

A 3.317-day eclipsing binary candidate: TIC 467474053

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Abstract

TESS Quick-Look Pipeline photometry of TIC 467474053 ($V = 12.06$) shows a repeating eclipse that is not identified with any catalogued variable found by the ring search. 41 primary minima in sectors 16, 17, 56, 57, 83 and 84 give

$$\text{BJD}_{\text{TDB}} = 2458741.12066 + 3.316988 E$$

with an rms O–C of 4.6 minutes. The primary falls to 0.841 of the sector median, 0.19 mag, and lasts about 4.0 hours below 98 percent of normal light. A shallower minimum at phase 0.5 falls to 0.968 of normal light, 3.2 percent, in all six sectors. A first look at the same dips called that secondary about 2 percent and the scatter about 6 minutes. Those round numbers are not the fit. Outside the two minima the light is flat. The centroid does not move off the star during eclipse, and no star within 1 arcmin is brighter than $V = 14.5$. Nothing in this note has been submitted to VSX.

1. How the star was found

Public TESS QLP light curves of stars brighter than $V = 12.5$ in the ring from 1.40 to 1.50 degrees around V345 Lac were screened for dips, brightenings and periods. The ring contains 296 such stars. TIC 467474053 lies 1.487 degrees from V345 Lac. It is the one new eclipsing binary candidate in that ring. Sectors 16 and 17 are 30-minute cadence (KSPSAP_FLUX); sectors 56, 57, 83 and 84 are 200-second cadence (DET_FLUX). Cadences with a nonzero quality flag were removed and each sector was divided by its median. No new observations were obtained.

2. The star

TIC 467474053 is TYC 3982-00755-1, Gaia DR3 2001807428293570816, 2MASS J22260958+5338543. TIC v8.2 J2000 position: 22h 26m 09.59s, +53° 38′ 54.3″ (RA 336.539953°, Dec 53.648408°). The Gaia DR2 and DR3 source IDs are the same. The DR2 neighbourhood table puts the two identifiers 0.19 mas apart. TIC: $V = 12.059 \pm 0.034$, $B = 12.113$, $T = 11.663$, contamination ratio 0.286, $l = 102.34^\circ$, $b = -3.31^\circ$. TIC quotes the Gaia DR2 parallax, 1.364 ± 0.027 mas, and proper motion -2.67 , -5.09 mas yr⁻¹. Gaia DR3 measures parallax 1.382 ± 0.009 mas and proper motion -2.65 , -5.29 mas yr⁻¹, with $G = 11.99$ (Gaia Collaboration 2023).

3. The ephemeris

A primary is a run of quality-zero flux below 0.90 of the sector median; its mid-time is the vertex of a parabola fit to the bottom. A linear fit to 41 primaries gives

$$T_0 = 1741.12066 \text{ BTJD}, P = 3.316988 \pm 0.000002 \text{ d.}$$

BTJD is $\text{BJD}_{\text{TDB}} - 2457000$. The formal error on T_0 is 1.4 minutes. The rms of the residuals is 4.6 minutes and the largest is 17.7 minutes. The median primary minimum is flux 0.841 (0.19 mag). The time below 98 percent of normal light is 4.0 hours (about 0.17 d); the time below half depth is 2.8 hours.

At phase 0.5 the flux falls to 0.968 (median of 37 events; range 0.966–0.982), present in every sector. A box search over the fold outside the primary finds the deepest feature at phase 0.500, depth 3.2 percent; nothing else exceeds 0.17 percent (box noise 0.02 percent). Two minima of unequal depth half an orbit apart are the signature of an Algol-type eclipsing binary. One primary, sector 83 cycle 552, only reaches flux 0.862. The other forty stay at 0.834–0.845.

