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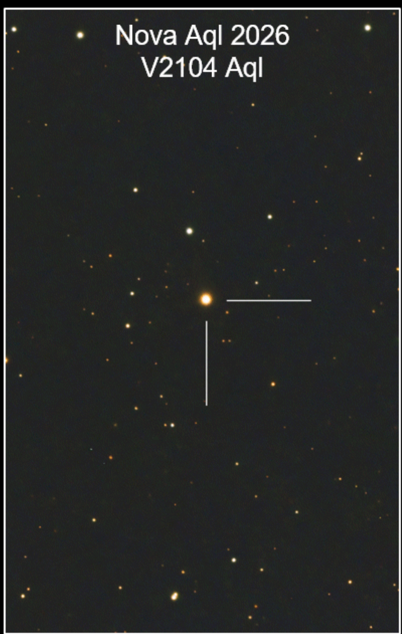
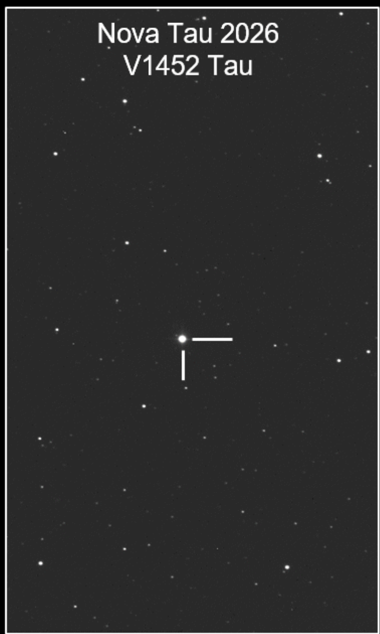
The British Astronomical Association

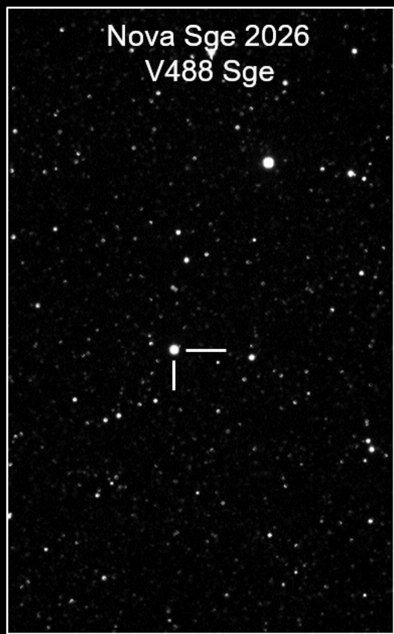
Variable Star Section Circular

No. 209 September 2026

Three Northern Summer Novae!







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From the Director – *Jeremy Shears*

STFC Funding Decisions: What They Mean for UK Astronomy

The recent funding decisions announced by the Science and Technology Facilities Council (STFC) have prompted widespread concern throughout the UK astronomical community. Although the changes have attracted attention because of their impact on Jodrell Bank Observatory, the consequences extend much more broadly, affecting major national facilities, international collaborations and the UK's future role in astronomical research.

Like so many around the country I was dismayed, not least because I am a volunteer at Jodrell Bank, prompting me to write a letter to *The Times* which was published on 29 July. There have been few things that have united the country as much as these announcements.

The most prominent announcement is the planned withdrawal of STFC funding for the e-MERLIN national radio telescope network from 2028, which includes the iconic 250 foot Lovell Telescope. Operated from Jodrell Bank, and partway through a major upgrade, e-MERLIN links seven radio telescopes across England into a single high-resolution instrument used to study black holes, star formation, pulsars, galaxies and transient phenomena. The e-MERLIN images following eruptions of novae, such as RS Oph, are remarkable. As are its images of OH, H_2O, and SiO masers in the gas shells surrounding evolved stars like Mira variables (e.g. U Her, R Cas, and o Ceti).

Unless alternative funding can be secured, the e-MERLIN network will cease scientific operations, bringing to an end decades of continuous radio astronomy at Jodrell Bank, Ironically, this year marks the 80th anniversary of the observatory's founding by Sir Bernard Lovell. The University of Manchester is looking at alternative funding arrangements. (The Headquarters of the Square Kilometre Array Observatory at Jodrell Bank are unaffected).

The reductions also affect Britain's participation in several international astronomy projects. Support for aspects of the Vera C. Rubin Observatory programme, expected to transform time-domain astronomy through its decade-long survey of the southern sky, has been reduced by 20%. Funding is also being completely withdrawn from the UK's participation in the Event Horizon Telescope collaboration, which produced the first image of a black hole, while other facilities and instrumentation programmes face closure or significant reductions. Even relatively low-cost operations like HiPERCAM are impacted.

Many argue that the greatest danger lies not in the loss of individual facilities but in the erosion of scientific capability. Modern observatories depend upon teams of highly specialised engineers, software developers, telescope operators and research scientists whose expertise has been built over decades. Once dispersed, these teams are extremely difficult to reassemble, raising concerns that the effects of the current decisions may be felt for many years.

The reductions are also expected to affect the next generation of researchers. National facilities provide training opportunities for postgraduate students and early-career scientists in instrumentation, data science and observational techniques. A contraction in these programmes risks encouraging talented young researchers to seek careers overseas, potentially contributing to a long-term loss of expertise.

The impact extends beyond professional astronomy. Jodrell Bank's Discovery Centre welcomes around 186,000 visitors each year, including many thousands of schoolchildren. While the visitor attraction will remain open, I fear that weakening the Observatory's research mission would diminish one of Britain's most successful centres for public engagement with science.

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STFC has argued that the decisions are necessary to balance its budget and concentrate resources on the highest-priority scientific programmes. Nevertheless, many astronomers believe the cumulative effect represents a significant retreat from the UK's long-standing position as a world leader in astronomy. The coming years will determine whether these reductions prove to be a temporary financial adjustment or mark the beginning of a more fundamental decline in Britain's astronomical capability.

If you wish to make your feelings known about the Jodrell Bank cuts or the other STFC cuts, the best thing to do is to write to your MP. I wrote to mine on the day the cuts were announced and I received a positive reply the following day in which she shared the letter she had written to the Secretary of State about the matter. I also received a positive reply from the MP for Macclesfield.

Three northerly novae

In better news, we have been treated to three novae this Summer.

Nova Aql 2026 (V2104 Aql) was reported on 2026 July 1 by Minrui Ning and Huixuan Lin on behalf of the Daily CV Alert Project (DCAP) which analyses publicly available data from the Zwicky Transient Facility (ZTF).

This is a highly reddened Fe II-type classical nova, reaching 11th magnitude visually. It is located 3° southeast of ζ Aql at RA 19 14 31.37 Dec +12 03 53.6 (J2000).

Nova Tauri 2026 was detected on August 7, reaching 9th magnitude. It is located at Location: RA 05 21 07.63 Dec +23 38 20.0 (J2000.0)

And as if these two novae weren't enough, as we were going to press, a seventh magnitude nova appeared in Sagitta **(V488 Sge**).

More details later in this Circular.

OJ 287 paper includes contributions from VSS observers

VSS observers have been following this interesting object for many years – see for example, Mark Kidger's article in VSSC 206, December 2025. Several of them appear as co-authors in this new paper accepted for publication in ApJS (The Astrophysical Journal Supplement): https://arxiv.org/abs/2607.07201

Congratulations to all involved

Cool Evolved Stars Newsletter

If, like me, you were disappointed about the demise of the AGB (Asymptotic Giant Branch) newsletter a while ago, you will be pleased that it has been replaced by the *Cool Evolved Stars Newsletter*. This is a monthly compilation of recently accepted publications in the field of cool evolved stars (red giant branch and asymptotic giant branch stars, red supergiant stars etc.). It also contains conference announcements.

You can sign up for the Newsletter here: https://cesn.obspm.fr/

Now in its fifth month, the August edition has ten articles covering red giants, AGB and post-AGB stars, red supergiants and planetary nebula topics.

Tim Withers

Readers will be sad to learn of the death of Dr Philip Barclay Withers, known to everyone as Tim, on 16 June 2026.

Tim was born on 5 September 1947. He was first elected to the British Astronomical Association on 30 November 1966 and rejoined the Association later in life, on 2 September 2009.

Always a dedicated visual observer, Tim submitted 33,909 estimates to the Variable Star Section (VSS) database. He attended numerous VSS meetings and was a familiar face at the annual Winchester Weekend, where his enthusiasm and willingness to share his knowledge made him a valued member of the community.

We send our deepest condolences to Tim's wife, Lisa.

Tim Withers with his Celestron C14

CV & E News

Gary Poyner

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Light curves of three northern Novae (V2104 Aql, V1452 Tau and V488 Sge) are discussed, along with BAAVSS light curves. The outburst of the old Nova GK Per, the fade of the RCB stars V482 Cyg and SU Tau and the rare outburst of the UGWZ star DDE 196 are also covered.

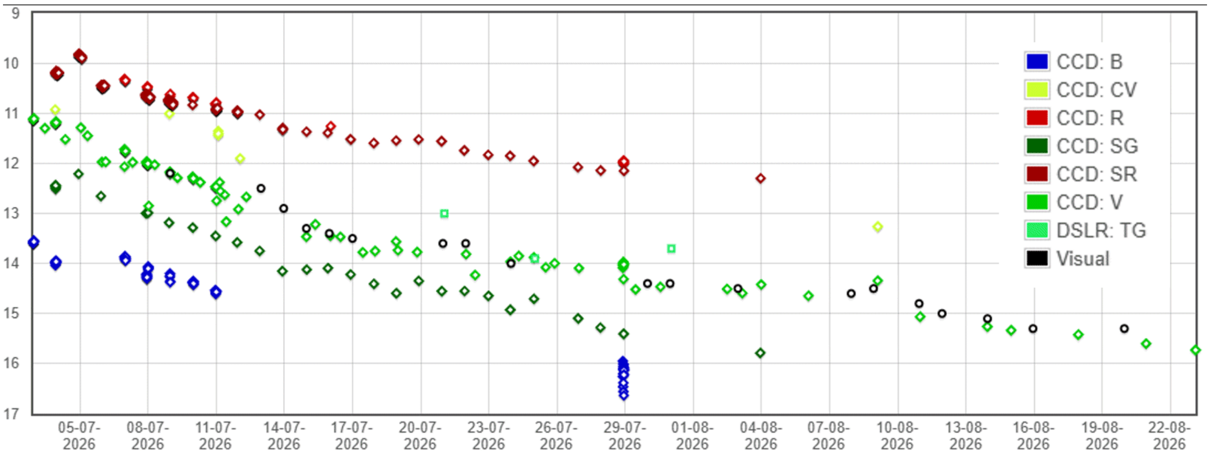
Three Summer Novae (see cover)

The summer of 2026 has been quite extraordinary. Unprecedented heat, drought, a decent run of clear(ish) skies and THREE Novae to keep us busy over the next few weeks.

V2104 Aql (Nova Aql, 2026) was discovered by M. Ning and H. Lin (DCAP collaboration) on 2026 July 1.305 UT at magnitudes g = 14.45 and r = 12.53. It's initial designation was AT 2026rdg, and the discovery was announced on Atel 17867. This ATel gives details of the early spectrum, and states that the nova is an FeII type classical nova around maximum brightness during discovery. BVRI photometric observations reveal a B-V of 2.36, indicative of a highly reddened field from interstellar dust.

From maximum brightness of 11.1V, the nova faded to magnitude 14.1V by July 22 – a t3 of ~11d from BAA data. The decline rate has continued consistently to the current level of 15.73V (August 24 – time of writing). An AAVSO chart was quickly drawn up, but the comparison stars are not perfectly placed due to the intense reddening of the field. This nova is a tricky object visually. An AAVSO 30 arc minute chart will show a low limit comparison star of 16.2.

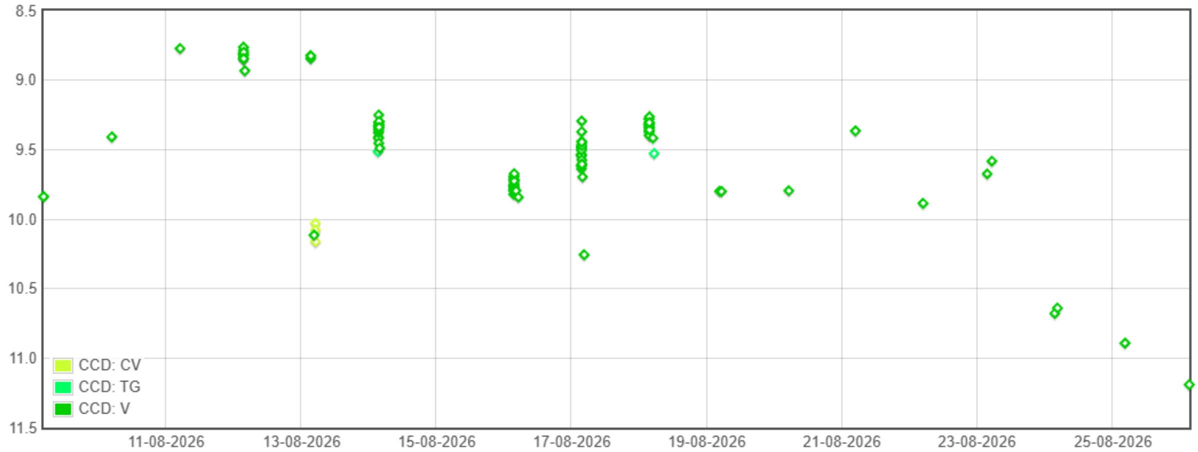
The BAA Spectroscopic database contains spectra obtained by D. Boyd, R. Leadbeater and U. Zurmuhl



V2104 Aql. July 2 – Aug 23, 2026. Observers D. Boyd, M A Hather, N D James, M Mobberley, G Poyner, I Sharp and I L Walton (*BAAVSS Database*)

V1452 Tau (Nova Tau, 2026) was discovered on 2026, Aug 06.410 UT at unfiltered magnitude of 11.2 by the NMW (New Milky Way)-TexasTech survey and announced on Atel 17947. Early photometric observations show the discovery was made just prior to maximum brightness, which occurred some five days later from BAAVSS data. Early spectroscopy reveals this also to be a FeII type classical nova. A possible counterpart has been identified from PanSTARRS images, which is too faint to be included in the PanSTARRS catalogue. This reveals an amplitude of at least 11 magnitudes.

With the field visible in the morning sky, photometric magnitudes and spectra are a bit thin on the ground. The light curve from Aug 9 to Aug 23 (time of writing) shows the rise from the discovery magnitude to maximum on Aug 11.1 UT at 8.8V, followed by a slightly erratic decline to ~11.2V by Aug 26.1 UT. At the time of writing, two spectra are available to view in the BAA spectroscopic database.



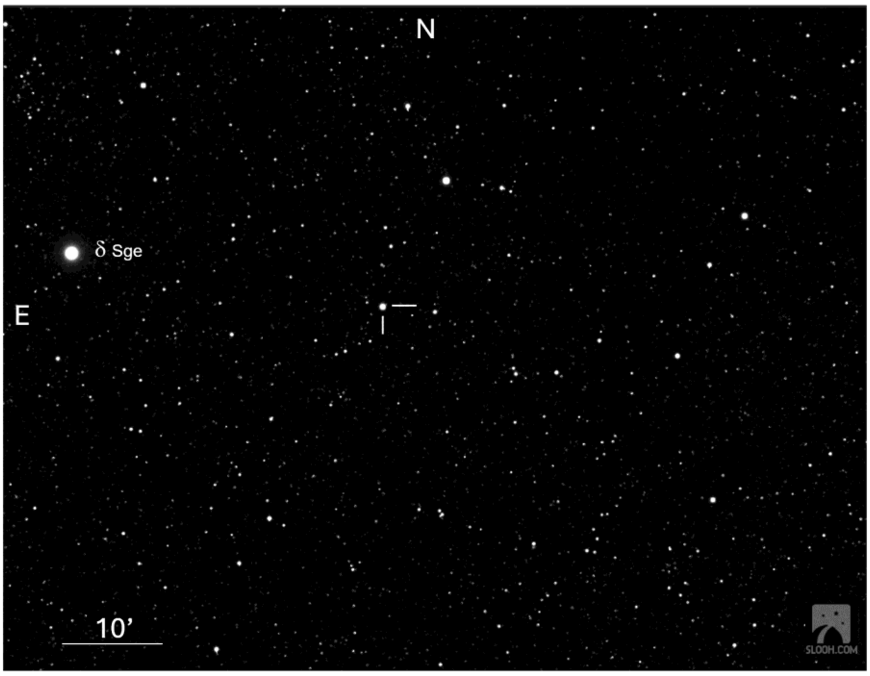
V1452 Tau. Aug 9 – Aug 26, 2026. Observers G. Poyner, I Sharp, I L Walton (*BAAVSS Database*)

V488 Sge (Nova Sge, 2026)

Originally discovered by the Gaia collaboration and published in the Gaia DR3 catalogue in 2022 as a 9.9 day EB. Subsequent analysis and surveys (Gaia DR3, ZTF DR24, Pan-STARRS1 DR2 and IPHAS DR2) however reveal it to be variable object of magnitude 19.3-21.1r, without any obvious periodicity.[3]

The Nova outburst was discovered by Katie Barnhart, Kirill Sokolovsky, Darien Perla, Pragati Acharya, John Worley, Vallia Antoniou, and Elias Aydi (NMW-TexasTech transient survey) on 2026, August 25.127 UTC. And announced on CBAT Transient pages [4].

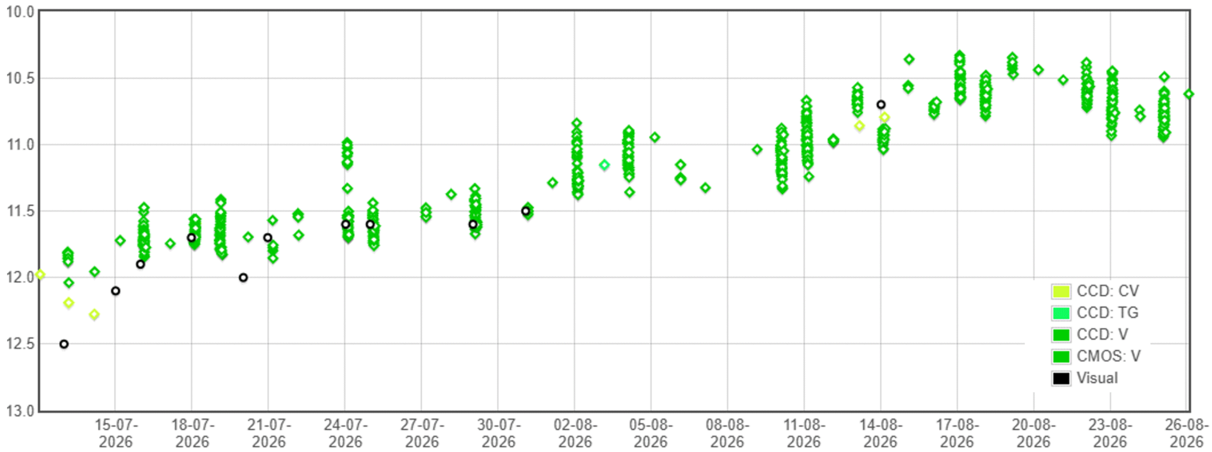
As this Nova has appeared just as these pages are being finalised, few data points are available. However, the Nova has been observed at magnitude 7.1-7.3 on the night of Aug 25, and Robin Leadbeater has posted an early spectrum on the BAA Spectroscopic Database, and comments that "*clear P Cygni profiles at H alpha and H beta. The velocity in H alpha is ~1500km/s confirming its status as a Nova*".



