

A 9.53-day eclipsing binary: TIC 422106434

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Tustin, California. Research note from the 1.105–1.20 degree ring around V345 Lac, 14 October 2026.

Abstract

TESS Quick-Look Pipeline photometry of TIC 422106434 shows an eclipsing binary that is not in the AAVSO Variable Star Index or the Gaia DR3 variable catalogue. Sixteen primary minima in sectors 16, 17, 56, 57, 83 and 84 give

$$\text{BJD}_{\text{TDB}} = 2458742.8501 + 9.53361 \text{ E}$$

with an O–C scatter of 4.8 minutes. The primary falls to 0.685 of the sector median, 0.41 mag, and stays below 80 percent of normal light for about 2.1 hours. A secondary falls to 0.864 of normal light, 0.16 mag, at phase 0.523. The star is $V = 9.96$, $G = 9.80$, at a Gaia parallax of 7.23 mas (138 pc). The TIC contamination ratio is 0.065. During primary eclipse the centroid moves by only a few hundredths of a pixel. A star 103 arcsec away repeats the same times at about 5 percent depth in the 200-second sectors, which is the eclipse diluted into that aperture. Nothing in this note has been submitted to VSX.

1. How the star was found

Public TESS QLP light curves around V345 Lacertae were searched on stars brighter than $V = 12.5$. Earlier rings, out to 1.105 degrees, had already been screened for eclipses. The ring from 1.105 to 1.200 degrees contains 253 such stars that had not been screened. The test kept a dip when quality-zero cadences fell about 1.2 percent or more below the local median, stayed down for at least four cadences, and did not bounce straight back. The same pass looked for brightenings of 2 percent and for periods between 0.08 and 12 days. TIC 422106434 is 1.113 degrees from V345 Lac. It is the one new eclipsing binary in that ring.

The photometry is the public QLP product (Huang et al. 2020; Kunimoto et al. 2021). Sectors 16 and 17 are 30-minute cadence and use KSPSAP_FLUX. Sectors 56, 57, 83 and 84 are 200-second cadence and use DET_FLUX. Sectors 76 and 77 have no QLP v01 file for this TIC. Cadences with a nonzero quality flag were removed before the fit, including the QLP poor-quality bit 2³⁰. Each sector was divided by its own median. Catalog values are from the TESS Input Catalog (Stassun et al. 2019), Gaia DR3 (Gaia Collaboration 2023), 2MASS and AllWISE. No new observations were obtained.

2. The star

TIC 422106434 is TYC 3986-02206-1, Gaia DR3 2005947815437527808, 2MASS J2225190+5536497, at 22h 22m 51.83s, +55° 36′ 49.9″. Galactic longitude and latitude from the TIC are $l = 102.99^\circ$ and $b = -1.40^\circ$. Gaia DR3 gives parallax 7.230 ± 0.015 mas, an inverse-parallax distance of 138.3 ± 0.3 pc, and proper motion $-42.16, +12.71$ mas yr⁻¹. The renormalized unit-weight error is 1.05. The non-single-star flag is 0. One radial velocity is published, 10.6 ± 9.8 km s⁻¹. GSP-Phot gives $T_{\text{eff}} = 5690$ K and $\log g = 4.23$. Those values assume a single star and are copied as published. The TIC lists $V = 9.959$, $T = 9.368$, $B = 10.514$, and a contamination ratio of 0.065. 2MASS gives $J, H, K_s = 8.732, 8.464, 8.418$. AllWISE gives $W1, W2, W3 = 8.350, 8.394, 8.387$. $W1 - W2$ is -0.04 mag. There is no large infrared excess in the bands with good quality.

Two catalogued variables sit inside an arcminute, and neither is this star. Gaia DR3 2005947811125936512 is 21.8 arcsec away, type ROT in VSX, $G = 14.99$ to 15.02. Gaia DR3 2005947815441752320 is 30.0 arcsec away, type S, $G = 16.41$ to 16.87. A $G = 15$ star is about one percent of the light of a $G = 9.8$ star. It cannot produce a 0.4 mag eclipse in this aperture.

3. The ephemeris

A primary is a run of quality-zero flux below 0.80 of the sector median. The mid-time is the vertex of a parabola fit to the bottom of that run. Sixteen primaries, on cycles 0 through 195, give

$$T_0 = 1742.8501 \text{ BTJD}, \quad P = 9.53361 \pm 0.00001 \text{ d.}$$

BTJD is $\text{BJD}_{\text{TDB}} - 2457000$. The rms of the sixteen residuals is 4.8 minutes and the largest is 11.9 minutes. The formal error on the epoch is 2.2 minutes. The median primary minimum is flux 0.685, which is 0.41 mag. The time spent below 80 percent of normal light is 2.1 hours. The time spent below 98 percent is 4.4 hours. Both numbers are medians over the sixteen events.

