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A NEW SATELLITE OF (172376) 2002 YE25 DETECTED BY STELLAR OCCULTATION

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Two observers in Australia, at two separate sites, observed (172376) 2002 YE25 occult TYC 6854-1090, an 11th magnitude star, on 2022 May 16.447 UT. The minor planet was nine magnitudes fainter than the star. An occultation at both sites was not expected to be observed due to the small diameter of the asteroid and the cross-path spacing of the two sites being much larger than the asteroid. However, both sites detected a clear occultation that reached the limit of 3 magnitudes fainter than the star for both recordings. We observed chord lengths across one body of 3.8 km and the second body of 3.3 km, with a mid-chord separation of 15.3 km. We rule out the possibility that the two occultations were caused by a double star, or a highly elongate object like 433 Eros or 216 Kleopatra.

D. Gault and P. Nosworthy observed (172376) 2002 YE25 occult TYC 6854-01090-1. An occultation at both sites was not expected due to the 5.7 km diameter of the asteroid and the 15.52 km cross-path spacing of the two sites being much larger than the asteroid. They observed from their home observatories located in The City of The Blue Mountains, west of Sydney, Australia, at Hawkesbury Heights and Hazelbrook. The sites are equipped with 28 and 30 cm Schmidt-Cassegrain telescopes, Watec 910BD video cameras, and IOTA-VTIs (2024), which inserted an accurate GPS-derived time stamp into the video stream. The occultation occurred at an altitude of 19 degrees. Observation circumstances and timings are shown in Table I and lightcurves of the target and a comparison star are shown in Figure. 1.

For this event, the recordings were closely analyzed to determine the limiting magnitude of the recording, noting that during the occultation events, the lightcurve dropped to zero light-level. The occulted star had a Gaia G-band magnitude of 11.0; stars fainter than 13.9 were visible on the recording. The equivalent magnitude drops of at least 3.0 magnitudes for both events in each recording is much larger than the 0.75 mag drop that would occur if the star was a double star of equal magnitude – thereby excluding a double star as being an explanation for the event.

Observer	Longitude	Latitude	Altitude	Event	Time UT	
Gault	150 38 27.9	-33 39 51.90	286m	D	10:43:31.52	+/-0.02
				R	10:43:31.96	+/-0.02
Nosworthy	150 27 06.5	-33 42 26.60	648m	D	10:43:30.07	+/-0.02
				R	10:43:30.46	+/-0.02

Table I. Observation circumstances and disappearance and reappearance times UTC of the 2022 May 16 occultations. The sites were separated by 15.52 km across the occultation path.

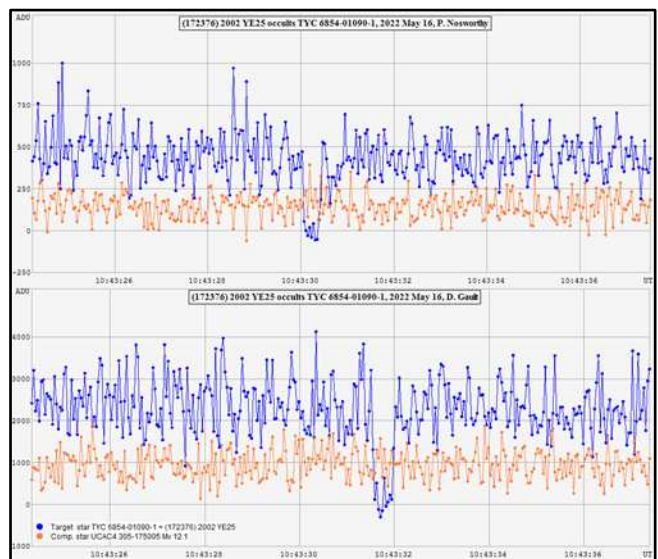


Fig. 1. Lightcurves by Gault and Nosworthy of the 2022 May 16 occultations of the MG 11.0 target star by the asteroid main body and satellite. Light values of the MG 12.1 comparison star are also shown.

Reduction of the Observations

Event times and observation circumstances were entered into *Occult* (Herald, 2024) and reduced for each observation. The sky-plane plots are shown on Figure 2.

The NEOWISE diameter of 2002 YE25, as determined at two epochs in 2010, is 5.7 ± 0.6 km, giving an equivalent cross-sectional area of between 20 and 31 sq km. The two occultation chords were of lengths 3.8 and 3.3 km, with a mid-chord separation of 15.3 km. Assuming a highly elongate cylindrical object similar to that of minor planets 433 Eros or 216 Kleopatra, the minimal apparent cross-sectional area would be greater than 55 sq km (i.e., much larger than that expected from the NEOWISE diameter).