Sector	Cycle	Mid-eclipse (BTJD)	UTC	Min. flux	O–C (min)
16	0	1741.1180	2019-09-14 14:44	0.841	-3.8
16	1	1744.4306	2019-09-17 22:14	0.836	-10.2

Sector	Cycle	Mid-eclipse (BTJD)	UTC	Min. flux	O–C (min)
16	4	1754.3890	2019-09-27 21:14	0.843	+0.6
16	5	1757.7015	2019-10-01 04:44	0.840	-5.9
16	6	1761.0349	2019-10-04 12:44	0.837	+17.7
17	8	1767.6598	2019-10-11 03:44	0.845	+4.7
17	9	1770.9723	2019-10-14 11:14	0.843	-1.8
17	10	1774.2848	2019-10-17 18:44	0.839	-8.3
17	12	1780.9305	2019-10-24 10:14	0.841	+8.6
17	13	1784.2429	2019-10-27 17:44	0.834	+2.0
17	14	1787.5553	2019-10-31 01:14	0.840	-4.6
56	327	2825.7785	2022-09-03 06:35	0.840	+3.9
56	328	2829.0954	2022-09-06 14:12	0.843	+3.7
56	329	2832.4095	2022-09-09 21:44	0.841	-0.4
56	330	2835.7268	2022-09-13 05:21	0.842	-0.0
56	331	2839.0443	2022-09-16 12:58	0.844	+0.7
56	332	2842.3603	2022-09-19 20:33	0.841	-0.7
56	333	2845.6773	2022-09-23 04:09	0.840	-0.7
56	334	2848.9953	2022-09-26 11:47	0.839	+0.7
56	335	2852.3107	2022-09-29 19:21	0.840	-1.5
57	336	2855.6272	2022-10-03 02:57	0.840	-2.2
57	338	2862.2631	2022-10-09 18:13	0.841	+0.5
57	340	2868.8978	2022-10-16 09:27	0.841	+1.7
57	341	2872.2121	2022-10-19 16:59	0.840	-2.3
57	342	2875.5322	2022-10-23 00:40	0.842	+2.2
57	343	2878.8456	2022-10-26 08:12	0.842	-2.9
83	549	3562.1485	2024-09-08 15:28	0.839	+1.9
83	550	3565.4629	2024-09-11 23:01	0.841	-1.8
83	551	3568.7785	2024-09-15 06:35	0.842	-3.9
83	552	3572.0997	2024-09-18 14:17	0.862	+2.2
83	553	3575.4138	2024-09-21 21:50	0.842	-2.0
83	554	3578.7297	2024-09-25 05:25	0.840	-3.5
83	555	3582.0435	2024-09-28 12:56	0.841	-8.1
84	556	3585.3686	2024-10-01 20:45	0.843	+3.5
84	557	3588.6856	2024-10-05 04:21	0.843	+3.6
84	558	3592.0004	2024-10-08 11:54	0.842	+0.3
84	559	3595.3176	2024-10-11 19:31	0.841	+0.7
84	560	3598.6324	2024-10-15 03:05	0.842	-2.4
84	561	3601.9538	2024-10-18 10:47	0.843	+3.9
84	562	3605.2689	2024-10-21 18:21	0.840	+1.1
84	563	3608.5870	2024-10-25 01:59	0.841	+2.8

Table 1. Primary minima of TIC 467474053. UTC = BJD_TDB - light time - 69.184 s. O–C is from the ephemeris above.