Nova Sge 2026. Aug 25.910 UT. Magnitude 7.39CV. 50 second, 80mm OG Slooh Ultra-Wide. G. Poyner

GK Per

Staying with the Nova theme, GK Per (Nova Per 1901, type NA/DQ+UG), has once again become active – some 3 years and 8 months since the last ‘outburst’. First picked up by Keisuke Isogai (Japan) and Bob Dryden on July 11, the rise has been somewhat slower than the 2023 outburst (36 days), in that, at the time of writing, we are now 46 days into the outburst which may be fading as I write these words (Aug 26) having peaked at magnitude 10.3V on the 19th, some 0.3 mag brighter than 2023, and slightly fainter by Aug 26 at 10.6V. GK Per maxima have varied by a magnitude in the past, with 2015 being the brightest recorded in the BAAVSS database at 9.6 mv. Outbursts generally last a couple of months. A more complete light curve will be included in the December VSSC.



GK Per. July 11 – Aug 26, 2026. Observers R C Dryden, M Finch, G Poyner, I Sharp, J Toone (*BAAVSS Database*)

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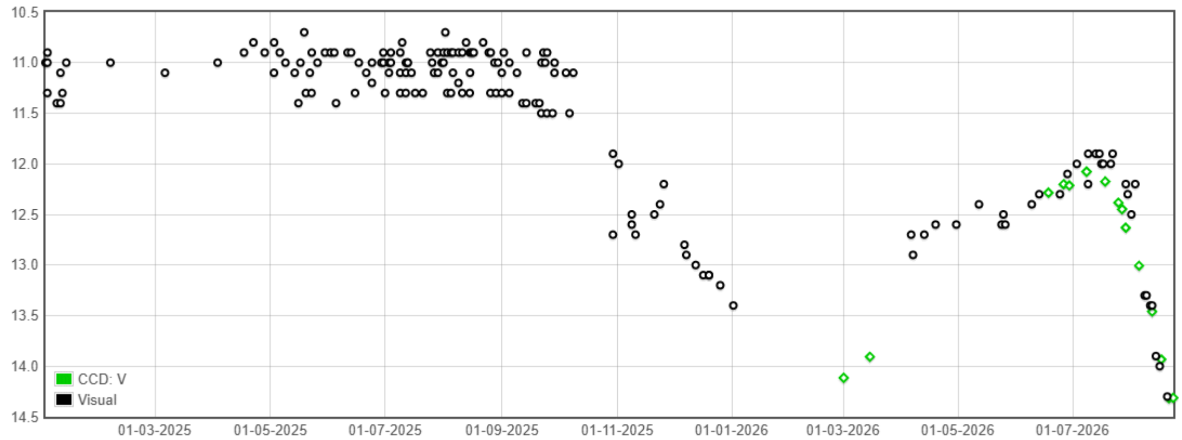
V482 Cyg

Following its historical low state of magnitude 16.0V reached in July 2022, after two decades of inactivity [1&2], this interesting RCB star has once again become active. A slow decline of 12 weeks over the winter period from November 2025 to March 2026, saw V482 Cyg drop to magnitude 14.2V during Spring of this year, recovering to magnitude 11.8 mv by early July and within two weeks fading once again to its current level of 14.4V by August 26. Similar behaviour occurred during the 1988 fading event, where two below magnitude 14.0 fades occurred in two years.

It's worth noting again that this star can be a challenge to observe visually as it approaches magnitude 14.0, due to the presence of a close 13.7 magnitude field star, and an even closer 15th magnitude star which will cause problems for CCD users at fainter limits [1]. Observers shouldn't be discouraged by this though, and hopefully we can follow V482 Cyg for the remainder of its observing season.



V482 Cyg. Jan 2025 to Aug 2026. Observers L K Brundle, R C Dryden, R Pearce, G Poyner, P B Withers (*BAAVSS Database*)

One other RCB star is also currently active and will be well placed for observation during the coming months. SU Tau has emerged in the morning sky following its annual solar 'downtime' to be seen lying at magnitude 15.0V. Its pre-solar conjunction level was magnitude 10.3 mv, with the last estimate being made in late April. SU Tau has the largest amplitude of all RCB stars, being in excess of ten magnitudes, and can fall to below magnitude 19.0V, as was the case during the 2012-16 epic fading event.

One can't fail to mention the unique DYPer type star DY Persei, when writing about RCB stars. Although not an RCB star, this hydrogen deficient star exhibits very similar behaviour to the more numerous RCB stars. Deep fades (but not as deep as RCB's) at irregular intervals, with a more symmetric fade and rise, DY Per also displays SR type activity whilst bright, with amplitudes much greater than classical RCB stars. Like SU Tau, DY Per has emerged from the summer period in a fainter state than which it entered. The last BAAVSS datapoint on April 18, 2026 showed DY Per at magnitude 11.3 mv, very slightly below maximum brightness following an active period since the deep fade of 2024. The next observation on July 28 had DY Per at 13.64V to which it has now faded to 14.2V by August 20, with a slight recovery to 13.9V by Aug 26. DY Per can reach below magnitude 16.0CV, so this is another one to watch during the coming months.

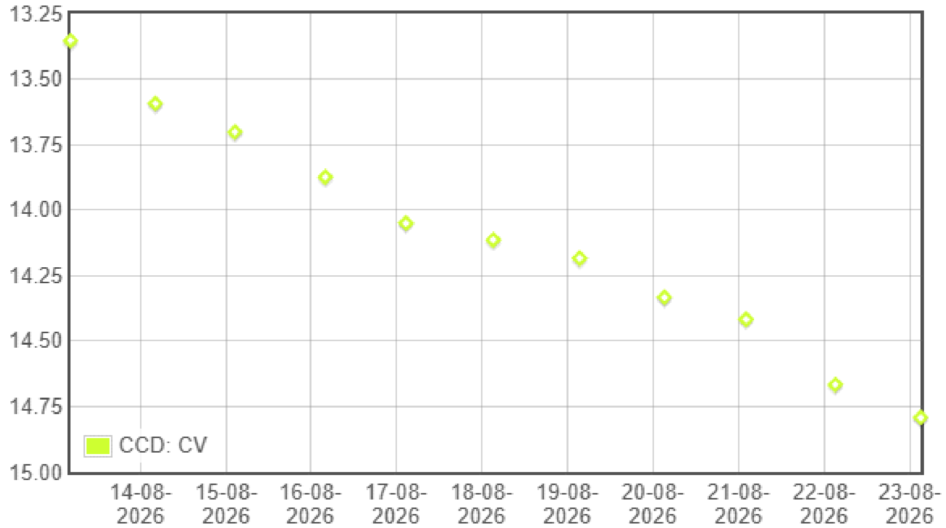
DDE 196

The UGWZ type stars are the most extreme types of dwarf novae, with large amplitudes, long outburst intervals, absence of normal outbursts, and short orbital periods. Only around 100 are known in the northern sky, and one under observed such star is currently in outburst in Perseus.

DDE 194 was originally found to be in outburst by Denis Denisenko from PanSTARRS-1 data in November 2021. This outburst was recorded by PanSTARRS in December 2013 and lasted around 20 days but went undetected by PanSTARRS and other surveys such as ASAS-SN and MASTER.

On Aug 12, 2026, Denisenko reported on vsnet-alert 28201, that Minrui Ning of the Chinese Daily CV Alert Project (DCAP) had detected DDE 196 to be in outburst on Aug 11 at magnitude 13.23r, having been <20.31r three days before. Denisenko comments that the long interval between outbursts, large amplitude and the absence of normal outbursts in the archive data, suggests that this object is a good candidate for the UGWZ class. In vsnet-alert 28210, Gianluca Masi (Virtual Telescope Project), reports his observation of early type small amplitude superhumps (0.02 mag) on the nights of Aug 15-17, and fully developed superhumps by Aug 18 of 0.15 mag amplitude. His analysis reveals Psh of 1.35 hours for the early and 1.45 hours for the regular superhumps. This data suggests that DDE 196 is indeed a UGWZ star.

At the time of writing (Aug 24), DDE had faded to magnitude 14.79CV. It's worth noting that UGWZ stars can sometimes undergo repeated outbursts following its primary event, so this object is worth monitoring once it has reached its minimum level.



DDE 196 Aug 13 – Aug 24, 2026 Observer G Poyner (*BAAVSS Database*)

1: BAAVSSC 193, September 2022

2: BAAVSSC 194, December 2022

3: AAVSO Alert Notice, Aug 25 2026

4: CBAT Transient Object Follow-up Reports

- Note. The vsnet archive is currently unavailable (hence the absence of a link above), even though alert messages are occasionally still being sent out. This follows a long period of relative inactivity from vsnet, which we all hope will improve sometime in the near future.

IX Dra: an update on the supercycle period

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The supercycle period averaged over the last seven years is 59 days. The importance of individual observations over the next 12 months is emphasised for this northerly object.

Introduction

Dwarf novae (DNe) are binary systems comprising a white dwarf with a companion star from which matter is being drawn into an accretion disc. This flow of matter leads to temperature oscillations in the accretion disc, which in turn produce a series of brightening events known as normal outbursts. When the disc radius grows to a certain size, the disc becomes unstable and a long-duration superoutburst, normally one magnitude brighter than normal outbursts, returns the disc to its initial state. The sequence of normal outbursts followed by a superoutburst then repeats. The time between superoutbursts is known as the supercycle period P(sc)

The Variable Star Index (VSX) [1] gives the following definition for UGER stars:

ER Ursae Majoris-type subclass of UGSU dwarf novae. These stars typically spend a third of their time in super-outburst with a super-cycle of 20–90 days. Outside of super-outburst they typically pack in a rapid succession of normal outbursts.

UGER stars therefore offer the opportunity to observe several superoutbursts per year and derive P(sc) values. VSSC 187, 194 and 208 included reports on IX Dra. This note updates the results for IX Dra to 2026 July 1.

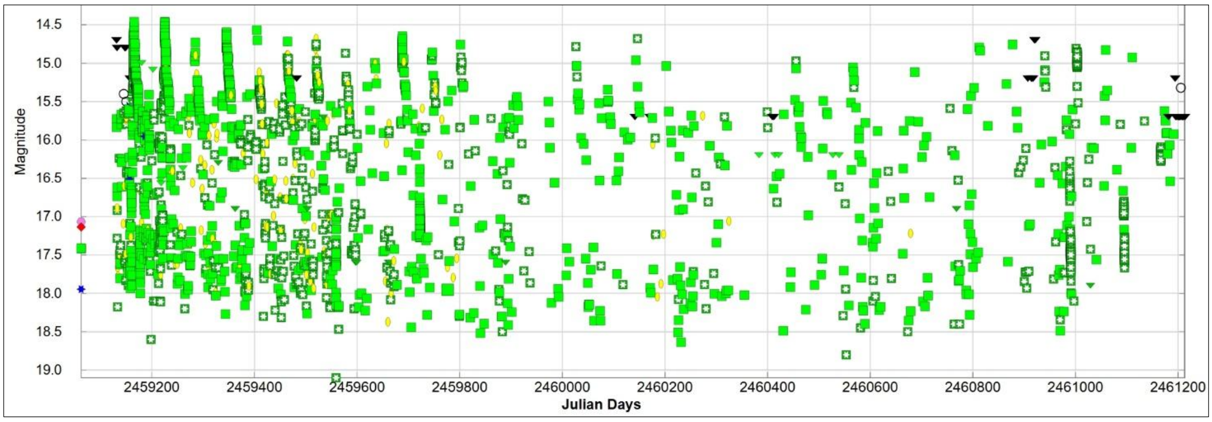

Figure 1. The AAVSO light curve for IX Dra

The AAVSO light curve for the period from JD 2459000 to 2461213 (2026 June 22) is presented in Figure 1. Observations made prior to JD 2459000 were too sparse to use. It is fortunate that TESS has observed IX Dra regularly since JD 2458681 and provides timings to a fraction of a day [2]. Furthermore, there is an expectation that TESS will continue in its extended mission for a few more years. TESS is currently pointed at the southern sky and will return to the northern sky in 2027. Whilst most of the observations have been provided by the AAVSOnet New Mexico telescope, critical contributions have been made by individual observers, including those from the VSS, that have completely defined a few superoutbursts. This is acknowledged in the table below.

The estimated start times of superoutbursts are presented in the table below. The uncertainty associated with the start of a superoutburst is probably +/- 1 day for most of the BAA and AAVSO observations. However, for a few superoutbursts, the earliest observation may have been mid-outburst, and so the date in the table is likely to be a couple of days late. This uncertainty does not influence the discussion of trends for the interval between superoutbursts.

Observer	Start of outburst - JD	Supercycle interval (days)
TESS	2458681	
TESS	2458739	58
TESS	2458800	61
TESS	2458863	63
TESS	2458923	60
TESS	2458984	61
Lasair	2459040	56
Lasair	2459106	66
AAVSO/BAA	2459164	58
AAVSO/BAA	2459224	60
AAVSO/BAA	2459283	59
AAVSO/BAA	2459344	61
TESS	2459404	60
AAVSO/BAA	2459463	59
AAVSO/BAA	2459520	57
AAVSO/BAA	2459577	57
TESS	2459632	55
AAVSO/BAA	2459688	56
TESS	2459745	57
TESS	2459801	56
TESS	2459853	52
BAA (Sargent)	2459906	53
Lasair	2459972	60
AAVSO	2460027	57
Lasair	2460084	59
AAVSO	2460143	59

AAVSO	2460202	66.5
Lasair	2460268.5	57.5
TESS	2460326	65
TESS	2460391	62
TESS	2460453	57
TESS	2460510	56
TESS	2460566	58
Lasair	2460624	63
Lasair	2460687	63
Lasair	2460750	62
Lasair	2460812	65
BAA (Darlington)	2460877	65
Lasair	2460942	59
BAA (Darlington)	2461001	57
AAVSO	2461058	52
AAVSO	2461110	63

Discussion

Figure 2 presents the above data graphically. The supercycle period average is 59.2 days with a standard deviation of 3.6 days. Individual intervals are not randomly distributed around the 59-day average. Generally, the subsequent interval appears influenced by the value of the previous one. A sine wave was fitted to this data and yielded a roughly 1,600-day cycle, although the residuals were quite significant. Nonetheless, the possibility of a longer underlying period exists, which another ten years of observing should clarify.

A fitted straight line has a very small gradient (0.004), suggesting that the average supercycle period is effectively constant. This contrasts with earlier historical literature results presented by Klose [3], who reported 45.7 days; Ishioka et al. [4], who reported 53 days; Olech et al. [5], who reported 54 days; and Otulakowska-Hypka et al. [6], who reported 58.5 days. The literature reported supercycle period has steadily increased and converged on 59 days as observations have accumulated.

The scatter around 59 days in Figure 2 might be related to the typical interval between normal outbursts. Normal outbursts seem necessary to tip the accretion disc into a superoutburst. If accretion disc conditions are very nearly (but not quite) right, a normal outburst will not initiate a superoutburst. Then the disc must wait until the next normal outburst before a superoutburst starts. This wait is set by the interval between normal outbursts which, for IX Dra, is 5-7 days. Hence the scatter in Figure 2 might reflect the normal outburst frequency and not, for example, short term variations in the mass transfer rate from the donor star.

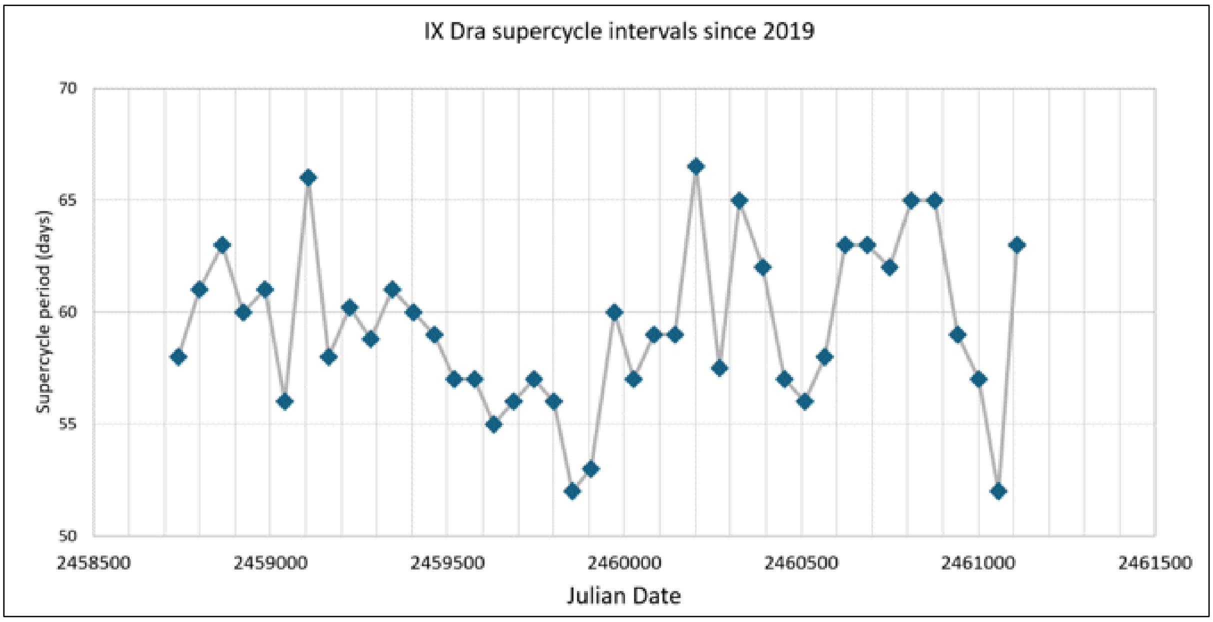

Figure 2. The evolution of the supercycle period from 2019 to the present.