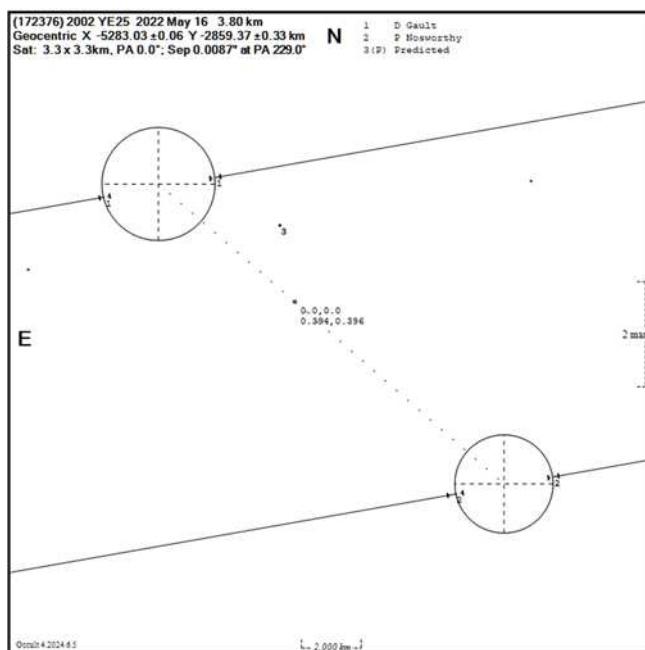


Figure 2. Reduction sky-plane plots of the 2022 May 16 occultation events for 2022 YE25.

However, if the two occultation chords were caused by spherical bodies 10 percent larger than the respective chords, the combined cross-sectional area of those bodies would be 24 sq km, fully consistent with that expected from the NEOWISE diameter. Accordingly, the observation is fully consistent with 2022 YE25 being a binary system.

Using a circular fit, we determined the chords for the two bodies:

Main body	3.8 ± 0.6 km
Satellite	3.3 ± 1.5 km

These diameters were then used to derive a separation of 8.7 ± 1.0 mas between the two with the satellite at position angle 229 ± 1 deg relative to the primary.

We are not aware of any lightcurve measurements of this asteroid. The observations of 2022 May 16 were the subject of *CBET* 5151.

References

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LIGHTCURVE ANALYSIS FOR FOUR NEAR-EARTH ASTEROIDS OBSERVED JULY-SEPTEMBER 2024

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Lightcurves and amplitudes for four near-Earth asteroids observed from Great Sheffield Observatory during close approaches between July and September 2024 are reported. All are small objects with rotation periods shorter than 5 minutes and one is identified as having tumbling rotation.

Photometric observations of near-Earth asteroids during close approaches to Earth between July - September 2024 were made at Great Sheffield Observatory using a 0.40-m Schmidt-Cassegrain and Apogee Alta U47+ CCD camera. All observations were made unfiltered and with the telescope operating with a focal reducer at $f/6$. The $1K \times 1K$, 13-micron CCD was binned 2×2 resulting in an image scale of 2.16 arc seconds/pixel. All the images were calibrated with dark and flat frames and *Astrometrica* (Raab, 2024) was used to measure photometry using APASS Johnson V band data from the UCAC4 catalogue (Zacharias et al., 2013) and G band data from the Gaia DR 2 catalogue (Brown et al., 2018). *MPO Canopus* (Warner, 2023), incorporating the Fourier algorithm developed by Harris (Harris et al., 1989) was used for lightcurve analysis.

No previously reported results have been found in the Asteroid Lightcurve Database (LCDB) (Warner et al., 2009), from searches via the Astrophysics Data System (ADS, 2024) or from wider searches unless otherwise noted. All size estimates are calculated using H values from the Small-Body Database Lookup (JPL, 2024b), using an assumed albedo for NEAs of 0.2 (LCDB readme.pdf file) and are therefore uncertain and offered for relative comparison only.

2024 NM3. The ATLAS facility at Rio Hurtado, Chile discovered this Aten ($H = 25.2$, $D \sim 28$ m) on 2024 Jul 14.3 UTC. It passed Earth at 2.0 Lunar Distances (L.D.) on 2024 Jul 17.6 UTC (Dupouy et al., 2024) and was observed on three consecutive nights, 2024 Jul 17.0, 18.0 and 19.0 UTC. Average apparent magnitude and speed (arcsec/min) over the three nights were 16.7, 16.7, 17.6 and 100, 113, 53 respectively, resulting in the least scatter being achieved in the first night's measurements. Independent period spectra from the three nights produced very similar results, combined here in one diagram separated vertically. It can be seen that all the significant minima in the last two dates correspond with minima in the plot for Jul 17.0 UTC. The best fit in all three dates is for a rotation period of 0.047 h and all the other significant minima are integer multiples of $1/4$, $1/3$ or $1/2$ of that period. *MPO Canopus* was configured to plot phased lightcurve diagrams for the three dates with the lightcurve maximum positioned at phase = 0.00 (= phase 1.00). The best-defined period, from Jul 17.0, of 0.046654 ± 0.000003 h (~ 2.8 min) was then used to propagate likely errors forwards to the other two dates to estimate whether the maximum in the first date matched the maxima in the following two dates and therefore whether the lightcurve shapes were directly comparable. The likely