TIC 414586640: unclassified variable, may be stellar variability

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Tustin, California. Research note from the 2.4 degree repeating-dip scan around V345 Lac, 18 November 2026.

Status: Variable star candidate, not an eclipsing binary. Found 18 Nov 2026 scan. Not filed with VSX. Not checked from the ground.

Abstract

TIC 414586640 (Tmag 10.222) showed 18 clean dips of at least 0.5 percent in TESS Quick-Look Pipeline photometry, so the 18 November 2026 scan around V345 Lac listed it among stars with repeated dips and no fold. A Lomb-Scargle amplitude spectrum of the full light curve, up to 50 cycles per day, shows variability in the star, but it does not settle whether the dips are part of it. The strongest frequency is 0.068 c/d (1.2 ppt). The best guess from these data alone is: unclassified variable, may be stellar variability. Nothing here has been checked from the ground or filed with VSX. The star is 2.397 degrees from V345 Lac, in the 2.30–2.40 degree ring.

1. How the star was found

A repeating-dip scan of TESS stars around V345 Lacertae (TIC 421726141) ran on 18 November 2026. It covered every TESS Input Catalog star within 2.4 degrees of V345 Lac with a TESS magnitude of 13.0 or brighter, 20,840 stars. The light curves are QLP SAP_FLUX, cadences with a quality flag of exactly zero, each sector divided by its own median. The scan searched each light curve with a 12-harmonic χ^2 periodogram (the multiharmonic approach of Rutkowski & Poleski 2026, computed with the finufft_chi2 backend of nifty-ls, Garrison et al. 2024) and a box least-squares (BLS) cross-check (Kovács, Zucker & Mazeh 2002). It also counted individual dips: at least five times the point scatter, at least three points, more than 0.3 days from a data gap, and not at a time when many stars dip together. TIC 414586640 did not pass as a periodic eclipse candidate, but it had 18 such dips of at least 0.5 percent. Its median dip depth was small enough that, on a star of its TIC radius, the body causing it could be under two Jupiter radii, so it first appeared in the planet-sized section of the "Possible planetary dips" page. A closer look at the light curve, below, moved it to the "Unclassified variables" page.

2. The star

TIC v8.2 gives RA 336.93704°, Dec +56.70753° (J2000), 22h 27m 44.89s, +56° 42′ 27.1″, Tmag = 10.222, T_{eff} = 6929 K and R = 1.63 $R_{\odot}$, with a contamination ratio of 0.675. From the scan positions of this star and of V345 Lac, the separation is 2.397 degrees, 143.8 arcmin, at position angle 31°, to the north-northeast. In 0.1-degree rings around V345 Lac it sits in the 2.30–2.40 degree ring. There is no VSX entry within 30 arcsec and no Gaia DR3 eclipsing binary within 5 arcsec. The same dips appear in TIC 414586639, 0.3 arcmin away (11 dips at the same times), so light from one star spills into the other aperture.

3. What the scan measured

Quantity	Value
TESS sectors	16, 17, 57, 83, 84
12-harmonic χ^2 periodogram peak	27.08992 d, SNR 39
BLS peak	0.80680 d, SNR 78.1, depth 0.12%
Adopted fold and its box depth	0.80680 d, 0.07%
Raw spread (1st to 99th percentile)	1.31%
Point scatter, detrended	0.135% per cadence
Dip events (all; not near a gap)	19; 19
Clean dips ≥ 0.5%, off systematic times	18, depths 0.68–1.26%, median 0.88%
Spacing of consecutive clean dips	median 27.1 h (10th–90th percentile 18.0–5317.3 h)
Scan flags	broad_dips(EW/ellipsoidal/rotation-like); chi2_peak_is_other

Table 1. Scan quantities for TIC 414586640, from the scan's own result file. Depths are not corrected for light from other stars.

4. Light-curve check

The light curve is the scan's cached QLP SAP flux, quality flag zero, each sector divided by its median, with no detrending. A Lomb-Scargle periodogram (Lomb 1976; Scargle 1982), as implemented in Astropy (Astropy Collaboration 2022), was computed from 0.05 to 50 cycles per day with a step of one fifth of the inverse time span. The strongest frequency was fitted with a sine wave and removed, and the search was repeated six times. The signal-to-noise ratio of each frequency is its amplitude divided by the mean amplitude of the residual spectrum within 1 c/d of it. Frequencies below about 0.2 c/d are near the TESS orbit and sector length and are treated as instrumental.

#	Frequency (c/d)	Period (d)	Amplitude (ppt)	SNR
1	0.0682	14.65416	1.22	12
2	2.1302	0.46944	0.84	9
3	1.2395	0.80679	0.78	8
4	0.1477	6.76911	0.77	8
5	2.6339	0.37966	0.69	12
6	0.0842	11.87366	0.67	7

Table 2. Frequencies of TIC 414586640 from iterative prewhitening, in the order found. Amplitudes are semi-amplitudes of the raw flux in parts per thousand.