Future work

Further observations will clarify these supercycle characteristics, particularly the legitimacy of the very long imposed cycle around 1,600 days. Observations of IX Dra are being continued by BAA VSS and AAVSO observers, alongside the New Mexico AAVSOnet telescope. TESS has provided useful complementary observations since 2019. However, as there will be no TESS observations of IX Dra this year (with the next results not expected until mid-to-late 2027), the role of individual observers has become even more important. I warmly thank those who have made contributions so far. IX Dra remains particularly well-placed for continuous monitoring by observers at higher latitudes.

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Discovery of the First Ever Recorded Fading Event of the Wolf-Rayet Star WR 59

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This paper presents the visual discovery of the first-ever recorded fading event of the Wolf-Rayet star WR 59. Historically documented as a stable star with an approximate magnitude of 13.9, the star underwent a sudden major decline during high-cadence visual monitoring in May 2021. On 11 May 2021 (JD 2459346), I observed the star plunge 1.3 magnitudes to a deep minimum of magnitude 15.2. It remained in this faded state for roughly 1 day before undergoing a structured 14-day recovery back to its baseline. This episode was independently verified by NASA's Transiting Exoplanet Survey Satellite (TESS) during Sector 38. The satellite's calibrated data stream confirms that the timing, structure, and recovery of the fade matched the ground-based observations. While a close 11.7 V companion star masked the true depth of the drop for automated large-pixel survey pipelines, this event firmly establishes WR 59 as an active dust-producing system. It demonstrates how high-magnification visual monitoring can successfully resolve crowded stellar fields.

1. Introduction and Discovery

The spectrum of WR 59 is classified as a WC9d-type Wolf-Rayet star, identifying it as a persistent dust maker (van der Hucht 2001), and it is capable of undergoing dust-fading events (Veen et al. 1998). Since April 2017, WR 59 has been a regular target in my visual observing programme, consistently remaining at its normal baseline brightness of magnitude 13.9.

All visual observations were performed from the Tetoora Road Observatory using a 22-inch (0.56-m) telescope at a magnification of 270× paired with an 8 mm Tele Vue Ethos eyepiece. Under optimal observing conditions, this specific optical configuration consistently achieves a pinpoint stellar limiting magnitude of 17.3.

On 11 May 2021 (JD 2459346), I detected that the star had faded rapidly to magnitude 15.2. This observation represents the first-ever recorded dust-fading event for WR 59. This dramatic 1.3-magnitude plunge lasted about 1 day, followed by a steady, structured 14-day recovery before the system fully returned to its stable baseline of magnitude 13.9. As the fading progressed, I requested independent verification from visual observer Stephen Hovell, who successfully confirmed that the star had faded. The resulting light curve captures my visual observations of WR 59 as it plunged below its normal baseline to an unprecedented magnitude of 15.2, before rising back to maximum light (Fig. 1).

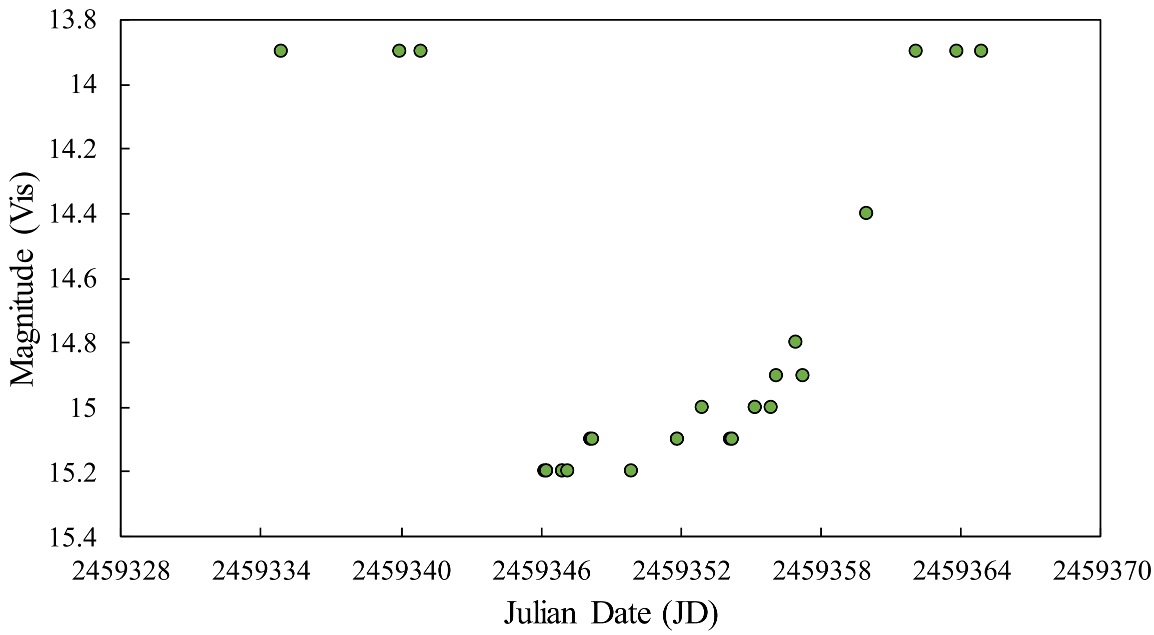

Figure 1. Visual light curve of WR 59 from April 2021 through May 2021. The plot documents the long-term steady baseline magnitude of 13.9 followed by the sudden 1.3-magnitude dust-fading event down to magnitude 15.2 (green circles) on 11 May 2021 (JD 2459346), and the structured recovery phase back to maximum light.

2. The Challenge of Pixel Contamination

WR 59 sits just 11 arcseconds away from a close companion star of magnitude 11.7 *V*, which causes major anomalies in automated and CCD data streams. Automated all-sky surveys, such as ASAS-3 and ASAS-SN, use wide pixel apertures that blend the two stellar targets. This spatial blending makes their recorded baselines appear falsely bright, at magnitudes 13.1 and 11.9, respectively. Converted *Gaia* and ATLAS datasets similarly yield an inflated baseline of magnitude 13.2 *V*. However, ground-based photoelectric data from the General Catalogue of Photometric Data (GCPD; Mermilliod et al. 1997) confirm that the true, isolated baseline of the Wolf-Rayet star alone is magnitude 13.85 *V*. My high-cadence visual data sits consistently and accurately at this unblended magnitude 13.9 baseline.

WR 59 has a colour index of *B*-*V* = 1.3 and a near-infrared colour of *J*-*K* = 2.19, indicating it is a heavily reddened system in an extreme environment of structured circumstellar carbon dust production (Zubko et al. 1992). When combining this severe interstellar and circumstellar reddening with the presence of the close 11.7 *V* companion star, sudden dust dips like the 2021 event can be smoothed out or entirely missed by automated data pipelines and standard CCD configurations. As a prime example, a CCD observation I requested during this faint state returned a misleading magnitude of 13.0 *CV* due to aperture contamination. The physical nature of the system adds another layer of complexity. Spectroscopic radial velocity variations suggest that WR 59 is a binary system (Williams et al. 2005), which further complicates crossmatching when reconciling data taken across different photometric filter bands. By using a 22-inch telescope at 270× magnification, my eye can cleanly resolve the 11-arcsecond gap, isolate WR 59 from its bright companion, and capture the true visual depth of this historic fade.

3. Ground-to-Space Verification

In 2026, I cross-referenced my visual findings with archival data from NASA's Transiting Exoplanet Survey Satellite (*TESS*). This archival check revealed that the spacecraft observed the exact field containing WR 59 back in May 2021, aligning with the timeframe of my visually detected fade. Against incredible odds, the spacecraft's high-cadence observing window captured this historic, first-ever dust-fading event at the same time I was observing it from the ground. The official, raw NASA Science Processing Operations Centre (SPOC) pipeline light curve for Sector 38 (Ricker et al. 2015; Jenkins et al. 2016), independently confirms the overall physical profile, timing, and structure of the fade (Fig. 2).

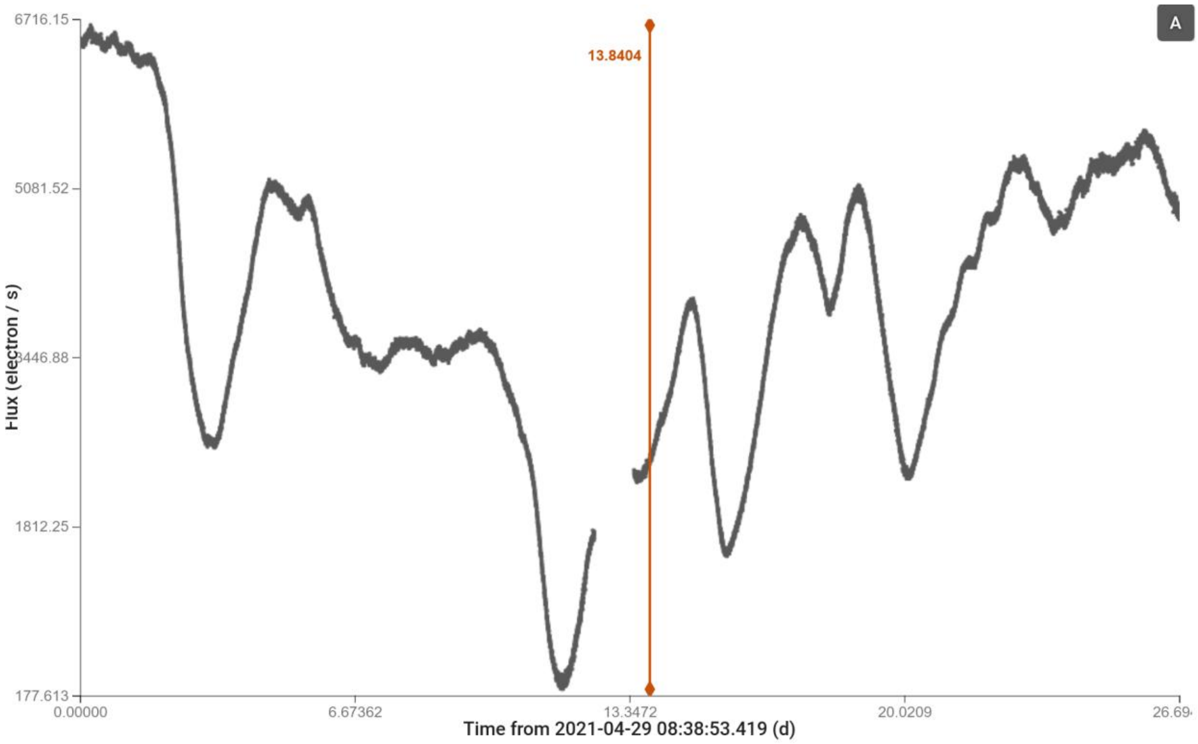

Figure 2. Continuous orbital light curve of WR 59 from NASA's Transiting Exoplanet Survey Satellite (*TESS*) Sector 38 (May 2021) processed via the SPOC pipeline, documenting the progression of the fading event and the telemetry downlink data gap just after minimum light.

Figure 3 displays an overlay plot of my visual observations, shown as orange circles, directly over the raw *TESS* light curve for comparison. Although the true magnitude depth is suppressed in the *TESS* data due to its near-infrared bandpass and the blended companion, Fig. 3 provides a valuable comparison of the structure and recovery phase between the two datasets.

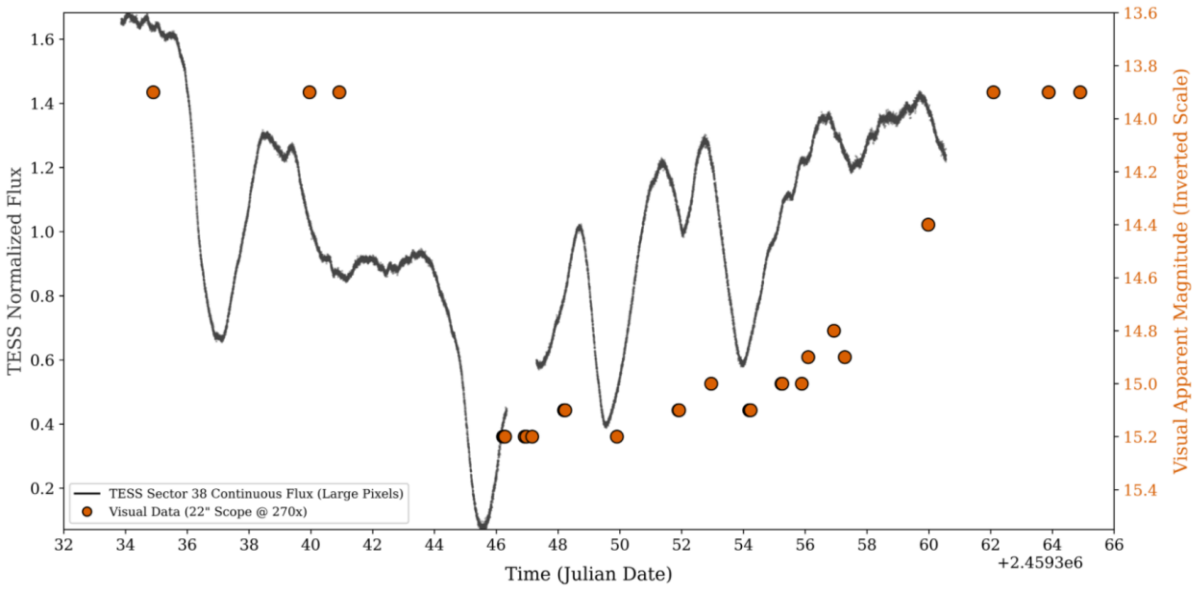

Figure 3. Visual-to-spaceborne data overlay displaying the visual observations (orange circles) plotted directly alongside the high-cadence, raw *TESS* near-infrared light curve (black high-density stream). This plot demonstrates the structural alignment between the two distinct datasets during the egress recovery phase. It highlights the critical **22.58-hour visual bridging window** successfully secured while the satellite instrument was offline for telemetry downlink.

When comparing my visual data directly alongside the satellite telemetry, the structural timeline matches remarkably well. The deep primary minimum of the *TESS* curve reaches its base near JD 2459345.50, placing my visual observations squarely within the critical primary minimum core on that exact night. Through my 22-inch telescope, I detected this deep minimum at magnitude 15.2 across seven distinct visual estimates spanning a 22.58-hour window from JD 2459346.20 through to JD 2459347.14. The small fluctuations I recorded as the star began its recovery were not observational errors or poor seeing conditions. The satellite sensors observed these same variations in real time, confirming that my eye was successfully resolving real short-term physical changes in the condensing dust envelope of this active WC9d Wolf-Rayet star.

Right around the core of this historic minimum, the satellite paused to downlink data to Earth, leaving a critical gap in the timeline. My visual observations successfully bridged that data void, capturing the true, flat minimum across this 22.58-hour timeline while the instrument was offline. This cross-verification underscores the ongoing value that targeted amateur visual observations of close, complex stellar systems bring to modern astrophysics.

4. Calibrated Overlay: Visual vs. Orbital Sensors

Figure 4 displays a calibrated overlay plot generated by Sebastian Otero of the AAVSO International Variable Star Index (VSX; Watson et al. 2006) to compare the visual and space-based datasets. In this plot, my visual observations (designated as SRX) act as the true zero-point baseline, with offsets applied to the different datasets. Specifically, a +3.0-magnitude offset was applied to the *TESS* data to normalise it against the visual optical system. This analysis demonstrates the distinct advantage of targeted visual astronomy over wide-field sensors when capturing the true physical behaviour of WR 59's dramatic fading event.

Because *TESS* uses a large pixel scale of 21 arcseconds per pixel, its automated pipeline extraction apertures naturally sweep in a wider area, blending WR 59 with its nearby 11.7 *V* companion star. This constant, extra light from the companion causes the satellite's minimum depth to register a shallower magnitude of 14.55 *V*. By visually isolating the companion star through the eyepiece, my eye successfully resolved the true optical depth down to magnitude 15.2. While the spacecraft registered a relatively shallow 0.7-magnitude dip in the near-infrared, the visual view revealed a profound 1.3-magnitude optical dust-fading event.

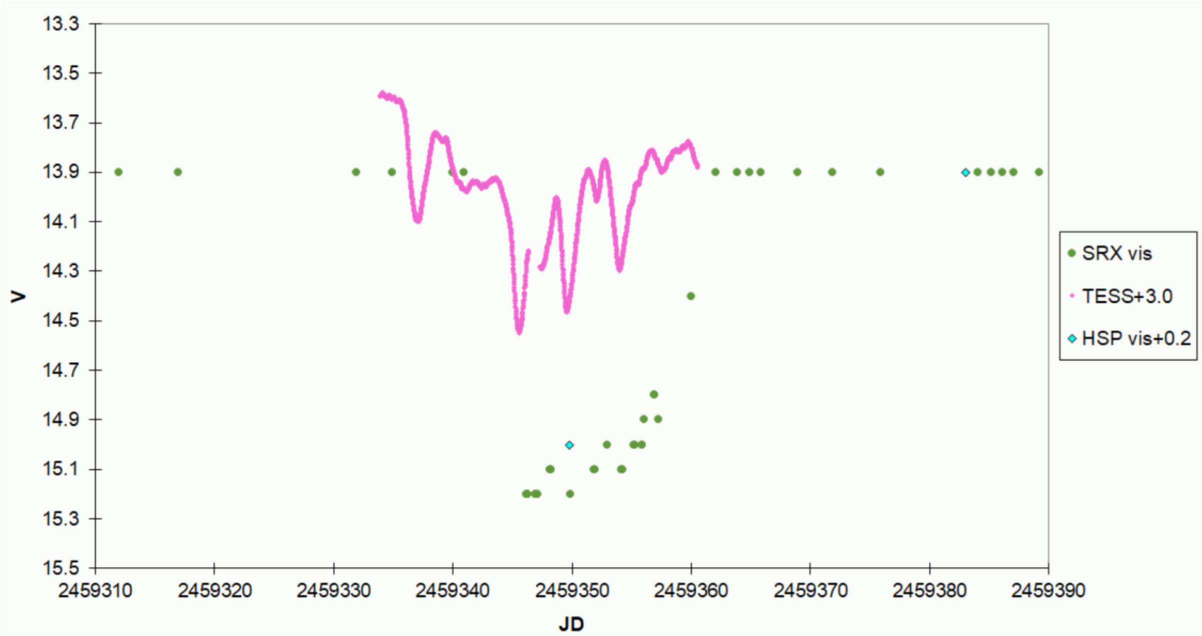

Figure 4. Calibrated multi-dataset overlay plot compiled by Sebastian Otero (AAVSO/VSX) using the primary visual observations (green circles, SRX) as the true baseline. Also displayed in this plot is the independent visual verification point from Stephen Hovell (cyan diamond, HSP vis+0.2), and the baseline-shifted *TESS* orbital photometry (pink curve, *TESS*+3.0). Offsets are applied to normalise the spaceborne sensors onto the visual optical system, highlighting the true optical depth of this dust-fading event and displaying the data gap during the satellite's downlink pause.