Twelve secondaries, defined as runs below 0.90 but not below 0.80, fall at phase 0.523. The scatter of those phases is 5.2 minutes. The offset from mid-orbit is 5.2 hours. The median secondary minimum is flux 0.864, 0.16 mag, and the time below 98 percent of normal light is 4.3 hours. The two minima have different depths, so the orbit is an Algol-type pair rather than a contact binary. The shift of the secondary past phase 0.5 is the signature of a slightly eccentric orbit. No eccentricity is fitted here.

Every primary predicted inside the six sectors is present in the quality-zero data, at the same depth. Secondaries that fall in a downlink gap are absent from the fit and present in the flagged cadences at the edge of the gap. In sector 16 the secondary at BTJD 1747.83 is carried entirely on quality flag 4096 and still reaches flux 0.86. In sector 84 the ingress at BTJD 3597.30 is on the QLP poor-quality bit and is already down to flux 0.92 before the gap. No extra deep eclipse appears off this ephemeris.

Sector	Cycle	Mid-eclipse	UTC	Min. flux	O–C (min)
16	0	1742.847	2019-09-16 08:14	0.682	-4.4
16	1	1752.389	2019-09-25 21:14	0.687	+7.3
16	2	1761.910	2019-10-05 09:44	0.682	-11.0
17	3	1771.451	2019-10-14 22:43	0.688	+0.5
17	4	1780.993	2019-10-24 11:44	0.698	+11.9
56	114	2829.681	2022-09-07 04:15	0.684	-2.0
56	115	2839.214	2022-09-16 17:02	0.684	-2.5
56	116	2848.748	2022-09-26 05:51	0.685	-1.5
57	117	2858.282	2022-10-05 18:40	0.685	-1.6
57	118	2867.815	2022-10-15 07:28	0.686	-1.5
57	119	2877.349	2022-10-24 20:17	0.686	-1.4
83	191	3563.771	2024-09-10 06:25	0.684	+1.1
83	192	3573.305	2024-09-19 19:13	0.686	+1.4
83	193	3582.838	2024-09-29 08:01	0.685	+1.1
84	194	3592.372	2024-10-08 20:50	0.686	+1.3
84	195	3601.906	2024-10-18 09:39	0.688	+1.3

Table 1. Primary minima of TIC 422106434. The mid-time is the vertex of a parabola on the bottom of the eclipse. UTC uses JD 2457000.0 = 2014-12-08 12:00. O–C is the residual from $T_0 = 1742.8501$ and $P = 9.53361$ d.

