Magnetic Orbital Decay of Solar-Type Binaries and Creation Implications

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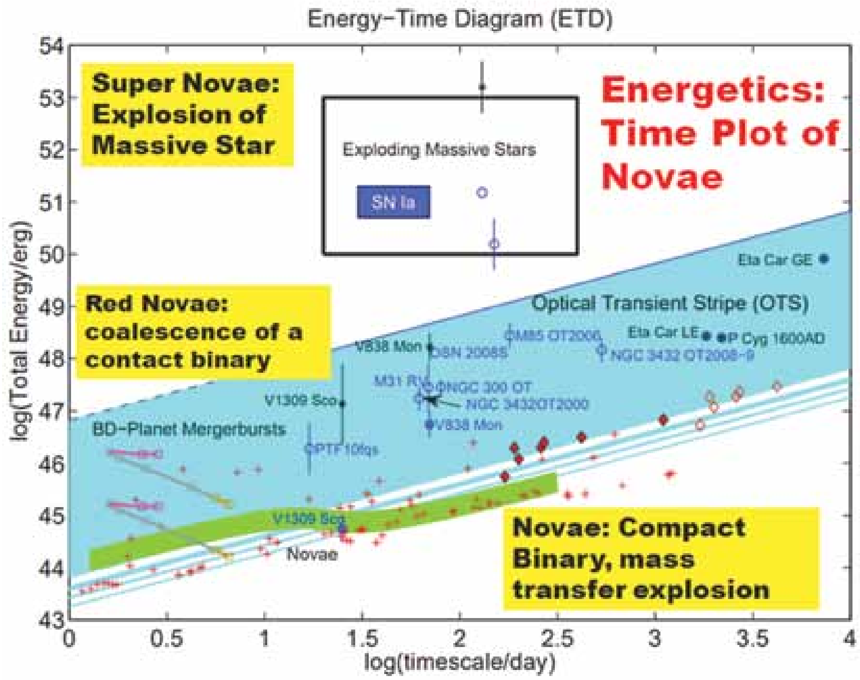
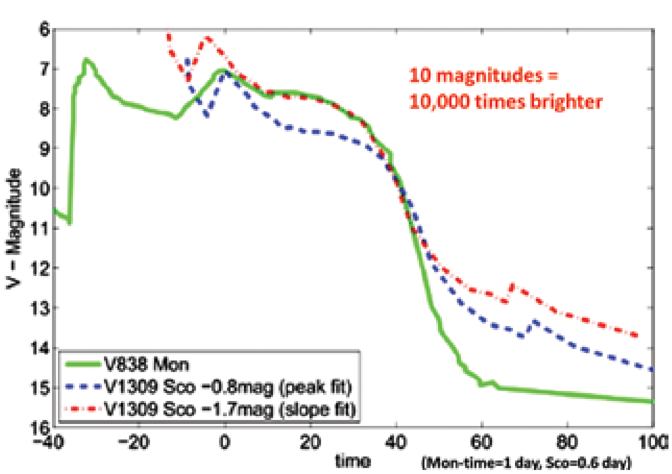
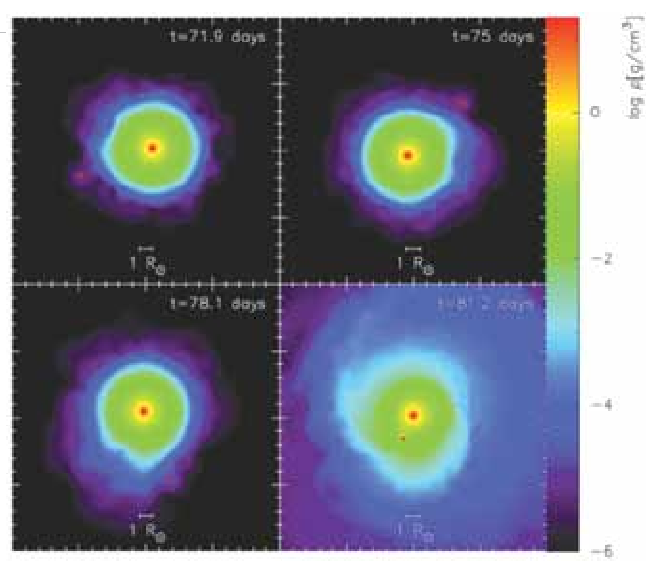


Figure 34 *(above)*. Energetics Time Plot of Novae comparing Super Novae, Red Novae, and Classical Novae. Note the energetics and the duration. (Kashi and Soker, 2010)

Figure 35 *(below left)*. The Observed Light Curve. Mon-time=1 day, Sco=0.6 d., arXiv:1011.1222, Amit Kashi, Noam Soker.

Figure 36 *(below right)*. The progression of a red novae. Follow left to right and up-down (explained in the text). (Nandez, Ivanova, and Lombardi, Jr., 2014)





Abstract

This study spins off the previously funded project from the Creation Research Society (CRS) entitled "The Apparent Age of the Time Dilated Universe: Gyrochronology, Magnetic Orbital Decay of Close Solar-Type Binaries" and the CRS undergraduate research initiative, allowing undergraduate mentors and their research students to request research grants from the society research committee. Our project involves answering the creation *time-dilation* cosmology question, "What maximum apparent age should be used to characterize the universe?" The basis for this part of the study centers on eclipsing binaries undergoing a clearly decaying orbit indicative of magnetic braking. This gives dP/dt (days/year) term where P (days) is the orbital period of the binary. From this, and the initial period of the binary, a *decay age* estimate is possible. Systems included in this study include eight recently analyzed by students, include the binary systems, V1695 Aquilae, NSVS 1083189, NSVS 10541123, V530 Andromedae, NSVS 5066754, FF Vulpeculae, GSC 3208 1986, V573 Pegasi, V1187 Herculis, GQ Cancri, and MT Camelopardalis. In addition, evidence of binary star coalescence into single stars and the subsequent and violent production of *red novae* will be reviewed. Young Earth Creation implications will be explored.

Introduction

This study spins off the previously CRS funded project, "The Apparent Age of the time Dilated Universe: Gyrochronology, Magnetic Orbital Decay of Close Solar-type Binaries" (Samec, 2016—hereafter referred to as Paper 2; Samec and Figg, 2012—hereafter referred to as Paper 1). In *Samec*-2, it was determined that binary evolution is taking place nearly 400 times faster than what was theorized. Observations have continued as a part of the CRS undergraduate research initiative, allowing undergraduate mentors and their research students to request research grants from the society research committee. Our project involves answering the creation *time-dilation* cosmology question, "What maximum apparent age should be used to characterize the universe?" The basis for this part of the study centers on eclipsing binaries undergoing a clearly decaying orbit indicative of magnetic braking. This gives dP/dt (days/year) term where P (days) is the orbital period of the binary. If an initial period of the binary is assumed, a *decay age* estimate is possible.

In paper 2, we extended the study to include longer-period solar-type binaries that were still undergoing continuous orbital decay (Samec et al., 2012a, 2012b, 2013, 2014, 2015). As a result, it was assumed that 5 days was the initial period for binaries that now have periods of 0.2–0.5 days. Furthermore, we assumed 8 days as the initial period for binaries that now have periods of 0.5–0.8 days, 10 days as the initial period for binaries that now have periods of 0.8–1.5 days, 15 and 20 days as the initial period for binaries that now have periods of 1.5–9.3 days. However, the periods of all of the binaries in this particular study are within the range of 0.3–0.6 days, intimating that we are only working with the short period end.

In a recent paper (Rucinski, 2017), a study was made of solar-type binaries of the OGLE project in Baade's Window. He found that the cut off of W Ursae Majoris (W UMa) type binaries (in this context, those undergoing angular momentum loss as well as other characteristics of this group) extend only

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to periods of ~1.5 days while the longer period types are a different group of binaries. In paper 2, plots and information from the benchmark paper (Guinan and Bradstreet, 1988) on these systems theorized that ~5 days was the limiting period for magnetic braking. In addition, Yildiz (2013) found in his "Origin of W UMa-type contact binaries…" study that the initial period of these binaries is less than about 4.45 days. Thus, the estimates of ages given in paper 2 could be regarded as an upper limit. I note that these papers again verify the assumption that these binaries are ancient. Mean ages of these contact binaries are found as 4.4 and 4.6 Gyr respectively. From kinematic studies, these ages are given as 4.5 and 4.4 Gyr respectively. The kinematic ages have to do with the space motions (velocity dispersions increase with age) and the other has to do with normally accepted stellar evolutionary treatments, such as the evolution on the H-R diagram. We have no problems with the kinematic interpretation save the long ages, which again are substantiated by accepted stellar ages (please see "Solar Age Condition" [the prevailing assumption of a 4.603 x 10^9 years or 4.603 Gyr age Sun] in paper 2).

