A repeating 8.33-day dip on TIC 415156807

Sean League

Tustin, California. 27 October 2026. Not submitted to VSX.

Abstract

TESS QLP photometry of TIC 415156807 (V = 11.92) shows a dip that repeats every 8.3304 days. 16 dips in sectors 16, 17, 56, 57, 83 and 84 give BJD_{TDB} = 2458754.40505 + 8.330376 E with an rms O−C of 8.8 minutes. The dip falls to 0.937 of the blended light (0.070 mag) and lasts about 3.0 hours. A first pass at the same dips counted 17 events down to about 92 percent of the light, with no second minimum and a flat neighbor. That pass is not the measurement. The fold finds a shallow dip, about 1.3 percent, at phase 0.5 in all six sectors (section 3). A star 33 arcsec away also fades, by about 1 percent, on the deeper clock (section 4). The source is not settled, and the star is not classified here.

1. How the star was found

Same search as the TIC 467474053 note: 296 stars brighter than V = 12.5 in the 1.40–1.50 degree ring around V345 Lac, QLP light curves, quality-zero cadences, sector medians. TIC 415156807 lies 1.468 degrees from V345 Lac. The search's own period finder returned 4.1652 d, half the period used here.

2. The star

TIC 415156807 is UCAC4 723-095827, 2MASS J22284817+5429495. TIC v8.2 lists Gaia DR2 2004869671255700736 and no parallax. The Gaia DR3 neighbourhood table matches that DR2 source to DR3 2004869675569704320 at 20.7 mas, with a G difference of 0.11 mag. TIC v8.2 J2000 position: 22h 28m 48.17s, +54° 29′ 49.3″ (RA 337.200699°, Dec 54.497016°). That position agrees with the DR3 source. TIC: V = 11.915 ± 0.046, B = 12.578, T = 11.455, contamination ratio 3.32. A contamination ratio above 1 means the catalog expects more light from other stars than from the target inside its aperture. Gaia DR3 gives parallax 1.449 ± 0.095 mas, proper motion +8.00, −0.36 mas yr^{-1}, and G = 11.98 (Gaia Collaboration 2023).

3. The ephemeris and the phase curve

A dip is a run of quality-zero flux below 0.95 of the sector median; its mid-time is a parabola vertex. A linear fit to 16 dips gives

$$T_0 = 1754.40505 \text{ BTJD}, P = 8.330376 \pm 0.000021 \text{ d}.$$

The formal error on T_0 is 4.9 minutes; the rms of the residuals is 8.8 minutes and the largest is 19.2 minutes. The median dip minimum is flux 0.937.

The fold shows a second, shallower dip exactly at phase 0.5. In 15 predicted phase-0.5 windows across all six sectors the flux is 0.985–0.991 (median 0.987). A box search over the fold outside the main dip finds its deepest feature at phase 0.500, depth 1.12 percent. No other feature off phase 0.5 exceeds 0.07 percent (box noise 0.03 percent), so no secondary displaced from phase 0.5 is seen. The first summary of this ring said there was no second minimum. The fold does not agree with that summary.

Because the two dips sit exactly half a cycle apart, the data are also consistent with a 4.165-day period in which alternate dips differ in depth. Which dip is the primary, and whether this is an eclipsing pair at all, is not decided here.

Sector	Cycle	Mid-eclipse (BTJD)	UTC	Min. flux	O−C (min)
16	0	1754.4098	2019-09-27 21:44	0.938	+6.9
17	3	1779.3889	2019-10-22 21:14	0.937	-10.5
17	4	1787.7220	2019-10-31 05:14	0.937	-6.5
56	129	2829.0299	2022-09-06 12:37	0.937	+9.1

Sector	Cycle	Mid-eclipse (BTJD)	UTC	Min. flux	O−C (min)
56	130	2837.3535	2022-09-14 20:23	0.937	-0.6
56	131	2845.6811	2022-09-23 04:15	0.935	-4.6
57	132	2854.0203	2022-10-01 12:23	0.939	+8.1
57	133	2862.3469	2022-10-09 20:13	0.938	+2.7
57	134	2870.6788	2022-10-18 04:11	0.936	+4.8
57	135	2879.0094	2022-10-26 12:08	0.937	+5.1
83	217	3562.0941	2024-09-08 14:10	0.936	-3.6
83	218	3570.4276	2024-09-16 22:10	0.936	+0.8
83	219	3578.7707	2024-09-25 06:24	0.939	+19.2
84	220	3587.0823	2024-10-03 13:52	0.940	-7.9
84	221	3595.4053	2024-10-11 21:37	0.941	-18.5
84	222	3603.7456	2024-10-20 05:48	0.938	-4.2

Table 1. Dip minima of TIC 415156807.