TIC 467474053 · QLP, sector median, quality flag zero

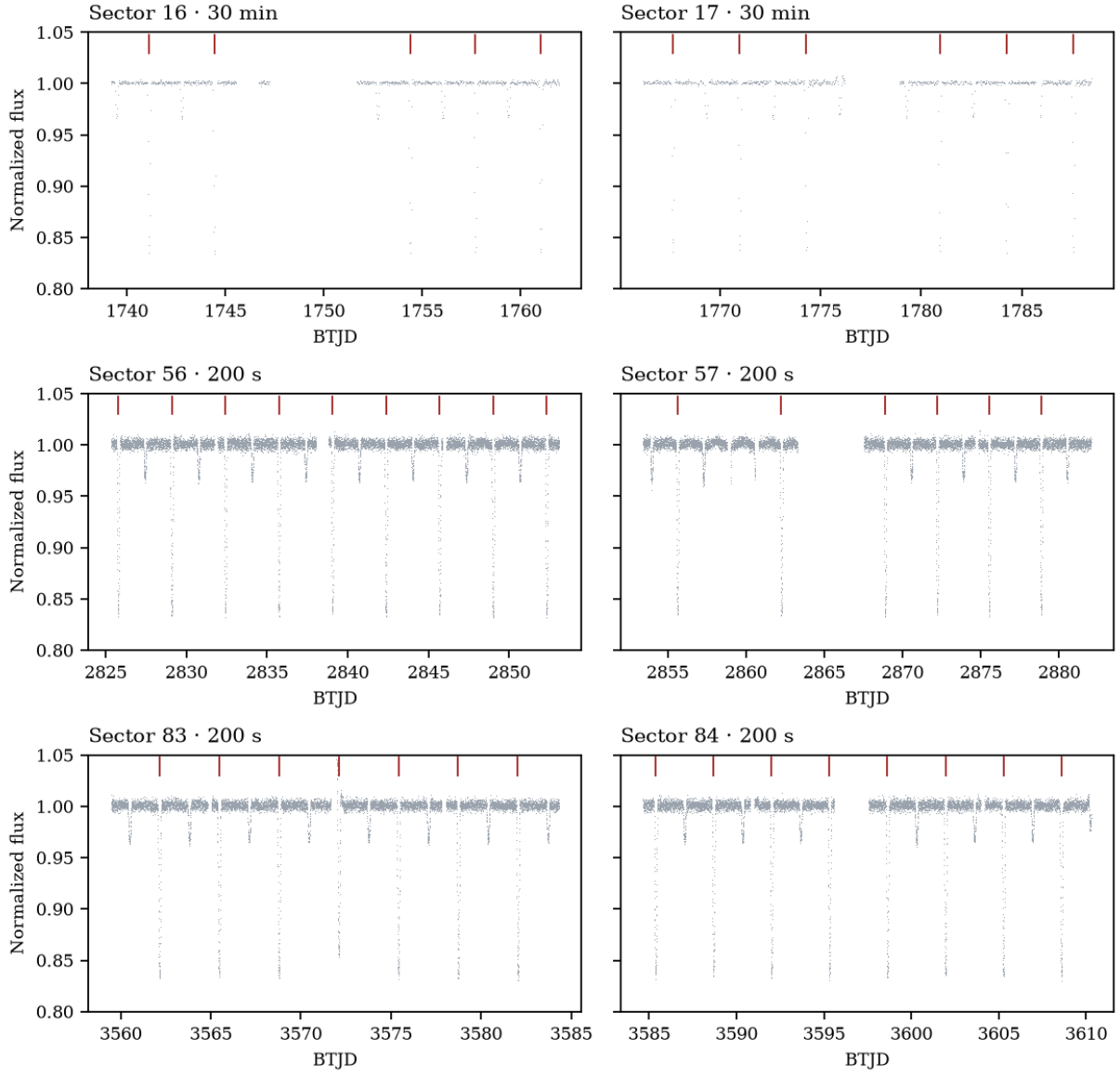


Figure 1. QLP light curves, quality-zero cadences, sector median. Red ticks are measured primary minima.