Magnetic Braking

This is only a brief review. For a more extensive explanation, see papers 1 and 2. Solar-type stars (roughly type F-V to M-V) have deep convective envelopes made up of swirling plasmas that are magnetic in nature with strong dipole magnetic fields and magnetic phenomena, notably star spots. Stellar plasma winds escape the North and South poles out to the Alfven radius of the stars (about 15–30 solar radii Goelzer et al., 2014). This allows the transport of charged mass particles on stiffly rotating magnetic field lines spinning with increasing radii, with increasing angular momentum into space, L=mvr. This continuously removes angular momentum, ΔL, from the binary causing angular momentum loss (AML). This effectively torques the star, $\tau = \frac{dL}{dt}$. For a single star (see Figure 2), it causes the the rotation to slow, finally leaving a slowly rotating star (from periods of a few days to about a month) like our present sun. For a solar-type *binary* system (two stars co-orbiting about a center of mass or barycenter), the same magnetic braking occurs but the orbital radius shrinks and, by Kepler's third law, the orbital period shortens (see Figure 3). When the atmospheres of the stars touch, the stars are called contact binaries. The stars continue to coalesce until they violently form, by a *red novae event* (discussed later in this paper), fast-rotating single stars such as A-type stars or subgiants, similar to the spotted FK Comae stars in globular clusters. The orbital period P_{orb} (days) is related to the stars' angular momentum by the relationship, $L_{orb}=1.242 \times 10^{52}\, q(1 + q)^{-2}(M_1+M_2)^{5/3}\, P_{orb}^{\,1/3} cm^2 gm/s$, where q is the mass ratio M_1/M_2 of the primary star (more massive, M_1) and secondary star (less massive, M_2), each expressed in Solar units (Guinan and Bradstreet, 1988). We used such angular momentum loss to determine star ages in paper 1.

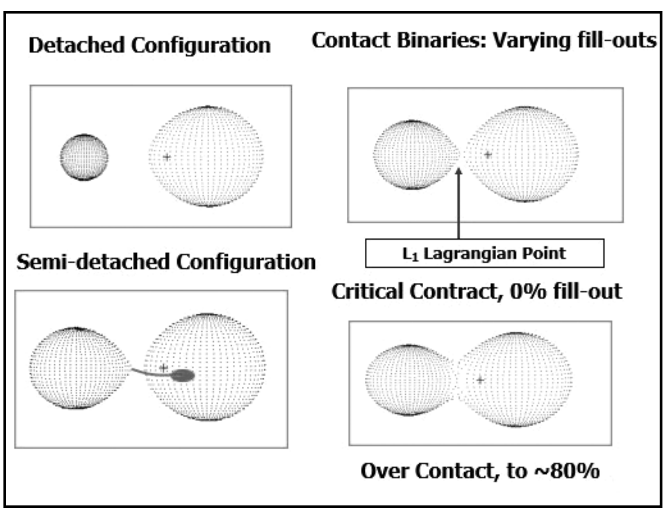

Figure 1. Some of the configurations of eclipsing binaries. The Ellipsoidal configuration is not shown (where no eclipse takes place but a light curve variation is present regardless as the binary rotates due to the non-sphericity of the stars). In the semi-detached configuration, a stream can arise from the so-called L_1 *point* to stream to the other star creating a hot stream spot.

Configurations (Definitions)

Binary stars may be found in various configurations. We will describe them in the context of magnetic braking. The stars begin separated as depicted in the upper left picture of Figure 1. As the binaries approach each other, one star will fill its Roche-lobe (bottom left). However, in normal evolution, the more massive star will fill its Roche-lobe first (the opposite is occurring in Figure 1). This configuration is one of the *semi-detached* states. This is also called a V1010 Oph configuration (after its prototype). Stars expand as they burn their nuclear fuels. When the stars have undergone two episodes of mass exchange (the Algol Paradox) due to normal nuclear evolution, the larger component has filled its Roche-Lobe and the smaller star is finally near filling its own lobe. This is also a semi-detached situation which is called an *Algol* configuration.

When contact is just made by both stars, the configuration is in critical contact, which is simply called a *contact binary*. As the degree of contact (defined as *fill-out* which may go from 0 to ~80%) increases, it is called an *over-contact binary* (also called *W UMa binaries*). In these cases, the mass ratio M_1/M_2 becomes more extreme, tending to smaller and smaller values. When the mass ratio drops to about 1/5, this configuration is an *extreme mass ratio binary*. Light curves of this type have certain characteristics (see Recent Work sections).

The Age of the Binary

In this paper, as in paper 2, we have decided to use the simpler, but more accurate, approach using the period and the dP_{orb}/dt rather than the L_{orb} and the dL_{orb}/dt. The quantity Q=dP/dE is determined as a matter of course in period studies from the calculated quadratic *ephemeris* equation:

$$T\ (HJD) = -QE^2 + PE + T_0. \tag{1}$$

This equation predicts the next eclipse timing T in Heliocentric Julian Days (HJD), which happens after so many epochs, or orbits, E, added to the initial eclipse timing, T_0, with a quadratic term, Q (the "deceleration" term in days/epoch/epoch or d/E^2), and P is the orbital period in days. "Helocentric" means that light time corrections were made to correct the observed times so that observation times are measured from the *center of the Sun*. There is a light time correction of up to ~16 minutes due to the fact that the time for light to travel from the earth (the observer's position) to the sun is ~8 minutes. In this paper, the ephemeris is given for each system analyzed and a plot is also given depicting the orbital period decrease. And this is related Q to dP/dt by the formula:

$$Q = \frac{dP}{dE} = \frac{1}{2}\frac{dP}{dt} \cdot \frac{P}{365.24} \tag{2}$$

This equation converts days/epoch (dP/dE) to "normal units," (dP/dt) days/year. The method only assumes that the chosen systems have a continuous, quadratically decreasing period as the observations show during the observational interval. The quantity, ΔP, is the difference in the present orbital period of the binary minus its initial period. The quantity, dP/dt, is the rate of change in the period, = $\dot{P}$, equation (2). The age, Δt, of the binary system is then given by

$$\Delta t = \frac{-\Delta P}{\dot{P}} \tag{3}$$

Recent Work (This Paper)

In 2015–2019 (publication dates), we have continued this work. During this interval of study, some 80% of the solar-type systems

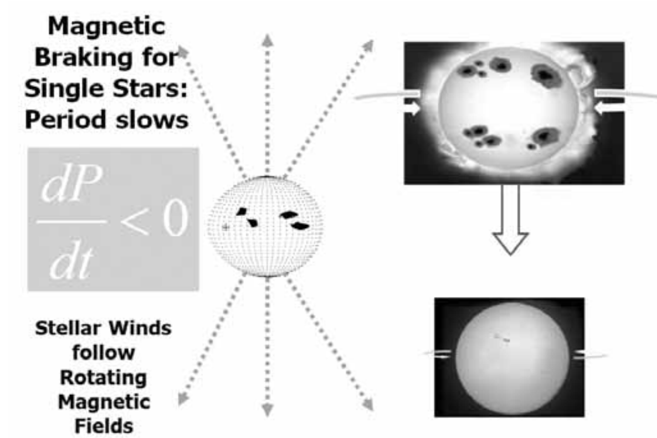

Figure 2. Depiction of single solar-type stars undergoing magnetic braking leading to angular momentum loss (AML). Plasmas leave along North and South Magnetic field lines causing young, magnetically active stars (spotted star in the upper righthand corner) to spin down and become slow rotating stars like our Sun with its ~27-day rotational period.

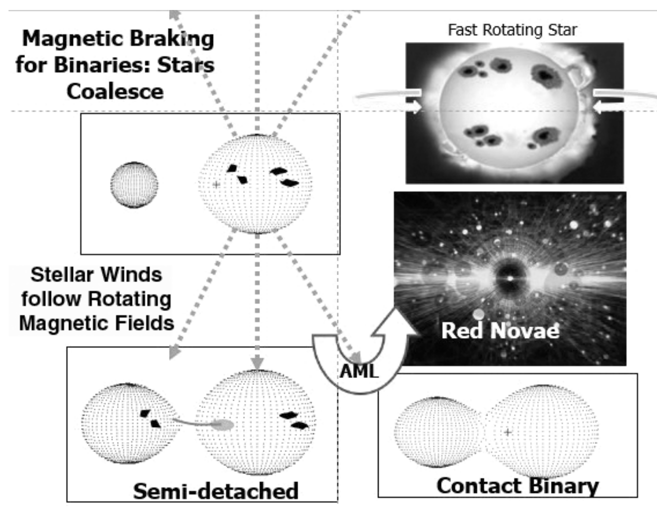

Figure 3. Depiction of a binary star made up of two solar-type stars undergoing magnetic braking which results in angular momentum loss (AML). Plasmas leave along North and South Magnetic field lines cause the magnetically active binary (detached spotted binary in the upper left-hand corner) to lose angular momentum and steadily fill their Roche-lobe and move to a semi-detached and then a contact binary configuration. The binary becomes unstable and a red novae event erupts finally resulting in a fast-rotating single star.

analyzed showed continuous period decreases. These include V1695 Aquilae, NSVS 1083189, NSVS 10541123, V530 Andromedae, NSVS 5066754, FF Vulpeculae, GSC 3208 1986, V573 Pegasi, MT Camelopardalis, and V1187 Herculis. A brief summary of each is given here for each binary. The prime work done directly for the CRS research grant was done in 2016 and 2017 by my research students, C.R. Gray and Amber Olsen at Emmanuel College. D. Maloney and R. Nyauadi were research students in the previous year. D. Maloney's star did not have enough past data available to do a reasonable period study. The other work summarized here is in addition to the paper 1 and paper 2 papers to bring this research up to date for completeness and publication. Much of the material in this paper was all reported at the 2017 Creation Research Society Meeting at Bob Jones University.