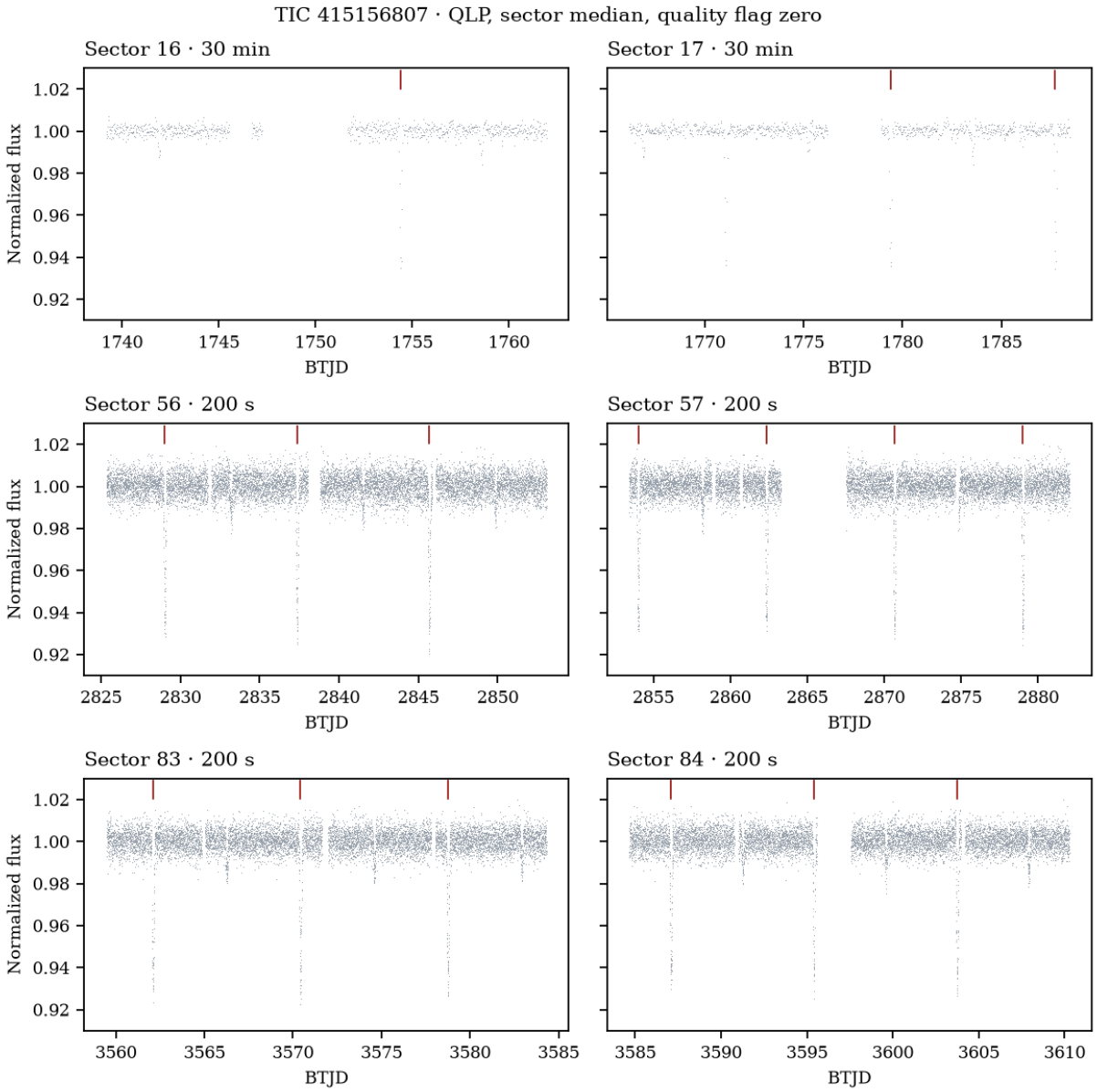

Figure 1. QLP light curves, quality-zero cadences. Red ticks are measured dips.

