COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 4416

Konkoly Observatory
Budapest
6 January 1997

HU ISSN 0374 – 0676

V676 Cen: NEW TIMES OF MINIMA AND A POSSIBLE SHORT PERIOD MODULATION

We present new photoelectric (hereafter pe) minima of the very short period, red, W-type W UMa star V676 Cen = GSC 7806:1187, V $\simeq$ 11$^{\rm m}_{.}$5, Sp.T. $\simeq$ K2. Other available minima are the photographic ones (hereafter pg) from the discoverer (Hoffmeister 1956) and the photoelectric ones by Gómez and Lapasset (1988, hereafter GL) and by Gray et al. (1996a, b; hereafter GWS). History, a finder chart, light curves and preliminary elements can be found in GWS. The first period study of V676 Cen was made by Wood and Forbes (1963).

The observations reported here were made in 1983 and 1995 at Cerro Tololo Inter-American Observatory[1] in Chile with the Lowell telescope, refrigerated phototubes, standard UBVRI filters and photon counting techniques. GSC 7806:1222 and GSC 7806:1059 = HD 128433(K2) = CoD $-38°9522$ were used as comparison and check stars, respectively. The derived minima are listed in the lower part of Table 1. The two minima corresponding to the 1983 season were determined through the Sliding Integral's Algorithm (Ghedini 1981, hereafter SIA), while the 1995 minimum was determined by extrapolation using the tracing paper method (Szafraniec 1948). With these minima we have extended the pe baseline of minima from about 4900 in GWS to 15500 cycles.

We made a least squares weighted parabolic solution taking into account all available minima to derive an improved ephemeris and a possible period variation. Standard deviations for the pg minima (0$^{\rm d}_{.}$005, 0$^{\rm d}_{.}$010 and 0$^{\rm d}_{.}$015) were estimated from a linear solution with equal weights; for the pe minima we used those published by GWS and those from the output of SIA. The standard deviations of the 1995 minimum were estimated visually, while those from GL were estimated as the pg ones (0$^{\rm d}_{.}$001, 0$^{\rm d}_{.}$002 and 0$^{\rm d}_{.}$005) because they are lacking in the publication. We have taken extreme care to reconcile the pg with the pe minima. The parabolic solution is:

$$\begin{array}{llll} \text{Min I} = \text{HJD}\,2446971^{\rm d}_{.}61072 & + \; 0^{\rm d}_{.}29239354 \times \text{E'} & - \; 1^{\rm d}_{.}76 \times 10^{-11}\ \text{E'}^2 & (1) \\ \phantom{\text{Min I} =}\pm\; 0^{\rm d}_{.}00056 & \pm\; 0^{\rm d}_{.}00000011 & \pm\; 0^{\rm d}_{.}29 \times 10^{-11}\ \text{m.e.} & \end{array}$$

Residuals from this solution are labeled (O$-$C)' in Table 1. Those labeled O$-$C are the residuals from the linear solution. As can be seen comparing the linear and parabolic residuals or from (1) the term that takes into account the total variation of the period is only marginally detectable. We might conclude that the system remained stable along the 53134 revolutions (cycles) covered by the available observations. The behavior of the O$-$C residuals is depicted in Figure 1.

[1]Operated by AURA Inc. under cooperative agreement with the NSF.

