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A FURTHER UPDATE ON THE PERIOD OF V 566 OPHIUCHI

V 566 Ophiuchi (BD + 5°3547, HD 163 611) is an A-type W Ursae Majoris system with a period that remained essentially constant at 0.40964091 day from 1952 to 1966 (Binnendijk, 1959; Bookmyer, 1969). Beginning about Julian Date 2440000 (1968) the O-C values begin to show a steep positive trend indicating an increase in period (Maddox and Bookmyer, 1981, hereafter MB). Since that time observations suggest that the period may be continuing to change at a slow rate.

Table I shows the results of solutions for the period using data from different Julian date ranges. Column six in this table lists the period increase (in seconds) relative to the pre-1968 period published by Bookmyer (1969).

The general trend of values in Table I suggests a small, continuous period change since 1968. However, attempts to fit a quadratic in E to the times of minimum (Dawson and Narayanaswamy, 1977; MB; Kennedy, 1984) have generated only very small second-order terms. Also, Dawson and Narayanaswamy (1977), fitting all data from 1952 to 1975, concluded that two linear fits, one to observations made before 1968 and one to observations made after 1968, were better than a single quadratic fit to the entire data set.

Table II lists nine newly published times of minima for V 566 Oph. Six of these were obtained with the 40 centimeter Boller and Chivens reflector at the Joseph R. Grundy Observatory of Franklin and Marshall College using a thermoelectrically cooled 1P21 tube and DC electronics. The observation on J.D. 2445928 was made with the same telescope using a thermoelectrically cooled RCA C31034A-02 photomultiplier tube and pulse counting electronics. The observations on Julian dates 2445925 and 2445943 were made with the 40 centimeter Boller and Chivens reflector at The Mount Laguna Observatory of San Diego State University using a dry ice cooled 1P21 tube and a charge integration photometer. The differential accuracy of these observations was better than 0.01 magnitude.

In all cases, the observations were made through V filters close to the UBV system. Photometry was taken differentially against BD + 4°3558. No corrections for differential extinction were made as the comparison star lies within

Table I

Previous Solutions

Year	Source	Data Range	Epoch	Period	dP(sec)	Rem.
1959	Bi	2434179-2436010	2435245.5440	0.40964101	0.009	
1969	Bo	2442579-2442590	2436744.4200	0.40964091	0.000	
1976	Bm	2440047-2442877	2441835.8617	0.40964387	0.26	
1976	Bm	2440047-2442203	2441835.8618	0.40964399	0.26	
1977	DN	2440000-2442590	2440418.4931	0.40964431	0.29	
1978	Sc	2441119-2442987	2441835.8617	0.409645	0.35	
1981	MB	2442600-2443677	2443281.5034	0.40964660	0.49	
1981	MB	2440000-2443677	2441863.7179	0.40964506		*
1981	MB	2440000-2443677	2441863.7188	0.40964504	0.36	
1984	Ke	2440400-2445197	2441119.8016	0.40964579	0.42	**
1985	SD	2440000-2445943	2440047.3478	0.40964600	0.44	
1985	SD	2440000-2445943	2440047.3542	0.40964392		***

Bi=Binnendijk 1959, Bm=Bookmyer 1976, Bo=Bookmyer 1969, DN=Dawson, Narayanaswamy 1977, Ke=Kennedy 1984, MB=Maddox and Bookmyer 1981, Sc=Scarfe and Barlow 1978, SD=Seeds and Dawson (present paper).

* Quadratic term: 5.6×10^{-10}

** Quadratic term:"negligible"

*** Quadratic term: 1.3×10^{-10}

Table II

Photoelectric Epochs of Minimum Light, V566 Oph

JD Hel.	Min	O-C	Source	JD Hel.	Min	O-C	Source
2443662.4770	I	+0.0032	PG	2445144.5759	I	+0.0029	SD
4406.8073	I	+0.0067	Sc	5169.9749	I	+0.0038	Ke
4448.7922	II	+0.0029	Sc	5170.9988	II	+0.0036	Ke
4750.4901	I	-0.0035	MS	5172.6355	II	+0.0017	SD
4751.5162	II	-0.0015	MS	5175.7085	I	+0.0024	SD
4780.8121	I	+0.0047	Sc	5183.4926	I	+0.0032	Po
4781.8357	II	+0.0042	Sc	5196.6001	I	+0.0020	SD
4795.3461	II	-0.0037	Ni	5197.0117	I	+0.0040	Ke
4796.3698	I	-0.0041	Ni	5207.6598	I	+0.0013	SD
4797.3946	II	-0.0034	Ni	5512.8463	I	+0.0015	Sc
4798.4191	I	-0.0030	Ni	5513.8700	II	+0.0011	Sc
4799.4434	II	-0.0029	Ni	5554.6307	I	+0.0020	SD
4825.2510	II	-0.0030	MS	5925.7694	I	+0.0014	SD
4826.2739	I	-0.0042	MS	5928.6376	I	+0.0021	SD
4827.2992	II	-0.0030	MS	5943.7952	I	+0.0028	SD

Ke=Kennedy 1984, MS=Mahdy and Soliman 1982, Ni=Niarchos 1983, PG=Pohl et al. 1981, Po=Pohl et al. 1983, Sc=Scarfe et al. 1984, SD=Seeds and Dawson (present paper).

