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IMPROVED EPHEMERIS AND NEW OBSERVATIONS OF NSV 02980

NSV 02980 (S 03990, CSV 00076, GSC 0141.0638) was originally announced as a variable star by Hoffmeister (1949). Additional observations carried out by Guarro-Flo et al. (1995) showed that NSV 02980 is in fact a W UMa-type eclipsing binary system. The following preliminary ephemeris was given:

$$\text{Min. I} = \text{HJD } 2449800.429 + 0^{\text{d}}.41630 \times \text{E}$$

To improve the above ephemeris and its light curve, NSV 02980 was observed in integral light and in the B and V bands during several nights, from December 29, 1995 to January 17, 1997, using the 0.32-m Ritchey-Chretien telescope (Moschner) and the 0.20-m SC-telescope (Kleikamp) equipped with ST-6 cameras, at private observatories in Germany, and the 0.51-m telescope at l'Ametlla del Valles Observatory, in Spain, equipped with a Starlight Xpress CCD camera. GSC 0141.0390 and GSC 0141.0666 were used as comparison and check stars respectively.

From the new set of data a list of minima were derived using the Kwee and van Woerden (1956) method. These new minima showed that the preliminary period given by Guarro-Flo et al. was an alias one. After performing a least-squares linear fit on the minima the following improved ephemeris was found:

$$\text{Min. I} = \text{HJD } 2450081.3665 + 0^{\text{d}}.34451 \times \text{E}$$
$$\pm 0.0001 \quad \pm 0.00003$$

Table 1

HJD	Epoch	Minimum	Filter	O−C	Observer
2450081.5394	0.5	II	no	0.0007	(1)
2450086.3616	14.5	II	no	−0.0003	(1)
2450086.5331	15.0	I	no	−0.0010	(1)
2450088.4287	20.5	II	no	−0.0002	(1)
2450096.5243	44.0	I	no	−0.0006	(1)
2450102.5542	61.5	II	V	0.0003	(2)
2450116.5057	102.0	I	V	−0.0008	(2)
2450120.4702	113.5	II	V	0.0018	(2)
2450122.5363	119.5	II	V	0.0008	(2)
2450125.4621	128.0	I	V	−0.0017	(2)
2450129.4269	139.5	II	B	0.0012	(2)
2450130.4605	142.5	II	B	0.0013	(2)
2450131.4931	145.5	II	B	0.0004	(2)
2450144.4120	183.0	I	B	0.0001	(2)
2450153.3679	209.0	I	no	−0.0013	(1)
2450154.4033	212.0	I	B	0.0006	(2)
2450155.4349	215.0	I	B	−0.0013	(2)
2450157.3311	220.5	II	no	0.0001	(1)
2450380.5737	868.5	II	no	0.0003	(1)
2450464.4617	1112.0	I	no	0.0001	(3)
2450465.4964	1115.0	I	no	0.0012	(1)

