Pre-Encounter Characterization of the *Lucy* Target (152830) Dinkinesh. S. Mottola[1], T. Denk[1], S. Marchi[2], R. P. Binzel[3], K. S. Noll[4], J. R. Spencer[2], H. F. Levison[2]. [1]Institute of Planetary Research, DLR, Rutherfordstr. 2, D-12489 Berlin, Germany, [2]Solar System Science & Exploration Division, Southwest Research Institute, 1050 Walnut St., Suite 300, Boulder, CO, 80302, USA, [3]Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge 02139, MA, USA, [4]Goddard Space Flight Center, 8800 Greenbelt Road, Greenbelt, MD 20771, USA.

Introduction: The small Main-Belt asteroid (152830) Dinkinesh was recently added to NASA's Lucy mission and will be the first fly-by target on November 1, 2023. Very little was known about the photometric and rotational properties of Dinkinesh, essentially consisting only of its approximate absolute (H) magnitude. Fortunately, this asteroid reached opposition geometry in December 2022, enabling a pre-encounter photometric reconnaissance observation campaign prior to the encounter.

Observations: The object crossed the Galactic plane during the 2022-2023 apparition, which, due to the corresponding crowded fields and the object's comparably faint apparent magnitude (between V=19 and V=21), made Dinkinesh a difficult target.

For this campaign, a total of 20 nights in the period Oct 2022 – Feb 2023 were allocated from the DLR guaranteed time contingent at the 1.23m telescope in Calar Alto, Spain, out of which, 14 were of useful quality. The illumination geometry covered the range (3-23 degrees) in solar phase angle.

In order to optimize telescope-time usage, exposures were scheduled for epochs at which the object was not proximate to stars brighter than V≈21.5, based on the object's ephemeris and on star charts. The telescope was tracked at half the apparent motion vector of the target, in order to obtain similar PSFs for the target and the field stars. In this way, exposures of 300s resulted in trails with an elongation smaller than 1 arcsec.

Observations were mainly carried out in the Cousins R_C filter, and, during one night, by alternating the R_C with the Johnson V filter.

Reduction and Analysis: Aperture photometry was performed with the AstPhot data reduction package [1]. Faint stars still present on the path of Dinkinesh were measured on multiple nights, in order to obtain a high-SNR magnitude, and then their flux subtracted from the target during close appulses. Reduction to the standard Johnson system was performed by using the Gaia DR2 catalog [2], with the color transformations reported in [3]. Typically, 26 in-field high-SNR Gaia stars were used as comparison. Flux ratios of the stars were checked to identify variability and eliminate outliers. Typical RMS accuracy of the photometric zero-points was of the order of 12 mmag, while typical SNR for the target was 30 in the R_C band and 20 in the V band.

Analysis: Already during the observations, it became apparent that Dinkinesh showed small intra-night intensity variations and a substantial night-to-night lightcurve variation. A rotation period analysis performed with the Lomb method [4] revealed a strong peak at a frequency $f_1 \approx 0.91$ d^{-1}. The fine period search was performed with the Fourier-analysis method described in [5], modified to simultaneously solve for period and phase coefficient.

Results: By assuming a lightcurve with 2 pairs of extrema, we find an unambiguous synodic rotation period $P_{syn}=52.67\pm0.04$ h, corresponding to half of f_1. The lightcurve maximum amplitude has been determined to be A=0.39 ± 0.02. The period fit was performed on absolute R magnitudes, without allowing for night-to-night magnitude shifts. The best-fit HG-system parameters for the R-band are $H_R=17.17 \pm 0.04$, and $G_R = 0.378 \pm 0.035$, measured for the lightcurve mean brightness.

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