A 7.101-day eclipsing binary beside a bright neighbor: TIC 330137446

Sean League
Tustin, California. Research note from the 2.00°–2.10° ring around V345 Lac, 6 November 2026. Nothing in this note has been submitted to VSX.

Abstract. TESS QLP aperture photometry of TIC 330137446 shows one deep minimum. Twenty-seven minima give the ephemeris below, with an O−C scatter of 7.1 minutes. The aperture falls to 0.795 of its sector median, 0.25 mag. The phase median at phase 0.5 stays at full light, so no second minimum is adopted. A star of V = 9.52 lies 15.6 arcsec away, inside one TESS pixel, and falls by 2.6 percent at the same times. The deep eclipse is on the fainter star. The note is not a VSX submission.

The star

TIC 330137446 is Gaia DR3 2198375097758073472. It has no Tycho match in the TESS Input Catalog. The catalog place is 22h 13m 39.04s, +56° 36′ 09.0″ (J2000). Gaia DR3 lies 0.1 arcsec from that place. V = 12.239 and the TESS magnitude is 11.616. The star is 2.061° from V345 Lac, 124 arcmin to the north-northwest, in the 2.00°–2.10° ring. Gaia DR3 gives G = 12.06, BP − RP = 0.85, parallax 2.793 ± 0.010 mas, and RUWE 0.82. That parallax is about 358 parsecs. The GSP-Phot solution is Teff 5942 K, log g 4.28, and radius 1.24 solar radii. The TESS catalog lists 5976 K, log g 4.32, mass 1.10 solar masses, and radius 1.21 solar radii. Metallicity in that header is the blank value −1 and is not used. The contamination ratio is 6.99.

How it was found

Public TESS Quick-Look Pipeline light curves around V345 Lacertae were searched on stars brighter than about V = 12.5. This star is one of 419 stars in the 2.00°–2.10° ring that were not already in an inner ring. A dip was kept when quality-zero cadences fell about 1.2 percent or more below the local median and stayed down for several cadences. Sectors 16, 17, 56, 57, 76, 77, 83, and 84 have QLP files. Sectors 76 and 77 are the v02 files, and they were not in the first ring list. The curves in this note are SAP_FLUX divided by the sector median, with the quality flag exactly zero. The same minima are in the detrended column, so the eclipse is not a spline artifact. The ring search returned a spacing of 3.5505 days. The deep minima are 7.10 days apart, so that spacing is half the period. The period below is a linear fit to the deep minima. Catalog values are from the TESS Input Catalog and Gaia DR3. No new observations were obtained.

Ephemeris

$$\text{Min I} = \text{BTJD } 1739.92173 + 7.101016\ E$$

Twenty-seven minima, from BTJD 1740 to 3607, were fit by linear least squares. The root-mean-square residual is 7.1 minutes. The largest residual is 13.1 minutes. Sectors 16 and 17 are sampled every 30 minutes, and a residual of 13 minutes is about half a cadence. The 200-second sectors scatter by a few minutes. Cycles 235 and 236, near BTJD 3409 and 3416, fall in the sector 77 gap. Both are missing data, not missed eclipses. Cycle 257, predicted at BTJD 3564.883, falls in a sector 83 gap. The last point before that gap, BTJD 3564.835, is still descending at 0.884 of the light. That time was left out of the fit. The median aperture minimum is 0.795 of the sector median, 21 percent of the light, 0.25 mag. In the 200-second sectors the light stays under 98 percent for 3.4 hours and under half that depth for 2.3 hours. The 30-minute sectors show the same eclipse, with the bottom sampled by one or two cadences. Cycle 258, in sector 83, loses its ingress to a 7.6-hour gap. The bottom is timed and kept. Its width is not used. For a central circular eclipse, 3.4 hours on a 7.101-day period means the two radii add up to about 6 percent of the separation. That is a size for the pair. It is not a mass, and the eclipse may be grazing, which would make the sum larger.

