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FOUR RR LYRAE STARS WITH VARIABLE PERIODS IN OPHIUCHUS

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 46, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: sternwartehartha@lycos.de, tb@stw.tu-ilmenau.de, pk@stw.tu-ilmenau.de

The discovery of the variability of these stars has been reported by Hughes-Boyce and Huruhata (1942) and Hoffmeister (1966, 1967); but there were no ephemeris published until today. Photographic plates of a field centered around 67 Oph, taken with the Sonneberg Observatory 40cm Astrograph during three intervals spread over the years from 1938-1994, were used to check the behaviour of these objects (see Table 1). To avoid effects of cycle count ambiguities due to the somewhat inauspiciously distributed plates with large gaps in time, importance has been attached to get well-fitted composite light curves representing all available observations. Therefore the reported period changes represent the smallest value of period alteration suitable to achieve this aim. The elements listed below were obtained by means of least-squares solutions.

Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. Individual data are available upon request.

Remarks:

V823 Oph
Elements valid for J.D. 2429100-2441200 and J.D. 2444000-2449500 resp.

V825 Oph
Elements valid for J.D. 2429700-2441200 and J.D. 2443300-2449500 resp.

NSV 9820
Elements given below are at least valid for an interval of JD 2438200-2449500. Unfortunately there were not enough older plates available to determine the date of the period change as well as the value of the period acting in the time before the interval mentioned above. The star was announced by Hoffmeister to be an eclipsing binary of EB type.

NSV 10115
Elements valid for J.D. 2429100-2440500 and J.D. 2443300-2449500 resp.