V1695 Aquilae

CCD, BVRI light curves of V1695 AQL were taken during the Fall 2016 season at the Cerro Tololo Inter-American Observatory with the 0.6-m reflector of the SARA South Observatory in remote mode. It is an eclipsing binary with a period of 0.4128406d. The light curves yield a total eclipse (duration: 51 minutes) but have an amplitude of only ~0.3 mags. The spectral type is ~G8 (~5500 K). Four times of minimum light were

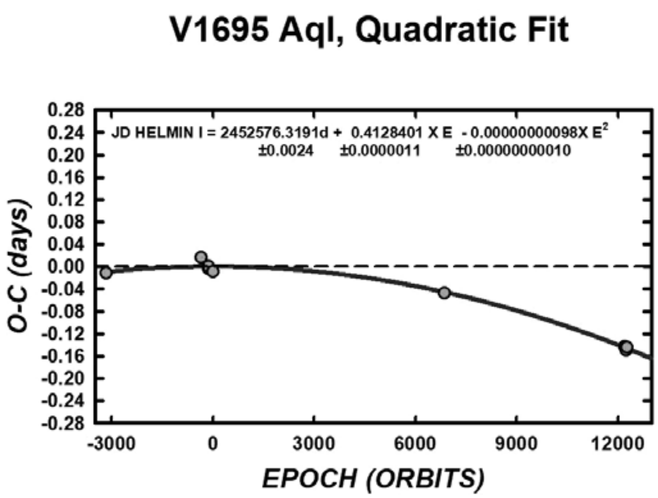

Figure 4. O-C Residuals from the Quadratic Ephemeris of V1695 Aql.

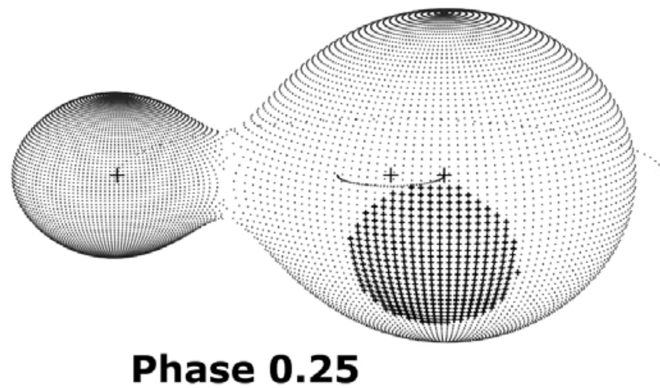

Figure 6. Geometrical Representation at phase 0.25 of V1695 Aql.

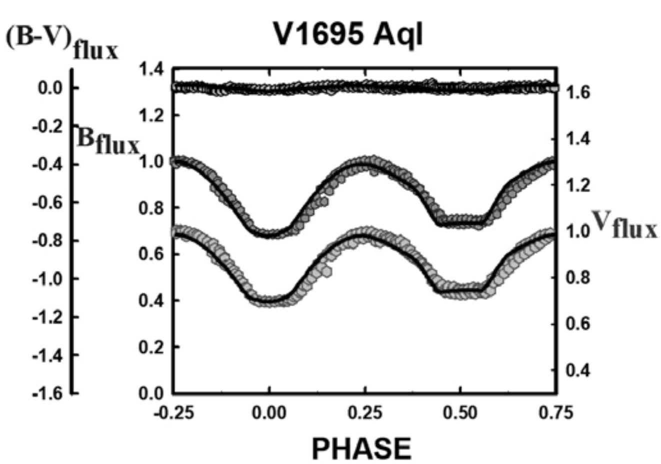

Figure 5. V1695 AQL, B,V Normalized Fluxes overlaid by our solution of V1695 Aql.

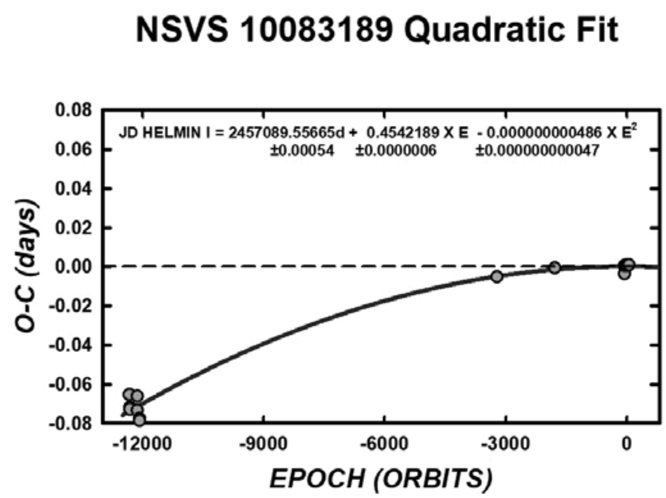

Figure 7. O-C Residuals from the Quadratic Ephemeris of NSVS 1083189.

calculated—all primary eclipses from our present observations. The period study result follows. (In this paper, the quadratic ephemeris is displayed in the residual plots.)

The 14-year period study reveals a period decrease in the orbital period at a high level of confidence. Thus, the binary is coalescing due to angular momentum loss. The solution is that of an Extreme Mass Ratio Binary. The mass ratio is found to be only 0.15. Its Roche-Lobe fill-out is a hefty 43%. The secondary component has a temperature of ~5800 K, which makes it a W-type W UMa Binary. As expected in binaries of this type, it has cool spot regions. The light curve solution for the B,V curves is shown.

NSVS 1083189

Precision BVR_cI_c light curves of NSVS 10083189 were taken on 10 nights in 2015 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University and on 1 night on the SARA 1-m reflector at Kitt Peak National Observatory (KPNO) in remote mode. It is an ~F8V eclipsing binary with a period of 0.4542238 (2) d. Seven times of minimum light were calculated. In addition, seven observations at minima were determined from archived NSVS Data. A statistically significant quadratic ephemeris was calculated.

Analysis with the Wilson-Devinney program led to a near, but non-contact, configuration (larger component filling its critical lobe and the secondary underfilling). This may indicate that NSVS 10083189 is coming into contact for the first time. Our semi-detached, near contact solution, gave a mass ratio of

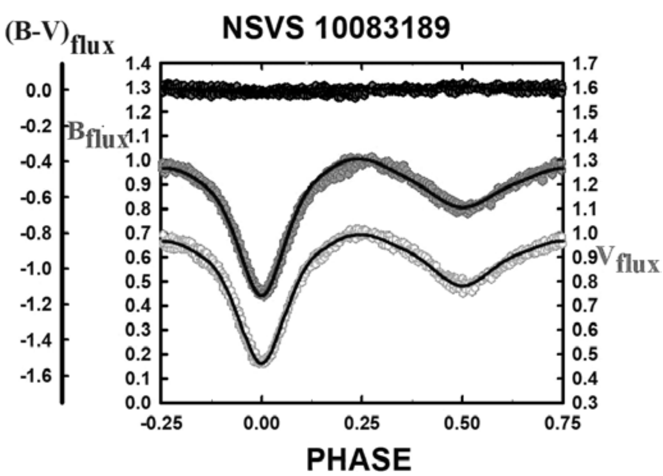

Figure 8. NSVS 1083189, B,V Normalized Fluxes overlaid by our solution.

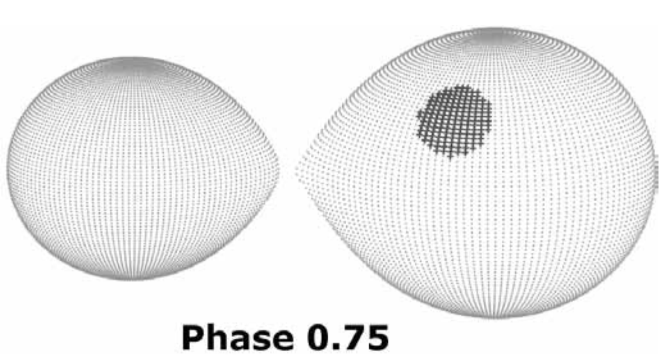

Figure 9. V1695 AQL, Geometrical Representation at phase 0.75

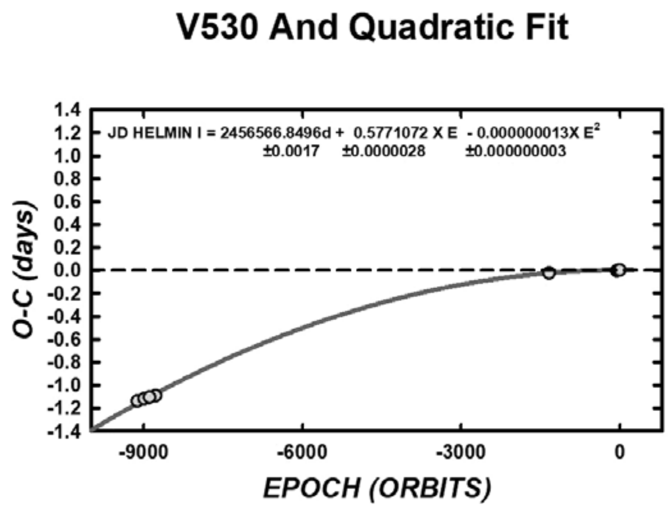

Figure 10. Quadratic O-C residuals from the period study.