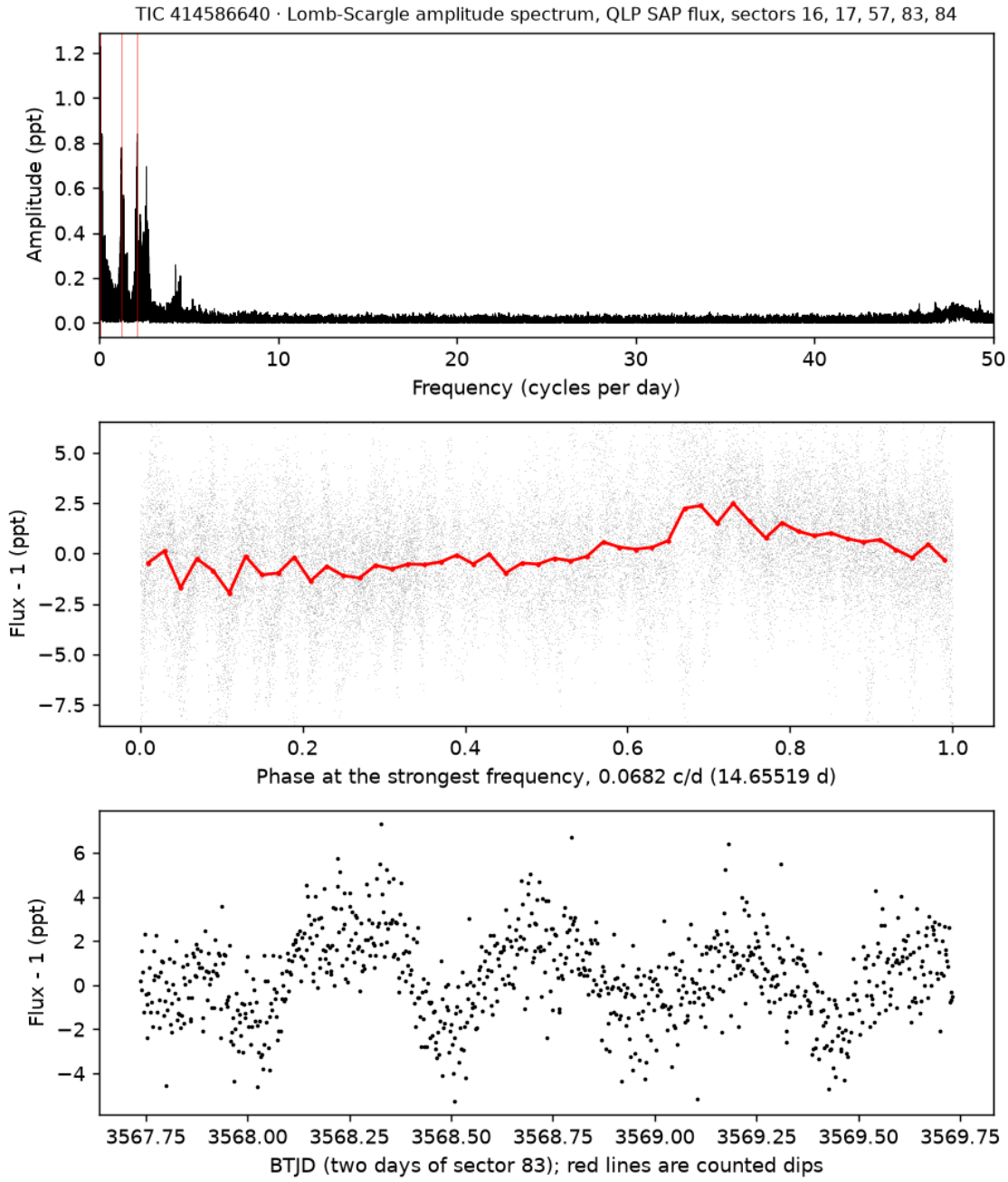


Figure 1. TIC 414586640. Top: amplitude spectrum to 50 c/d, with the three strongest frequencies marked. Middle: all data phased on the strongest frequency, with 50-bin medians in red. Bottom: two days of the best-sampled sector, with the counted dips marked. Compare the dips with the size of the periodic signal.

5. Best-guess classification

Unclassified variable, may be stellar variability. No frequency is strong: the largest peaks are 0.068 c/d (likely instrumental), 2.130 c/d and 1.239 c/d, all near 1 ppt with signal-to-noise ratios of 8 to 12, and the strongest one changes from year to year. The 18 dips of about 0.9 percent are much deeper than any periodic signal in the light curve. Eleven of them appear at the same times in TIC 414586639, 0.3 arcmin away, so they come from one source shared by both apertures. They may be stellar variability, a blended eclipse or an instrumental effect.

This classification uses the TESS light curve and catalog values only. TESS pixels are 21 arcseconds wide, so the variability could come from a neighbor, and the TIC temperature and radius are photometric estimates. The amplitudes are not corrected for light from other stars. None of this has been checked from the ground.

6. Follow-up

This is not a request to time eclipses. Useful next steps are a few hours of time-series photometry with a small telescope to confirm the main frequency on the target itself, and a low-resolution spectrum for the spectral type. Results would decide whether the star belongs in VSX and under which type. Nothing in this note has been submitted to VSX.

References

Astropy Collaboration, 2022, Astrophys. J., 935, 167
Brasseur C. E. et al., 2019, Astrocut: Tools for creating cutouts of TESS images, ascl:1905.007 (TESScut)
Gaia Collaboration, 2023, Astron. Astrophys., 674, A1 (DR3)
Garrison L. H., Foreman-Mackey D., Shih Y., Barnett A., 2024, Research Notes of the AAS, 8, 250 (nifty-ls)
Huang C. X. et al., 2020, Research Notes of the AAS, 4, 204 (QLP)
Kovács G., Zucker S., Mazeh T., 2002, Astron. Astrophys., 391, 369 (BLS)
Kunimoto M. et al., 2021, Research Notes of the AAS, 5, 234
Lomb N. R., 1976, Astrophys. Space Sci., 39, 447
Rutkowski K., Poleski R., 2026, Faster χ^2 periodogram: Accelerating linear algebra with fast Toeplitz solvers, arXiv:2611.20300
Scargle J. D., 1982, Astrophys. J., 263, 835
Stassun K. G. et al., 2019, Astron. J., 158, 138 (TIC)
Watson C., Henden A., Price A., 2006–, AAVSO International Variable Star Index (VSX)