Ground confirmation of the eclipsing binary TIC 422106434

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Tustin, California, and STB Astro observatory, Setúbal, Portugal. 1 November 2026.

Abstract

TESS photometry shows that TIC 422106434 fades by 0.41 mag every 9.53361 days. The star is V = 9.96 and had not been observed in eclipse from the ground. On the night of 31 October to 1 November 2026, Alexandre Santana recorded the predicted primary from Setúbal with an 8-inch Newtonian, an IMX533 camera, and a UV/IR cut filter. The star fell to 0.682 of its opening light, 0.416 mag, and stayed below 80 percent of that light for 2.11 hours. The minimum is BJD_{TDB} 2461345.5292, 3.8 minutes later than the TESS ephemeris and inside the scatter of the satellite timings. The eclipse is on TIC 422106434. The discovery is confirmed.

1. The star and the TESS ephemeris

TIC 422106434 is TYC 3986-02206-1, Gaia DR3 2005947815437527808, and 2MASS J22225190+5536497, at 22h 22m 51.91s, +55° 36′ 49.7″. It lies 67 arcmin from V345 Lacertae. Gaia gives G = 9.80 and a parallax of 7.23 mas, about 138 pc. The TESS magnitude is 9.37 and V is 9.96. The eclipses and the ephemeris are those of the research note of 14 October 2026.

Sixteen primary minima in TESS sectors 16, 17, 56, 57, 83, and 84 give

$$BJD_{TDB} = 2458742.850134 + 9.5336135\ E.$$

The October note rounds this to 2458742.8501 + 9.53361 E. The period is uncertain by 0.00001 day. The times in this paper use the unrounded fit. The root-mean-square residual of the sixteen minima is 4.8 minutes, and the largest is 11.9 minutes. The primary falls to 0.685 of the sector median, 0.410 mag, and stays below 80 percent of normal light for 2.11 hours. A secondary of 0.16 mag falls at phase 0.523. The two depths make the pair an Algol-type eclipsing binary. The star is not in the AAVSO Variable Star Index, and Gaia DR3 does not flag it as a variable.

Cycle 273 falls at BJD_{TDB} 2461345.5266. Reading that Julian date as UTC gives 00:38 on 1 November 2026, which is how the October note expressed a prediction. The photons reach Earth earlier than the solar-system barycenter. On this night the heliocentric light-time term for the star is +3.9 minutes, and the TDB clock is 1.2 minutes ahead of UTC. The same instant is 00:33 UTC at the geocenter. A full barycentric correction differs from this heliocentric term by a few seconds.

2. The observation

Alexandre Santana collected the data between 22:00 and 02:00 UTC in Setúbal, Portugal. The telescope was his 8-inch Newtonian. The camera uses an IMX533 sensor, and the filter is a UV/IR cut. The series reduced here is that run: 154 exposures of 90 seconds, with mid-exposures from 22:09:44 UTC on 31 October to 02:00:09 UTC on 1 November. No frame is saturated. The camera temperature in the image headers runs from −9.8 to −10.1 °C. Airmass rose from 1.11 to 1.82.

Santana measured the images in AstroImageJ 6.0.11. The target aperture has a radius of 16 pixels, and the sky annulus runs from 31 to 62 pixels. Coordinates in the measurement table give a plate scale of 0.77 arcsec per pixel, so the aperture radius is 12 arcsec and the sky annulus is 24 to 48 arcsec. The median image width is 10 arcsec. Three comparison stars, 3.81, 7.43, and 7.86 arcmin from the target, form the ensemble. Each one, divided by the other two, scatters by 3.8, 5.1, and 4.4 millimagnitudes. The formal error on the target is 1.6 millimagnitudes. Gaia DR3 2005947811125936512, at G = 15.0 and 22 arcsec from the target, lies outside the aperture. That star is about one percent of the target’s light.

The AstroImageJ table records the geocentric JD and leaves the heliocentric and barycentric columns at zero. Each mid-exposure was shifted onto BJD_{TDB} with the light-time term in Section 1. The measurement table accompanies this paper.

3. The minimum

Figure 1 shows the 154 points. The target is divided by the median of the seven exposures taken before the predicted contact. The comparison stars are divided by their own medians and shifted downward. They stay level while the target fades and recovers.

The time of minimum is the vertex of a parabola fit to the 85 points fainter than 80 percent of the opening light. That is the rule used for the TESS minima. The vertex is BJD_{TDB} 2461345.5292, which is 00:37 UTC on 1 November 2026 at the geocenter. The residual from the ephemeris is +3.8 minutes. Folding the ingress onto the egress gives +3.5 minutes. Midpoints of the two branches, from 0.15 mag down to the bottom, fall between +2.6 and +5.1 minutes. The light curve locates the bottom to about a minute. The ephemeris residuals are larger than that. This one minimum does not revise the period.

The parabola reaches 0.682 of the opening light, 0.416 mag. The TESS primary is 0.685 of normal light, 0.410 mag. The opening light here is the first ten minutes of the series, so the ground depth is good to about a hundredth of a magnitude. The two depths agree. The 0.16 mag secondary falls on 6 November and is not in this series. The star stays below 80 percent of the opening light for 2.11 hours, the TESS duration. The last exposure is still 0.17 mag below the opening light, so the full 4.4-hour width is not covered.

Table 1. The ground minimum of TIC 422106434 on cycle 273.