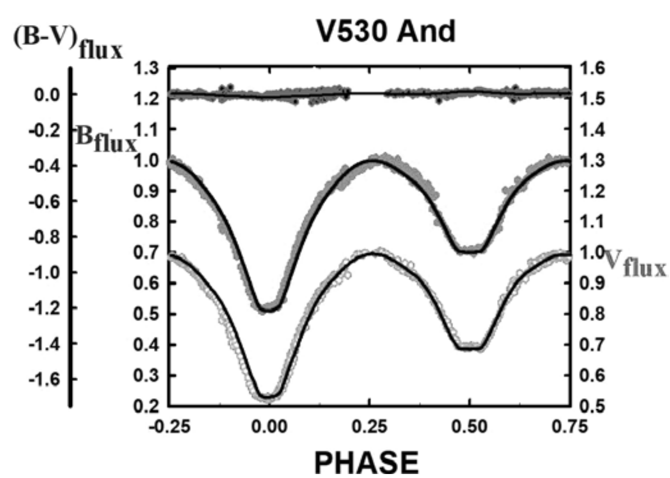

Figure 11. B,V synthetic light curve solutions overlaying the normalized flux curves.

0.58, with temperatures of 6250 and 4573 K. A 15° radius cool spot with a t-factor of 0.85 was determined on the primary star. The fill-out of the secondary star was 99%.

V530 Andromedae

We follow up on our single coverage UBVRcIc light curves and analyses from 2011. Our present UBVRcIc light curves with ample coverage were taken on October 2013, November 2013, and January 2014 with the Dark Sky Observatory 0.81-meter reflector of Appalachian State University. They reveal that the early-type V530 A as a totally eclipsing shallow or critical contact solar-type binary rather than a semi-detached near-contact one. In our extended period study, over a 14.25-year interval, we found a continuously decreasing period. This fits the scenario of magnetic braking for solar-type binaries. The temperatures of the primary and secondary components are estimated at 6750 and 6030 K, respectively. The component temperature difference is large for a contact binary. The fill-out, however, is a mere 5%, so it just passes critical contact. The mass ratio, M_2/M_1, was found to be 0.386. Two star spots, probably magnetic in origin, were determined. We suspect that the binary has recently achieved physical contact for the first time.

NSVS 5066754

BVR_cI_c light curves of NSVS 5066754 were observed on May 2014 at Dark Sky Observatory in North Carolina. It is a

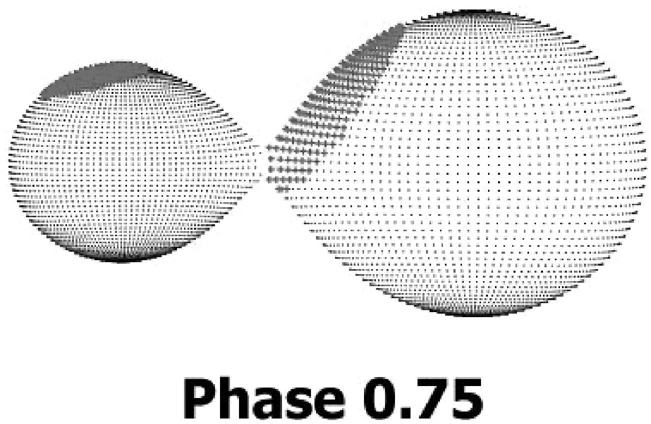

Figure 12. Roche-Lobe surfaces from our BVRI solution, phase 0.75.

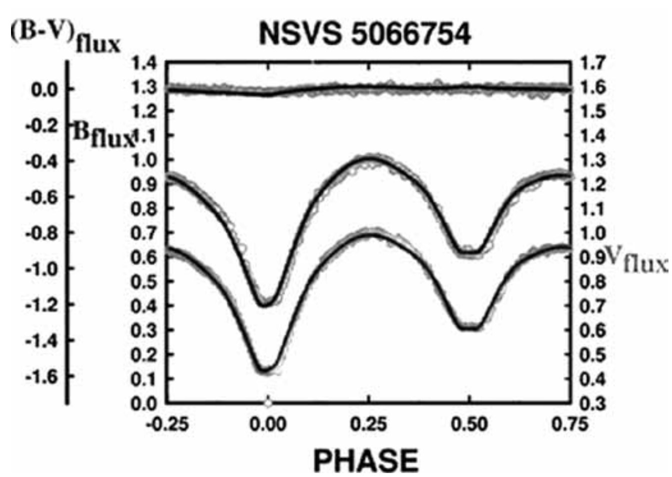

Figure 14. NSVS 5066754, B,V Normalized Fluxes overlaid by our solution of NSVS 5066754.

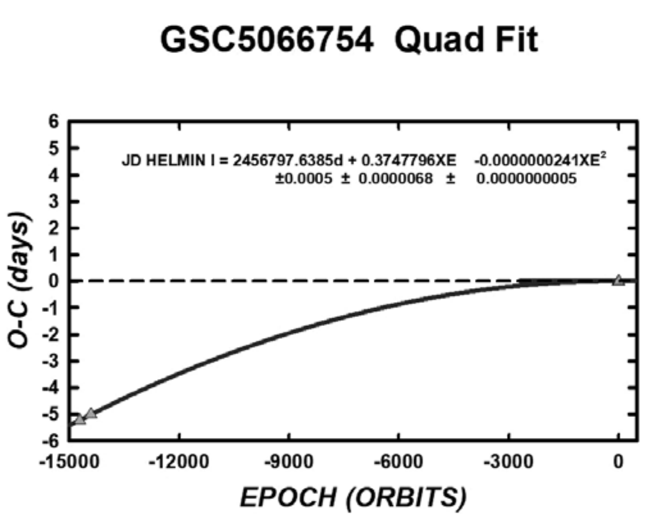

Figure 13. Quadratic O-C residuals from the period study.

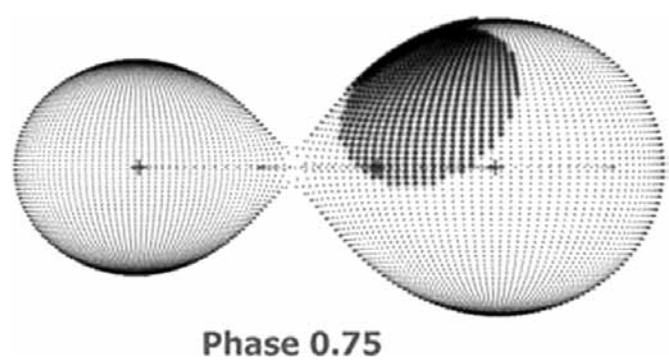

Figure 15. NSVS 5066754, Geometrical Representation at phase 0.75 of NSVS 5066754.

solar-type eclipsing binary (T_1~5750 K) with a period of only 0.3751689(1)d. In fact, it appeared as one of the shortest periods in Shaw's list of near-contact binaries (Shaw 1990, 1994). The Binary Maker fits and our Wilson-Devinney solutions show that the binary could have semi-detached or contact binary configurations.

Five new times of minimum light were calculated, along with two minima determined from archived All Sky Automated Survey observations. From these minima, plus the discovery epoch, a quadratic ephemeris was determined, so a magnetic braking scenario is hypothesized.

The contact solution that has the best sum of square residuals gave a mass ratio of 0.50, and a component temperature difference of ~360 K—somewhat large for a contact binary. Two substantial cool spots were determined in this solution of 48% and 28% radii with a t-factor or 0.94 and 0.78 respectively. The fill-out is very shallow, ~6%.

FF Vulpeculae

High precision BVR_cI_c light curves of FF Vul were observed during the Fall 2015 season with the Dark Sky Observatory 0.81-m reflector of Appalachian State University, and the SARA North 0.91-m reflector at KPNO. It is an eclipsing binary with a period of only 0.444983 (2) d. Our Wilson-Devinney solution shows that the binary is a near-contact, semi-detached binary

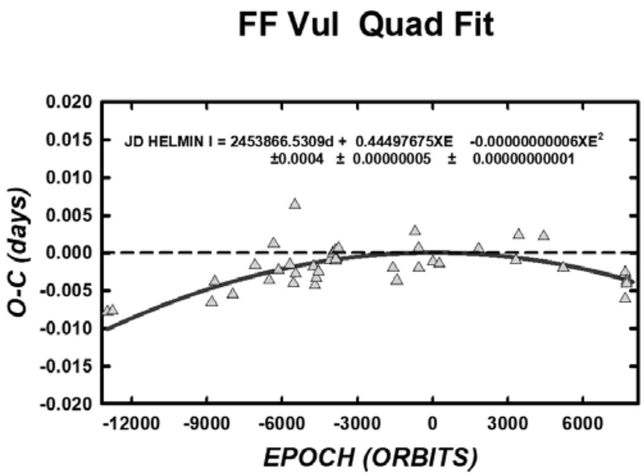

Figure 16. The period study covers over 20 years and shows that a period is decreasing (at about the 6 sigma level).

