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Lightcurve of Asteroid (52246)Donaldjohanson from the Lucy Spacecraft's Observations

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The Lucy Mission is a NASA Discovery class mission to study the Trojan asteroids. Its targets are the asteroids Eurybates (Aug. 2027), Polymele (Sep. 2027), Leucus (Apr. 2028), Orus (Nov. 2028) and the Patroclus – Menoetius binary (Mar. 2023). On its way to the Trojans, Lucy performed test flybys of two main belt asteroids. The second flyby was of the asteroid Donaldjohanson (DJ), with closest approach occurring April 20th, 2025. One of the aims of the flyby was to test planning and executing a complex science encounter sequence.

Images taken during the approach phase by the L'LORRI instrument, the high-resolution panchromatic camera onboard Lucy, were used to build up a lightcurve of DJ. The ground-based lightcurve, with a large amplitude and long period, had already shown unusual characteristics, but Lucy provided a highly complementary dataset with uniform cadence, no weather interruptions, and a unique viewing geometry. The relevant Lucy datasets include L'LORRI images taken for optical navigation and for potential satellites, which were taken at a lower cadence of once every two days or once a day closer to encounter, and approach photometry observations. The approach photometry imaging, from E-4 days to E-13 hours from closest approach, provided higher cadence data alternating between 0.75 hours and 1.25 hours. This higher time-resolution data provided detailed observation of one minimum of the lightcurve.

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