Observer: (1) Moschner, (2) Garrigos, (3) Kleikamp

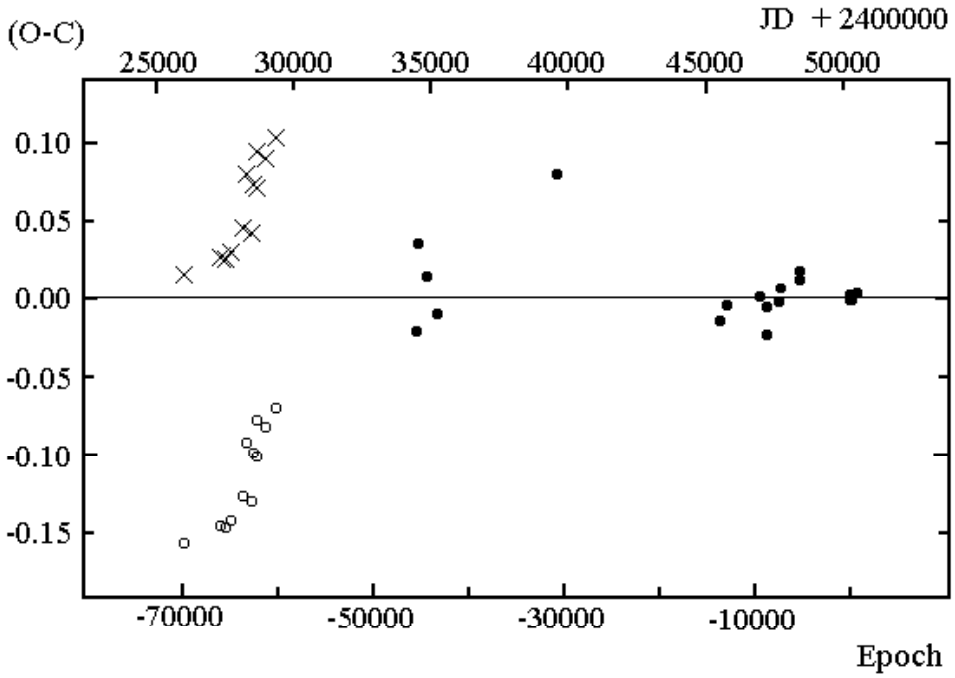

Figure 1

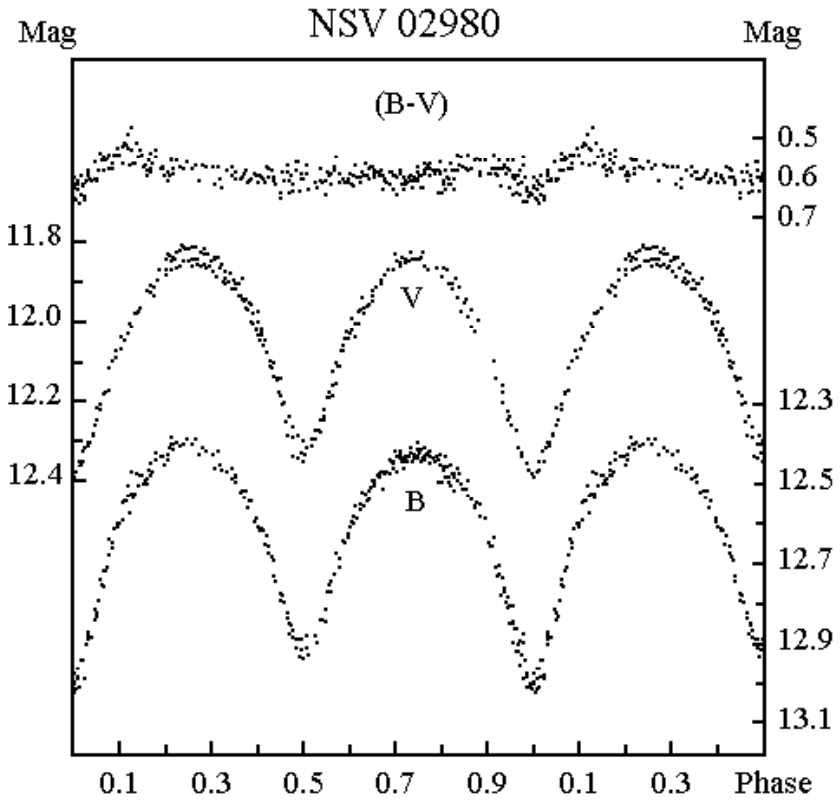

Figure 2

Table 1 summarizes minima timings and O−C residuals according to the new ephemeris.

After computing the improved ephemeris, to obtain a history of the period behaviour of NSV 02980, the variable was investigated (Moschner) on 350 plates taken with the 0.4-m astrograph at Sonneberg Observatory. The variable was found to be at minimum light on 26 plates, covering the interval from January 5, 1930 until January 17, 1991.

Analysis of the timings suggests that the period of NSV 02980 has remained fairly constant from JD 2434391.5 until now. The observational gap between JD 2429302 and JD 2434391 does not allow to ascertain whether the period before JD 2434391 was different from the present one. Figure 1 shows O−C residuals calculated against the new ephemeris. The typical error of photographic measurements is ±0.02 days whereas that of the CCD measurements is ±0.00005 days. Before JD 2434391 it is not possible to unambiguously assign an epoch number. For this reason, Figure 1 shows residuals for the two closest computed epochs to the observed photographic minima before JD 2434391, which are represented by open boxes and crosses. Solid circles represent residuals after JD 2434391. Table 2 lists photographic minima before JD 2434391 and gives the key to Figure 1. Table 3 lists photographic minima after JD 2434391.

Table 2

HJD	Epoch [Open boxes]	Epoch [Crosses]	O−C [Open boxes]	O−C [Crosses]
2425981.5293	−69953.5	−69954.0	−0.1569	0.0154
2427344.5938	−65997.0	−65997.5	−0.1462	0.0261
2427479.4689	−65605.5	−65605.0	−0.1468	0.0255
2427718.5626	−64911.5	−64912.0	−0.1430	0.0293
2428126.4781	−63727.5	−63728.0	−0.1274	0.0449
2428249.3306	−63371.0	−63371.5	−0.0927	0.0796
2428428.6097	−62850.5	−62851.0	−0.1310	0.0413
2428496.5094	−62653.5	−62654.0	−0.0998	0.0725
2428609.3341	−62326.0	−62326.5	−0.1021	0.0702
2428629.3392	−62268.0	−62268.5	−0.0786	0.0937
2428963.3371	−61298.5	−61299.0	−0.0832	0.0891
2429302.3481	−60314.5	−60315.0	−0.0700	0.1023

Table 3

HJD	Epoch	O−C
2434391.4982	−45542.5	−0.0216
2434451.3273	−45369.0	0.0350
2434809.4239	−44329.5	0.0135
2435192.3223	−43218.0	−0.0110
2439500.3383	−30713.5	0.0797
2445397.3933	−13596.0	−0.0152
2445672.4948	−12797.5	−0.0050
2446850.3830	−9378.5	0.0005
2447088.5847	−8687.0	−0.0234
2447099.6266	−8655.0	−0.0059
2447558.5165	−7323.0	−0.0033
2447566.4500	−7300.0	0.0065
2448271.4952	−5253.5	0.0120
2448273.5671	−5247.5	0.0168

Also, observations allowed to obtain a new light curve in the B and V bands. To obtain the B and V magnitudes of the light curve of NSV 02980, the comparison star GSC 0141.0390 was standardized using an OPTEC SSP-5A photoelectric photometer attached to the Cassegrain focus of the 0.6-m telescope at Esteve Duran Observatory (Spain). Results indicate that NSV 02980 is an object with a V magnitude of 11.83 ± 0.03 at maximum I (maximum I is the maximum following the primary minimum), and an average B−V color index of $+0^{m}.59 \pm 0^{m}.08$. Figure 2 depicts B, V, and B−V phase curves. Table 4 summarizes amplitudes of the primary and secondary minima and maximum light levels in the B and V bands. Systematic differences appearing around Max. I might be due to observational uncertainties.

Table 4

	Max. magnitude	Min. I amplitude	Min. II amplitude
B Band	$12^{m}.42 \pm 0.05$	$0^{m}.59 \pm 0.04$	$0^{m}.50 \pm 0.03$
V Band	$11^{m}.83 \pm 0.03$	$0^{m}.54 \pm 0.03$	$0^{m}.47 \pm 0.04$

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