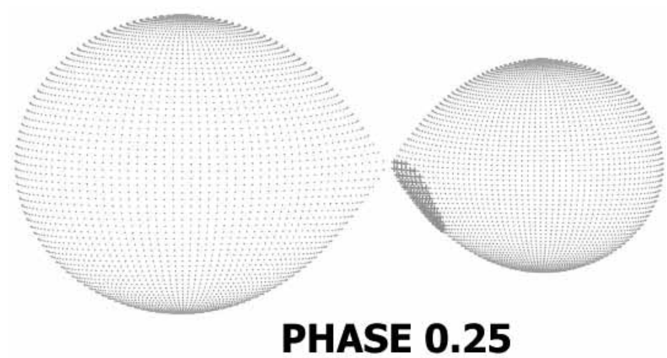

Figure 18. FF VUL, geometrical representation at phase 0.24 of FF Vul.

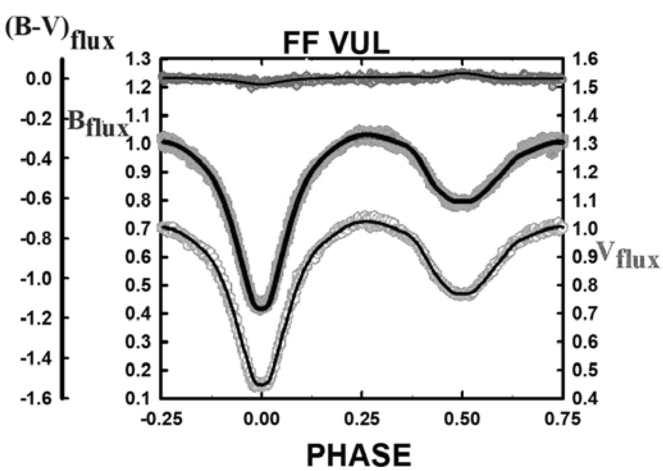

Figure 17. FF VUL, B,V Normalized Fluxes overlaid by our solution of FF Vul.

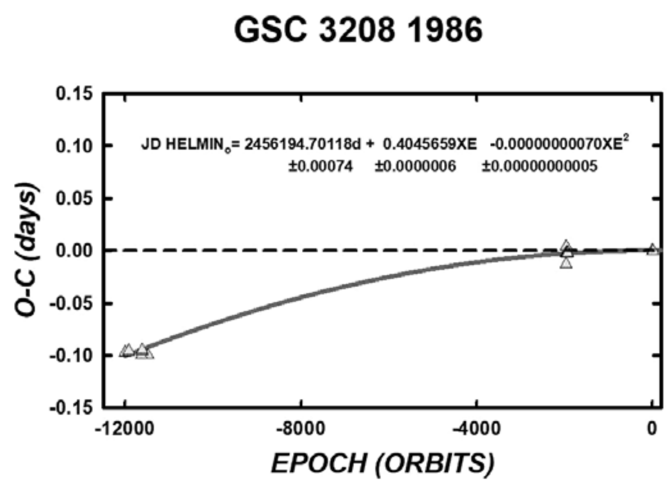

Figure 19. Quadratic O-C residuals from the extended period study, JD $HELMIN_0$= 2456194.70118d + 0.4045659 -0.00000000070.

(i.e., a V1010 Oph type configuration). Five times of minimum light were calculated—3 primary and 2 secondary eclipses. A quadratic ephemeris was determined. The period is decreasing.

A near-equatorial hot spot is probably due to matter transferring onto the secondary component. The component temperature difference is more than 1500 K. The solution shows a total secondary eclipse of 23 minutes duration. As expected in binaries of this type, it has a cool spot region on its hotter component.

GSC 3208 1986

GSC 3208 1986 is a NSVS and TYCHO variable, observed in September 2012, at Lowell Observatory, in Flagstaff, AZ. It is a W UMa variable with a period of 0.405 d. The curve is of high precision, averaging some 5 mmag (milli-magnitudes).

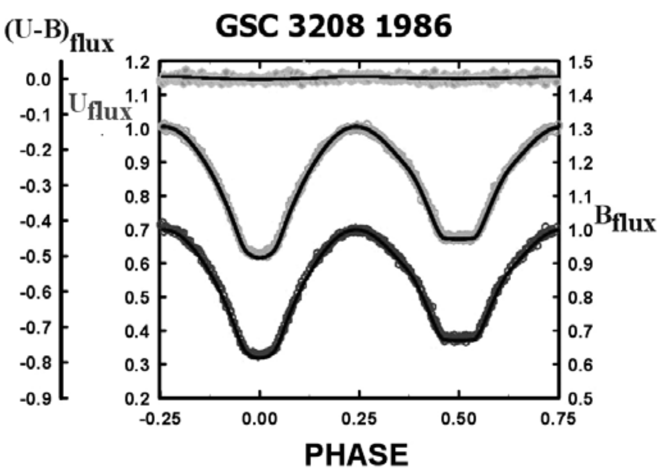

Figure 20. B,V synthetic light curve solutions overlaying the normalized flux curves.

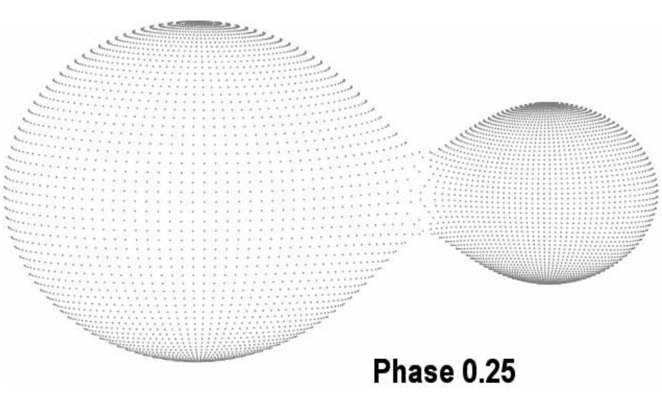

Figure 21. Roche-Lobe surfaces from our UBVR$_c$I$_c$ solution, phase 0.25.

The amplitude of the light curve is very nearly 0.5 mag. A color index determination by Terrell (2012) gives a F6V type. The linear period determination of 0.4045672 d was done with the available epochs. An early NSVS light curve reveals that the period has been decreasing over its past 12,000 orbits. The binary is evidently undergoing magnetic braking despite its early type. The high inclination of 85° results in a long duration secondary eclipse, lasting some 49.5 minutes. Findings indicate that GSC 3208 1986 is an immaculate (no star spot) extreme mass ratio, q= 0.24, A-type W UMa system.

V573 Pegasi

CCD, VRI light curves of V573 Peg were taken in 2017 on September 26 and 27 and October 2, 4, and 6 at the Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University by the observatory director. V573 Peg was discovered by the SAVS survey which classified it as a V=0.51 amplitude, EW variable. Five times of minimum light were calculated, two primary eclipses and three secondary—from our present observations:

HJD I = 2458023.6420±0.0012,

2458028.6522±0.0021,

HJD II = 2458022.5991±0.0011,

2458023.8510±0.0010 and

2458028.8608±0.0005,

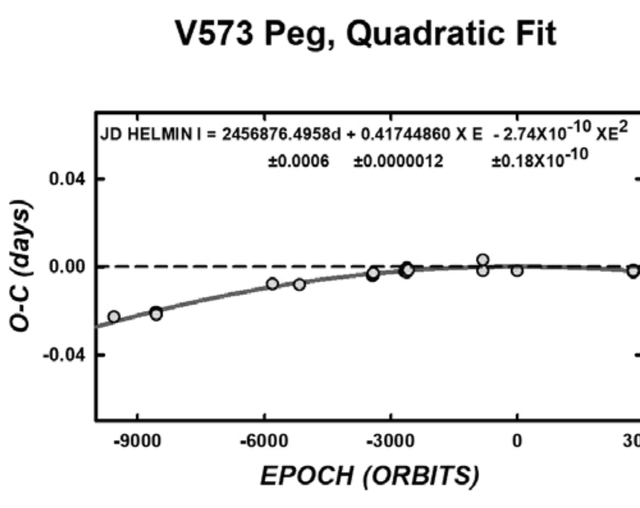

Figure 22. Quadratic O-C residuals from period study, V523 Peg.

The following quadratic ephemeris was determined from all available times of minimum light.

$$JD\ Hel\ MinI = 2456876.4958 \pm 0.0002d + 0.41744860 \pm 0.00000008 \times E - 0.000000000274 \pm 0.000000000012\ X\ E^2 \quad (4)$$

A 14-year period study (covered by 24 times of minimum light) reveals this orbital period decrease with high confidence, possibly due to magnetic braking. The mass ratio is found to be somewhat extreme, M_2/M_1=0.2629±0.0006 (M_1/M_2=3.8).