Quantity	Value
Predicted BJD_{TDB}	2461345.5266
Observed BJD_{TDB}	2461345.5292
O−C	+3.8 minutes
Geocentric UTC	1 November 2026, 00:37
Minimum, fraction of opening light	0.682
Depth	0.416 mag
Time below 80 percent	2.11 hours
TESS depth	0.410 mag
TESS time below 80 percent	2.11 hours

Table 2. Comparison stars in the AstroImageJ ensemble. The positions are the mean coordinates in the measurement table. The scatter is the root-mean-square of each star divided by the other two.

Star	J2000 position	Separation	Scatter
C2	22h 23m 17.3s, +55° 38′ 01″	3.81 arcmin	3.8 mmag
C3	22h 22m 06.3s, +55° 33′ 04″	7.43 arcmin	5.1 mmag
C4	22h 23m 28.7s, +55° 42′ 41″	7.86 arcmin	4.4 mmag

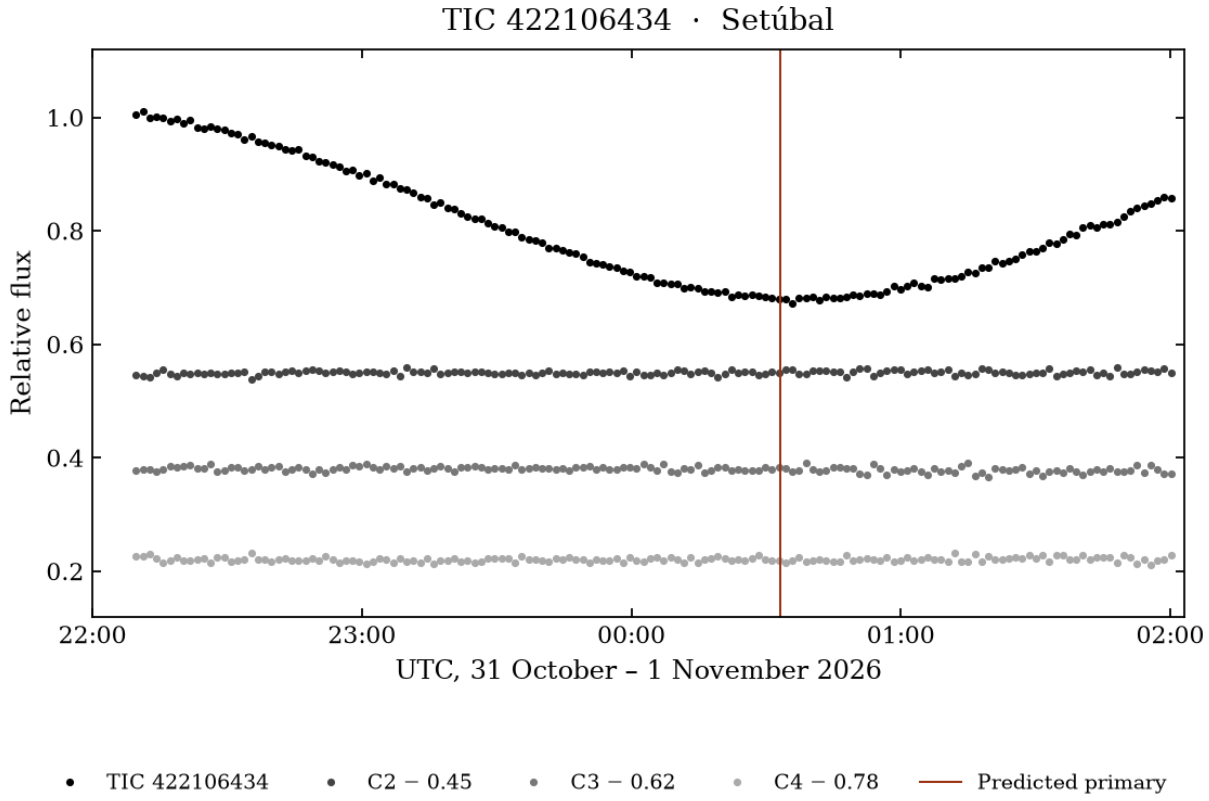


Figure 1. TIC 422106434 on 31 October to 1 November 2026, observed by Alexandre Santana at STB Astro observatory, Setúbal. Black points are the target divided by the median of the seven exposures before the predicted contact. Gray points are the three comparison stars, each divided by its own median and shifted by the amount in the legend. The line marks the predicted primary, 00:33 UTC. Each exposure is 90 seconds.

4. Confirmation

The ground minimum has the depth of the TESS primary, the duration of the TESS primary, and the time of the TESS primary. The comparison stars do not fade. The 22-arcsec neighbor is outside the aperture, and an eclipse of that neighbor would change the combined light by about a hundredth of a magnitude. The eclipse belongs to TIC 422106434.

This is the first light curve of the star from the ground. TIC 422106434 is a confirmed Algol-type eclipsing binary, on the ephemeris of the October note. A residual of 3.8 minutes, from a single minimum, leaves that ephemeris as it stands. This confirmation has not yet been sent to the AAVSO Variable Star Index.

5. Contributions

Sean League identified the eclipses in the TESS Quick-Look Pipeline light curves, derived the ephemeris, and measured the time and depth in the ground series. Alexandre Santana collected the data between 22:00 and 02:00 UTC in Setúbal, Portugal, with his 8-inch Newtonian telescope, an IMX533 camera, and a UV/IR cut filter, and he produced the AstroImageJ measurements used here.

References

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