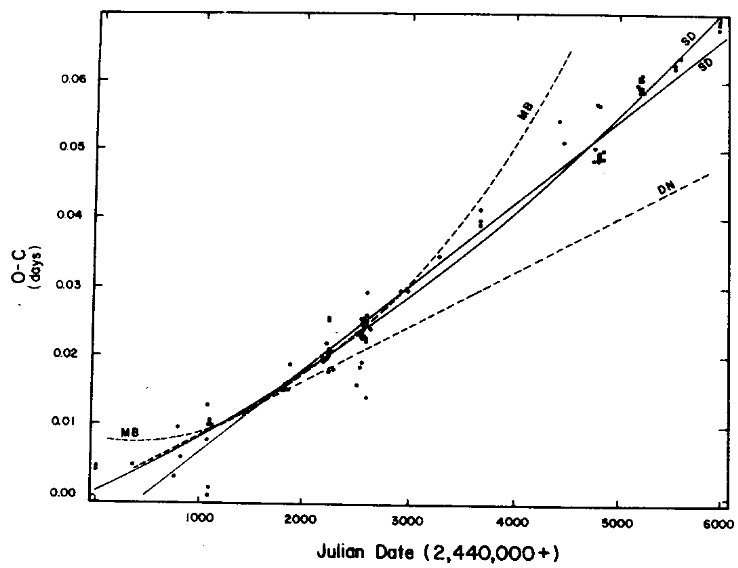

Figure 1. Observed minus computed heliocentric times of minimum for V566 Oph versus Julian Date. The computed times of minimum are based upon the linear elements of Bookmyer (1969). Curve MB: quadratic solution of Maddox and Bookmyer (1981). Curve DN: linear solution of Dawson and Narayanaswamy (1977). Straight line and curve labeled SD: linear and quadratic solutions based upon the present data.

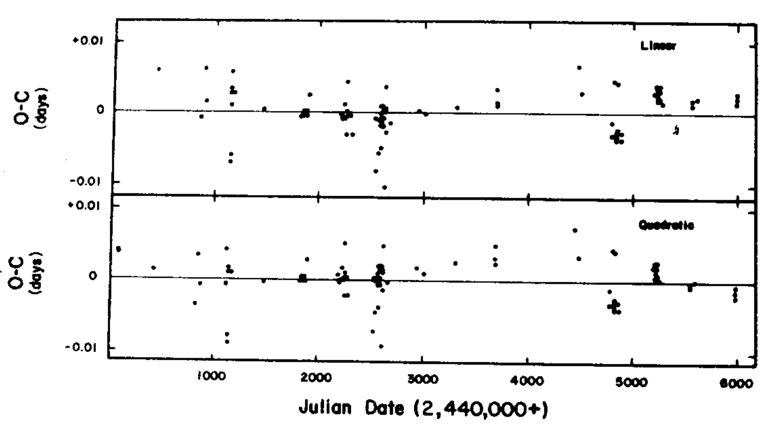

Figure 2. O-C residuals for the authors' linear and quadratic fits to the data of Table II. The s.e. is ±0.0034 day for the linear fit and ±0.0029 day for the quadratic fit.

10 arc-minutes of the variable and is of nearly identical spectral type.

Times of minimum were found using the tracing paper method or by bisection of times of equal brightness on declining and rising light.

In addition to our new observations, Table II includes twenty-one recent times of minimum collected from the literature. All of these times are derived from photoelectric observations using V filters. The O-C values in the table were computed from the linear elements derived in this paper.

The total data base for this analysis includes the times of minimum listed in Table II of this paper plus those since Julian Date 2440000 as listed in Table II of MB. Three minima in their tabulation (Julian Dates 2442225.4170, 2442230.3329, 2442621.3892) were not included in our analysis because they fell beyond three standard deviations from any reasonable solution. The omission of these three data points has little effect on the final solutions.

We applied first and second order least squares solutions to the data described above. The results of these solutions are shown in Figure 1, which is a continuation of Figure 1 of MB, in which the (O-C)s of observations and solutions are calculated using the linear solution given by Bookmyer (1969). The curve labeled "MB" represents their second-order solution, and the straight line labeled "DN" represents the linear solution of Dawson and Narayanaswamy (1977).

Our linear solution to these data yields the following ephemeris:

$$\text{J.D. Hel.Min. I} = \underset{\pm\ 7}{2440047.3478} + \underset{\pm\ 9}{0\overset{d}{.}40964600} \cdot E$$

The errors given are standard errors. The scatter of points about this solution is ±0.0034 day. Our linear solution is the straight line labeled "SD" in Figure 1.

A quadratic solution to the same data produces the following ephemeris:

$$\text{J.D. Hel.Min. I} = \underset{\pm\ 3}{2440047.3542} + \underset{\pm\ 9}{0\overset{d}{.}40964392} \cdot E + \underset{\pm\ 11}{1.32\text{x}10^{-10}} \text{x} E^2$$

The point scatter about this solution is ±0.0029 day. The quadratic solution is represented in Figure 1 by the curve labeled "SD".

The linear and quadratic solutions are further compared in Figure 2. The quadratic solution is slightly better than the linear fit. This suggests that the period could be changing gradually by about $2.6\text{x}10^{-10}$ day/cycle. These data do not permit a conclusive identification of this continuing period change, nor do they permit analysis by higher order solutions. All data in these analyses have been equally weighted (except for omitted points which have effective weights of zero); Without a detailed knowledge of the observers' methods of observation and reduction, further tests of significance do not seem warranted.

Future observations of V 566 Oph are desirable to confirm a continuing change in the period and to detect additional sudden changes in period such as that which evidently occurred in 1968.

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