5. Conclusion

The 2021 fading of WR 59 stands as the first-ever recorded dust-fading event in the history of this star. For four years leading up to this event, my visual monitoring programme established a highly consistent baseline of magnitude 13.9. The subsequent 1.3-magnitude plunge down to magnitude 15.2 firmly shifts our understanding of WR 59 from a seemingly stable, flat-baseline star into a highly variable dust maker. Independent space-based data from NASA's *TESS* satellite provides verification of this discovery. Despite the 11-arcsecond pixel contamination caused by the close 11.7 *V* magnitude companion star, which completely masked the true depth of the fade for automated ground-based surveys, the continuous orbital data matched the timing of my visual observations to the exact day. The short-term fluctuations captured by *TESS* during the egress phase validate that the rapid brightness variations I observed by eye were not due to human error or poor atmospheric seeing. Instead, they were the genuine physical signatures of a circumstellar dust environment.

This historic event highlights the unique role traditional visual astronomy still plays in an era of advanced space-based instruments. By using high magnification to isolate the star from its companion, my eye successfully captured the true optical amplitude. It filled the critical data void left by the satellite's downlink gap. These results underscore the ongoing value of dedicated amateur visual observations in complementing modern space-based astrophysics. To date, my long-term visual monitoring has captured an additional ten distinct fading events for WR 59. I am continuing to monitor this star nightly and plan to publish the full records of these subsequent light-curves in a follow-up paper (Stubbings, in preparation).

Acknowledgments

My sincere thanks to Sebastian Otero (AAVSO/VSX) for verifying the data and for generating the calibrated *TESS* overlay plot. I want to thank fellow visual observer Stephen Hovell for his independent confirmation of the fade. I acknowledge the Mikulski Archive for Space Telescopes (MAST) for providing access to the *TESS* mission data. In addition, I gratefully acknowledge the American Association of Variable Star Observers (AAVSO) and the use of data from the AAVSO International Database contributed by observers worldwide.

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Consecutive Nights Observing in the UK

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A summary of the longest consecutive night observing spells experienced in the UK between 1975 and 2026.

The UK's fine spell of weather in July 2026 included 23 consecutive nights where the sky was sufficiently clear at some point to undertake reliable visual photometry of variable stars. This exceeded my previous record for continuous nightly observing exclusively within the UK set as far back as 1984. This is an outline account of the longest consecutive nightly observing spells undertaken since I commenced visual photometry in 1975:

April/May 1984

Favourable weather in Manchester led to 18 consecutive nights observing between the 20th April and 7th May. During this time R CrB was observed on 16 consecutive nights rising from magnitude 8.7 to 7.0. Seven nights observations of chi Cyg also recorded a rise from magnitude 6.5 to 5.5 ahead of a maximum of 5.3 attained at the end of May. Additionally, Z Cam entered a standstill and the near continuous (16 nights) run of observations revealed a couple of oscillations between magnitudes 11.3 & 11.6 before the star settled down at magnitude 11.4-11.5. This standstill of Z Cam would last until September 1984. Finally in the northern sky, epsilon Aur was recovering from an eclipse and 4 observations during this spell recorded a marginal rise from magnitude 3.4 to 3.3. During the daytime within this observing spell, I found time to scale England's highest mountain Scafell Pike (Figure 1).

Figure 1: The west face of the summit of Scafell Pike from an elevation of 2300 feet on the 21st April 1984. This was a challenging hike amidst a record-setting 18 night observing run.

July/August 2023
Although only 14 nights long the spell from 14th to 27th August in Shrewsbury deserves mentioning because it followed a spell of 20 continuous photometric nights (13 in Gibraltar flanked by 7 in Shrewsbury) commencing on 24th July with just a single cloudy night separation. This meant that for over a month some variables were monitored practically nightly. In the case of SS Cyg which underwent a long outburst, observations were made on 34 nights out of 35.

April/May 2025
I came close to breaking my record set 41 years earlier with 17 consecutive photometric nights from Shrewsbury but was foiled by a business trip to Glasgow where the first night was cloudy. The second and third nights in Glasgow were clear and I was able to make observations of R CrB (as well as checking that T CrB was not in outburst) with binoculars from the city centre. Meanwhile in Shrewsbury the sky was clear and the following 3 nights were also clear, so I missed an opportunity of a 23-night observing run. The observation of R CrB on the 9th May was a key milestone because it was timed precisely 50 years after my first observation in the BAA VSS database, which was also of R CrB.

July 2026
From Shrewsbury (latitude 52.6^0 N) July is limited to 3-hour observing windows with all-night twilight prevailing in the first half of the month. In order to escape the twilight in the months of May, June & July I frequently visit Lizard Point (latitude 50^0 N) and two weekend visits (Figure 2) over 5 nights in 2026 contributed to a spell of 23 consecutive photometric nights between the 2nd and 24th July. T CrB was observed on every one of those nights (fluctuating between magnitudes 9.9 & 10.3) and the near continuous coverage of RX And, Z Cam & AH Her revealed small scale variations within standstill events. In the case of RX And the standstill was just starting with oscillations present rather like as seen with Z Cam 42 years earlier. There was also a brief but very bright maximum of R UMa peaking at magnitude 6.2.

Figure 2: Sunset over Kynance Cove near Lizard Point on the 10th July 2026. A pleasant fresh-air location that contributed to a record-breaking 23 night observing run.

From a personal perspective the month of July 2026 now sets the bar for consecutive nights observing from the UK. In addition to the consecutive night record in July 2026, I made observations of T CrB on 27 nights in total which exceeds my previous best for a calendar month which was 26 nights of R & T CrB data back in May 2020.

The nightly monitoring achievable during such clear spells of weather has enabled the detection of the pulsations in RCB stars, variations during standstills in UGZ stars and fine detail in long outbursts of UGSS stars. Since three of the spells presented here have occurred within the past three years it indicates a positive trend for consecutive clear nights and visual photometry at large in the UK.

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The Ellipsoidal Variable CW Ceti also exhibits γ Dor type pulsations

John Greaves

TESS photometry show that superposed upon the ellipsoidal lightcurve of the variable star CW Ceti lie low amplitude variations likely due to the star showing gamma Doradus type pulsations.

Introduction

CW Ceti appears in the Variable Star indeX (VSX) as a candidate RR Lyræ variable having inherited this classification from an initial import of the General Catalogue of Variable Stars (GCVS) which itself inherited it from the Variability Annex of the Hipparcos Catalogue. Unfortunately the latter is replete with false positive variables whilst the actual valid variable stars that can be found within it are not infrequently given wrong variability types.

A quick search of multiple catalogues via CDS VizieR gives some later assumptions as to variability type but these are beleaguered by being based on batch automated machine learning variability classifications which never has readily distinguished between certain contradictory categories of variability that have very subtle differences in their lightcurves, thus it has at times been logged as ROT (rotational variable) or EB (eclipsing binary) like classifications with the former consequently having literature periods roughly half of the latter.

The GCVS team produce namelists of new variable stars from the literature (ignoring bulk survey lists on the whole and concentrating more on individually or small numbers of objects from targeted observations) which soon become absorbed into the full GCVS 5 catalogue. Meanwhile the team investigates, inhouse, extant GCVS variables using online photometric time series resources, that is engages in manual classification. Unfortunately updates and additions of the GCVS have not been imported into the VSX for some time and its reference of RR: is from an out of date GCVS version. The current GCVS incarnation classifies CW Ceti as an ellipsoidal variable of 1.085095 day period.

Ellipsoidal variability can be loosely stated to be due to the star being more ‘egg shaped’ than spherical and during the orbit around its companion (the shape deformation is due to tidal effects) first the big end then the little end of the spheroid is pointed towards us whilst the inclination of the pair is such that no eclipses occur. Thus the variation is not due to the rotation of the object but due to its swinging around in its locked synchronous orbit. Accordingly they have two maxima and two minima per cycle and thus can be found to have half period or full period solutions depending on how they have been classified: whether as a periodic intrinsic pulsator or rotator or as a periodic extrinsic eclipser.

TESS-SPOC photometric data is utilised to confirm the above as well as reveal novel variability.

Results

Figure 1 shows the folded phase plot for an ellipsoidal lightcurve with full differential amplitude around 0.1 magnitudes and a primary and secondary minimum depth difference of around 0.01 magnitudes (such a small difference would be unnoticeable for just about any other time series photometry than TESS). The elements are

HJD 2458395.825 + 1.085064 (days) x E

Where E is the cycle number.

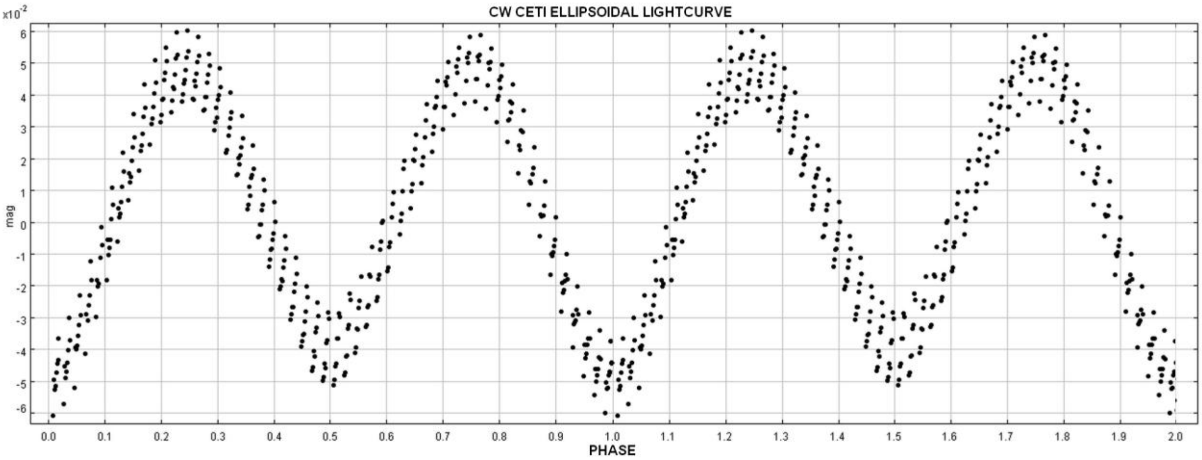

Figure 1 – The phase plot for CW Ceti's ellipsoidal variation – two cycles are shown for illustrative purposes.

Figure 2 shows the main pulsation period of 0.36188 days and an amplitude of roughly 0.012 magnitudes. Further periods of 1.079 days are possible but they do not fold cleanly and their phase plots are very noisy so are not listed here.

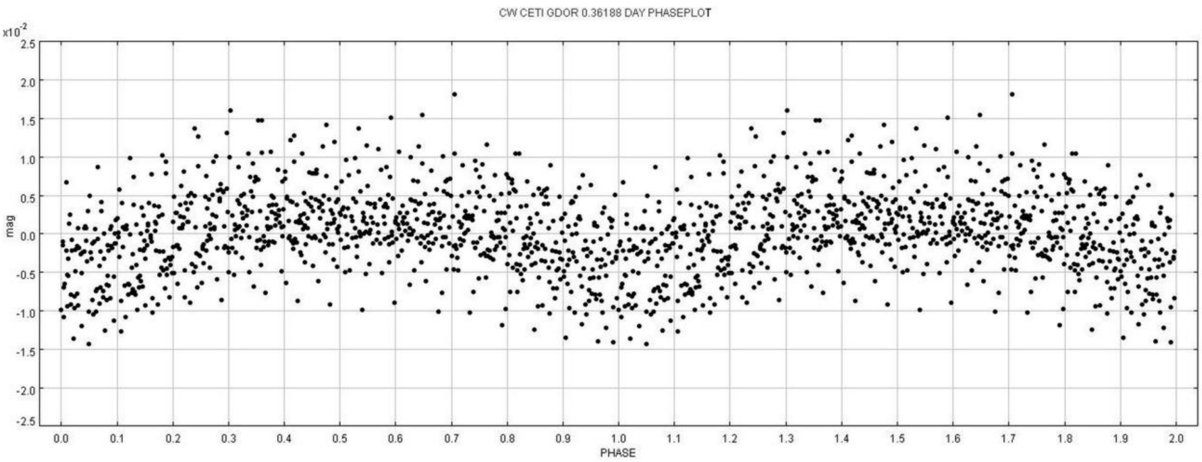

Figure 2 – The phase plot for CW Ceti's pulsational cycle – two cycles are shown for illustrative purposes.

Figure 3 – The raw differential magnitude lightcurve for CW Ceti with the model fit made by combining the ellipsoidal and the primary pulsational periods overlain. The mean magnitude drift trend that is of the scale of the data duration that can be seen in the raw lightcurve was removed before the period analyses.

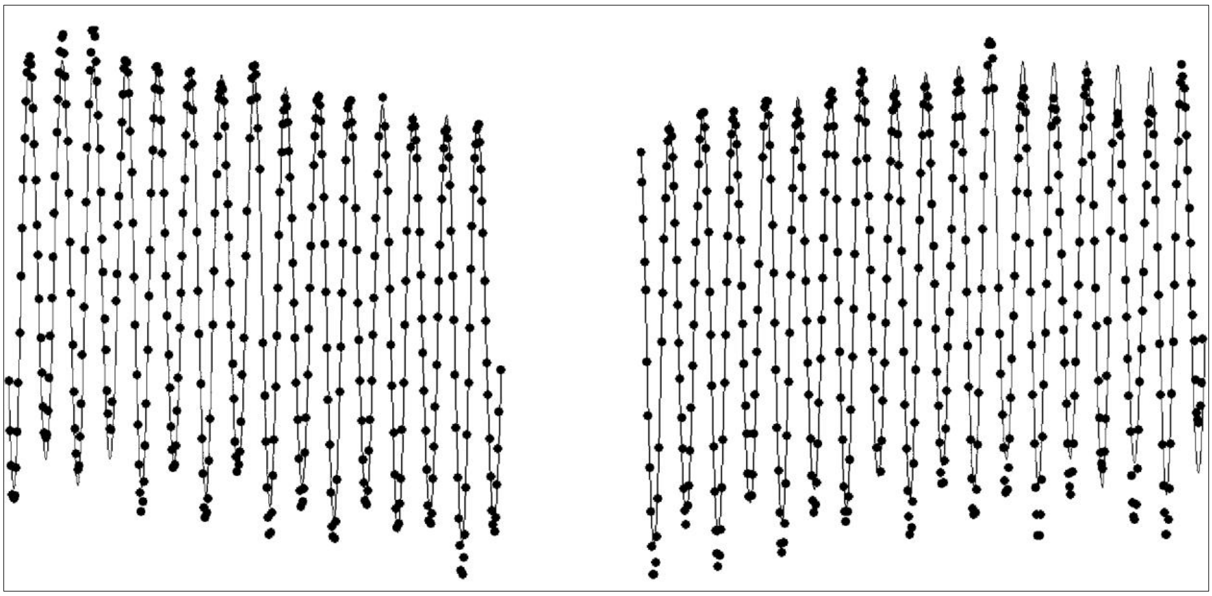

Figure 3 – The raw TESS lightcurve with observational measures as black dots which are overlain by a line generated from the synthesis of the main ellipsoidal period and the main pulsation period, showing a mostly reasonable fit.

Discussion

CW Ceti is a spectral type F6 IV star and the amplitude variation would not be inappropriate for a delta Scuti variable which type can also show various periods, however the main period is somewhat beyond the long end range for those stars as the spectral type just a little too late, albeit still suitable for an outlier.

Conclusion

TESS epoch photometry confirms the current GCVS listed ellipsoidal variability type and periodicity to around four decimals whilst revealing a superposed pulsational signal of 0.36188 days. The period length, the overall amplitude and the spectral type plus the hint of further short pulsational periods are suggestive of a gamma Doradus variable star.

Data and Analysis Resources

SIMBAD and VizieR at CDS Strasbourg for basic astrophysical data and variability results, MAST at stsci.edu for TESS Epoch Photometry and SAI Moscow for an up to date version of the GCVS. Data acquisition and presentation used TOPCAT from Bristol University and the time series analysis utilised PERIOD04 https://period04.net/

Eclipsing Binary News

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Eclipsing Binary Patrol

This is a partnership project set up by NASA which uses citizen scientists to examine data from TESS which suggests eclipsing binary systems. More information can be found on <https://www.zooniverse.org/projects/vbkostov/eclipsing-binary-patrol/about/research>. The first paper of the project has been accepted for publication by the Astrophysical Journal. The paper can be studied at <https://arxiv.org/abs/2506.05631>

The paper is entitled "The TESS Ten Thousand Catalog:10,001 uniformly vetted and validated Eclipsing Binary Stars detected in Full-Frame Image data by machine learning and analysed by citizen scientists". Machine learning looked at 1.2 million systems that might be EBs and found 60,000 that were worthy of further examination. The paper illustrates the identification of 7936 new eclipsing binaries and 2065 known systems. The paper highlights new, interesting, systems worthy of further and sustained examination.

The human examination was necessary because machine learning could only identify EB candidates. Human checking was necessary to confirm that the system was an EB. There was a possibility of contaminated light curves. For example. because stars were close together, had transiting exoplanets, ellipsoidal features, and star spots.

In looking at known EBs the human volunteers identified 2065 systems where the correctly measured periods differed from literature values.

Interesting Systems

The paper identifies a number of systems which are worthy of follow up investigation. As the vast majority of the systems are in the magnitude range 12 to 14 this may be of interest to CCD users.

The categories of interesting systems are:

- Additional eclipses suggest a triple or a quadruple system.
- Eclipse timing variations possibly due to the presence of additional bodies.
- Disappearing eclipses.
- Switching eclipses.
- Apsidal Motion.
- Stellar variability.
- Transiting planets.