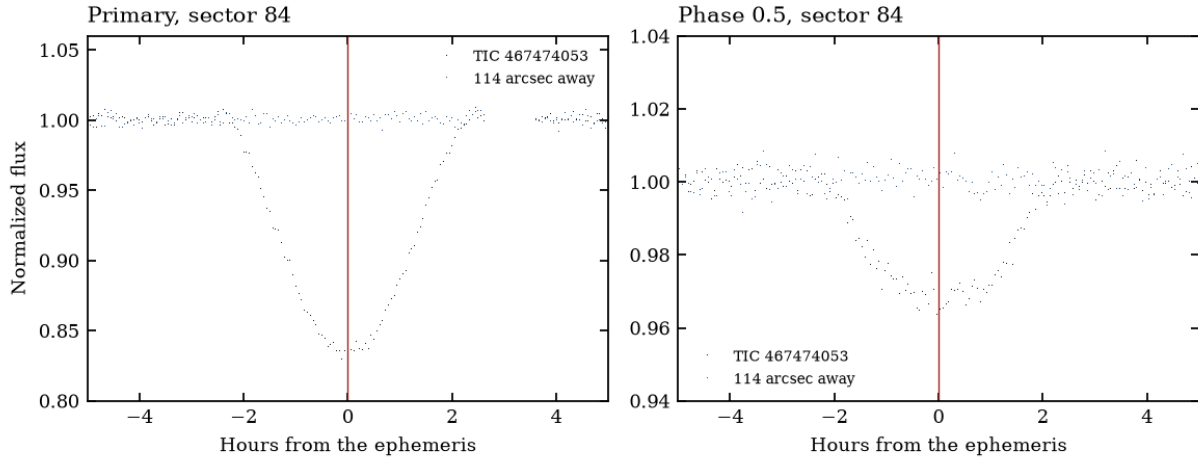


Figure 2. One primary and the phase-0.5 minimum in sector 84. Black is TIC 467474053. Blue is TIC 467473916, 114 arcsec away, which stays at full light.

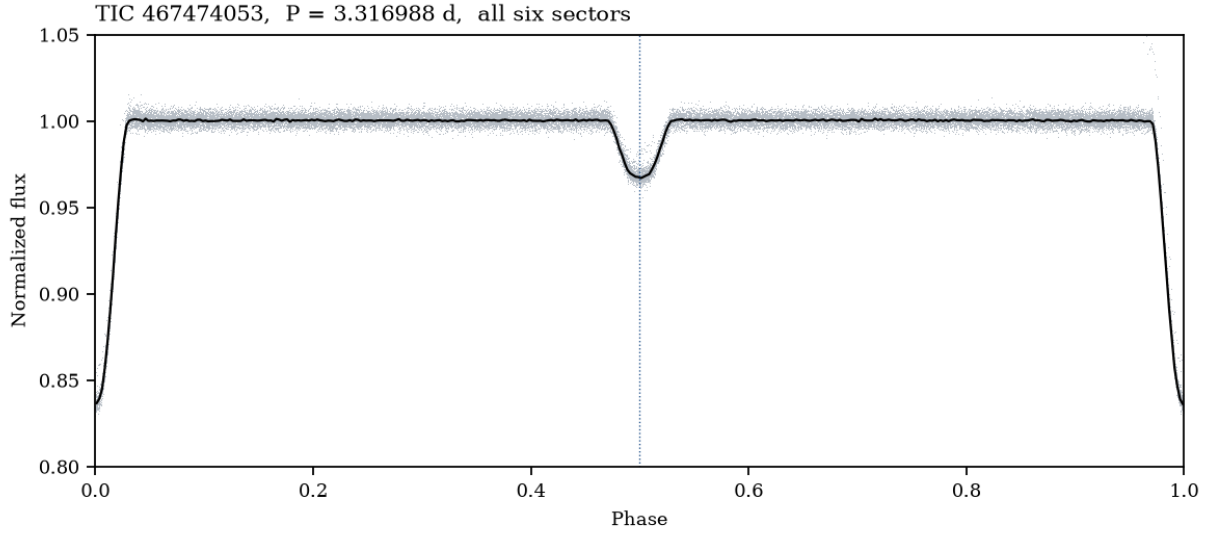


Figure 3. All six sectors folded on the period above. The line is a median in 0.0025 phase bins. The dotted line marks phase 0.5.