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

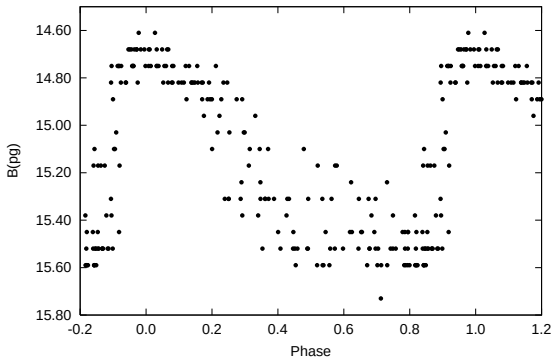

Figure 1. Composite light curve of V823 Oph

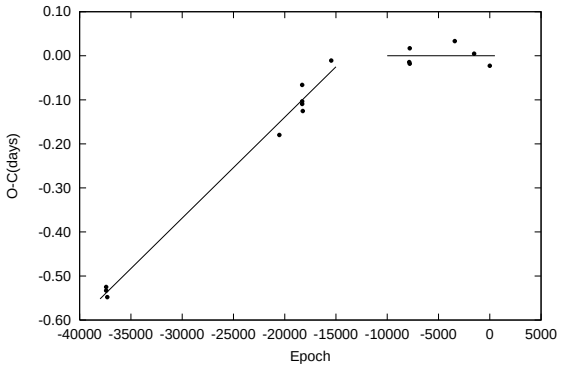

Figure 2. (O−C) diagram for V823 Oph

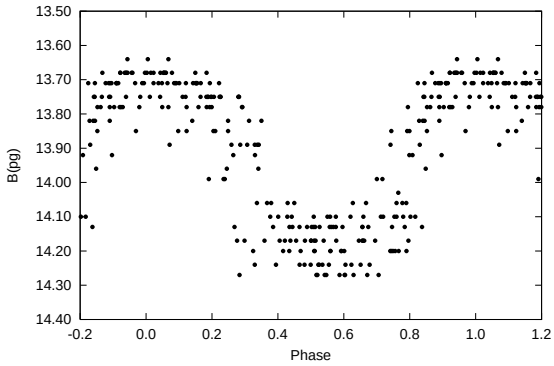

Figure 3. Composite light curve of V825 Oph

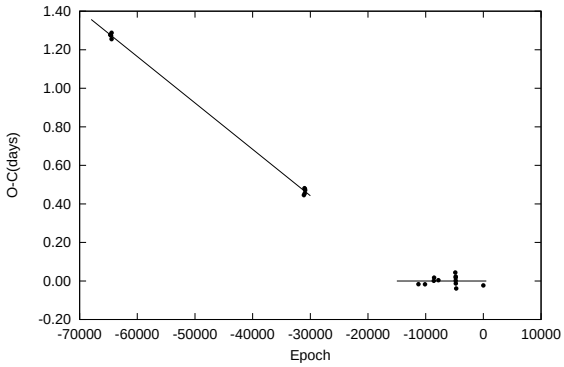

Figure 4. (O−C) diagram for V825 Oph

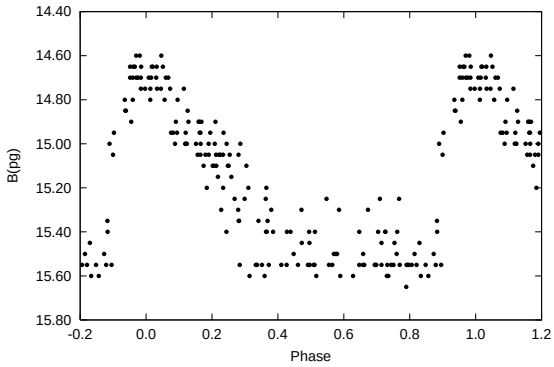

Figure 5. Light curve of NSV 9820 (J.D. 2438258 − 2449475)

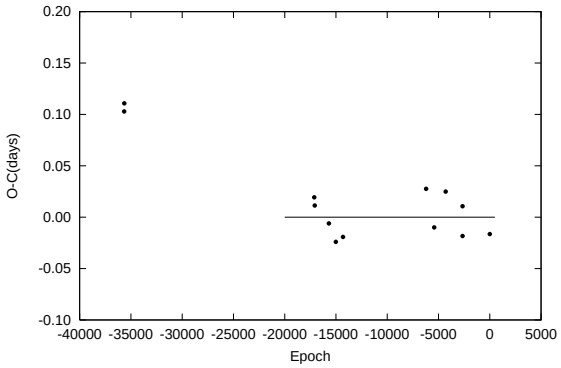

Figure 6. (O−C) diagram for NSV 9820

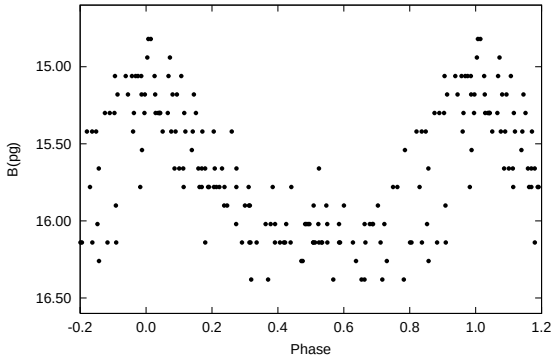

Figure 7. Composite light curve of NSV 10115

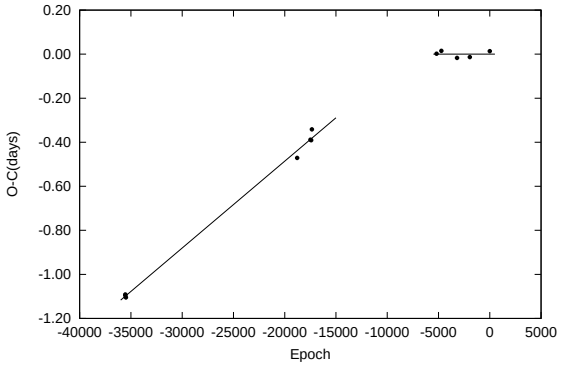

Figure 8. (O−C) diagram for NSV 10115

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V823 Oph (1)	RRab	29785.481 ±13	0.5176480 ±8	$14^{m}.7$	$15^{m}.5$	$0^{p}.15$	103
V823 Oph (2)		49154.516 ±18	0.5176251 ±31				93
V825 Oph (1)	RRc	29816.434 ±6	0.2940934 ±3	$13^{m}.7$	$14^{m}.2$		114
V825 Oph (2)		48802.505 ±16	0.2941175 ±24				133
NSV 9820	RRab	48801.529 ±11	0.5326038 ±10	$14^{m}.6$	$15^{m}.5$	$0^{p}.12$	217
NSV 10115 (1)	RRab	29786.519 ±14	0.5440501 ±10	$15^{m}.0$	$16^{m}.1$	$0^{p}.13$	88
NSV 10115 (2)		49124.475 ±15	0.5440106 ±41				56

