SELAM: THE REMARKABLE SATELLITE OF (152830) DINKINESH. J. R. Spencer[1], H. F. Levison[1], S. Marchi[1], K. S. Noll[2], E. B. Bierhaus[3], S. Mottola[4], N. Dello Russo[5], T. R. Lauer[6], and the Lucy Science Team, [1]Southwest Research Institute, Boulder CO (john.spencer@swri.org), [2]NASA Goddard Space Flight Center, Greenbelt, MD, [4]Lockheed Martin Space, Littleton, CO, [4]Institute of Planetary Research, DLR, Berlin, [5]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [6]NSF's NOIR Lab., Tucson AZ.

Introduction: The Lucy mission, launched in October 2021, [1, 2] will encounter the first of its primary targets, the Trojan asteroids, in August 2027. A flyby of main-belt asteroid (MBA) Donaldjohansen in April 2025 had always been planned as a rehearsal and system test for the Trojan encounters. 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 [3, 4, 5, 6], 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.

Encounter Observations: The encounter was designed primarily as a test of Lucy's close-loop target tracking capabilities, and the science observation sequence was intentionally simple. Highest-resolution imaging was obtained with the Lucy Long-Range Reconnaissance Imager (L'LORRI) [7], which obtained images at three different exposures, each with 15-second cadence, in the period from -10 to +9 minutes of closest approach, and lower-cadence imaging at greater range. L'LORRI image scale near closest approach was 2.1 m/pixel. All images were targeted at the best estimate of the location of the primary target, as determined by onboard tracking.

Imaging of Selam: Selam, located about 3 km from Dinkinesh, was visible in all approach L'LORRI images of Dinkinesh, though in a few images between -2.0 and -1.3 minutes Selam was clipped by the edge of the frame. Fortuitously, Selam's orbital location placed it almost directly behind Dinkinesh at closest approach (Fig. 1), providing 2.1 m/pixel imaging of its Dinkinesh-facing side. However, Selam left the L'LORRI frame at +0.2 minutes, and did not fully return to the L'LORRI field of view until +5.5 minutes. Excellent stereo data for shape determination was obtained during approach and near C/A (Fig. 2), though the approach phase angle of ~115º put much of the surface in shadow until shortly before C/A. However, the coverage gap during departure resulted in lower-resolution, largely monoscopic, coverage of the better-illuminated outbound hemisphere (Fig. 3).

Selam's Shape: The images reveal Selam to be a contact binary, the first contact binary asteroid satellite ever seen. The two components are each about 200 meters in diameter, compared to Dinkinesh's diameter of about 720 meters. Selam is seen end-on near C/A, and its binarity is only obvious in stereo (Fig. 2), but outbound images (Fig. 3) show its nature more clearly. The contact region of the two components is in shadow at the outbound phase angle of 46º, and cannot be seen. Both components are highly angular in shape, with a prominent, obliquely oriented ridge separating surface facets on the Dinkinesh-facing side of the near component. The shape of the far component is less well constrained, but it has a strongly polygonal outline in the outbound images, with an apparently squared-off facet facing the near component. Both components, like Dinkinesh itself, show abundant surface boulders, and few craters. The angular, binary, shape of Selam is thus dramatically different from the ellipsoidal shape of Dimorphos, the moon of Didymos impacted by the DART mission [8], implying very different histories for the two bodies.

Detailed results on the shape and dynamics of Selam will be presented at the conference, and in a paper currently in preparation.

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Figure 1. L'LORRI image of Dinkinesh and Selam, taken near closest approach. The image has been sharpened using deconvolution.

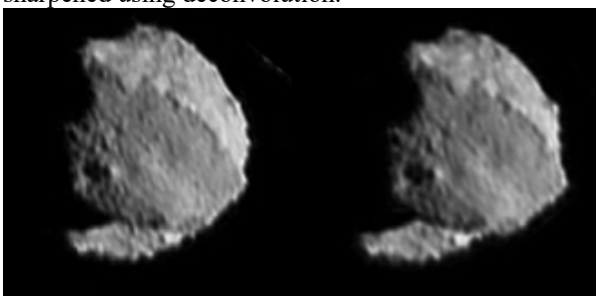

Figure 2. L'LORRI cross-eyed stereo pair of Dinkinesh, obtained near closest approach. The image has been sharpened using deconvolution.

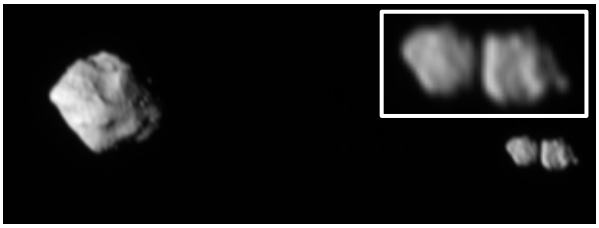

Figure 3. The best L'LORRI outbound view of Dinkinesh and Selam, taken 5.5 minutes after closest approach. The inset shows an enlargement of Selam. The image has not been deconvolved.