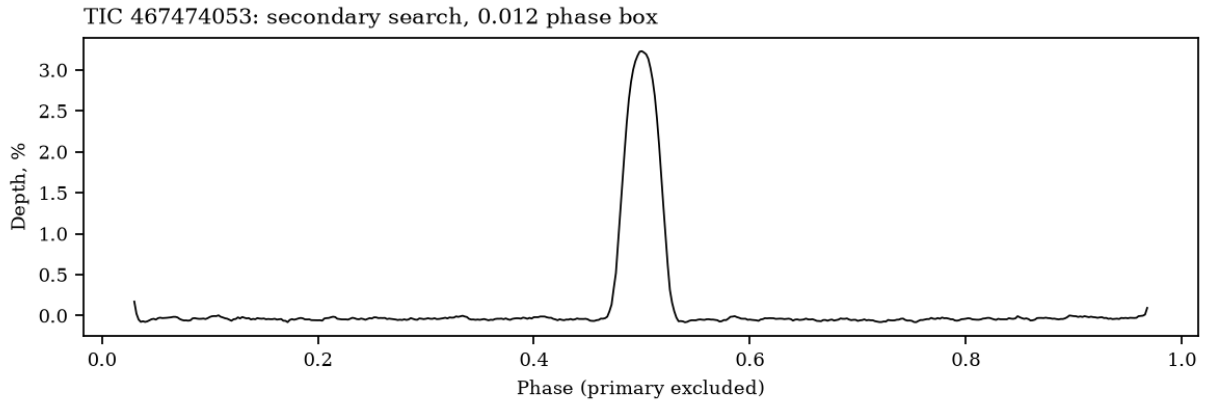


Figure 4. Depth of a 0.012-phase box moved across the fold, with the primary excluded.

4. The eclipse belongs to this star

The QLP centroid during primary eclipse (± 0.03 d) was compared with the out-of-eclipse centroid in each sector. The shifts are 5 to 17 millipixels, 0.11 to 0.36 arcsec, and the direction changes from sector to sector. In every sector the shift is inside the out-of-eclipse scatter. Every star within 1 arcmin is $V = 14.5$ or fainter. The nearest catalogued variable, 36 arcsec away, is a Gaia rotator at $G \approx 15.7$ with an amplitude of a few hundredths of a magnitude; it cannot produce a 16 percent eclipse in a $V = 12.06$ aperture. TIC 467473916 ($V = 12.10$), 114 arcsec away, stays at 0.999–1.004 of its normal light at the primary times. Figure 2 is one of those primaries, and the phase-0.5 minimum beside it. The neighbor is flat in both panels.

5. Status

Not submitted to VSX. A new VSX account can have only one new star in review, and TIC 330739083 is Sean League's one VSX entry so far. TIC 467474053 would be the next submission.

6. Related finds and controls in the ring

TIC 415156807 ($V = 11.92$, 1.468° out) shows a repeating dip every 8.330 d and is described in its own note. Catalogued variables recovered by the same search, used as controls:

Star	Type	Period (d)	Note
TIC 422226963 = ASASSN-V J222336.95+555418.1	EA	1.4949	eclipses $\sim 19\%$; $\sim 3.5\%$ leak into a star $101''$ away
V0343 Lac	EA/SD	12.94	both eclipses, down to $\sim 75\%$ of light
GSC 03982-02627	EA	2.80	
DN Cep	EA/SD	3.31	
ASASSN-V J221306.03+532915.1	EA	1.83	
Gaia eclipsing star	EB	2.00	neighbors within $20''$ repeat it

7. The next minima

- phase 0.5: BTJD 4343.2980, 2026-10-29 19:03 UTC
- primary: BTJD 4344.9565, 2026-10-31 10:52 UTC
- phase 0.5: BTJD 4346.6150, 2026-11-02 02:40 UTC
- primary: BTJD 4348.2735, 2026-11-03 18:28 UTC
- phase 0.5: BTJD 4349.9320, 2026-11-05 10:17 UTC
- primary: BTJD 4351.5905, 2026-11-07 02:05 UTC
- primary: BTJD 4354.9074, 2026-11-10 09:41 UTC

The ephemeris error propagated to 2026 is under a few minutes; the largest O–C in Table 1 is 18 minutes. The primary lasts about 4 hours, so a series from about 3 hours before to 3 hours after mid-eclipse covers it.

References

- Gaia Collaboration, 2023, A&A, 674, A1 (DR3)
- Huang C. X. et al., 2020, RNAAS, 4, 204 (QLP)
- Kunimoto M. et al., 2021, RNAAS, 5, 234
- Stassun K. G. et al., 2019, AJ, 158, 138 (TIC)
- Watson C., Henden A., Price A., 2006–, AAVSO VSX