

A 100.8-day fade of BD+54 2721, with no earlier record

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TESS QLP aperture photometry shows the G0 giant BD+54 2721 fading to about 40 percent of its usual light, and recovering, on four dates between 2019 and 2024. Each fade lasts about a day. The three deep minima are one event repeating every 100.846 days. The shallower minimum falls 21.56 days later. No shorter period fits, and the six TESS sectors do not contain a fade that this clock forbids. The star is a catalogued double, measured since 1898, and it is not in VSX, the Gaia DR3 variable tables, the ASAS-SN variable catalog, or Hipparcos. The 90 percent drop reported by an automated search belongs to the companion's aperture, which goes blank while the bright star is faint. The period is a fit to four TESS minima. It has not been checked from the ground.

The star

BD+54 2721 = TIC 330615780 = TYC 3986-232-1 = Gaia DR3 2006084017438486656 = WDS J22152+5530 A. It lies at 22h 15m 11.18s, +55° 29' 15.5". V = 9.54, G = 9.324, T = 8.86. Gaia DR3 gives a parallax of 2.848 ± 0.014 mas (351 pc), $T_{\text{eff}} = 5680$ K, and $\log g = 3.34$. The spectral type on SIMBAD is G0III, from McCuskey (1955). The Gaia RUWE is 1.07, and the source is not in the Gaia non-single-star or variable-summary tables. The photometric variability flag is NOT_AVAILABLE.

The Washington Double Star catalog lists the pair as ES 1017 AB, discovered by Espin in 1898, separation about 12 arcsec then and 11 arcsec in later measures, magnitudes 9.6 and 11.6. The companion is BD+54 2721B = TIC 330615753 = Gaia DR3 2006084017438484992, 15.2 arcsec north of A, G = 11.41. Its parallax is 2.870 ± 0.055 mas, the same distance as A, so the pair is physical. The projected separation is about 5300 AU. WDS also lists wider, fainter companions (AC, AD, AF, AG, AH). B has RUWE 3.27. A one-day fade of A is not an eclipse by B.

What TESS recorded

The light curves are QLP aperture (SAP) flux with the quality flag exactly zero, sectors 16, 17, 56, 57, 83, and 84. SAP in these files is already divided by the sector median. Four minima fall below 0.75:

Sector	Minimum (BTJD)	Middle (UTC)	Which	SAP	Depth
16	1759.785	2019 Oct 3, 06:44	primary, E = 0	0.395	1.00 mag
17	1781.347	2019 Oct 24, 20:14	secondary	0.577	0.60 mag
57	2869.097	2022 Oct 16, 14:14	primary, E = 11	0.419	0.94 mag
83	3575.019	2024 Sep 21, 12:21	primary, E = 18	0.411	0.97 mag

BTJD is BJD_TDB minus 2457000. UTC subtracts light time and 69.184 s. The middles above use that correction. Sectors 56 and 84 stay above 0.997 outside the predicted times. The time from full light back to full light is about 1.2 days. The flux is under 0.75 for about 0.6 days. A least-squares fit to the three deep minima is

Min I = BTJD 1759.785 + 100.84635 E

The residuals are -0.9, +2.2, and -1.3 minutes at cycles 0, 11, and 18. Min II is phase 0.2138, 21.562 days after Min I, fixed by the single shallow minimum in sector 17. No period from 2 to 40 days puts all four minima on two phases. Integer cycle counts of the three deep minima, for any period longer than 40 days, leave only 100.846 days and its half. The half, the third, and the quarter each predict at least one extra minimum on a night these sectors cover at full light. The

nearest is the half-period secondary at BTJD 2840.23 in sector 56, where SAP is 0.999. Every other primary and secondary from cycle 1 through 17 falls outside these six sectors. The cycle-18 secondary, BTJD 3596.58, falls in the middle of a two-day gap in sector 84. The next primary is cycle 26, BTJD 4381.79, which is 2026 December 7 at 06:55 UTC. The next secondary is 2026 December 28 at 20:25 UTC. An automated fit that printed $P = 5.34$ d was using the blanked points of the companion, and the other predicted times in these sectors are flat.

The fades are on the sky, not a bad camera pixel. The star falls on different detector coordinates in sector 16 (near pixel 1247, 332) and sector 83 (near 1517, 740). During a fade the measured center of A moves about 0.06 pixel and returns. Stars 2.5 arcmin away, and two eclipsing stars elsewhere in this TESS field, stay at full light and do not share the motion. Two fainter stars 47 and 71 arcsec from A have their measured centers pulled toward A at normal light. During the fade those centers move back away from A, by 0.2 to 0.3 pixel, in both sector 16 and sector 83. The light that left was the light of A.

TIC 330615753 does not have its own brightness in this measurement. Its contamination ratio in the TIC is 7.4, and its aperture is mostly A, 15 arcsec away, inside one TESS pixel. Its SAP flux follows A down and then the flux cell is blank for the middle of the fade, quality flag still 0. A dip finder that rejects non-positive flux bridged that blank and reported an 87 percent and a 96 percent eclipse. Those numbers are the blank, not a magnitude of B. In the extended-mission sectors the QLP detrended flux of A has the fade removed, while the raw SAP flux keeps it. The year-1 curve keeps it. That disagreement is why this is a note and not a classification.