Table 2. Comparison stars and cross references

	V823 Oph HV 11044 USNO 0900-10538562		V825 Oph HV 11047 USNO 0900-10598218	
Comp. No.	USNO	m*	USNO	m*
1	0900-10551987	$14^{m}.3$	0900-10595254	$13^{m}.5$
2	0900-10540298	$15^{m}.0$	0900-10608192	$14^{m}.0$
3	0900-10538956	$15^{m}.3$		
4	0900-10541236	$15^{m}.7$		

	NSV 9820 S 9844 USNO 0900-10833595		NSV 10115 S 9287 USNO 0900-11413039	
Comp. No.	USNO	m*	USNO	m*
1	0900-10828563	$14^{m}.4$	0900-11409203	$15^{m}.4$
2	0900-10834041	$14^{m}.9$	0900-11412225	$16^{m}.1$
3	0900-10826923	$15^{m}.1$		
4	0900-10831651	$15^{m}.3$		

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

Table 3. Heliocentric times of maxima and $O-C$ values according to the elements derived in this paper; the more recent second set of elements was used in the cases with two given sets.

Star	JD (max.*)	Epoch	$O-C$	Star	JD (max.*)	Epoch	$O-C$
V823 Oph	29785.481	−37418	−0.539	V825 Oph	47388.390	−4808	0.002
	29786.522	−37416	−0.533		47390.470	−4801	0.023
	29843.446	−37306	−0.548		47391.347	−4798	0.018
	38528.528	−20528	−0.180		47395.434	−4784	−0.013
	39682.428	−18299	−0.066		47418.349	−4706	−0.039
	39683.420	−18297	−0.109		48802.482	0	−0.023
	39684.461	−18295	−0.104	NSV 9820	29808.450	−35660	−0.430
	39712.391	−18241	−0.125		29816.447	−35645	−0.422
	41150.468	−15463	−0.011		39685.503	−17116	0.019
	45087.521	−7857	−0.014		39708.397	−17073	0.011
	45115.486	−7803	−0.001		40444.438	−15691	−0.006
	47387.377	−3414	0.033		40803.395	−15017	−0.024
	48362.554	−1530	0.005		41179.418	−14311	−0.019
	49154.493	0	−0.023		45492.490	−6213	0.028
V825 Oph	29786.438	−64659	1.278		45916.405	−5417	−0.010
	29788.495	−64652	1.276		46507.630	−4307	0.025
	29816.433	−64557	1.273		47386.398	−2657	−0.003
	29843.474	−64465	1.255		48801.513	0	−0.016
	29844.389	−64462	1.288	NSV 10115	29785.438	−35547	−1.091
	39651.484	−31115	0.446		29786.522	−35545	−1.095
	39684.461	−31003	0.481		29816.433	−35490	−1.105
	39686.492	−30996	0.454		38901.500	−18791	−0.471
	39702.398	−30942	0.477		39611.517	−17486	−0.388
	39712.391	−30908	0.470		39648.507	−17418	−0.391
	45492.490	−11254	−0.017		39684.461	−17352	−0.342
	45822.489	−10132	−0.017		46298.342	−5195	0.002
	46272.507	−8602	0.001		46554.584	−4724	0.015
	46288.406	−8548	0.017		47387.432	−3193	−0.017
	46506.628	−7806	0.004		48067.449	−1943	−0.014
	47368.432	−4876	0.044		49124.489	0	0.014

* Mid-exposure times of plates with brightest observations

References:

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Hughes-Boyce, E., Huruhata, M., 1942, *Harvard Annals*, **109**, 4