INTERPRETATION OF THE DISK-INTEGRATED LIGHTCURVE OF THE DINKINESH SYSTEM AS OBSERVED BY LUCY.

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Introduction: The Lucy mission, launched in October 2021, will encounter the first of its primary targets, the Trojan asteroids, in August 2027. A flyby of main-belt asteroid (MBA) Donaldjohanson in April 2025 had always been planned as a rehearsal and system test for the Trojan encounters [1]. However in early 2023 the project decided to spend a small amount of fuel to enable an additional close (430 km) flyby of MBA (152830) Dinkinesh on November 1st 2023, providing a valuable opportunity for an earlier rehearsal. Ground-based data showed Dinkinesh to be a typical small (~1 km diameter) S-type inner main-belt asteroid [2,3], and it was chosen only for its accessibility to the spacecraft. However, Lucy data has revealed it to be an exceptionally interesting science target, in particular due to the discovery of its satellite, now named Selam.

Lightcurve Observations: Lucy's science observations at Dinkinesh were deliberately kept simple, given that this encounter was primarily an engineering test. However, a dedicated set of observations of Dinkinesh's disk-integrated rotational lightcurve were obtained with the L'LORRI camera on the outbound leg of the encounter. Sets of 3 images were obtained every hour between 8 hours and 4 days after closest approach, using L'LORRI's 4x4 pixel binning mode to limit data volume. This 3.7-day observing interval was chosen to cover more than a full period (2.19 days) of the ground-based lightcurve obtained in late 2022 and early 2023 [4]. Exposure time was gradually increased from 50 to 500 msec during this time to compensate for Dinkinesh's rapid fading due to increasing range. Viewing geometry was very constant during this interval, with solar phase angle varying only between 60.5º and 59.7º, and the apparent sky position of Dinkinesh varying by only a small fraction of a degree. The resulting lightcurve can thus be interpreted without the need for significant solar phase function or view direction corrections, though we did apply a nominal phase function correction to account for the 0.8º change in phase angle.

Opportunistic disk-integrated lightcurve data were also obtained by L'LORRI during the 2-month optical navigation campaign that preceded the encounter. However, the large and significantly changing solar phase angle during this campaign (105º - 120º), with corresponding changes in viewing direction, long cadence (1 day or longer) and lower SNR of many of the data, make interpretation more complex.

Results: Detailed results will be presented at the conference, and in a paper currently in preparation. The outbound lightcurve provides information about the dynamics of the Dinkinesh system that is highly complementary to the high-resolution snapshot obtained during closest approach. The high quality of the lightcurve reveals the rotational periods and constrains the shapes of the two bodies, and also constrains Selam's orbit around Dinkinesh.

We will also discuss comparisons to the ground-based lightcurve [4], and to the more problematic lightcurve data obtained by L'LORRI on approach to Dinkinesh.

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