Sector	Cycle	BTJD	UTC	Min. flux	O−C (min)
16	0	1739.930	2019-09-13 10:19	0.797	+12.2
16	1	1747.014	2019-09-20 12:19	0.798	-13.1
16	2	1754.118	2019-09-27 14:49	0.800	-8.5

Sector	Cycle	BTJD	UTC	Min. flux	O−C (min)
16	3	1761.222	2019-10-04 17:19	0.797	-3.9
17	4	1768.326	2019-10-11 19:49	0.789	+0.6
17	5	1775.430	2019-10-18 22:19	0.815	+5.1
17	6	1782.534	2019-10-26 00:49	0.792	+9.4
56	153	2826.376	2022-09-03 21:01	0.791	-1.2
56	154	2833.476	2022-09-10 23:25	0.791	-3.1
56	155	2840.580	2022-09-18 01:55	0.791	+1.6
56	156	2847.682	2022-09-25 04:22	0.790	+2.9
57	157	2854.789	2022-10-02 06:55	0.792	+10.8
57	158	2861.879	2022-10-09 09:05	0.797	-4.6
57	159	2868.983	2022-10-16 11:35	0.796	-0.2
57	160	2876.078	2022-10-23 13:52	0.795	-9.1
76	230	3373.151	2024-03-03 15:37	0.792	-6.1
76	231	3380.264	2024-03-10 18:20	0.793	+11.6
76	232	3387.355	2024-03-17 20:30	0.796	-4.1
76	233	3394.456	2024-03-24 22:57	0.791	-3.0
77	234	3401.556	2024-04-01 01:20	0.791	-5.2
77	237	3422.862	2024-04-22 08:41	0.783	+0.0
83	258	3571.991	2024-09-18 11:46	0.798	+10.1
83	259	3579.076	2024-09-25 13:49	0.792	-12.3
84	260	3586.183	2024-10-02 16:23	0.804	-4.3
84	261	3593.294	2024-10-09 19:03	0.795	+10.3
84	262	3600.389	2024-10-16 21:19	0.798	+1.4
84	263	3607.491	2024-10-23 23:46	0.796	+2.4

No second minimum

The phase median at phase 0.5 is 0.999. A broad sag of about 0.4 percent sits near phase 0.56. It is not a sharp eclipse, and it is not adopted. With one minimum, this note does not call the orbit eccentric.

Which star fades

TIC 330137431 is TYC 3990-01007-1 and Gaia DR3 2198375097758073984. It lies 15.6 arcsec from the target, inside one 21-arcsec TESS pixel. V = 9.522 and the TESS magnitude is 9.309. Gaia DR3 gives G = 9.46, BP − RP = 0.30, parallax 2.847 ± 0.019 mas, and RUWE 1.20. The GSP-Phot solution is Teff 9902 K, log g 4.05, and radius 2.07 solar radii. The two parallaxes differ by 0.05 mas, two to three times the combined uncertainty. At 15.6 arcsec and 358 parsecs the projected separation would be about 5600 AU if the stars were at one distance. This note does not call them a bound pair. The bright star’s own QLP curve falls to 0.974 at these minima, 2.6 percent. This star’s curve falls to 0.795, 21 percent. The centroid, SAP_X and SAP_Y, shifts by 0.0009 pixel between the minima and the light an hour away. The deep eclipse is in this aperture.

The TESS catalog contamination ratio of the target is 6.99. In that catalog aperture the neighbors outweigh this star, and a total eclipse of this star alone would remove about an eighth of the blended light. The QLP curve is this star’s own aperture, and it falls by a fifth, so that catalog ratio is not turned into an intrinsic depth. The bright neighbor’s contamination ratio is 0.14, and its 2.6 percent dip is the diluted eclipse. A ground aperture that keeps the V = 9.5 star out is the measurement that gives the undiluted depth. TIC 330137355, 86 arcsec away, falls by 2.6 percent on the same times. It is already in VSX as Gaia DR3 2198375200840543488, a rotator at G = 11.01–11.03. That dip is leakage. The nearest VSX object to the target is Gaia DR3 2198374994678852096, type RS, G = 15.29–15.36, 74 arcsec away. It is not this clock.