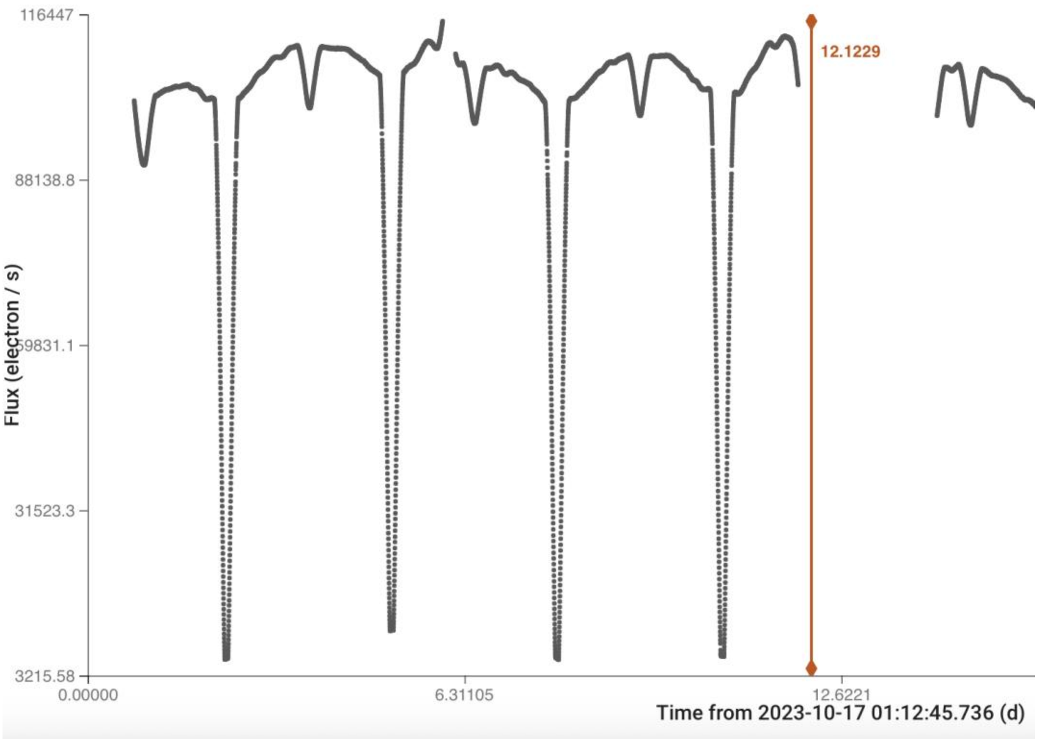
RW Tau

RW Tau is an EA system on our observing list. It has a period of 2.77 days and varies from 7.98 to 11.59 magnitude. This is the largest variation of any eclipsing binary. In an article on the system in

VSSC 171 (2017) Chris Lloyd commended observations/ measurements of an ‘interesting and unpredictable’ system. It deserves to be observed more frequently.

It appears from our database that the system has not been observed since 2018. It may seem a challenge to DSLR measurements because of the depth of the primary eclipse. However, out of eclipse measurements of an active system will always be useful and an easy DSLR target between 8 and 9th magnitude. It should be possible to make good measurements of the time of the midpoint of the primary eclipse by making five measurements between 9 and 10.5 magnitude on the fade and on the recovery from the primary eclipse. Of course, the primary eclipse will be an easy target for CCD observers.

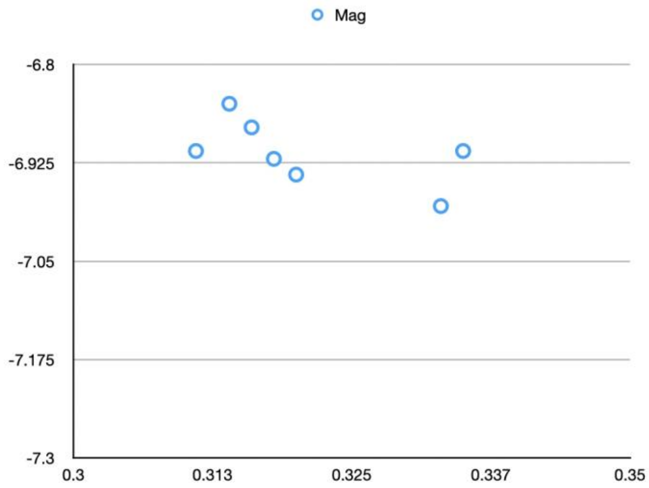
Below is fairly recent (October 2023) set of RW Tau light curves using TESS data obtained from the MAST website. It shows active features.



U Cephei

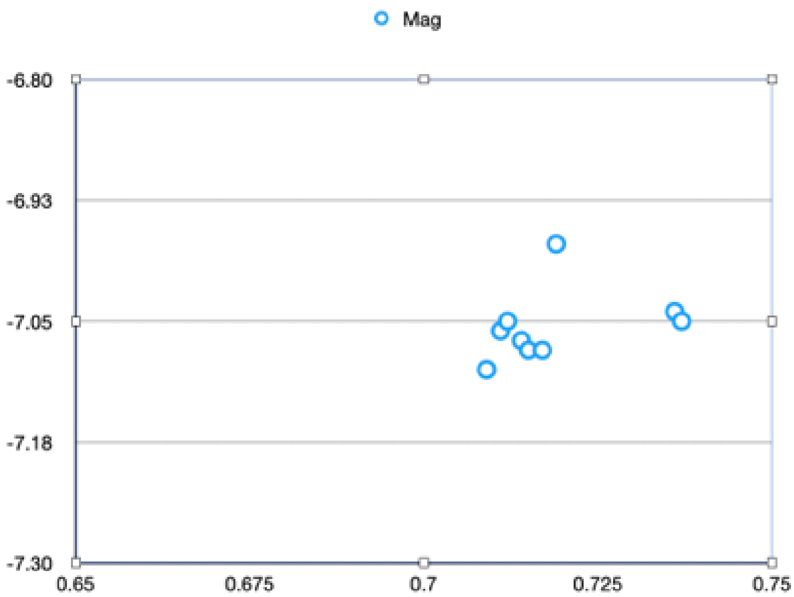
U Cep is a well-known system in which the literature states have an out of eclipse magnitude of 6.75. It is also known as a system with active mass accretion which creates a turbulent circumstellar disk. Gas and mass streams across from the secondary to the primary. TESS has looked at this system and recorded significant out of eclipse variations. On two nights in April, I made some out of eclipse measurements to discover if U Cep continues to be an active system.

Below is a diagram showing seven measurements on the night of 5/4/26 (JD 2461136) between 9pm and 10.30pm. The vertical axis is magnitude, and the horizontal axis is the phase of the system. It can be seen that general brightness is less than 6.75 and the measurements show an out of eclipse variation of 0.13 magnitude.



The diagram below shows nine measurements on the night of 6/4/26 (JD2461137) between about 9pm and 10.30pm. The vertical and horizontal axes are as before. It can be seen that the general brightness is around 7.05 magnitude. Much less than 6.75. The out of eclipse variation is once again 0.13 magnitude.

These results confirm that U Cep continues to be an active system with fluctuations in brightness caused by the dynamics of the accretion disk process. It is planned to do, this coming autumn, a much longer sequence of DSLR measurements to get a better picture of what is going on.



Spectroscopy of the Algol Eclipsing Binary star U Cephei

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The Algol-type eclipsing binary star U Cephei is investigated with a low resolution Alpy 600 spectroscope (resolving power 600). An estimate is made of the spectral type of the giant secondary star, and variable hydrogen Balmer emission lines are observed. Significant variation is also noted in the spectrum continuum outside of eclipse.

Introduction

The eclipsing binary U Cephei was the BAA's Variable Star of the Year for 2006.[1] Since 2006 almost 24,000 photometric observations have been added to the BAA and AAVSO Databases combined, whilst just 4 spectroscopic observations were recorded. This article aims to show why U Cephei deserves more spectroscopic attention from amateurs.

Primary eclipse (orbital phase = 0) occurs every 2.49 days when the hot, bright primary star slips behind its cooler giant companion and the star fades from 6th to 9th magnitude.[2] Total primary eclipse lasts around two hours, due to a high 83° orbital inclination and a 0.62 ratio of the diameters of the primary and secondary stars.[3] A possible schematic of the system is presented in Figure 1, inspired by the 1983 paper by Mirek Plavec which discusses the ongoing mass transfer from the secondary to the primary star.[4]

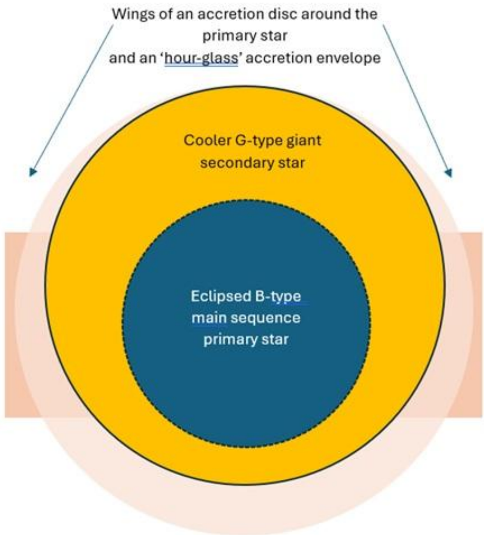

Figure 1: Schematic projection on the sky of the U Cephei system at the time of mid-primary eclipse

The U Cephei spectrum undergoes a remarkable transformation on entering total primary eclipse, when only the secondary star is visible (Figure 2). Hydrogen Balmer lines are also in net emission during total eclipse, arising from the envelope and accretion disc around the primary star.[3]and[4]

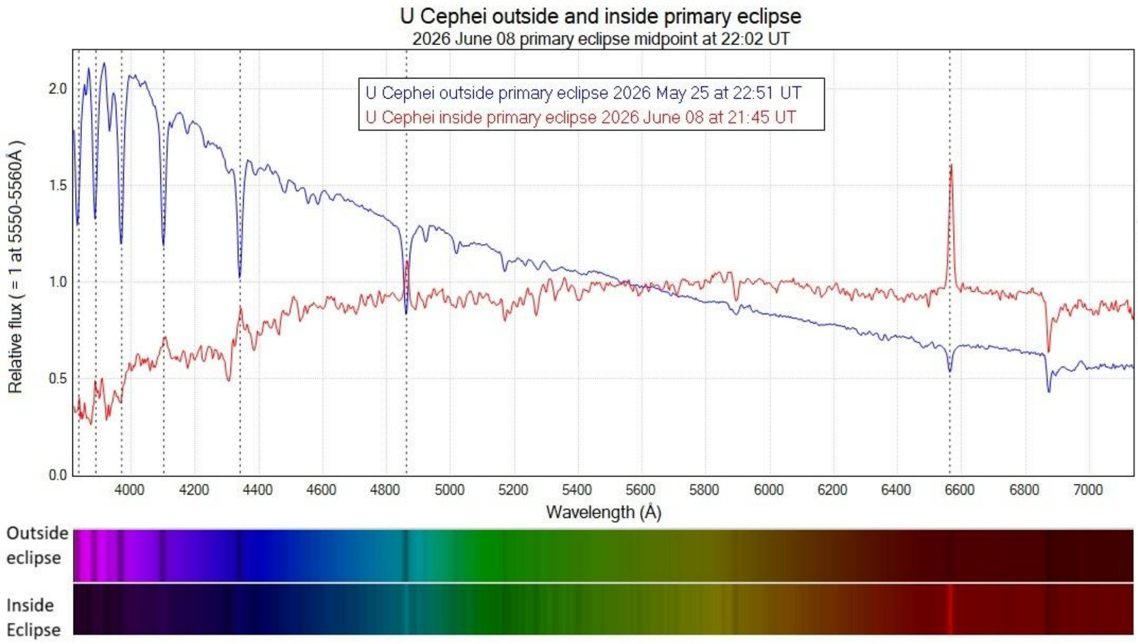

Figure 2: U Cep spectrum comparison outside and inside primary eclipse. Hydrogen Balmer lines marked by vertical dashes
Primary eclipse midpoint timing from TIDAK (TIming Database at Krakow)

Using an Alpy 600 spectroscope (resolving power R = 600 at hydrogen-alpha wavelength) on an 8" Meade LX90 telescope, a dozen observations were made over a range of orbital phases including three during total primary eclipse (Table 1). All spectra are available to view and download from the British Astronomical Association Spectroscopy Database https://britastro.org/specdb/

Observation date	Start of first exposure (UT)	Corresponding orbital phase
2016 August 08	21:13	0.61
2016 August 09	21:15	0.01
2023 April 03	19:58	0.88
2026 May 24	22:19	0.99
2026 May 25	22:51	0.40
2026 June 08	21:35	0.00
2026 June 13	21:36	0.00
2026 July 10	22:02	0.84
2026 July 12	21:42	0.63
2026 July 16	22:11	0.25
2026 July 19	21:45	0.44
2026 July 24	21:31	0.44

Table 1: Timings of the observations used in this article. Orbital phase calculated from ephemerides in TIDAK (TIming Database At Krakow)

Spectral type of the giant secondary star

The 2-hour duration of primary eclipse gives the spectrum of the secondary star. By comparing to reference spectra from the Pickles Library, a G5III giant classification is derived (Figure 3), which is within the range G5/8 III-IV found in the literature.[3] Interstellar reddening has not been considered, based on the low colour excess E(B-V) = 0.03 reported for U Cephei.[4]

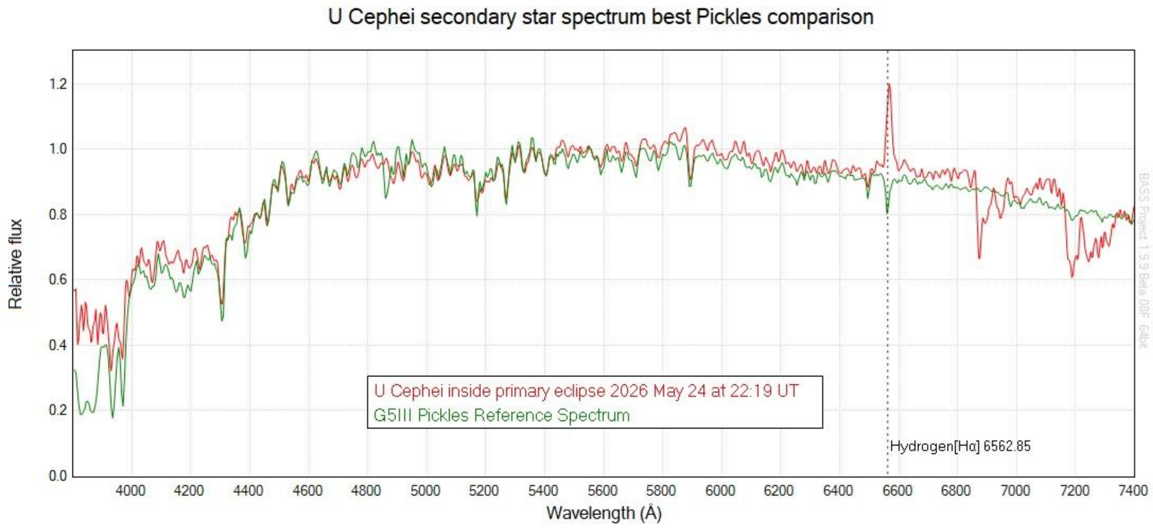

Figure 3: U Cephei secondary star with best Pickles comparison spectrum G5III giant

Variable hydrogen alpha emission

During total primary eclipse, the spectrum of the secondary star displays hydrogen Balmer emission lines. Their relative intensity (Equivalent Width EW) has been measured in the spectra calibrated in relative flux, after dividing out the background using the G5III Pickles reference spectrum. Using relative rather than absolute flux works only because the visual magnitude of the secondary star is quite stable e.g. V-band data from observer SAH in the AAVSO database gives a spread of average V-magnitudes of 9.027 to 9.042, for eclipses between 2025 August 21 and 2025 September 15.

From one primary eclipse to another, a significant variation is seen in the intensity and Doppler shift of the hydrogen Balmer emission lines, particularly visible in the hydrogen-alpha emission (Figure 4). This can be explained by the dynamic nature of the material transfer process from the secondary to the primary star.[5] It would be interesting to observe the hydrogen Balmer emission at higher resolution, to reveal any structure in more detail.

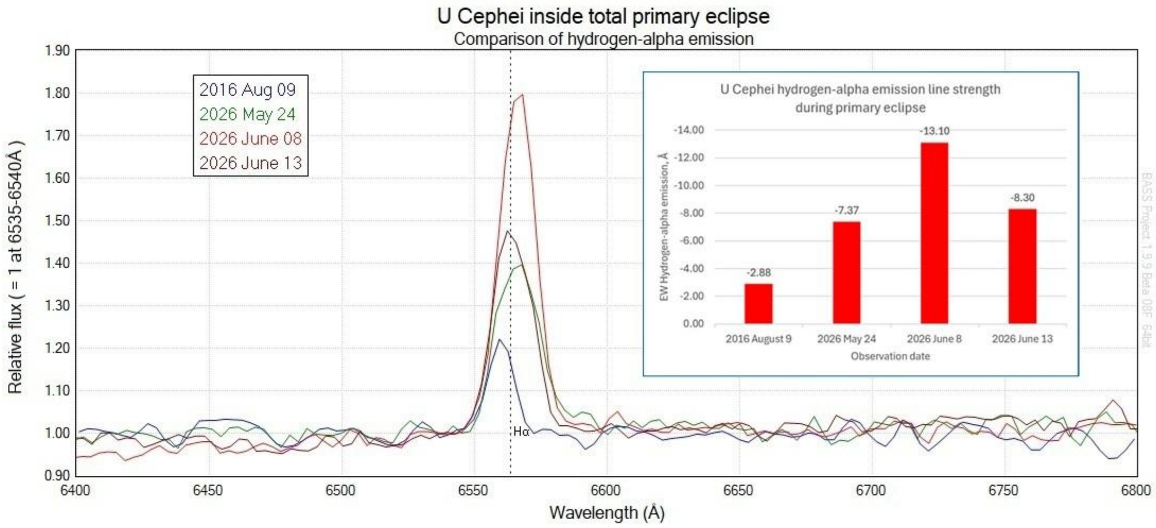

Figure 4: Variable hydrogen-alpha emission line intensity in the spectrum of the red giant
Absorption lines in the spectra have been divided out using the G5III Pickles reference spectrum

Outside primary eclipse, variation in the hydrogen Balmer emission can continue to be observed by following the relative intensity (Equivalent Width) of the hydrogen Balmer absorption lines – their intensity is reduced by compounding with the emission. Interestingly, by plotting the observed intensity against orbital phase (Figures 5) a possible correlation emerges, but more data is needed.

