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FOUR RR LYRAE STARS WITH VARIABLE PERIODS IN OPHIUCHUS

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Hoffmeister (1967) has reported the discovery of the RR Lyr stars analysed in the present paper. No ephemerides were published for V1097 Oph and V2029 Oph until today and, in the other cases, period variations were detected as a result of our observations. 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). The elements listed below were obtained by means of least-squares solutions. Already published times of maxima for V1077 Oph and V1090 Oph (Ivanij and Samus, 1994, and Konoplyov, 1986) were included in these solutions.

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

Remarks:

V1077 Oph

A first and somewhat preliminary set of elements consisting of 3 slightly different periods derived from observations covering only about 2000 days was published by Konoplyov (1986). The light curves in this paper show considerable scatter especially between phases 0.3 and 0.8. The observations reported here allow to confirm in principle the value of the period and have ascertained a major period change occurred around J.D. 2441500. Elements listed in Table 1 are valid for J.D. 2429100–2439600 and J.D. 2442900–2449500, resp.

V1090 Oph

Although a precise time of the period change can not be clearly deduced from the (O–C)-diagram, the composite light curve drawn with these period values gives some hints to assume a period change took place around J.D. 2438500. Elements are at least valid for J.D. 2429100–2431700 and J.D. 2438200–2449500, resp.

V1097 Oph

A similar situation applies to V1097 Oph. Our elements given below are at least valid for the intervals of JD 2429100–2431700 and J.D. 2438200–2449500. Unfortunately there were no plates available in between these times. So, the (O–C)-diagram represents only one reasonable version of the stars period history.

V2029 Oph

Only observations from J.D. 2438258–2449488 were displayed in the light curve because of the uncertainties concerning the set of elements valid prior to this date. The given ephemeris is valid for J.D. 2438900–2449200.

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M–m	No. of Plates
V1077 Oph (1)	RRab	39259.556 ±15	0.3739892 ±8	15 ^m 2	15 ^m 9	0P18	58
V1077 Oph (2)		48100.422 ±6	0.3739738 ±6				67
V1090 Oph (1)	RRab	38528.505 ±12	0.5266866 ±10	14 ^m 9	>15 ^m 6	0P15	41
V1090 Oph (2)		43933.604 ±4	0.5266592 ±10				74
V1097 Oph (1)	RRab	29790.437 ±8	0.5927486 ±3	14 ^m 8	16 ^m 4	0P20	132
V1097 Oph (2)		47770.340 ±6	0.5927533 ±8				42
V2029 Oph	RRab	49154.467 ±12	0.5900729 ±11	14 ^m 9	15 ^m 5	0P13	114

Table 2. Comparison stars and cross references

V1077 Oph S 9843 USNO 0900-10764128		V1090 Oph S 9863 USNO 0975-10473162		
Comp. No.	USNO	m*	USNO	m*
1	0900-10762796	15 ^m 3	0975-10468047	14 ^m 7
2	0900-10758477	15 ^m 6	0975-10481309	15 ^m 0
3	0900-10756678	15 ^m 8	0975-10473364	15 ^m 2
4	0900-10759166	16 ^m 1	0975-10476690	15 ^m 7

V1097 Oph S 9874 USNO 0900-12237409		V2029 Oph S 9846 USNO 0900-10886697		
Comp. No.	USNO	m*	USNO	m*
1	0900-12236119	14 ^m 5	0900-10893744	14 ^m 6
2	0900-12237108	15 ^m 2	0900-10891766	15 ^m 0
3	0900-12241628	15 ^m 7	0900-10892260	15 ^m 3
4	0900-12240377	16 ^m 4		

