Pre-Encounter Characterization of the Lucy Target (152830) Dinkinesh

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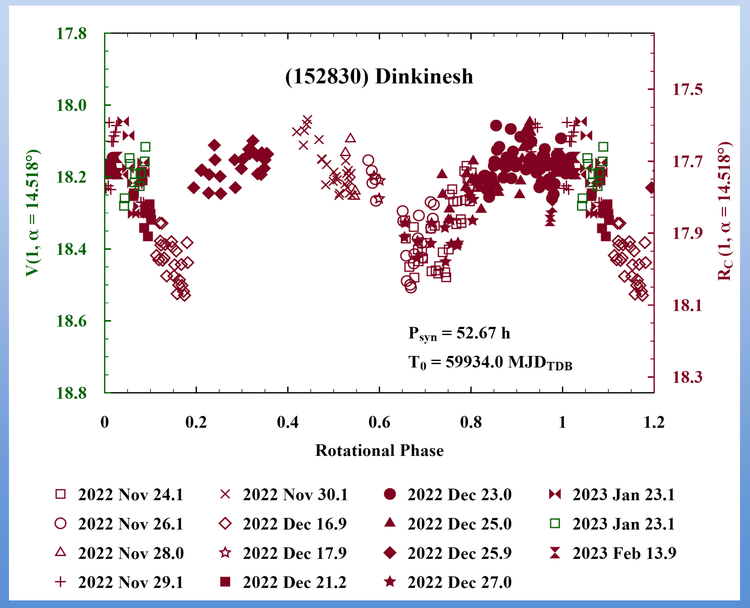
Introduction

Main Belt asteroid (152830) Dinkinesh will be the first fly-by target of the Lucy mission on November 1, 2023, during its cruise to the Trojan clouds. We report our photometric time-series observations of this target performed on 14 nights over nearly 3 months during the 2022-23 apparition with the 1.23 m telescope at Calar Alto, Spain, aimed at determining its rotation and photometric properties.

Observational Circumstances

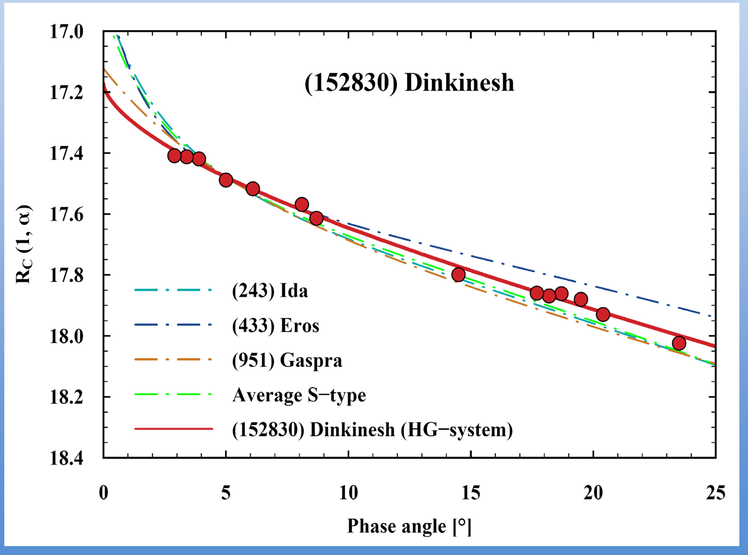
Date (UT)	λ (° J2000)	β	α (°)	r (au)	Δ (au)	λ (PAB) (° J2000)	β	Band	Observatory
2022 Nov 24.1	104.6	+3.3	20.4	1.9462	1.1057	94.5	+2.6	R_C	493
2022 Nov 26.1	104.5	+3.4	19.5	1.9460	1.0911	94.8	+2.7	R_C	493
2022 Nov 28.0	104.4	+3.4	18.7	1.9459	1.0780	95.1	+2.7	R_C	493
2022 Nov 29.1	104.4	+3.4	18.2	1.9458	1.0712	95.3	+2.7	R_C	493
2022 Nov 30.1	104.3	+3.5	17.7	1.9458	1.0642	95.4	+2.7	R_C	493
2022 Dec 16.9	101.5	+3.9	8.7	1.9465	0.9847	97.3	+3.0	R_C	493
2022 Dec 17.9	101.3	+4.0	8.1	1.9466	0.9819	97.4	+3.0	R_C	493
2022 Dec 21.2	100.5	+4.0	6.1	1.9471	0.9742	97.6	+3.0	R_C	493
2022 Dec 23.0	100.0	+4.0	5.0	1.9474	0.9710	97.7	+3.0	R_C	493
2022 Dec 25.0	99.5	+4.1	3.9	1.9477	0.9684	97.8	+3.0	R_C	493
2022 Dec 25.9	99.2	+4.1	3.4	1.9479	0.9676	97.9	+3.1	R_C	493
2022 Dec 27.0	99.0	+4.1	2.9	1.9481	0.9670	97.9	+3.1	R_C	493
2023 Jan 23.1	92.8	+3.9	14.5	1.9566	1.0408	100.0	+3.0	V, R_C	493
2023 Feb 13.9	91.9	+3.4	23.5	1.9679	1.2059	103.7	+2.8	R_C	493