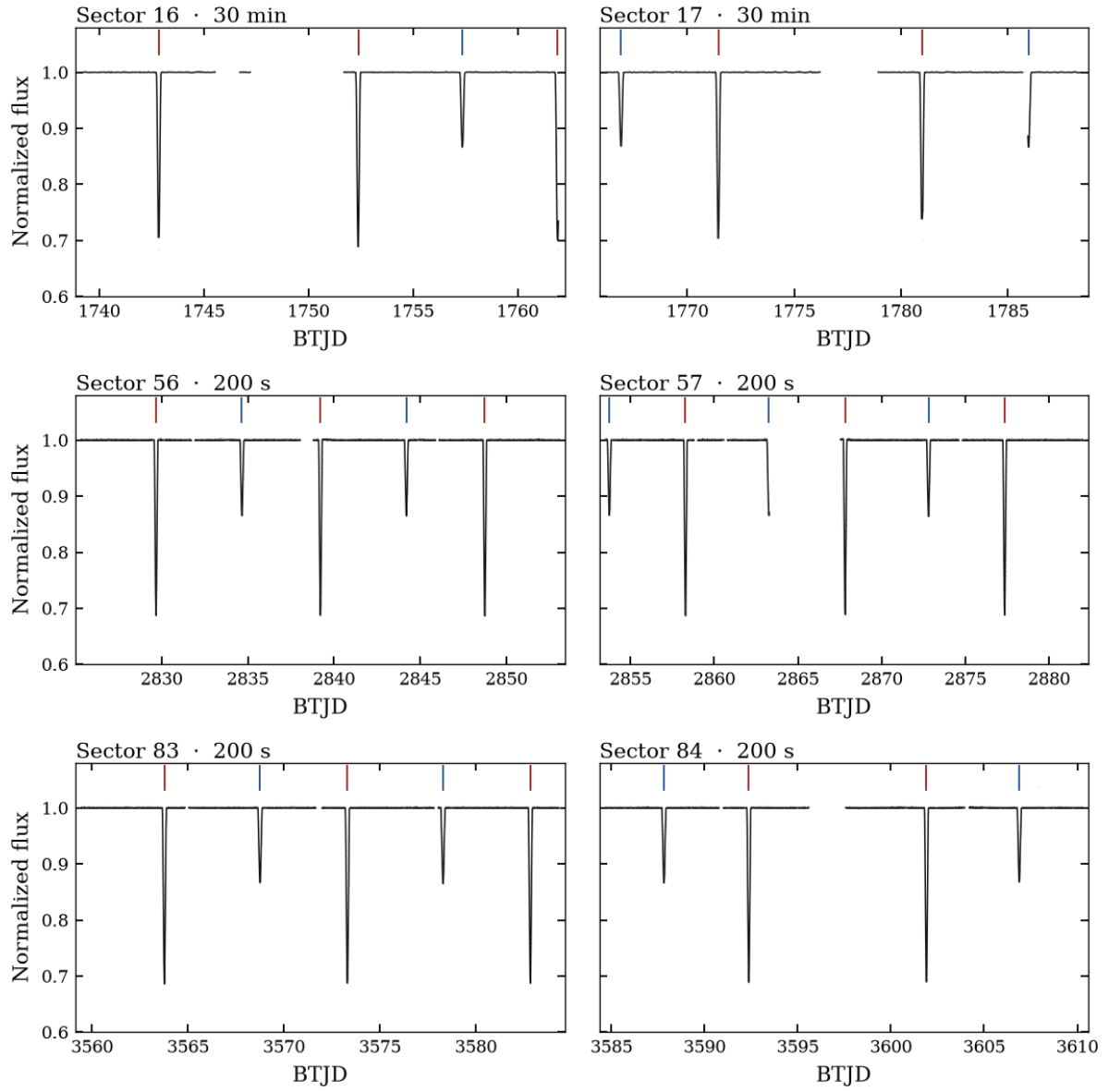


Figure 1. QLP light curves. Grey points are quality-zero cadences. The line is a 30-minute median. Red ticks are primary minima. Blue ticks are secondary minima.

TIC 422106434 in black. TIC 422106556, 103 away, in blue.

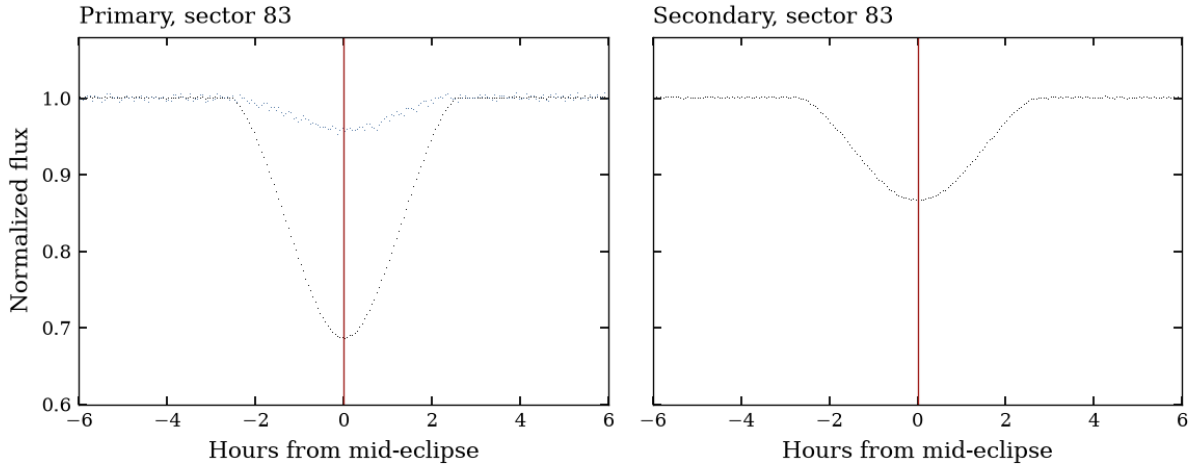


Figure 2. One primary and one secondary in sector 83. Black is TIC 422106434. Blue, on the primary only, is TIC 422106556, 103 arcsec away, on its own sector median. The neighbor fades by about 5 percent at the same time.