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

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

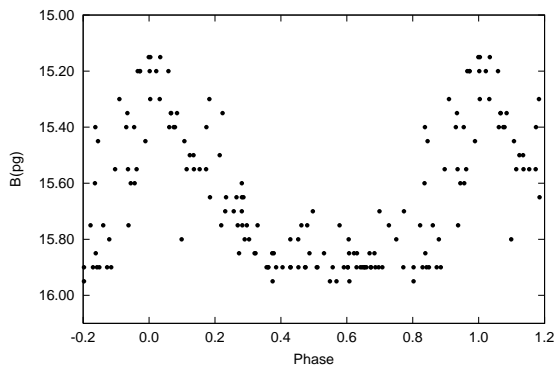


Figure 1. Composite light curve of V1077 Oph

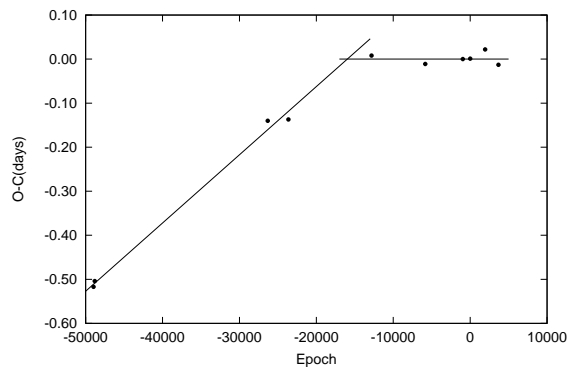


Figure 2. (O-C) diagram for V1077 Oph

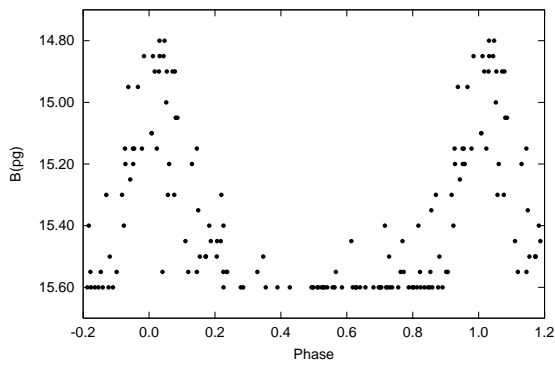


Figure 3. Composite light curve of V1090 Oph

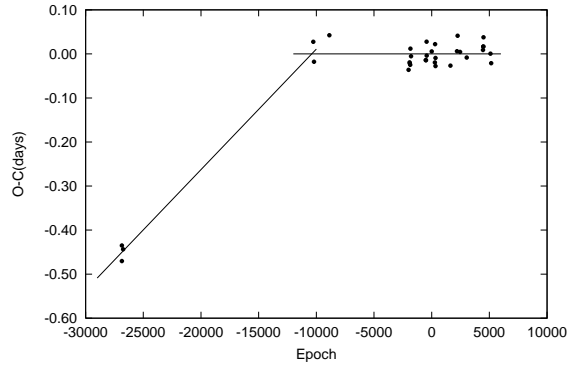


Figure 4. (O-C) diagram for V1090 Oph

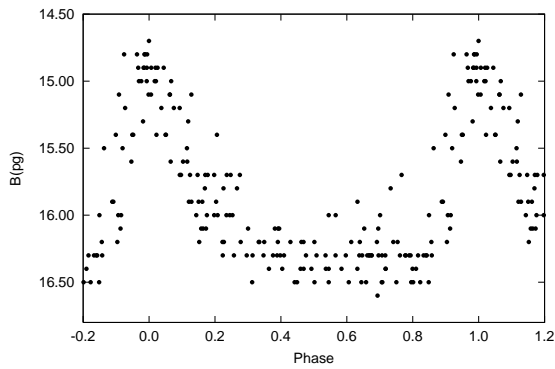


Figure 5. Composite light curve of V1097 Oph

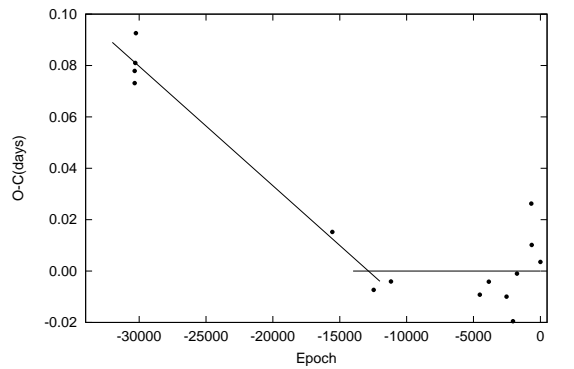


Figure 6. (O-C) diagram for V1097 Oph

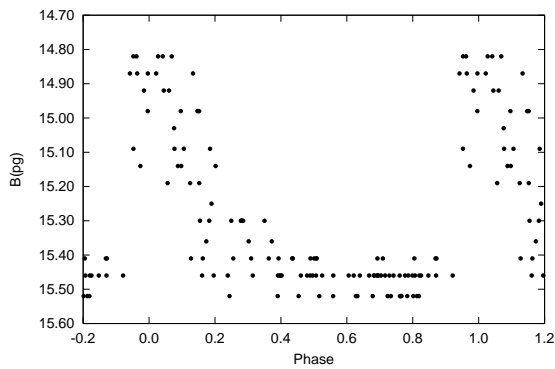


Figure 7. Light curve (J.D. 2438258 - 2449488) of V2029 Oph

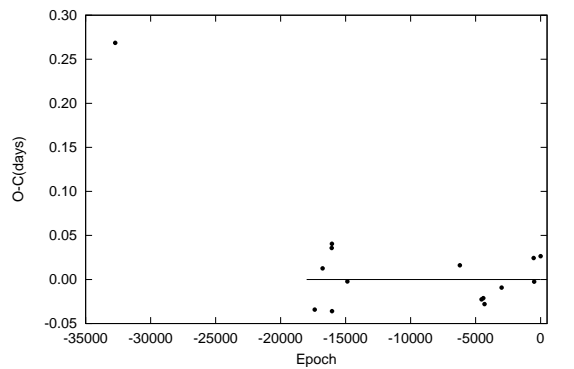


Figure 8. (O-C) diagram for V2029 Oph

Table 3. Heliocentric times of new found maxima and $O - C$ values according to the elements derived in this paper

Star	JD (max.*)	Epoch	$O - C$	Star	JD (max.*)	Epoch	$O - C$
V1077 Oph (1)	29786.410	-25330	0.001	V1097 Oph (1)	38549.486	14777	0.002
	29844.389	-25175	0.012		40383.442	17871	-0.006
	38258.415	-2677	0.028		41150.468	19165	0.003
	39259.546	0	-0.010	V1097 Oph (2)	45087.530	-4526	-0.011
V1077 Oph (2)	43303.469	-12827	0.008	45486.458	-3853	-0.004	