Figures

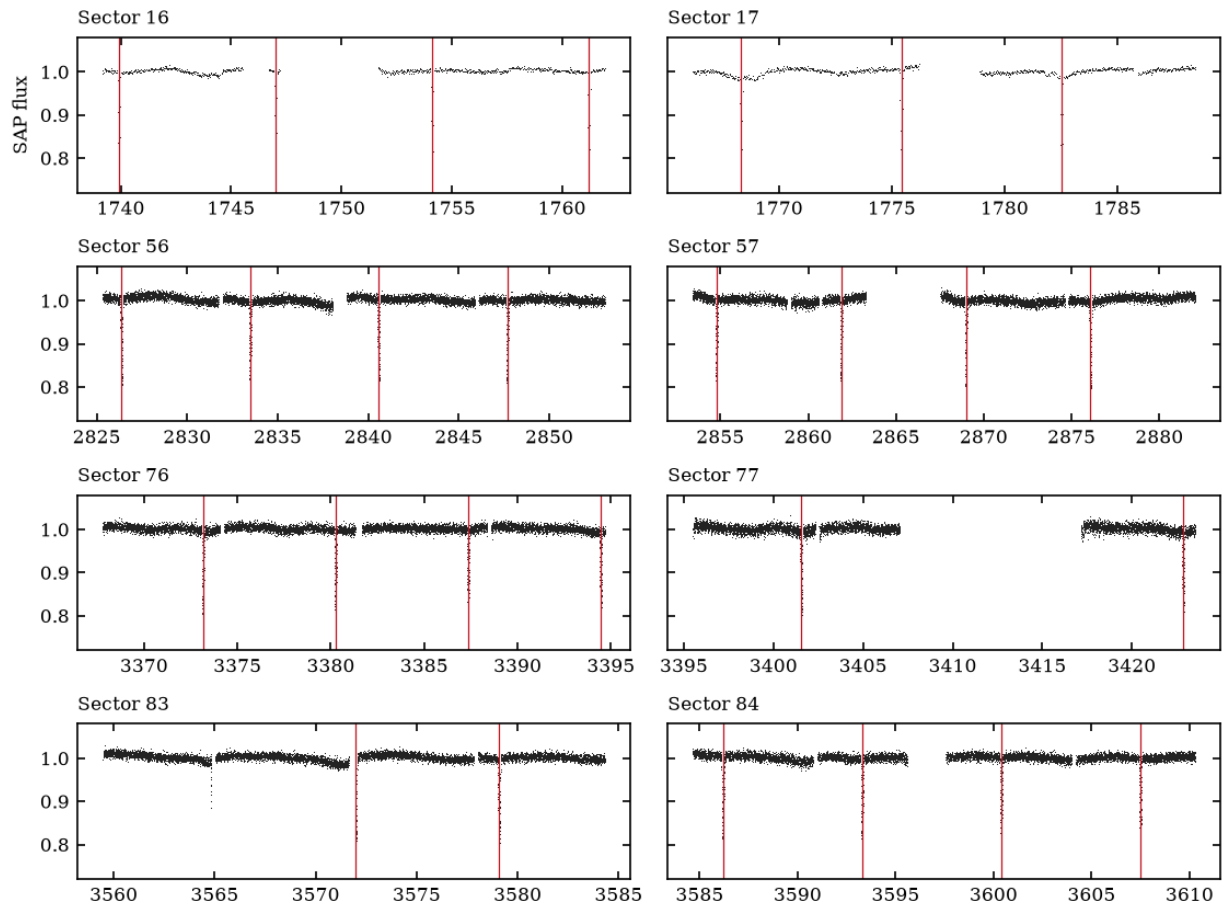


Figure 1. Eight TESS sectors. QLP SAP flux divided by the sector median, quality flag zero. Red ticks are the minima used in the fit. The unticked notch near BTJD 3565 in sector 83 is the minimum cut by a gap.