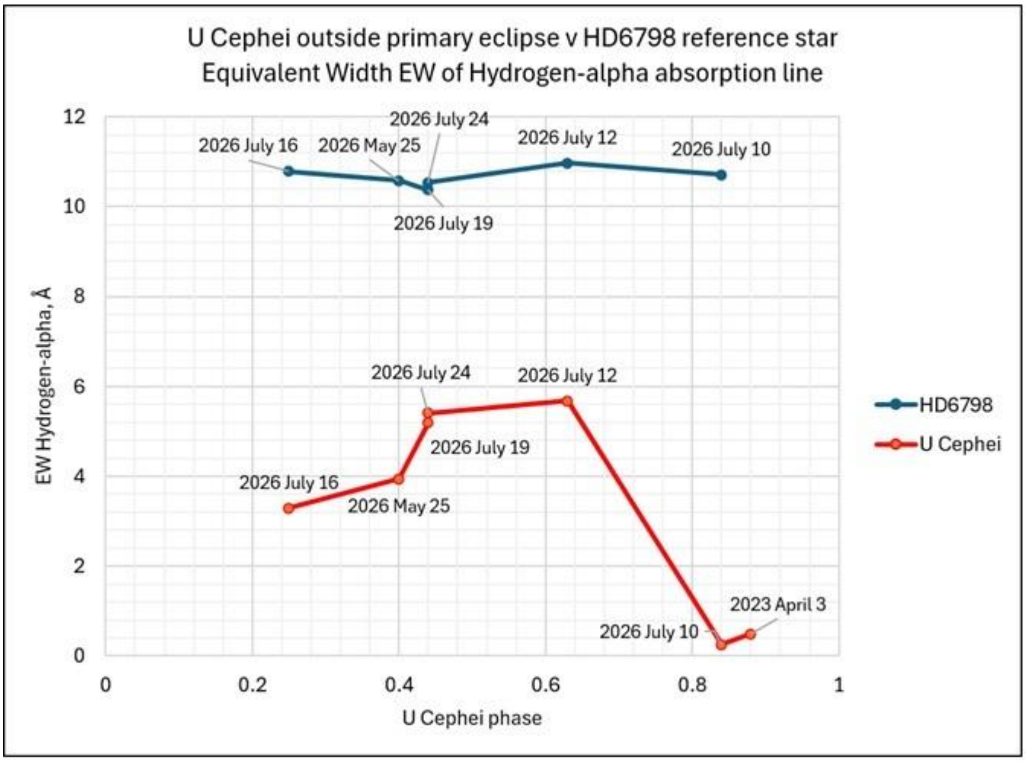

Figure 5: Variation in the hydrogen-alpha absorption line strength.
By plotting the contemporaneous variation in the reference star it is clear how the variation in U Cephei exceeds experimental error

Changes in the spectrum continuum outside primary eclipse

Outside primary eclipse, the shape (continuum) of the U Cephei spectrum varies significantly at the blue end (Figure 6).

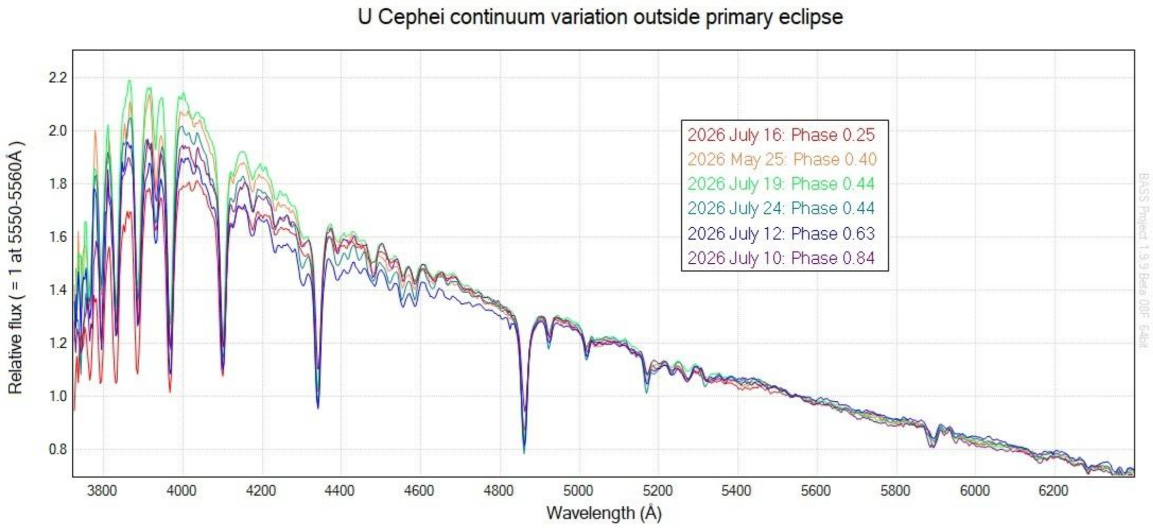

Figure 6: Comparison of U Cephei spectra outside primary eclipse, zoom onto the blue end of the spectra

Correction of the U Cephei spectra for atmospheric and instrumental effects is consistent from night to night, based on the same correction to the reference star HD6798 on each night (Figure 7). More data could highlight any interesting phase dependency, but follow-up observations should use the same reference star. The observed continuum variation may be linked to structure in the envelope and accretion disc around the primary star noted in a paper by Narusawa.[6]

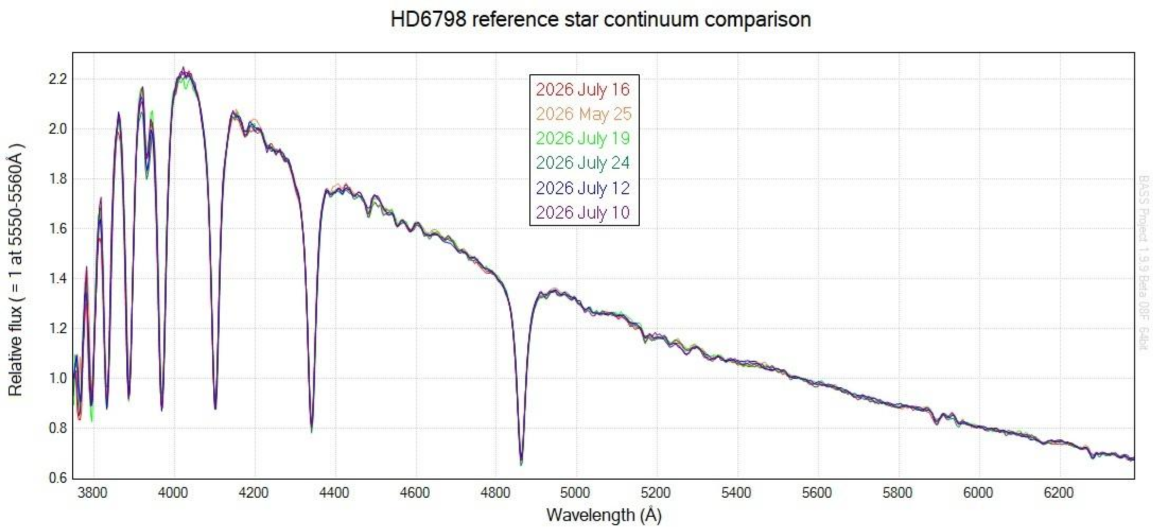

Figure 7: Comparison of HD6798 spectra showing the consistency of the response correction then applied to each U Cephei observation

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Period evolution of the solar-type binary UV Leonis

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The short-period, solar-type binary UV Leonis has a variable period that can be interpreted in a variety of different ways. The dominant variation appears to be an abrupt change between two constant periods, but it is also consistent with the light-travel time effect of a low-mass star in a 109-year orbit. A more complex scenario with a secular change and additional cyclical components could also be constructed. The eclipse timings appear to be particularly disturbed by spots on the surfaces of the components

Understanding the period behaviour of close binaries is important because it helps identify third bodies in the systems, evolutionary changes, and other physical processes that are taking place. These results feed into population studies and evolutionary models of single and binary stars, and stellar atmospheres. Unfortunately, the O–C diagrams of many short-period binaries do not cover enough time and are open to interpretation, and the problem is exacerbated if the times of eclipse is confused by surface activity. UV Leonis is one such star.

UV Leonis (HD 92109, HIP 52066, BD+15◦2230, GSC 00845-00146) is a bright and well-observed eclipsing binary containing two solar-type components. The variability was discovered by Hoffmeister (1934) and it was identified as an eclipsing system by Jensch (1935). The period was initially given as 0.3 days, but the true value is close to 0.6 days (attributed to H. Schneller in Guthnick & Prager, 1936). The system has V ≃ 8.8 outside eclipse and the eclipse depths are ≃ $0^{m}.6$ (see Fig. 1). Light curves of the system show a variable O'Connell effect (O'Connell, 1951, Johnston et al., 2019) and changes in the depth of the eclipses (see e.g., Soliman et al., 1985, Frederik & Etzel, 1996), and over time (see Mikuz et al., 2002, and Fig. 2). These are usually attributed to spots, and spotted

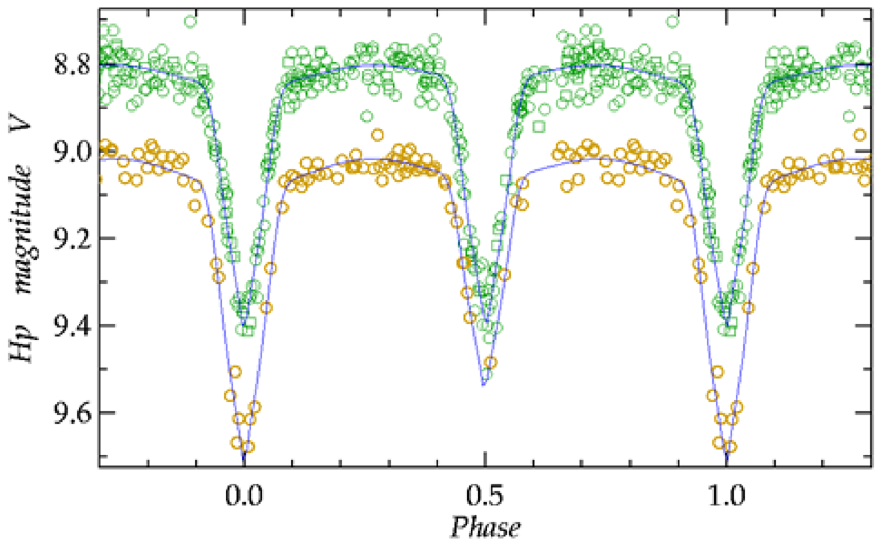

Figure 1: The light curve of UV Leonis showing the ASAS3 V-band data covering the years 2003 – 2009, and the Hipparcos Hp photometry from 1989 – 1992. The light curves are modelled using the procedure of Mikulasek (2015) and the residuals from the ASAS3 fit are shown vs. time in Fig. 2.

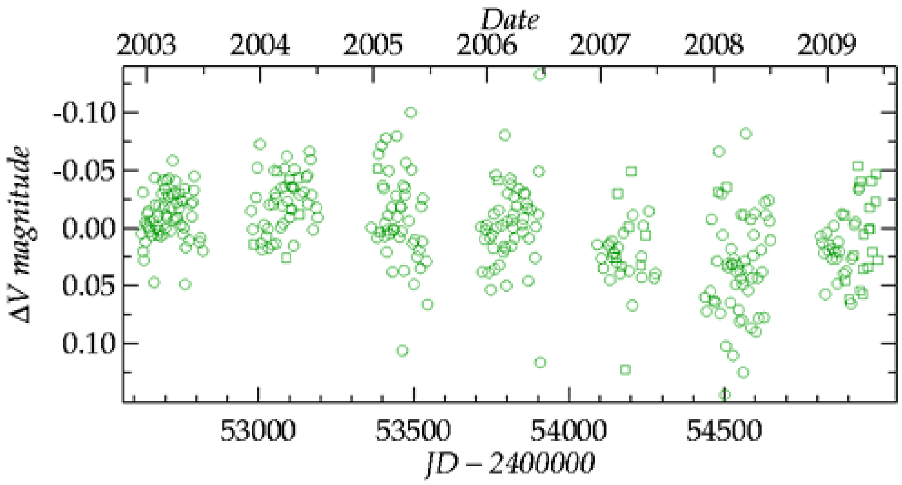

Figure 2: The residuals of the ASAS3 photometry from the mean light curve in Fig. 1 showing the change in level and dispersion over time, indicating changes in the level of activity on the surface.

photometric models find one or two spots generally towards the poles (see e.g., Frederik & Etzel, 1996, Djurasevic et al., 2005, Manzoori, 2012). Photometric models suggest that the components are slightly hotter and larger than the Sun and consistent with the spectral types of G0V+G2V. The light curve is variously described as Algol-type and β Lyr, but the models show that the components are detached with about 1 $R_\odot$ between their surfaces, and nearly spherical (see Frederik & Etzel, 1996). Radial velocity studies consistently give masses of the components near 1.2 and 1.1 $M_\odot$ (Zwitter et al.), The system is an X-ray source (Kiraga, 2012) and shows chromospheric lines (Zwitter et al.), which combined with its apparent magnetic cycles has led to its comparison with short-period RS CVn variables.

There have been suspicions about the stability of the period for many years, as was noted by Broglia (1965), and this probably reflected the effect of the spots on the times of minima. Longer term trends

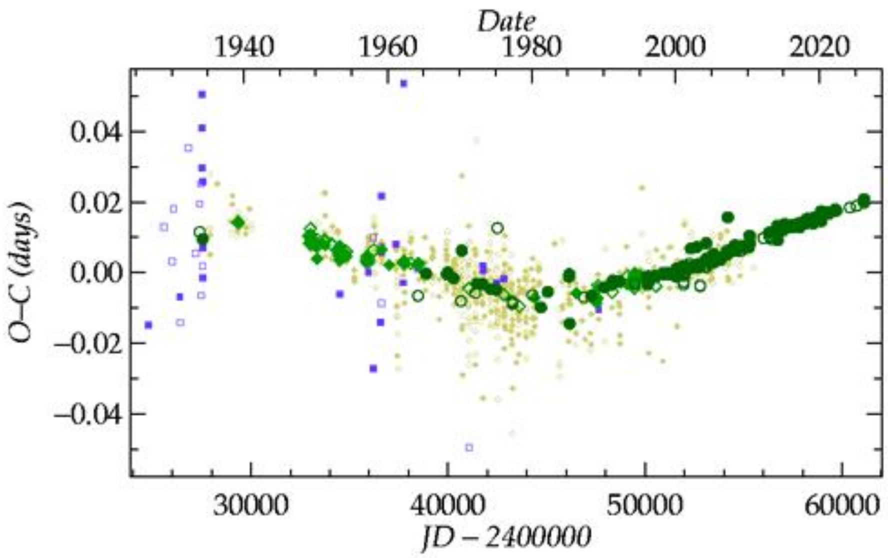

Figure 3: The full O–C diagram of UV Leo. Different symbols identify the photographic data (blue), visual data (yellow) and PEP/CCD/CMOS data (green). Filled symbols are primary minima and open symbols show the secondary. One discrepant pg timing lies outside the plot. The most obvious variation could be described by two broadly constant periods or could be consistent with the light-travel-time effect (LTTE) of a third body, or indicate a secular decrease in period, but this would generate low-amplitude cyclical variations.

in the period were suggested by Ahnert (1973) and Mallama (1980), while Rafert (1982) excluded apsidal motion, but rather optimistically fitted both quadratic and periodic terms. The first convincing evidence of any change in period was given by Wunder (1995), who suggested an abrupt increase between two constant periods from $0^d.60008478$ to $0^d.6008641$ at JD ≃ 2444000 (1979). Using rather less data Snyder & Mattingly (1995) fitted an increasing quadratic term, but then later Snyder (1998) fitted both quadratic and periodic terms. With slightly more data Mikuz et al. (2002) reverted to the abrupt period increase interpretation, with results very similar to Wunder. More recently, Elmasli et al. (2005) provided a convincing third-body light-travel-time effect (LTTE) fit to the O–C residuals, with a slightly elliptical, e = 0.3 orbit, and a period of 72 yr. The LTTE amplitude is $0^d.0060$ and is consistent with a suitably low-mass third body. The main concern is that barely one cycle of the third-body orbit has been covered. In the most recent study Manzoori (2012) treats the main variation as a continuous, secular change and then fits a periodic term to the residuals. Consequently, this results in a shorter period at 30 yr, which generates a suspiciously large third-body mass at 0.7 $M_{\odot}$.

In addition to the photometry mentioned earlier UV Leo has a long history of eclipse timings, including photographic, visual and the more modern pep/CCD/CMOS data. These have been taken from the collection of the O–C Gateway, and supplemented with recent data from the *Circulars* (Conner, 2021, 2026, Vale, 2024, 2025). The full O–C diagram is given in Fig. 3 and shows a clear increase in period at JD ≃ 2446000 (1985), between two apparently constant periods. However, it is immediately obvious that there is significant scatter in the timings, with apparently discordant points, and coherent runs suggesting some underlying structure. The dominant variation does not appear to be parabolic, so does not suggest a secular increase in period, and a quadratic fit immediately generates cyclical variations that require another explanation, such as a short-period third body or magnetic cycles, as found by Snyder (1998) and Manzoori (2012). The discussion here is limited to fitting a third body, and two constant periods.

In order to calculate the parameters of the third-body orbit the observed times of minimum are fitted to a standard form of a linear ephemeris for the eclipsing binary plus an offset due to the light-travel-time effect (LTTE), so

$$HJD_k = T_0 + P_0 C_k + \tau_k \qquad (1)$$

where T_0 and P_0 are the epoch zero and period of the eclipsing binary, C_k is the cycle number at minimum k and τ_k is the LTTE offset at minimum k. The LTTE expression given by Irwin (1952, 1959) has been used here, in which the light-travel time is given by,

$$\tau_k = A[(\cos E_k - e)\sin\omega + (1 - e^2)^{1/2} \sin E_k \cos\omega] \qquad (2)$$

where E_k is the eccentric anomaly at minimum k, e is the orbital eccentricity, ω is the argument of periastron, and $A = a_{12} \sin i/c$ is the semi-amplitude of the light-travel time of the orbit of the close-binary pair in reaction to the motion of the third body, where $a_{12} \sin i$ is the projected semi-major axis of the orbit. The parameters fitted are the eclipsing-binary period and zero point of the linear ephemeris, P_0 and T_0, and similarly for the third-body orbit, P_3, and the time of periastron T_3, as well the eccentricity, e, the argument of periastron, ω, and the semi-amplitude of the light travel time, A. In the first instance the orbit was treated as circular, so e = 0 and ω = 0.

While there may be some suggestion that the earliest data show some rolling over, that is clearly not the case for the most recent timings, so a complete cycle has not been seen and the period of any third body must be longer than the span of data. The pg and PEP/CCD/CMOS data were used for the LTTE fit, but the vast majority of these timings have no uncertainties associated with them. After some trial solutions the pg and electronic data were assigned errors of 0.0266 and a minimum of 0.00214 d respectively, so that their separate contributions led to a final reduced chi-squared close to one.

Where measured errors are available for the electronic data, they are significantly smaller, suggesting that timing errors due to distortion of the eclipses far exceeds measurement errors.

Table 1: Circular Light-Travel-Time solution

T_0 (HJD)	=	2447615.4434(8)	
P_0 (d)	=	0.600085952(31)	
A (d)	=	0.0118(7)	
e	=	0.0 (fixed)	
ω (°)	=	0.0 (fixed)	
T_3 (HJD)	=	2456445 ± 657	
P_3 (d)	=	2439641 ± 1882	109 ± 5 yr
a_{12} sin$i$ (au)	=	2.05(12)	
$f(m)$ ($M_{\odot}$)	=	0.00073	
m_3 sin^3i ($M_{\odot}$)	=	0.16	

Despite the limited coverage of the third-body orbit, the LTTE solution surprisingly converged on a period just longer than the run of data. The parameters of the circular fit are given in Table 1 and the solution is shown in Fig 4. Given that the two main sections of O–C residuals appear straight, the LTTE solution provides a remarkably competent fit. The only sections where it could be more thoroughly tested are near the maximum and minimum of the fit, but unhappily here the data thin out. The expanded plot of the residuals from the solution shows a weak oscillation in the later data and clearly identifies clusters of points that stand off the fit, and again these are probably related to distortion of the eclipses by spots. Attempts to improve the fit using elliptical orbits, with the period fixed at the circular value, yielded no convincing improvement.