	45916.405	-5840	-0.011	46272.443	-2527	-0.006	
	47744.399	-952	0.000	46554.584	-2051	-0.014	
	48100.423	0	0.001	46731.243	-1753	0.005	
	48830.441	1952	0.022	47368.480	-678	0.035	
	49475.511	3677	-0.013	47387.432	-646	0.019	
V1090 Oph (1)	29785.522	-16600	0.016	47770.344	0	0.015	
	29786.540	-16598	-0.020	V2029 Oph	29843.418	-32727	0.269
	29843.446	-16490	0.004	38902.505	-17374	-0.034	
	38528.528	0	0.023	39259.546	-16769	0.013	
	38557.449	55	-0.023	39671.440	-16071	0.036	
39259.546	1388	0.000	39681.476	-16054	0.040		
V1090 Oph (2)	45087.521	2191	0.006	39684.350	-16049	-0.036	
	45115.469	2244	0.041	40382.440	-14866	-0.002	
	45530.427	3032	-0.008	45492.490	-6206	0.016	
	46272.507	4441	0.009	46476.693	-4538	-0.023	
	46289.368	4473	0.017	46554.584	-4406	-0.021	
	46290.421	4475	0.016	46609.454	-4313	-0.028	
	46298.342	4490	0.038	47388.369	-2993	-0.009	
	V1097 Oph (1)	29787.470	-5	-0.003	48839.392	-534	0.024
29790.429	0	-0.008	48862.378	-495	-0.002		
29816.518	44	0.000	49154.493	0	0.026		
29844.389	91	0.012					

* Mid-exposure times of plates with brightest observations

References:

- Hoffmeister, C., 1967, *Astron. Nachr.*, **290**, 43
 Ivanij, M. B., Samus, N. N. 1994, *Perem. Zvezdy*, **23**, 251
 Konoplyov, P. I., 1986, *Perem. Zvezdy*, **22**, 417