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NEW EPHEMERIDES FOR FOUR SOUTHERN HEMISPHERE ECLIPSING BINARIES

Times of minimum light were obtained for four southern hemisphere eclipsing binaries, and these enabled us to obtain new ephemerides for these stars. The observations were made during 1984 with the 40 cm reflector of the Black Birch Station of the Carter Observatory, which is located near Blenheim, New Zealand. A d. c. amplifier was used, and usually the observations were made in only one bandpass. All times quoted in this paper are heliocentric. The ephemerides were obtained from least squares solutions, and unless otherwise noted, all times of minimum light were given unit weight.

V535 ARAE

V535 Arae (formerly BV 419) was previously observed by Chambliss (1967) and by Schöffel (1970). Both of these investigators calculated ephemerides and orbital elements for this system. The observations of Chambliss were made in 1966, while those of Schöffel were made in the following year. An additional time of minimum light observed in 1980 was reported by Wolf et al. (1982), but this time was of lower precision than that of the earlier ones or of the two obtained in this investigation, and consequently it was given a lower weight (one-tenth instead of unit weight) in the least squares solution.

A least squares solution using all available photoelectric times of minimum light for V535 Arae yields the following ephemeris:

$$\text{JD } 2439292.9351 + 0^{d}.62930098\ E$$
$$\pm \quad 3 \pm \qquad 9 \text{ p.e.}$$

The times of minimum light together with their residuals are as follows:

JD Hel.	E	O-C	Observer
2439292.9332	0	-0^{d}.0019	Chambliss
293.2508	0.5	+0.0011	"
296.0828	5	+0.0012	"
315.9076	36.5	+0.0030	"
319.0525	41.5	+0.0014	"
328.1751	56	-0.0008	"
329.1191	57.5	-0.0008	"
2439608.5313	501.5	+0.0018	Schöffel
610.4180	504.5	+0.0006	"
611.3619	506	+0.0005	"
619.5416	519	-0.0007	"
620.4857	520.5	-0.0005	"
625.5208	528.5	+0.0002	"
626.4639	530	-0.0007	"
627.4075	531.5	-0.0011	"
628.3522	533	-0.0003	"
629.6105	535	-0.0006	"
630.5541	536.5	-0.0010	"
643.4545	557	-0.0012	"
2444458.533	8208.5	-0.0192	Wolf
2445908.1485	10512	+0.0015	this paper
920.1039	10531	+0.0002	"

The residuals show no systematic trends, and thus there is no evidence for a variation of period over the interval in which this system has been observed photoelectrically. The period given above falls within the range implied by the mean error given by Schöffel, but this period is now much more precisely known, since the time baseline is now very much longer than was previously the case.

RR CENTAURI

RR Centauri has been known to be variable for many years, but the first photoelectric investigation of this system was made by Knipe (1965). This was

followed by an investigation by Chambliss (1971). RR Centauri has long been known to have a variable period, and both Knipe and Chambliss discussed this fact in their respective papers. Knipe's observations were obtained in 1960, while those of Chambliss were made in 1969. Sistero (1970) also reported times of minimum light for RR Centauri, and two times of minimum light were obtained in the present investigation.

A linear least squares solution for all eight photoelectric times of minimum light yields the following ephemeris:

$$\text{JD } 2437092.3206 + 0^{d}.60569243\ E$$
$$\pm\ 22 \pm\ 26 \text{ p.e.}$$

The times of minimum light together with their residuals are as follows:

JD Hel.	E	O-C	Observer
2437092.326	0	$+0^{d}.0054$	Knipe
7132.301	66	+0.0047	"
2440410.6002	5478.5	-0.0064	Chambliss
417.5652	5490	-0.0069	"
2440761.6003	6058	-0.0051	Sistero
762.5158	6059.5	+0.0019	"
2445914.8376	14566	+0.0010	this paper
917.8703	14571	+0.0053	"

The residuals for this solution are not random, and thus they indicate that a systematic change of period has taken place for this system. A quadratic least squares solution yields the following ephemeris:

$$\text{JD } 2437092.3256 + 0^{d}.60568992\ E + 1.64 \times 10^{-10}\ E^{2}$$
$$\pm\ 17 \pm\ 54 \pm\ 0.34 \text{ p.e.}$$

The sum of the squares of the residuals for the linear solution is 1.97×10^{-4}; for the quadratic solution it is 0.63×10^{-4}, implying a better fit to the data. The latter solution indicates that the period of RR Centauri has increased by about $0^{s}.2$ during the 24 years in which this system has been under photoelectric investigation.

V716 CENTAURI

Despite its brightness (V = 5.96 at maximum) the eclipsing binary V716 Centauri (formerly BV 516) has received very little attention from astronomers. In 1966 Chambliss (1969) obtained four photoelectric times of minimum light for this system, and an additional time of minimum light was obtained in this investigation. These seem to be the only photoelectric times of minimum light reported for this star.

A least squares solution for the five times of minimum light yields the following ephemeris:

$$\text{JD } 2439262.0045 + 1^{d}.49009305\ E$$
$$\pm\ 34 \pm\ 55 \text{ p.e.}$$

The times of minimum light together with their residuals are as follows:

JD Hel.	E	O-C	Observer
2439262.0070	0	$+0^{d}.0025$	Chambliss
264.9801	2	-0.0046	"
282.8659	14	+0.0001	"
291.8084	20	+0.0020	"
2445907.8195	4460	0.0000	this paper

The period given above falls within the range implied by the mean error previously given by Chambliss, and thus there is no evidence for any change of period over the interval in which this system has been observed photoelectrically.

V701 SCORPII

V701 Scorpii was observed photoelectrically in 1966 by Leung (1974), and one time of minimum light was obtained in the present investigation. The ephemeris quoted by Leung was based on his own observations as well as on the earlier photographic observations of Plaut, which were made between 1934 and 1937. The

time of minimum light observed in this investigation was 1.5 hours later than it would be according to Leung's ephemeris. This implies a significant increase in the period of V701 Scorpii over the interval in which this system has been observed photoelectrically.

A least squares solution for all photoelectric times of minimum light yields the following ephemeris:

$$\begin{array}{l} \text{JD } 2439329.6674 + 0^{d}.76187804\ E \\ \qquad \pm 25 \quad \pm \qquad 55 \text{ p.e.} \end{array}$$

The times of minimum light together with their residuals are as follows:

JD Hel.	E	O-C	Observer
2439330.0455	0.5	$-0^{d}.0029$	Leung
331.9516	3	-0.0015	"
341.8572	16	-0.0003	"
2445918.0107	8647.5	+0.0029	this paper

The period quoted in this paper is about $0^{s}.6$ longer than that quoted by Leung, and thus it appears that the period of V701 Scorpii has increased by that amount over the past 18 years. Wilson and Leung (1977) consider V701 Scorpii to be an overcontact system. Such systems have considerable amounts of material flowing between the two components, and consequently significant changes of period are to be expected.

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