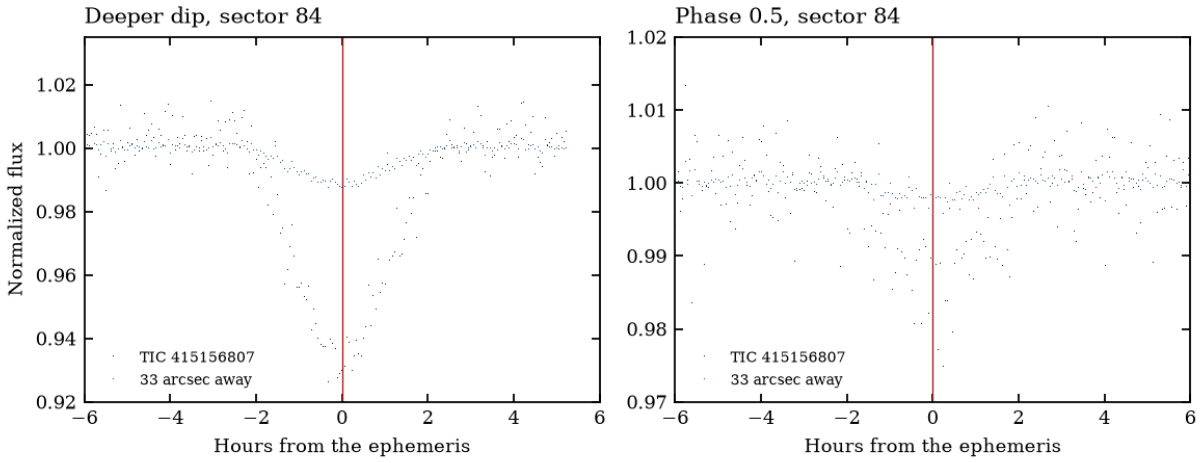

Figure 2. Sector 84. Left: the deeper dip. Right: phase 0.5. Black is TIC 415156807. Blue is TIC 415156814, 33 arcsec away. The neighbor drops on the deeper dip and stays near full light at phase 0.5.

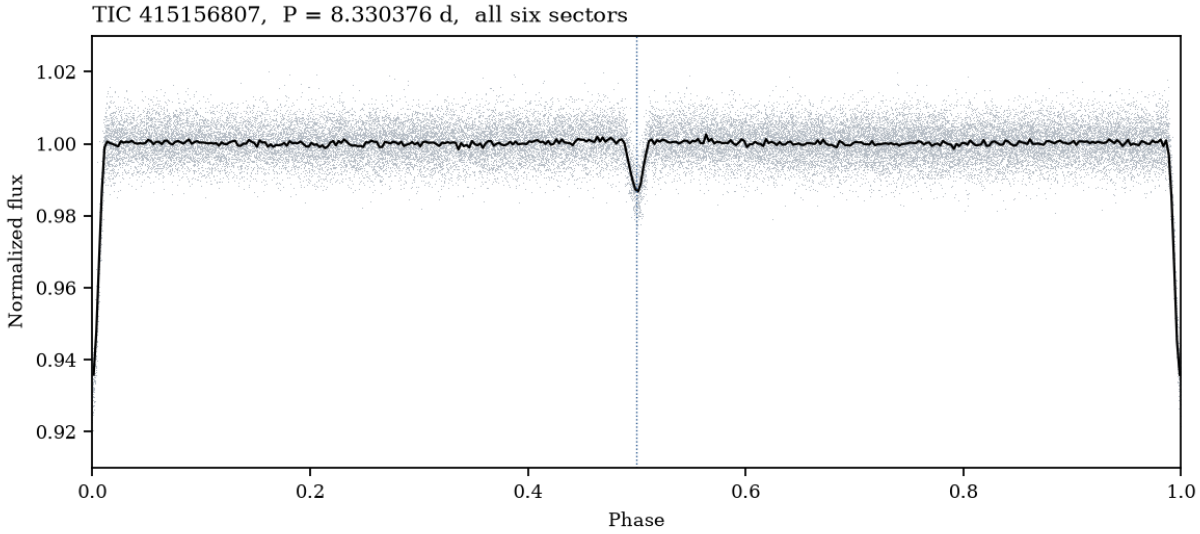

Figure 3. All six sectors folded on the period above. Dotted line: phase 0.5.