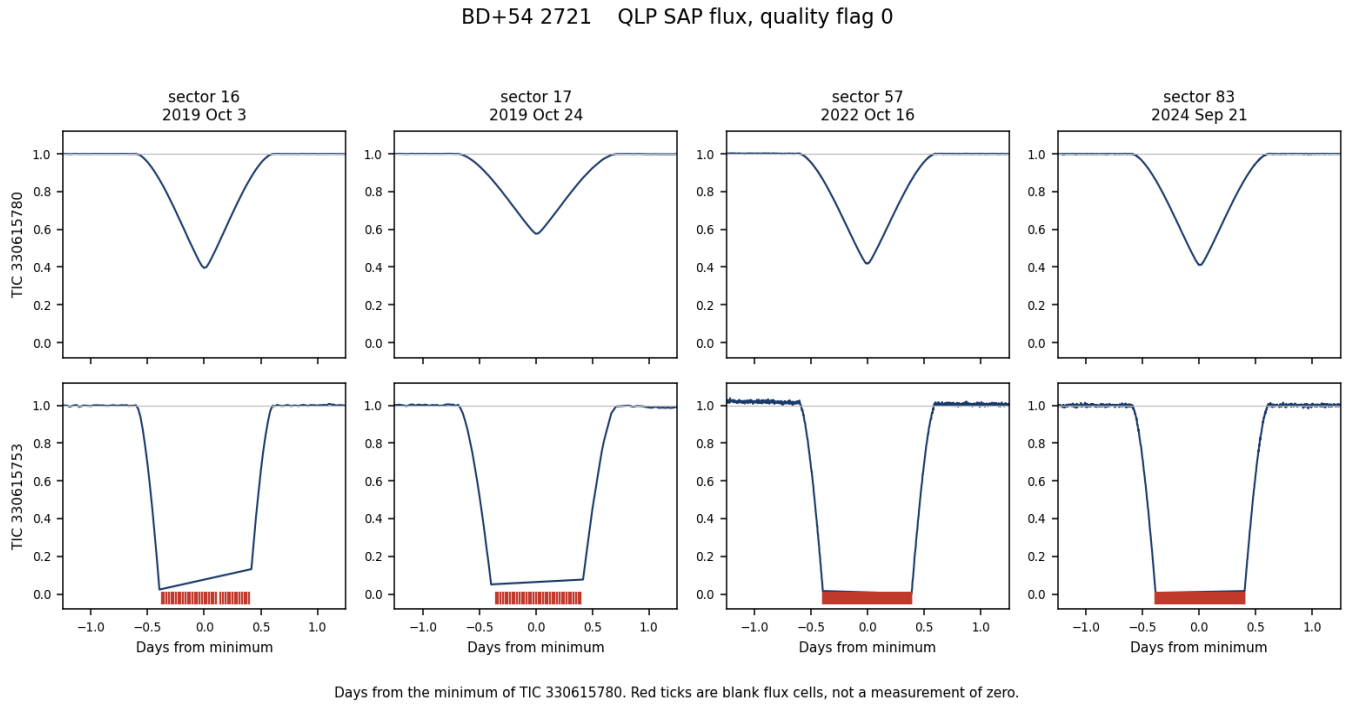


Figure 1. QLP SAP flux around the four minima. Top row, TIC 330615780. Bottom row, TIC 330615753. Red ticks sit on blank flux cells and are not measurements of zero light. Sector 16 and 17 points are 30 minutes apart. Sectors 57 and 83 are 3.3 minutes apart.

What existed before TESS

SIMBAD lists five references for BD+54 2721. None is a light curve. McCuskey (1955) classified the spectrum in a Cepheus-Lacerta field. Mermilliod (1987) is the UBV compilation that supplies $B = 10.16$ and $V = 9.54$. Abt and Corbally (2000) included the star in a trapezium list. Mason, Hartkopf, and Hurowitz (2013) is a speckle paper whose tables do not add a close

companion at this position in a cone search. Cantat-Gaudin et al. (2018) is an open-cluster catalog. The mean magnitude has sat near 9.6 for as long as it has been written down: Espin's visual magnitude 9.6 in 1898, Tycho-2 VT = 9.601 and BT = 10.299, and Gaia G = 9.32.

There is no variable-star entry at the coordinates. VSX within 20 arcsec contains one star, Gaia DR3 2006084017438489216, G = 13.75 to 13.79, typed only as a possible short-period pulsator. The ASAS-SN variable catalog II/366 (edition of 10 Sep 2024) has no row within 30 arcsec. Hipparcos has no star within 2 arcmin. A ZTF light-curve cone of 3 arcsec returned no detections; a star of V = 9.5 saturates that survey. Gaia did not publish epoch photometry or a variability class. The ASAS-SN Sky Patrol images themselves were not downloaded here, because that service sits behind a browser check. A single exposure taken inside a one-day fade would look like one faint point, and that point would not have to appear in a variable catalog. No such point is on record in the catalogs above.

So the fades are new in the published record. They are not new as a change in the star's mean light, and they are not a 90 percent eclipse of either component. What faded is BD+54 2721, by about one magnitude, for about a day. The one period that fits is 100.846 days, with a second minimum 21.56 days later. That is a clock fitted to four TESS points. A ground measurement, or a later TESS sector, is what would confirm it.

Data: MAST QLP light curves in /tmp/lac345-ring/qlp, TIC 330615780 and 330615753, sectors 16, 17, 56, 57, 83, 84. Catalog checks on 10 Oct 2026: SIMBAD, Gaia DR3 TAP, VSX cone, Vizier II/366/catv2021, Vizier I/239, Vizier B/wds, Vizier I/259/tyc2, IRSA ZTF light-curve service.