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Photometry, astrometry and dust productivity analysis of comet 67P/Churyumov-Gerasimenko in 2021-2022

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In this work, we are presenting the results of astrometric, photometric, and dust productivity analysis of comet 67P/Churyumov-Gerasimenko. The results are based on 14 nights of observations at the Kyiv Comet Station (MPC Code 585) during the near-perihelion and Earth approach periods of 2021-2022. We also analyzed the photometric and astrometric data of 67P comet appearance in the 1969-2022 period of observations published in Minor Planet Center and Comet OBServation databases. For observations, we used the 0.7 m (f/4) reflector AZT-8 with the FLI PL4710 CCD camera. On the basis of our images, we have measured precise astrometrical positions, magnitudes of 67P in different apertures for all the period of our observations, and values of $Af\rho$ parameter for most of our observations. Based on observations published in the MPC database, we calculated orbital elements of 67P during 11 epochs. Also, on the basis of the Comet OBServation database, we calculated photometrical parameters for comet appearances in 1982-2022 and analyzed the dynamics of their change. Astrometrica and FindOrb software was used for astrometric analysis and orbital elements calculations, and Comet for Windows and FoCAs 3.70 software was used for photometric and dust productivity analysis.
We checked the accuracy of our astrometric results by comparing them with MPC data from the last 6 months in FindOrb software. We sent the results of 7 nights of observations to the MPC database with O-C residuals less than $1''.4$ Overall, 157 results of observations were published in MPC database, and the observations with the highest precision were published in Minor Planet Circulars. The RA (O-C) residuals of published results of observations vary from 0.02+ to 1.4- arcseconds and Declination (O-C) residuals vary from 0.01+ to 1.4+ arcseconds. The mean residuals of elements of 67P orbit, calculated considering gravitational and non-gravitational effects of A_1 and A_2 comet model, vary from $0''.87$ to $0''.34$. As a result of our photometric research, we measured that the photometric parameters of 67P for 2021-2022 appearance are $H_0 = 9.59^m$ and $K = 5.65$, and the values of the $Af\rho$ dust productivity parameter were changing from 102 cm (1 month before the perihelion) to 317 cm (2 months 2 weeks after the perihelion) without phase correction. As a result of our photometrical analysis, we report asymmetry between the maximum of apparent magnitude and the moment of perihelion.

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