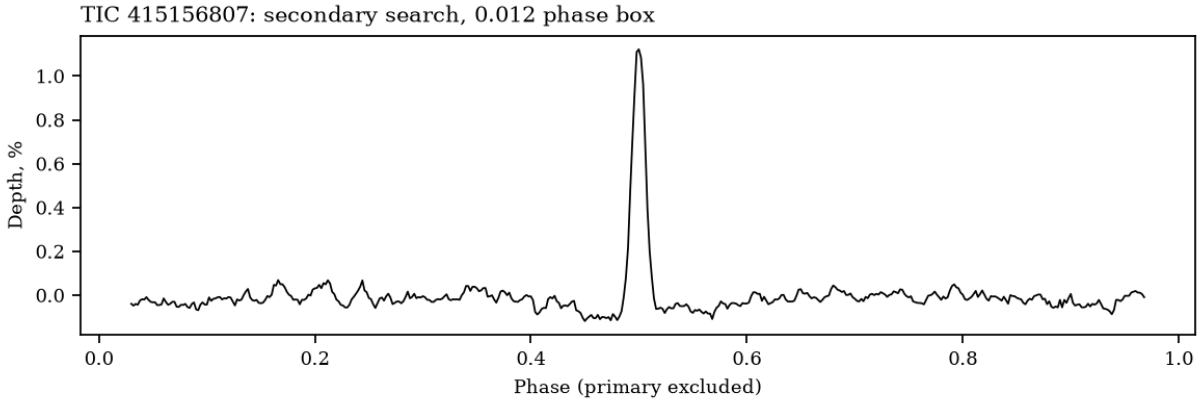

Figure 4. Depth of a 0.012-phase box across the fold, main dip excluded.

4. Where the dip comes from

TIC 415156814 (V = 10.05, T = 9.66, TYC 3987-02068-1) lies 32.5 arcsec away, about 1.5 TESS pixels. Gaia DR3 2004869675565979776 gives that star G = 10.01, parallax 2.198 ± 0.013 mas, and proper motion +16.64, +5.37 mas yr^{-1}. The parallax and the proper motion do not match TIC 415156807, so the two are not one star and not a pair at one distance.

The first summary of the ring said the brighter star stays at full light. It does not. At all 16 deeper dips its QLP flux is 0.989–0.990, about 1.1 percent down. At the phase-0.5 time in sector 84 its flux is 0.998, while TIC 415156807 is at 0.989. The contamination ratio of 3.32 means most of the light in the fainter aperture is not the target, so a 6 percent aperture dip is not the depth on either star. A dip on the fainter star that leaks into the brighter aperture, and a dip on the brighter star that is diluted in the fainter aperture, both remain possible. The centroid during the deeper dip shifts by 6 to 10 millipixels in five sectors. Sector 57 shifts by 45 millipixels, about 1 arcsec, which is about the scatter in that sector. Sector 16 has only three points inside the dip. The source stays open until a resolved ground series separates the two stars.

5. What it could be

Without a clear classification, possibilities include: an eclipsing binary with a 1.3 percent secondary at phase 0.5; an eclipsing binary at 4.165 d with unequal alternate minima; a binary on the neighbor, seen diluted; or a non-binary cause. None of these is claimed.

6. The next predicted dips

- primary: BTJD 4345.1520, 2026-10-31 15:33 UTC
- phase 0.5: BTJD 4349.3172, 2026-11-04 19:31 UTC
- primary: BTJD 4353.4824, 2026-11-08 23:29 UTC
- phase 0.5: BTJD 4357.6476, 2026-11-13 03:27 UTC
- primary: BTJD 4361.8127, 2026-11-17 07:25 UTC
- phase 0.5: BTJD 4365.9779, 2026-11-21 11:23 UTC
- primary: BTJD 4370.1431, 2026-11-25 15:22 UTC

Times at phase 0.5 are the shallow dip. Each dip lasts about 3 hours.

7. Status

Not submitted to VSX. TIC 330739083 is the one VSX entry in review.

References

- Gaia Collaboration, 2023, A&A;, 674, A1 (DR3)
- Huang C. X. et al., 2020, RNAAS, 4, 204 (QLP)
- Stassun K. G. et al., 2019, AJ, 158, 138 (TIC)