From the amplitude of the light-travel time, the period and the mass of the binary pair it is possible to derive additional parameters using the well-known expressions for the mass function (see e.g.,

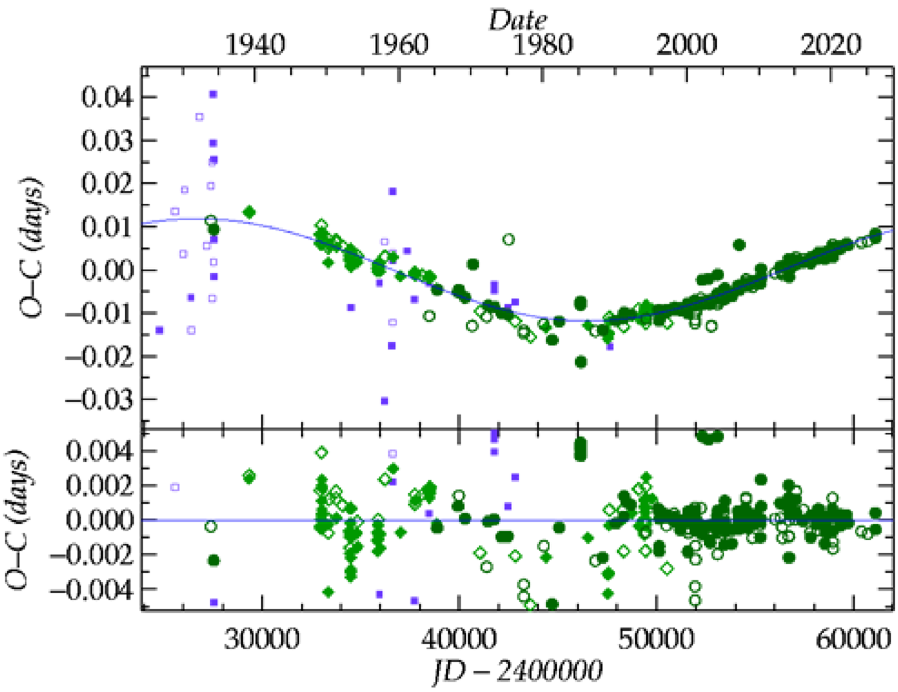

Figure 4: The O–C diagram of UV Leo showing the pg and electronic data, with the LTTE fit. The symbols are as before. The lower panel shows an expanded view of the residuals from the fit.

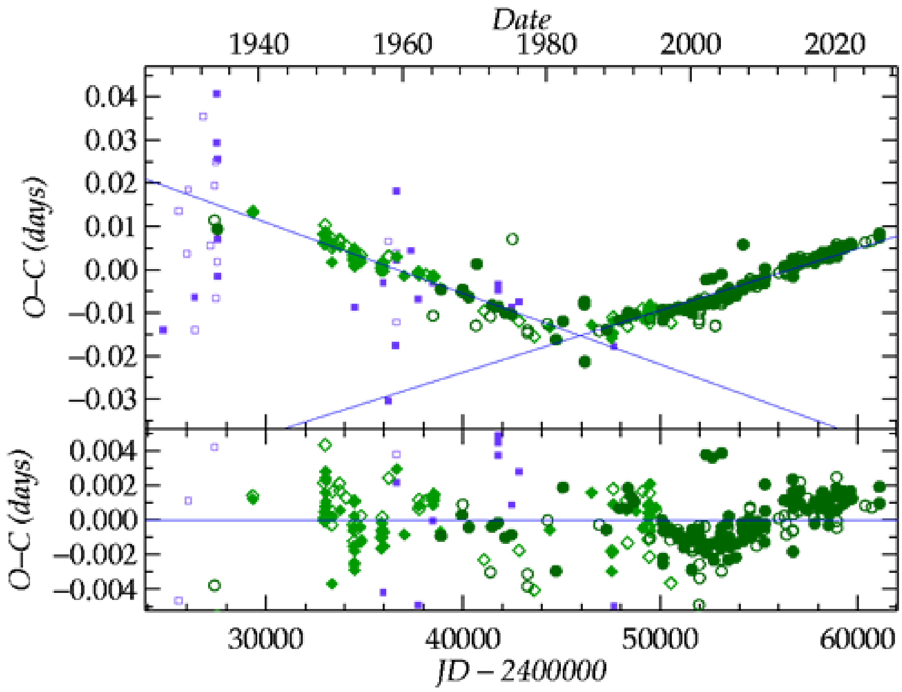

Figure 5: The O–C diagram of UV Leo showing the pg and electronic data, with the two linear fits. The symbols are as before. The lower panel shows an expanded view of the residuals from the individual fits.

(Hilditch, 2001)

$$f(m) = \frac{(a_{12}\,sin\,i_3)^3}{P_3^2} = \frac{(m_3\,sin\,i_3)^3}{(m_{12} + m_3)^2} \qquad (3)$$

where m_{12} is the mass if the close-binary pair, m_3 is the mass of the third body and a_{12} is the semi-major axis of the binary pair in the third-body orbit, and the other constants have their usual meaning. Taking the total mass of the binary as $m_{12} = 2.3\ M_\odot$ (Zwitter et al.) then the minimum mass of the third body is $m_3 = 0.16\ M_\odot$, and well within the range of companions seen in similar systems.

The two constant periods were calculated from weighted fits, using the same errors as for the LTTE solution. While this approach may have some dependence on the LTTE solution, it is probably the least subjective way of assigning these uncertainties. Previous attempts at separating these two sections suggested a dividing line at JD $\simeq$ 2444400, and experiments from this time to JD= 2446900 suggest that the time most consistent with the crossover point is JD= 2445900. However, the total χ^2 of the fits improves later when the points around JD= 2446153, which are rather inconsistent, are included in the first set, as they are less incompatible with that fit. The solutions and residuals are shown in Fig. 5 and highlight the coherent variations during the second half of the data, that are also suggested in Fig. 4. The weighted ephemerides of primary minimum for the two sections divided at JD = 2445900 is...

$$JD_{MinI} = 2447615.4254(7) + 0.600084966(35) \times E \ldots\ JD < 2445900 \qquad (4)$$

$$JD_{MinI} = 2447615.4306(3) + 0.600086813(23) \times E \ldots\ JD > 2445900 \qquad (5)$$

giving $\chi^2_v = 1.25$, significantly larger than the LTTE solution. Not surprisingly, the quadratic fit is worse still, with $\chi^2_v = 1.36$, but all of these are to some extent at the mercy of which of the more discordant points are excluded, and here everything is included. Nevertheless, the one feature that is clear from the analysis is the low-amplitude oscillation that is imprinted on all the fits from JD ~ 2450000. It is possible, even likely, that this is due to the spots, but it is not clear if the times of minima are just perturbed, or if the period of the system is physically altered by magnetic cycles acting on the atmospheres of the stars. As for the dominant period changes all the explanations have their issues. The secular change and quadratic fit will by default generate additional cyclical terms if the simpler explanations are correct. Despite the difference in χ^2_v there is little to choose between the LTTE and two-period solution. The two sections are not linear, but that may have more to do with the spots than the dynamics of the system. Equally, the LTTE solution has not completed a full cycle, which is usually a prime requisite for a period, and for an orbital period of over 100 yr it is suspiciously circular. The problems with UV Leo are common to many short-period binaries, and the only way to resolve them is by continued observation.

Acknowledgements

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Light curves and phase diagrams for the eccentric eclipsing binary NS Draconis, including a query regarding its period.

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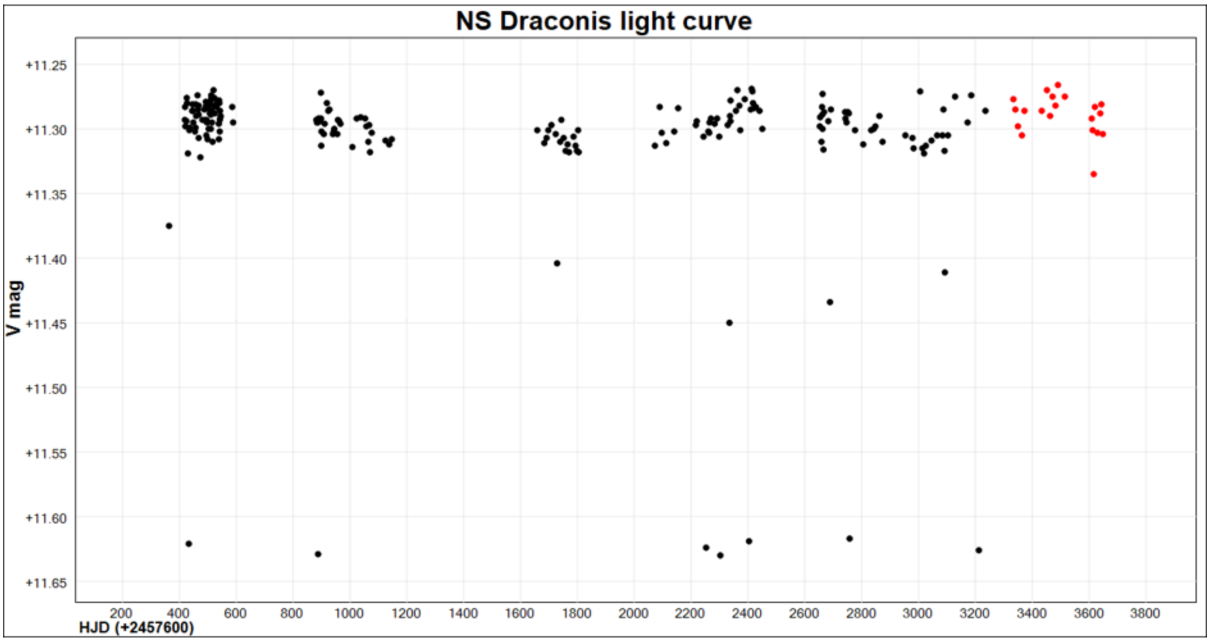
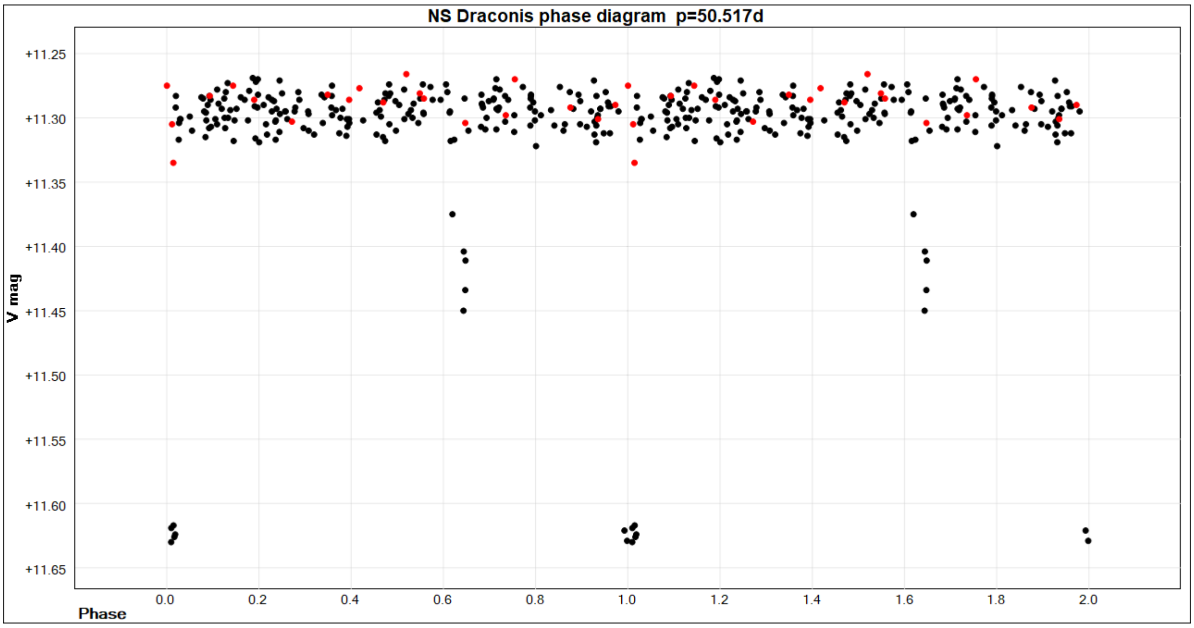
My observations of the long period (~50d) EA type eclipsing binary NS Draconis over the last 9 years (using the Open University observatories in Tenerife) have recently shown a small inconsistency with the catalogue period and a slightly different period is suggested which fits these observations better.

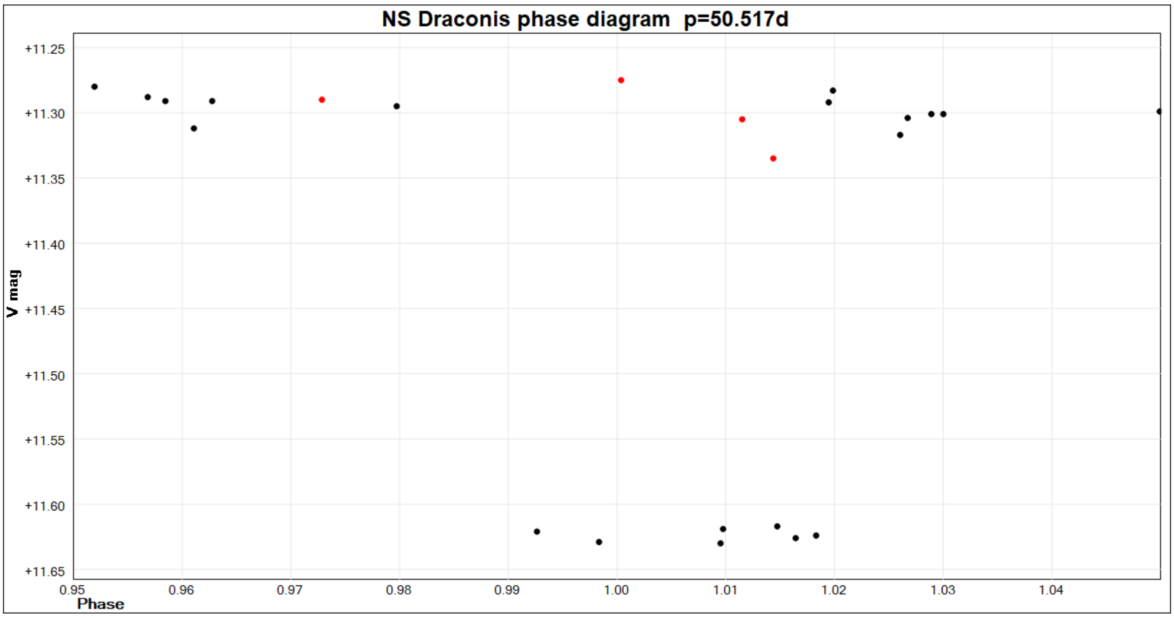
Light curve and phase diagrams of the EA type eclipsing binary NS Draconis / NS Dra, constructed from photometry of 222 images taken between 2017 July 28 and 2026 July 26 by the Open University COAST and PIRATE telescopes. The images were taken with a V filter and have been uploaded to the BAAVSS database.

There is a question mark regarding the period of this system as derived from these particular observations, in particular the later ones which are marked in red in the diagrams which follow.



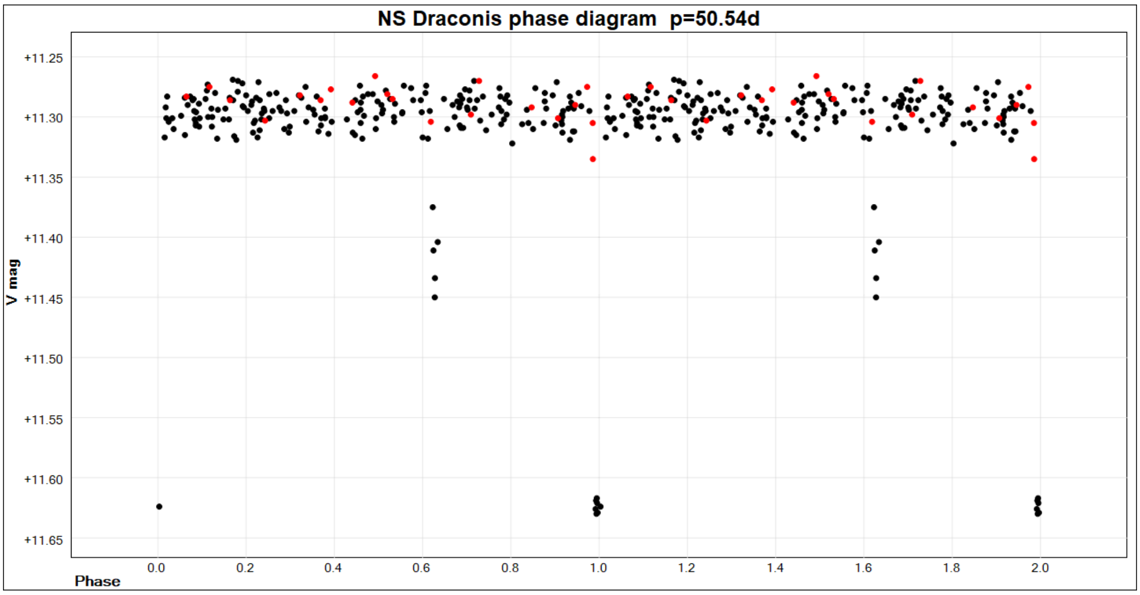
The catalogue value of the period at the time of writing (2026 August 6) is 50.517d (GCVS, AAVSO VSX). Plotting the phase diagram with this period and enlarging the primary minimum generates the following;

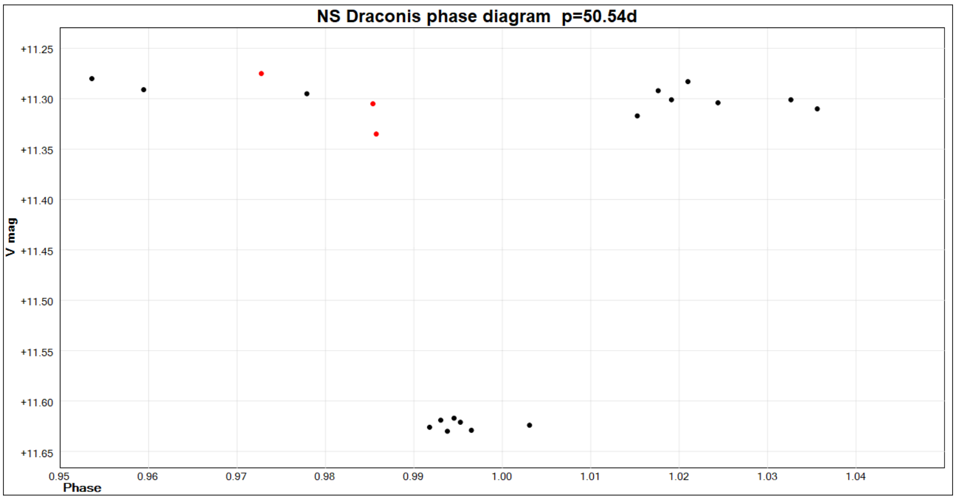


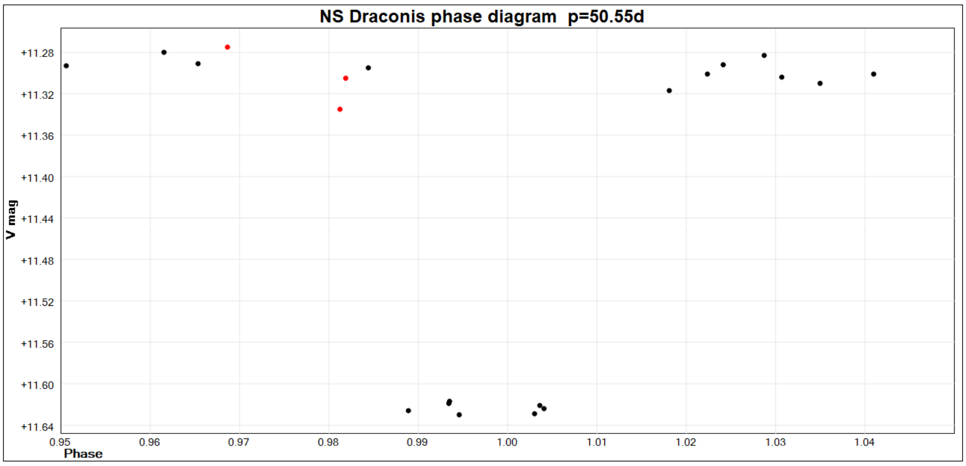


It will be seen that three of the recent data points, all of which essentially have the *maximum* magnitude, occur within what otherwise would be the primary minimum. These occurred on 2025 October 15, 2026 March 15 and 2026 June 24. (HJD 2460963.6714, 2461114.6596 and 2461216.4006 respectively). The times between these data points are 151 days and 102 days, or three periods and two periods of the system.