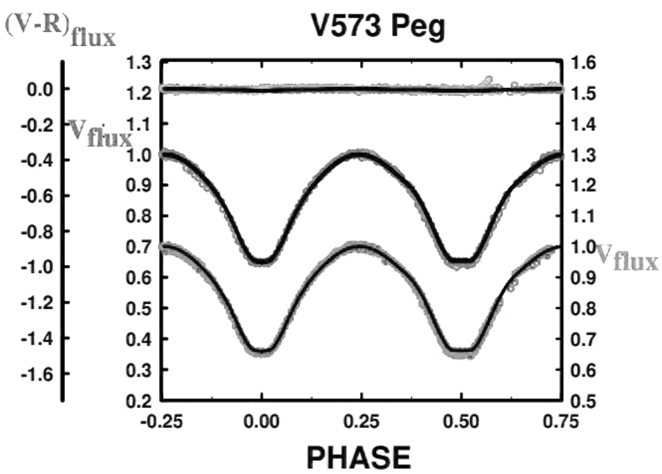

Figure 23. V,R synthetic light curve solutions overlaying the normalized flux curves.

Its Roche-Lobe fill-out is ~25%. The solution had no need of spots. The temperature difference of the component is about ~130 K, with the less massive component as the hotter one, so it is a W-type W UMa Binary. The inclination is 80.4±0.1°. Our secondary eclipse shows a time of constant light with an eclipse duration of 24 minutes.

MT Camelopardalis

We report here on a period study and the analysis of 2017 BVRI light curves of MT Cam (GSC03737-01085). It is a solar-type (T ~ 5500K) eclipsing binary. It was observed for six nights in December 2017 at Dark Sky Observatory with the 0.81-m DSO reflector. Five times of minimum light were calculated from Terrell, Gross, and Cooney, 2016 and 2004 observations (hereafter TGC). In addition, six more times were taken from the literature and 6 were from the present observations. From these 14 years of observations, a quadratic ephemeris was calculated (see Figure 25):

$$JDHelMinI = 24\ 58103.6611\ d + 0.3661389\ X\ E - 0.000000000041\ X\ E^2$$
$$\pm 0.00064 \qquad \pm 0.0000003 \qquad \pm 0.000000000021 \quad (5)$$

A BVR_cI_c Bessell filtered simultaneous Wilson-Devinney Program (W-D) solution gives a mass ratio (0.3385±0.0014) very nearly the same as TGC's (0.347±0.003), and a component temperature difference of only ~140 K. As with TGC, no spot was needed in the modeling. Our modeling (beginning with Binary Maker 3.0 fits) was done without prior knowledge of

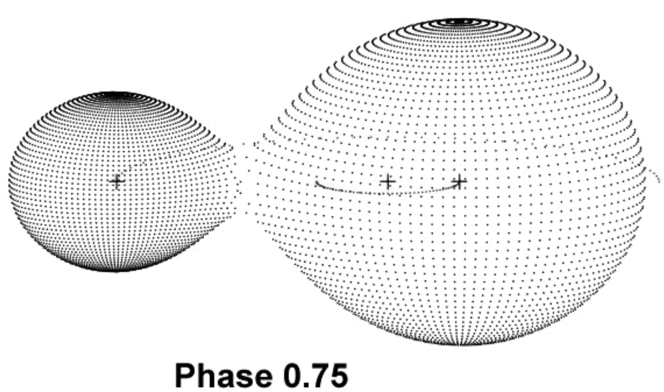

Figure 24. Roche-Lobe surfaces from our VR_cI_c solution, phase 0.75.

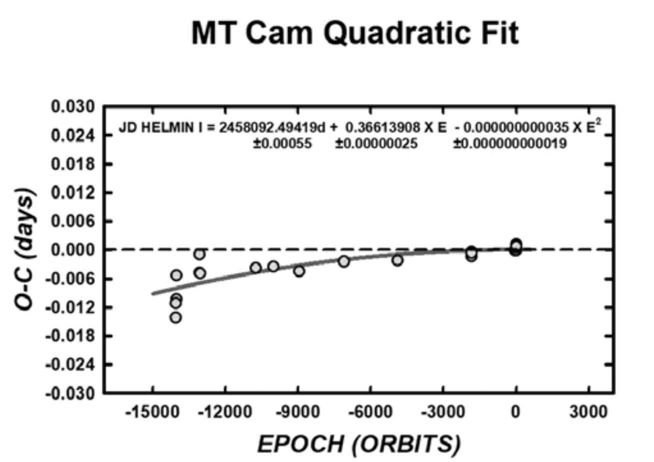

Figure 25. Quadratic O-C residuals from period study, MT Cam.

TGC's. This shows the agreement achieved when independent analyses are done with the Wilson code. The present observations were taken 1.8 years later than the last curves by TGC, so some variation is expected.

The Roche-Lobe fill-out of the binary is ~13% and the inclination is ~83.5 degrees (see Figure 26 and 27). The system is a shallow contact W-type W UMa Binary, albeit, the amplitudes of the primary and secondary eclipse are very nearly identical. An eclipse duration of ~21 minutes was determined for the secondary eclipse and the light curve solution.

V1187 Herculis

CCD, BVRI light curves of V1187 Her were taken in May 2017 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University. A spectrum was taken earlier at Dominion Astrophysical Observatory (DAO) with the 1.8m telescope. The spectral type is F8±1V (6250 K) so solar-type activity is expected. V1187 Her was previously identified as a low amplitude ($\Delta V < 0.2$ mag), short period, over-contact eclipsing binary (EW) with a period of 0.310726 d. Strikingly, despite its low amplitude, the early light curves show a total eclipse (eclipse duration: 31.5 minutes). This leads us to believe that the binary is an exceptionally extreme mass ratio binary, perhaps the most extreme known. Four times of minimum light were calculated, from our present observations. An 11-year period study reveals a period decrease in the orbital period with good confidence (see Figure 28). The rate of period change is dp/dt =2.3Í 10^{-07} d/yr, probably due to magnetic braking.

Its Roche-Lobe fill-out is found to be a hefty 79% along with a mass ratio of only 0.0440 ±0.0001, the shortest known among solar-type binaries! It has a cool spot region. The secondary component has a temperature of ~6643±4 K, which makes it a W-type W UMa Binary. The inclination is only 66.85±0.05° despite its total eclipses (see Figures 29 and 30).

NSVS 10541123

NSVS 10541123 is a F2±2 type (T~ 6750K) eclipsing binary. It was observed in April and May of 2015 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University. Six times of minimum light were determined from our present observations, which include two primary eclipses and four secondary eclipses. In addition, six observations at minima were introduced as low weighted times of minimum light taken from archived NSVS Data.

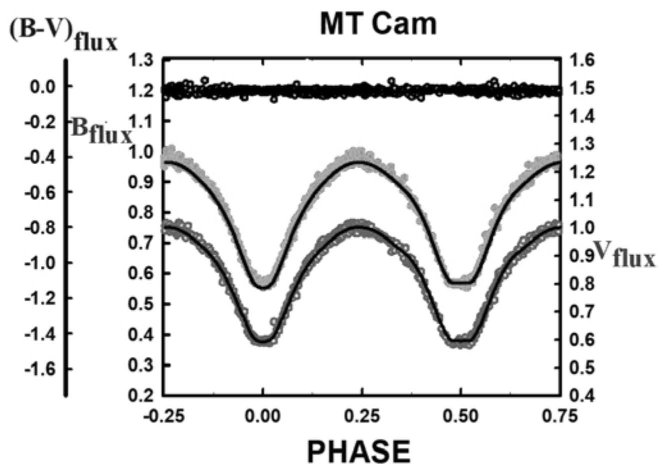

Figure 26. B,V synthetic light curve solutions overlaying the normalized flux curves.

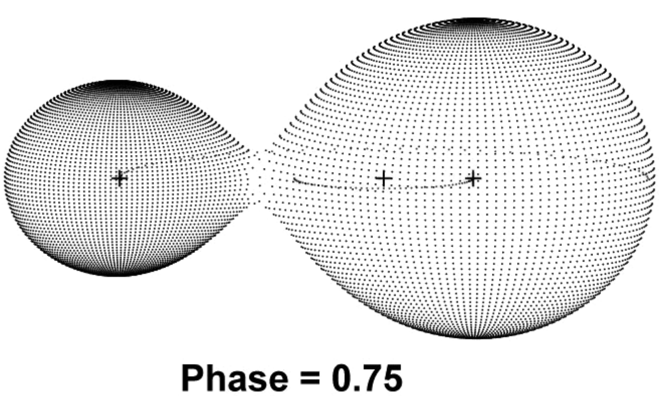

Figure 27. Roche-Lobe surfaces from our BVR_cI_c solution, phase 0.75 of MT Cam.

