dates 26.2. & 28.2.2022 and 1.3. & 2.3.2022. The X-axis shows RA and the Y-axis DEC. Model calculations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

EQUIPMENT

The telescope used was 305mm aperture and 1205mm focal length F4 Newton with coma corrector. Mount was iOptron CEM60 and autoguider was configured to track stars during each exposure. The telescope was placed in Viestikallio Remote Controlled Observatory at Artjärvi, Finland under Bortle 3 rural sky conditions.

CCD-camera was cooled QSI690wsg having Sony ICX814 CCD-sensor. Exposures 90s and 45s were used with CCD binning 2x2 and 3x3, giving 1.3 and 1.9 arcsec/px resolution. Baader Clear filter was used.

SOFTWARE

Image processing software used was PixInsight (PI), images were registered and stacked with PI Star and Comet registration and PI Integration functionality. PI PixelMath was used in image subtraction.
ASTAP software was used for plate solving and astrometric analysis.

SUMMARY AND CONCLUSIONS

The particles released by the comet 17P/Holmes during the 2007 outburst formed a dust trail which is still possible to observe with relatively small aperture amateur sized telescopes using CCD-camera and image processing technology giving useful research data by amateur astronomers. Observations ensure that the developed dust particle model is producing the realistic results and can be used to forecast dynamics of meteoroid streams.

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