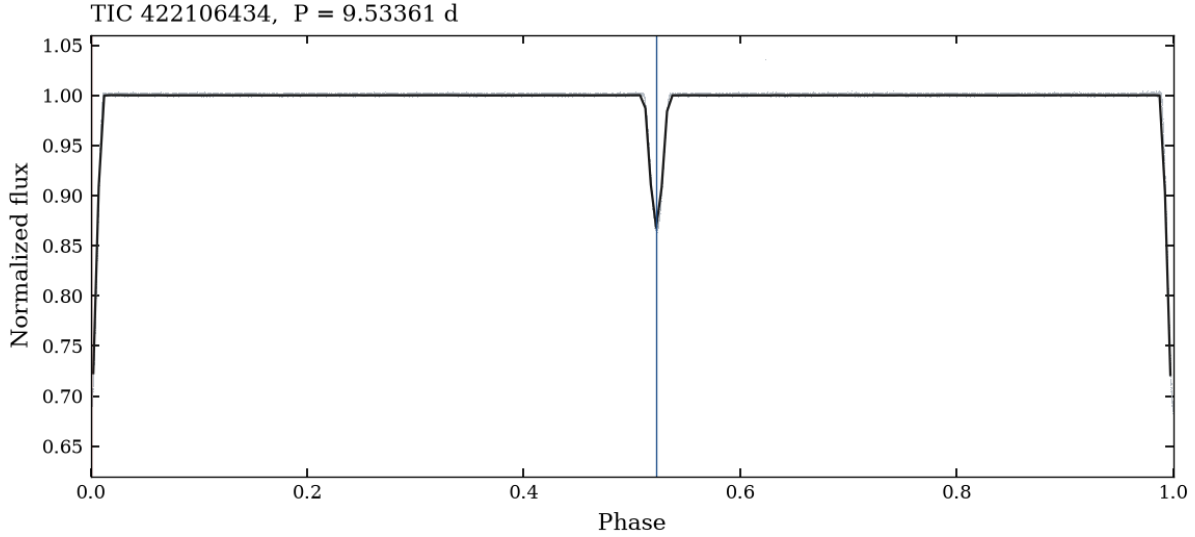


Figure 3. All six sectors folded on $P = 9.53361$ d. The line is a median in phase. The red mark is phase 0. The blue mark is the secondary. Outside the two eclipses the median stays within about 1 percent of normal light.

4. The eclipse belongs to this star

The TIC contamination ratio of 0.065 means other stars contribute 6.5 percent of the target's flux inside the catalog aperture. If every contaminant vanished, the aperture would fall by about 6 percent. The observed primary falls by 32 percent. The eclipsed light is the light of TIC 422106434.

The QLP centroid, SAP_X and SAP_Y , was compared inside ± 0.04 days of primary mid-eclipse with the out-of-eclipse centroid. The shift, in millipixels, is sector 16: +0, -14 (scatter 6, 24); sector 17: +5, +1 (scatter 12, 8); sector 56: -3, -35 (scatter 26, 21); sector 57: +12, -21 (scatter 33, 22); sector 83: +20, -15 (scatter 20, 12); sector 84: +4, -4 (scatter 9, 18). A TESS pixel is 21 arcsec. The nearest catalogued variable is 22 arcsec away, about one pixel. A shift of a few tens of millipixels is the size of the out-of-eclipse scatter, not a jump onto that neighbor.

TIC 422106556, $V = 11.61$, lies 103 arcsec from the target. In the 200-second sectors, and in sector 17, its flux falls to 0.95–0.96 at each primary. Sector 16 is 30-minute cadence and does not sample the bottom of the two-hour eclipse, so it stays above 0.99. The repeat is the same eclipse seen through a diluted aperture, not a second star eclipsing on its own. At one primary, BTJD 3573.30, three unrelated stars in the same ring stay near full light (TIC 329766579 to 0.994, TIC 430642347 to

0.990, TIC 329863992 to 0.983). The dip is not one of the field-wide artifacts that show up near BTJD 1744, 3591 and 3604 on many stars at once.

5. What the catalogs already say

Queried on 14 October 2026. VSX has no object on the coordinates of TIC 422106434. The closest entries are the two stars in section 2, at 22 and 30 arcsec. Gaia DR3 `vari_summary` and `vari_eclipsing_binary` have no row for source 2005947815437527808. The ASAS-SN variable catalogue (VizieR II/366/catv2021) has no entry within 1 arcmin. The star was not previously filed from this search. This note is not a VSX submission. A new VSX account can have only one new star in review, and TIC 330739083 is that star.

6. The next minima

The next secondary, the shallower minimum, is cycle offset phase 0.523 at BTJD 4331.442, 2026-10-17 22:31 UTC. The next primary is BTJD 4335.993, 2026-10-22 11:44 UTC. The clock is good to about 12 minutes, the size of the largest residual in Table 1. The primary is about 4 hours from first contact to last, and the deep part lasts about 2 hours. A ground series confirms the star in a resolved aperture. At $V = 9.96$ the 0.41 mag primary is large enough that a modest telescope and a comparison star can time it. The 22-arcsec neighbor should stay out of the aperture. No equipment was used for this note.

References

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