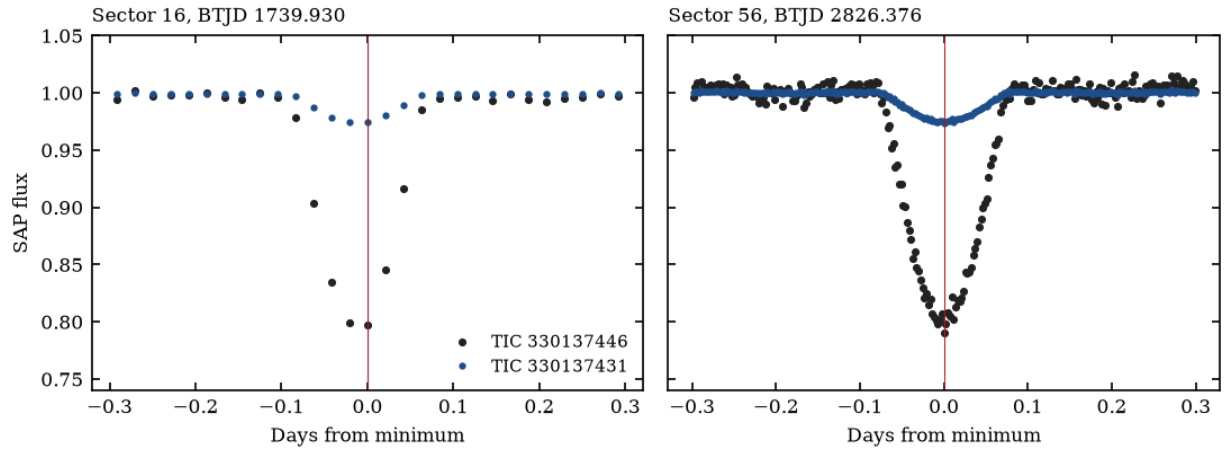


Figure 2. Sector 16 at 30 minutes, and a sector 56 minimum at 200 seconds. Black is TIC 330137446. Blue is TIC 330137431, 15.6 arcsec away, near full light.

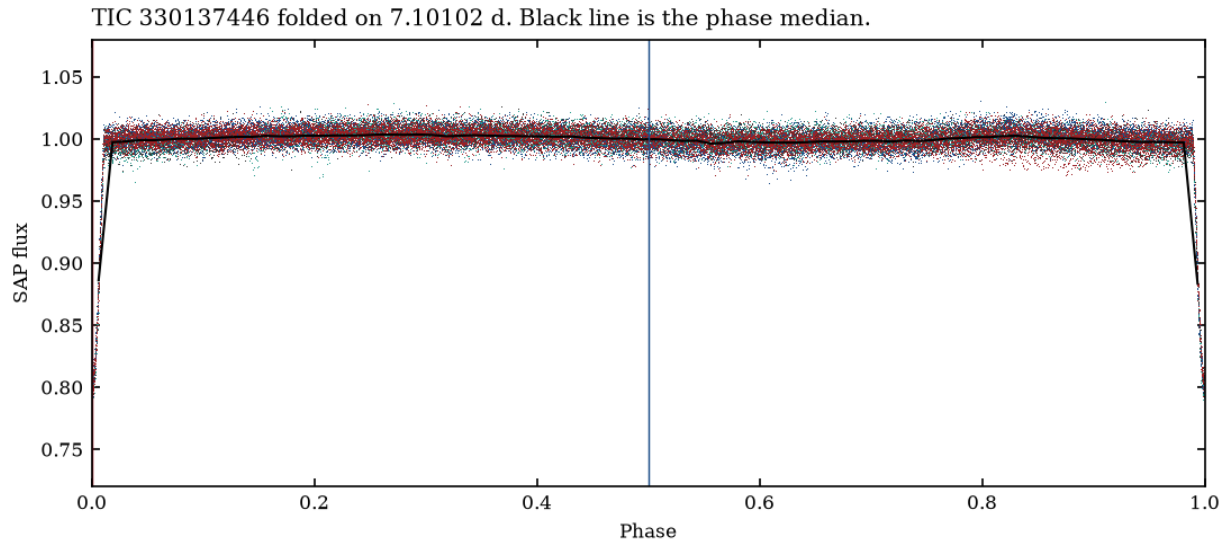


Figure 3. Folded on 7.101016 days. The black line is the phase median. The blue line is phase 0.5. No secondary is adopted.

Nothing in this note has been submitted to VSX. TIC 330739083 is still the one New submission on this account, so this star stays unfiled.

References

Gaia Collaboration, 2023, Astron. Astrophys., 674, A1 (DR3)
Huang C. X. et al., 2020, Research Notes of the AAS, 4, 204 (QLP)
Stassun K. G. et al., 2019, Astron. J., 158, 138 (TIC)
Watson C., Henden A., Price A., 2006–, AAVSO International Variable Star Index (VSX)