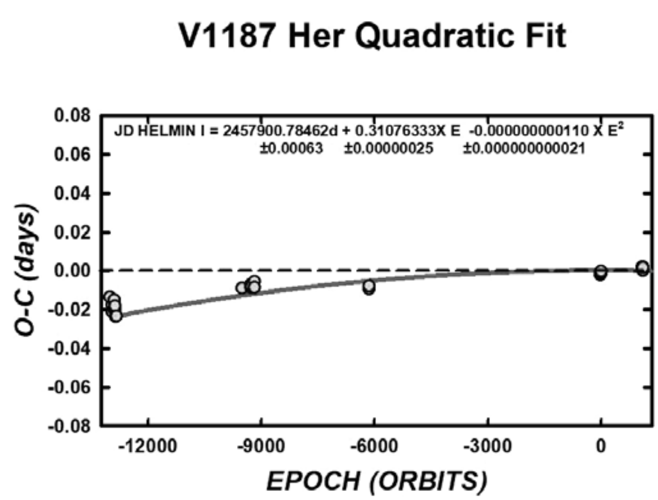

Figure 28. Quadratic O-C residuals from period study, V1187 Her.

Improved linear and a quadratic ephemeris was determined from all available times of minimum light giving a quadratic term -0.0000000043 (12)* (see Figure 31).

The rapid period decrease may indicate that the binary is undergoing magnetic braking and is approaching its contact configuration. A BVR_cI_c simultaneous Wilson-Devinney Program (W-D) solution indicates that the system has a mass ratio (q) of 0.5828±0.0004 (solutions taken from q=0.3 to 1.2 indicates this is the value with the lowest sum of square residual), and a component temperature difference of 2350 K. The large ΔT in the components verify that the binary is not in contact. A Binary Maker fitted hot spot changed somewhat but was not eliminated in the WD Synthetic Light Curve Computations. It remained on the larger component at the equator on the correct (following) side for a stream spot directed from the secondary component (as dictated by the Coriolis effect) (see Figure 32). This could indicate that the components are near filling their respective Roche-Lobes. The fill-out of our model is 96.3% for the primary component and 95.0% for the secondary component (see Figure 33). The inclination is ~79°, not enough for the system to undergo a total eclipse.

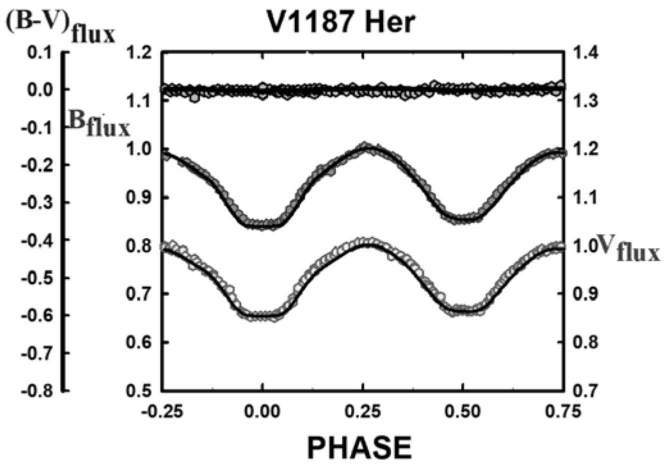

Figure 29. B,V synthetic light curve solutions overlaying the normalized flux curves.

Geochronology Results

The summary or update of the study of *Samec-2*, which now includes the systems of this paper, follows. Tables 1 and 2 summarize the period studies and derived ages. Table 3 shows the gyrochronology results from the 11 systems. An age of each binary is included. The age result is on the order of ~40 million years as the apparent age of the *time dilated universe*. Although this seems large for a creation-based paper, it is much, much smaller than the proposed age of W UMa binaries of some 5–10 billion years. The age is about 1/100th of the theoretical age. The final summary of this paper, plus *Samec-2*, is shown in Table 3. The 5-day initial period binaries (see paper 1 and paper 2), including 82 eclipsing solar-type binaries, have an age of 5.69×10^{7} years or 0.4% of the age of the universe proposed by secular astronomers—13.8 Gyr. As reiterated in *Samec-2*, although this does not equal the often-cited age of 6000–10,000 years in creation literature, I remind the reader that this value is the apparent age of a time-dilated universe. The earth and, I believe, the entire solar system remains in the range of ages

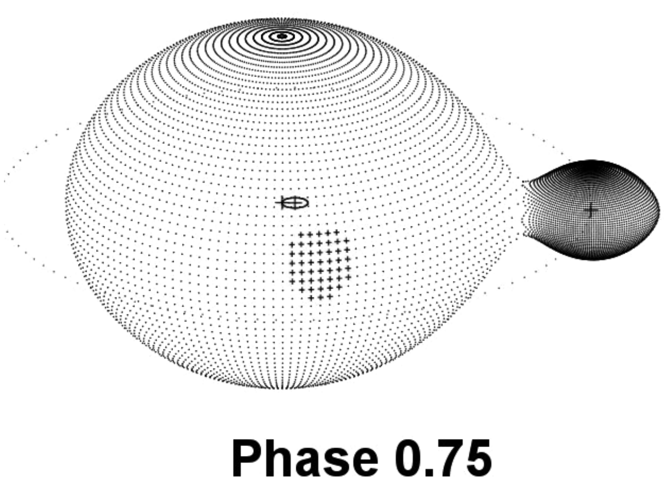

Figure 30. Roche-Lobe surfaces from our BVR_cI_c solution, phase 0.75, of V1187 Her.

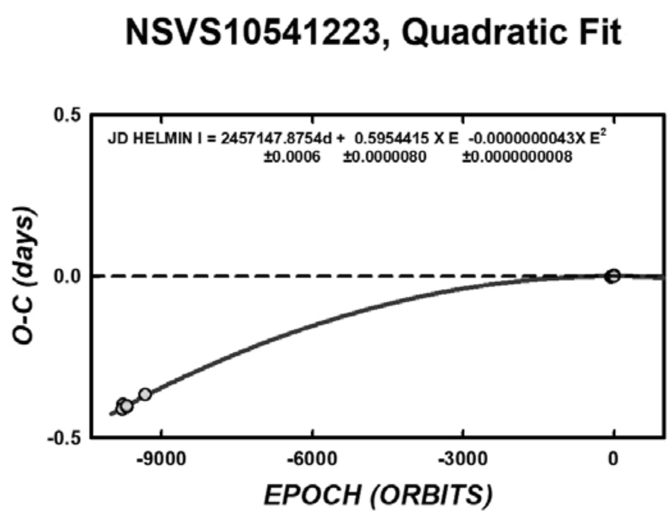

Figure 31. Quadratic O-C residuals from period study, NSVS1054 1223.

last mentioned (6000–10,000 years). And only some ~100 million years (not 13.8 billion!) years of *apparent* history is exhibited at least in the nearby (<2 kiloparsec, or about 6000 LY) cosmos—and probably for the "deep" universe as well.

Red Novae

The critical nature of these studies was recently highlighted by the phenomena of *Red Novae*, a violent event which appears to be the final coalescence of a contact binary into a fast rotating, blue straggler-like single star. This is important since it highlights that these stars are indeed coalescing into single stars. The recovery of archived observations of a contact binary with high fill-out at the site of the red nova V1309 Sco (Tylenda et al., 2011; Tylenda and Kamiński, 2016) has underlined the need for study of the characterization and continued patrol of such binaries in transition. Heavy and continuous sky coverage has yielded the unexpected—actual evidence and observations of mergers of binaries into single stars. It has been found that these events are culminated by a bright and long-lasting peculiar novae—a Red Novae. The color is not the usual blue, high temperature event as expected for a novae and supernovae. It also appears that archival data has revealed that these have happened in the past. Thus, binaries have undergone a complete metamorphosis inside of the age of the universe—covering time intervals much shorter than imagined by secular astronomers. We have shown that the rate of transition is much higher than 100 times faster than expected. These are referred to as *mergebursts*. Mergebursts range of luminosities or energies intermediate between classical novae (explosions from compact binary systems) and supernovae (usually annihilating the star or stars involved). The time interval of the eruption also lasts an intermediate time interval between that of novae and supernovae. They also display a peculiar red spectra (~1000K). V1309 Sco, V838 Mon and M31-RV are examples. Figure 34 (page 4) notes these differences.

The typical light curve of red novae is shown in Figure 35 (page 4) with an irregular rise of about 10 magnitudes (10,000

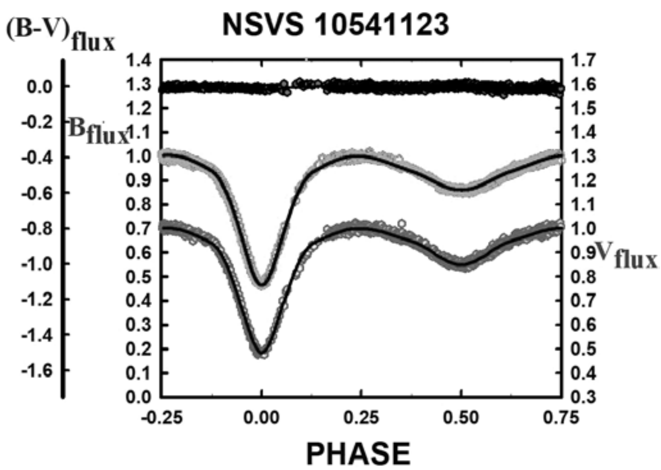

Figure 32. B,V synthetic light curve solutions overlaying the normalized flux curves.