Rotational lightcurve of Dinkinesh



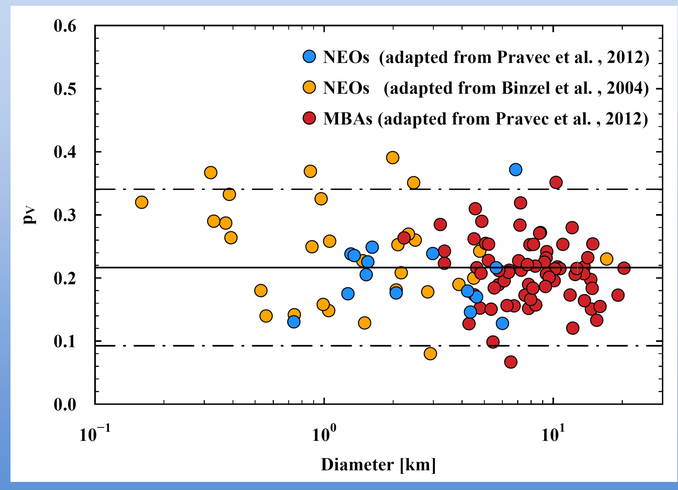
The composite lightcurve for Dinkinesh was derived by using the Fourier-analysis method described in Harris et al. (1989), modified to simultaneously solve for synodic period, phase coefficient of the HG-system and V − R color index. All observations were expressed in the Johnson-Cousins system, and no arbitrary magnitude shifts for night-to-night adjustments were applied in the fitting procedure.

Phase curve of Dinkinesh in the context of other members of the spectral S-complex



Phase curve of Dinkinesh in the R band. The solid line corresponds to the HG-function with the best-fit parameters HR=17.17 and GR = 0.379. The dashed lines represent synthetic phase curves of a few reference S-type asteroids, obtained by integrating the Hapke (1993) photometric model over a sphere, with the parameters listed in Li et al. (2004). For the purpose of comparison, the dashed curves are normalized to the magnitude value of Dinkinesh at the phase angle of 5°.

Albedo distribution of small S-complex asteroids



Dinkinesh has been independently classified by de León et al. (2023) and Bolin et al. (2023) as belonging to the S-spectral complex. The figure shows the geometric albedo for S-complex NEOs and MBAs smaller than 25 km. The solid line represents the average value of the albedo and the dashed lines show the ±2σ envelope for the distribution. If Dinkinesh's albedo falls within the ±2σ range of S-complex small asteroids, then its spherical equivalent diameter lies between 0.66 and 1.36 km.

Summary of results

Synodic Period (h)	52.67 ± 0.04
Amplitude (mag)	0.39 ± 0.02
a/b	$\gtrsim$ 1.43
H_V	17.62 ± 0.04
H_R	17.17 ± 0.04
G_R	0.378 ± 0.035
V − R	0.455 ± 0.025
$H_{R-(H,G_1,G_2)}$	17.17 ± 0.14
G_1	0.37 ± 0.17
G_2	0.43 ± 0.04

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