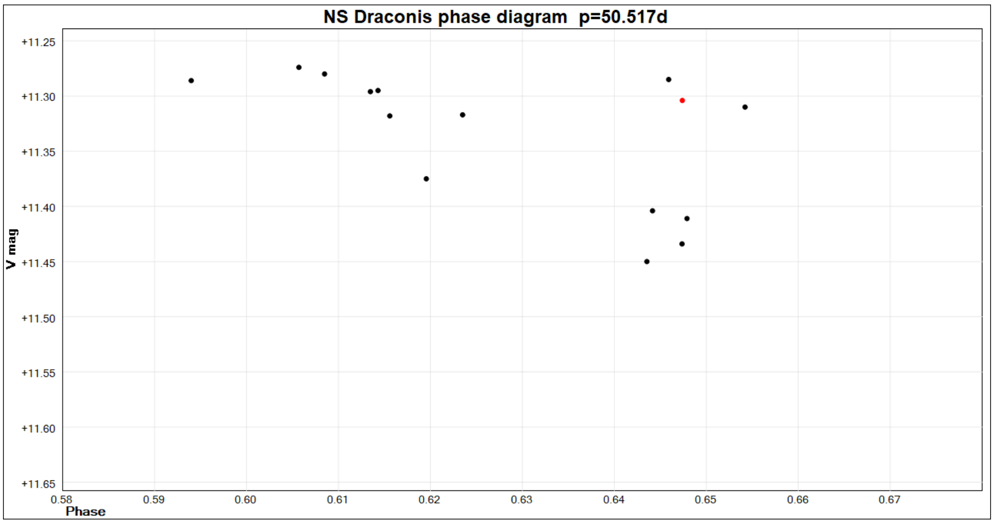
Notwithstanding that there are *only* three data points that appear inconsistent with the catalogue period, these data points fit the phase diagram better when it is plotted with periods within the range of 50.54 days and 50.55 days approximately. The shorter of these two periods suggests that one of the data points *could* be the start of the primary minimum.

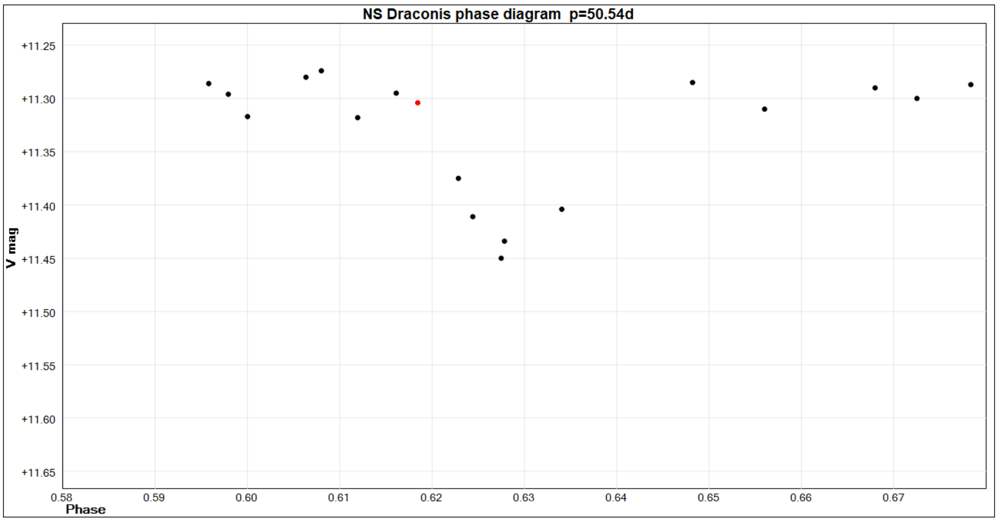






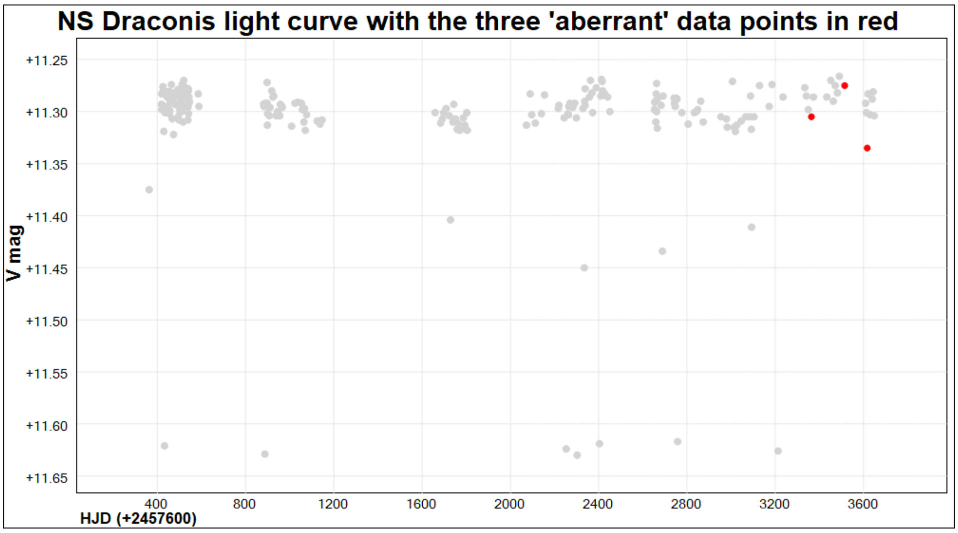
It should be noted that, from these results alone, the secondary minimum is consistent with both the catalogue period and the longer period of 50.54-50.55 days, as is its phase of 0.63.





During this analysis it was evident that different methods of determining the period of the system gave slightly different values for the period, some of which resulted in phase diagrams where the three current points of interest were actually within the primary minimum and some of which didn't. Different methodologies can generate different results from the same data, so checking is essential.

Another point of interest, the three data points in question are highlighted in red in the following light curve.



This raises the question; why are they all recent observations? The catalogue period of 50.517 days was originally published in 2006 (1), under the identifier GSC 04544-00439. This is a classic example of 'more observations needed' in order to provide more information, and this system remains in my current observing program.

https://davidsconner.weebly.com/

Reference

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WISE J164051.8+464105 is an Asynchronous EA/RS + UV Variable Star

John Greaves

A variable star typed as MISC in its source catalogue exhibits detached and symmetric primary and secondary eclipses with a period that differs from the RS Canum Venaticorum variability period and also presents the occasional stellar flare according to TESS QLP epoch photometry.

Introduction

Epoch photometry data for this spectral type K3 V (LAMOST) object from Chen et al 2018 WISE variability catalogue was obtained in an attempt to improve upon the stated MISC variability type given. General examination of the object readily revealed it to be an EA eclipsing binary with symmetric primary and secondary maxima that was likely also part of a common proper motion binary only 1.8 arcseconds in separation with a secondary of roughly 17th magnitude and likely a red dwarf. Period search was conducted upon the TESS epoch photometry and results obtained. GAIA and SDSS dr16 colour photometry and parallax measures showed that the secondary has Absolute G magnitude around 10.1 and SDSS g'-r' of 3.5 suitable for it being a red dwarf star, whilst the parallax indicates a distance for the system in the 250 parsec region.

Results.

The star shows RS CVn (RS Canum Venaticorum) type variability as well as varying depths minima of apparent multiple minimum magnitudes which is caused by the varying maximum light due to the RS CVn variability. In places small flares can be seen, identified by their fast rise with slow decline outburst profiles. It is assumed they come from the eclipsing pair as the visual secondary common proper motion companion is around four times fainter than the visual primary and flares rarely reach over four magnitudes of amplitude except into the UV range which the TESS flux passband (when converted to differential magnitudes) does not extend to.

The EA and RS variability periods are discordant showing that this system is of the less common asynchronous type as such close pairs of eclipsing stars are more often tidally locked as well as having strong interacting magnetic fields highlighted by the large starspot(s) presence and the X-ray suggested chromospheric and coronal activity. This may be due to it being a relatively youthful system where the stellar dynamo has not undergone significant magnetic field braking as yet (so called magnetochronology) but could be caused by some other factor such as past interference from interaction with an external object, although strong magnetic fields (if one is confirmed) can be suggestive of stellar youth in convective atmosphere main sequence stars. The star lies in a region of the sky not known for having any form of star formation.

The periods and amplitudes derived for the three variabilities are

EA	0.4894 days	amplitude	0.14	magnitude	minI
EA	0.4894 days	amplitude	0.12	magnitude	minII
RS	1.8 days	amplitude	0.07	magnitude	
UV	erratic	amplitude	0.035	magnitude	

The profile of the RS CVn variability matches well with both the spectral type and the X-ray sources associated with the star, the XMM-Newton and Chandra sources having arc second resolution astrometry allowing the secondary to be disregarded as a candidate source, with the X-rays potentially being a further indication of chromospheric and or coronal stellar activity that can be found connected with spectral K type variable stars that show signs of having large starspots. Similarly despite the separation of the secondary being less than the resolution of TESS telescope the difference of 4 magnitudes precludes any photometric signal from the secondary modifying the overall epoch photometry. The EA category of eclipses is obvious in both the raw and folded lightcurve with symmetric maxima and minima and have the same period as published in Chen et al 2018 when rounded down to four decimals.

The below four figures show the epoch photometry, folded RS CVn phase plot, folded eclipsing binary phase plot and finally the epoch photometry detail of the best covered flare.

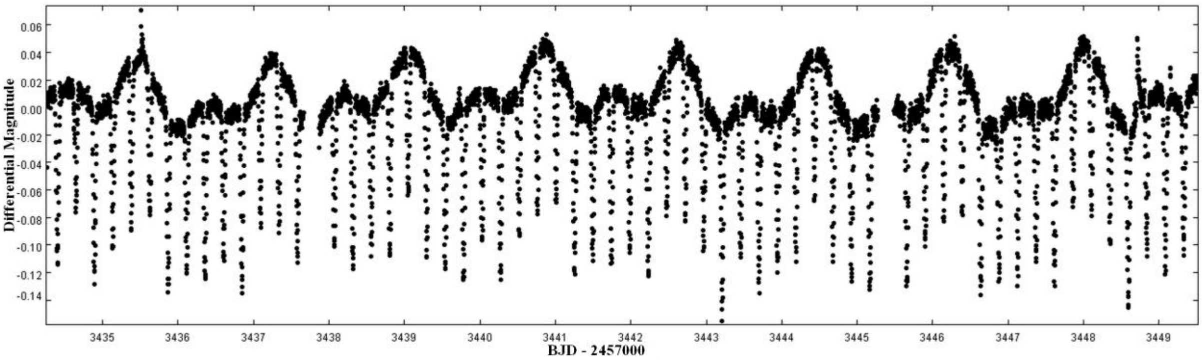

Figure 1 : TESS Epoch Photometry for WISE J164051.8+464105

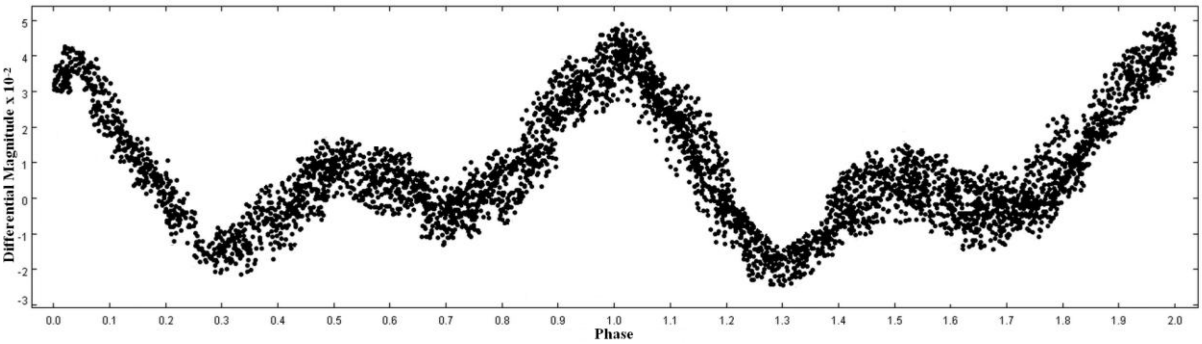

Figure 2 : RS CVn variability folded on a period of 1.8 days

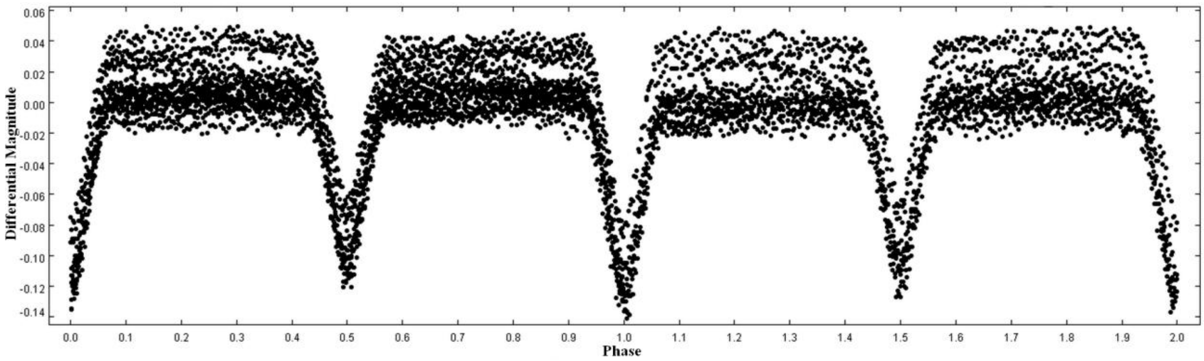

Figure 3 : Eclipsing variability folded on a period of 0.4894 days

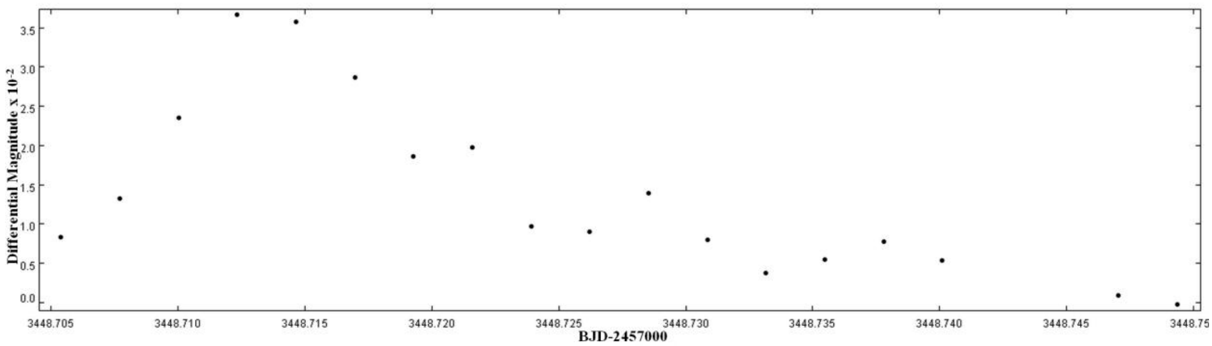

Figure 4 : Detail Epoch Photometry for a flare

Conclusion

The K3 V spectral type main sequence common proper motion pair primary star WISE J164051.8+464105 is actually an eclipsing binary with symmetric primary and secondary minima and 0.4894 day period with a tandem asynchronous RS Canum Venaticorum variation modifying maximum light of 1.8 day period is also subject to occasional stellar flares.

Accordingly the star is an EA/RS + UV variable with asynchronous EA and RS periodicity.

Acknowledgement of Data Sources

The WISE Catalogue of Periodic Variables is published in Astrophysical Journal Series Vol 245 Page 28 by Chen et al in 2018
The TESS QLP epoch photometry was sourced from the MAST Portal at mast.stsci.edu
The Spectral Type is from LAMOST data release 11 www.lamost.org/dr11/v2.0
CSC and XMM4 X-ray identification are from Chandra and XMM-Newton respectively
Two band photometry to estimate secondary's spectral type is from SDSS data release 16
Binary Star identification is from the USNO WDS Supplement Catalogue crf.usno.navy.mil/wds
TOPCAT www.star.bris.ac.uk/~mbt/topcat was used for figure generation from the TESS epoch photometry FITS file obtained from MAST

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Deadline for the next VSSC is November 15th 2026

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