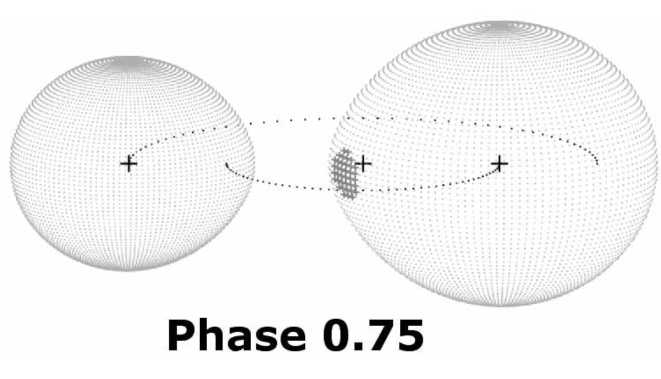

Figure 33. Roche-Lobe surfaces from our BVR_cI_c solution, phase 0.75, of NSVS10541123.

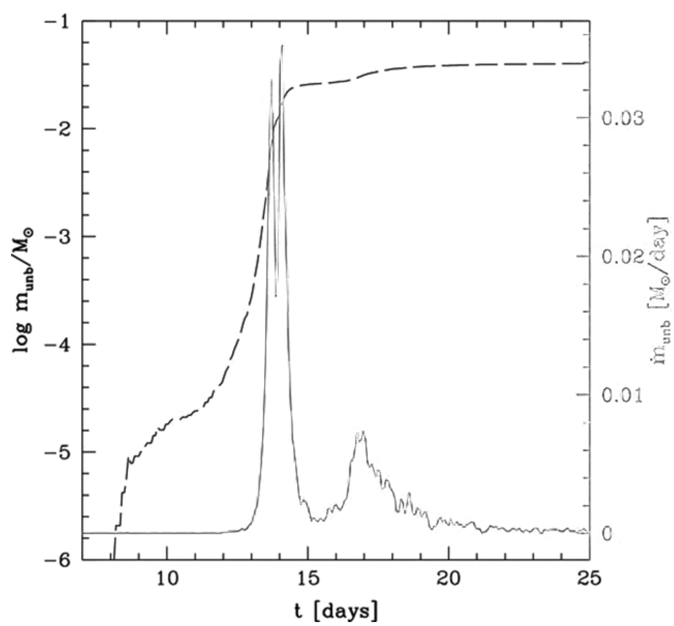

Figure 37. The Mass of the ejecta (black dashed line) and its derivative (blue solid line) as functions of time. Each peak shown in the plot corresponds to one episode of the mass outburst. Shows 3 outbursts (Nandez, Ivanova, and Lombardi, Jr., 2014).

Table I. A summary of the recent solar-type systems analyzed with continuously decreasing periods.

System	Orbital Period	Quadratic Period Change $\frac{dp}{dt}$	Research Student/s	Publication
V1695 Aql	0.41281623 d	$-1.7 \times 10^{-10} \frac{d}{yr}$	Gray, C.R.	JAVSO 45, 140, Samec et al. 2017
NSVS 10083189	0.4542189 d	$-4.9 \times 10^{-10} \frac{d}{yr}$	Olsen, Amber	AAS 2017, JAVSO 2017
V530 And	0.577107 d	$-1.4 \times 10^{-8} \frac{d}{yr}$	Clark, J. D.; Shebs, T.	JAVSO 2016, AAS 2015
NSVS 5066754	0.37478 d	$-2.4 \times 10^{-8} \frac{d}{yr}$	Nyaude, Ropafadzo	AJ 2016, AAS 2016
FF Vul	0.444976 d	$-6.0 \times 10^{-11} \frac{d}{yr}$	Nyaude, Ropafadzo	AJ 2016, AAS 2016
GSC3208 1986	0.404566 d	$-7.0 \times 10^{-10} \frac{d}{yr}$	Kring, J.D.	AJ 2015, AAS 2014
V1187 Her	0.310763 d	$-3.3 \times 10^{-7} \frac{d}{yr}$	Heather Chamberlain	RNAAS 2,1 2018, PASP 2019
V573 Peg	0.417449 d	$-4.8 \times 10^{-7} \frac{d}{yr}$	-	AAS 2018, JAVSO 2018
GQ Cnc	0.422208 d	$-5.0 \times 10^{-8} \frac{d}{yr}$	Olsen, Amber	JAVSO 2017
MT Cam	0.3661389 d	$-9.18 \times 10^{-8} \frac{d}{yr}$	-	AAS 2018
NSVS 1054 1123	0.5954966 d	$-5.23 \times 10^{-6} \frac{d}{yr}$	-	AAS 2018

AAS: Abstracts, Meeting of the American Astronomical Society
AJ: Astronomical Journal
JAVSO: Journal of the American Association of Variable Star Observers

times increase in brightness) and an irregular decrease occurring over the course of ~100 days. A simulation of such an explosion is shown in Figure 36 (page 4). The top left panel is when the primary has overflown its Roche-lobe and more material is being passed to the companion. The top right panel shows that the Roche-lobe of the companion is overflown. The bottom left panel is for the stage when the companion spirals into the primary, while the bottom right panel shows the two orbiting cores engulfed by the envelope of the primary; after about 0.5 days the cores merge. The mass of the ejecta as a function of time is given in Figure 37.

These violent, relatively cool, events mark the transition from binaries to single stars. It is interesting that many fast-rotating A-type stars exist in the heavens—all possible results of such mergers. Contact binaries are believed by many to be the most abundant of all variable stars in the cosmos—indeed, they are very frequent in the heavens! Their abundance of both contact binaries and fast rotating A-type stars (as well as FK coma variables) conveys a message that should be heeded by the creation community. The occurrence of such objects in the evolutionary view is untenable in regards to age. They should not exist in a universe of such a "young age" as 13.80

Table 2. Update for 2015-1018

Name	dP/dE (d/E)	dP/dt (d/yr)	Period (d)	Est. Spec. Type	Age (years)
V1187 Her	-1.42×10^{-10}	-3.34×10^{-07}	0.310763	F7V	$\mathbf{1.40\times10^{07}}$
MT Cam	-4.60×10^{-11}	-9.18×10^{-08}	0.366139	G7V	$\mathbf{5.05\times10^{07}}$
NSVS 5066754	-2.41×10^{-08}	-4.70×10^{-05}	0.374780	G5V	$\mathbf{9.89\times10^{04}}$
GSC32081986	-7.00×10^{-10}	-1.26×10^{-06}	0.404566	F3V	$\mathbf{3.64\times10^{06}}$
V1695 Aql	-1.73×10^{-06}	-3.05×10^{-03}	0.412816	G8V	$\mathbf{2.66\times10^{06}}$
V573 Peg	-2.74×10^{-10}	-4.79×10^{-07}	0.417449	F7V	$\mathbf{6.58\times10^{07}}$
GQ Cnc	-2.90×10^{-11}	-5.02×10^{-08}	0.422208	K0V	$\mathbf{9.12\times10^{07}}$
FF Vul	-6.00×10^{-11}	-9.85×10^{-08}	0.444976	F4V	$\mathbf{4.62\times10^{07}}$
NSVS 10083189	-4.90×10^{-10}	-7.92×10^{-07}	0.452189	F8V	$\mathbf{5.75\times10^{06}}$
V530 And	-1.40×10^{-08}	-1.77×10^{-05}	0.577107	F4V	$\mathbf{1.15\times10^{08}}$
NSVS 10541123	-4.26×10^{-09}	-5.23×10^{-06}	0.595442	F2V	$\mathbf{6.04\times10^{05}}$
				Average	$\mathbf{3.6\times10^{07}}$

Table 3. Average values from Samec-1 and -2 including this paper

	P_0 5d (initial)	P_0, 8d (initial)	P_0, 10d (initial)	P_0, 15d (initial)	P_0 20d (initial)	Average
AGE (Years)	5.69×10^{7}	2.52×10^{8}	6.65×10^{7}	2.14×10^{7}	2.44×10^{7}	8.432×10^{7}
Maximum	7.15×10^{8}	3.36×10^{9}	1.67×10^{8}	1.02×10^{8}	1.45×10^{8}	3.36×10^{9}
Minimum	1.33×10^{1}	2.20×10^{5}	1.24×10^{6}	8.74×10^{5}	1.64×10^{6}	1.64×10^{6}
% age of Universe	0.4	1.8	0.5	0.2	0.2	0.6

billion years—at least to an evolutionary astronomer. We repeat from *Samec-2* that this paper gives physical confirmation of the youthful age, in a creationist sense, of the universe in a time-dilation scenario. As I noted, as someone called to our attention at a recent meeting, much of this prehistory took place during the Creation Week following the creation of the first stars on Day 4. Therefore, the time-dilation event postulated by Humphreys falls into the category of a Creation Week event. Regardless, the phenomena did take place and are not due to an apparent, ex nihilo, created history. The events we see truly took place and are objects of legitimate scientific inquiry that the Lord has allowed His children to study. Exodus 20:11: *For in six days the LORD made heaven and earth, the sea, and all that in them is, and rested the seventh day*. Revelation 4:11: *Thou art worthy, O Lord, to receive glory and honor and power: for thou hast created all things, and for thy pleasure they are and were created.*

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