Table 1. Times of minima and residuals for V676 Cen

Ref.	Min.	Band	HJD (sigma) 2400000+	E	O−C	(O−C)'
1	I	pg	34425.5630(0.0100)	−42908.0	0.0059	0.0069
1	II	pg	34431.5510(0.0050)	−42887.5	−0.0002	0.0008
1	I	pg	34474.3820(0.0050)	−42741.0	−0.0050	−0.0041
1	I	pg	34477.3180(0.0100)	−42731.0	0.0071	0.0079
1	II	pg	34479.5000(0.0050)	−42723.5	−0.0039	−0.0030
1	II	pg	34480.3830(0.0050)	−42720.5	0.0019	0.0028
1	I	pg	34480.5190(0.0100)	−42720.0	−0.0083	−0.0074
1	II	pg	34481.2500(0.0100)	−42717.5	−0.0082	−0.0074
1	I	pg	34481.3950(0.0100)	−42717.0	−0.0094	−0.0086
1	II	pg	34481.5470(0.0050)	−42716.5	−0.0036	−0.0028
1	I	pg	34482.2840(0.0050)	−42714.0	0.0024	0.0032
1	II	pg	34482.4260(0.0050)	−42713.5	−0.0018	−0.0010
1	I	pg	34482.5790(0.0100)	−42713.0	0.0050	0.0058
1	II	pg	34483.3010(0.0050)	−42710.5	−0.0040	−0.0032
1	I	pg	34483.4550(0.0050)	−42710.0	0.0038	0.0046
1	I	pg	34485.4850(0.0100)	−42703.0	−0.0130	−0.0121
1	II	pg	34485.6430(0.0050)	−42702.5	−0.0012	−0.0003
1	I	pg	34486.3650(0.0100)	−42700.0	−0.0101	−0.0093
1	I	pg	34488.4260(0.0050)	−42693.0	0.0041	0.0049
1	I	pg	34489.5920(0.0050)	−42689.0	0.0005	0.0013
1	II	pg	34490.3120(0.0100)	−42686.5	−0.0105	−0.0096
1	II	pg	34490.6190(0.0050)	−42685.5	0.0041	0.0050
1	I	pg	34491.6390(0.0050)	−42682.0	0.0008	0.0016
1	I	pg	34503.3290(0.0050)	−42642.0	−0.0050	−0.0042
1	II	pg	34504.3550(0.0050)	−42638.5	−0.0024	−0.0016
1	I	pg	34505.3800(0.0050)	−42635.0	−0.0008	0.0000
1	I	pg	34508.3140(0.0100)	−42625.0	0.0093	0.0101
1	II	pg	34509.6250(0.0050)	−42620.5	0.0045	0.0053
1	II	pg	34511.3710(0.0050)	−42614.5	−0.0038	−0.0031
1	I	pg	34511.5220(0.0050)	−42614.0	0.0010	0.0017
1	I	pg	34512.3950(0.0050)	−42611.0	−0.0032	−0.0025
1	II	pg	34512.5600(0.0150)	−42610.5	0.0156	0.0163
1	I	pg	34513.2750(0.0050)	−42608.0	−0.0004	0.0003
1	II	pg	34513.4150(0.0050)	−42607.5	−0.0066	−0.0059
1	I	pg	34513.5520(0.0150)	−42607.0	−0.0158	−0.0151
1	II	pg	34514.5800(0.0100)	−42603.5	−0.0112	−0.0104
1	II	pg	34516.3500(0.0050)	−42597.5	0.0045	0.0052
1	I	pg	34516.4930(0.0050)	−42597.0	0.0013	0.0020
1	II	pg	34516.6330(0.0050)	−42596.5	−0.0049	−0.0042
1	I	pg	34517.3700(0.0050)	−42594.0	0.0011	0.0018
1	II	pg	34517.5160(0.0050)	−42593.5	0.0009	0.0016
1	I	pg	34518.2500(0.0050)	−42591.0	0.0039	0.0046
1	I	pg	34518.5400(0.0050)	−42590.0	0.0015	0.0022
1	II	pg	34519.5660(0.0050)	−42586.5	0.0041	0.0048
1	II	pg	34521.6100(0.0050)	−42579.5	0.0014	0.0021
1	II	pg	34529.2260(0.0150)	−42553.5	0.0151	0.0158
1	I	pg	34530.2250(0.0100)	−42550.0	−0.0093	−0.0086
1	II	pg	34531.2480(0.0100)	−42546.5	−0.0097	−0.0090
1	I	pg	34532.2790(0.0050)	−42543.0	−0.0020	−0.0013
1	II	pg	34532.4170(0.0100)	−42542.5	−0.0102	−0.0095
1	II	pg	34533.3040(0.0050)	−42539.5	−0.0004	0.0003
1	I	pg	34533.4460(0.0050)	−42539.0	−0.0046	−0.0039
1	I	pg	34534.3290(0.0050)	−42536.0	0.0012	0.0019
1	II	pg	34534.4760(0.0050)	−42535.5	0.0020	0.0027
1	II	pg	34535.3400(0.0100)	−42532.5	−0.0112	−0.0105
1	I	pg	34535.4910(0.0050)	−42532.0	−0.0064	−0.0057
1	II	pg	34536.2300(0.0050)	−42529.5	0.0016	0.0023

Table 1 (cont.)

Ref.	Min.	Band	HJD (sigma) 2400000+	E	O−C	(O−C)'
1	I	pg	34536.3730(0.0050)	−42529.0	−0.0015	−0.0009
1	II	pg	34537.4010(0.0050)	−42525.5	0.0031	0.0037
1	II	pg	34538.2800(0.0050)	−42522.5	0.0049	0.0056
1	I	pg	34538.4340(0.0150)	−42522.0	0.0127	0.0134
1	I	pg	34539.2950(0.0050)	−42519.0	−0.0035	−0.0028
1	II	pg	34539.4500(0.0050)	−42518.5	0.0053	0.0060
1	II	pg	34540.3210(0.0050)	−42515.5	−0.0009	−0.0002
1	I	pg	34541.3400(0.0050)	−42512.0	−0.0053	−0.0046
1	II	pg	34541.4890(0.0050)	−42511.5	−0.0024	−0.0018
1	I	pg	34542.2250(0.0050)	−42509.0	0.0026	0.0032
1	II	pg	34543.2410(0.0050)	−42505.5	−0.0048	−0.0042
1	I	pg	34543.3890(0.0050)	−42505.0	−0.0030	−0.0024
1	II	pg	34546.4650(0.0050)	−42494.5	0.0029	0.0035
1	I	pg	34562.4000(0.0050)	−42440.0	0.0024	0.0030
1	I	pg	34564.4430(0.0050)	−42433.0	−0.0014	−0.0008
1	II	pg	34565.4580(0.0100)	−42429.5	−0.0098	−0.0092
1	II	pg	34566.3500(0.0050)	−42426.5	0.0050	0.0056
1	II	pg	34568.3950(0.0050)	−42419.5	0.0033	0.0039
1	I	pg	34569.4230(0.0100)	−42416.0	0.0079	0.0085
1	I	pg	34570.3000(0.0100)	−42413.0	0.0077	0.0083
1	II	pg	34571.3140(0.0050)	−42409.5	−0.0017	−0.0011
1	I	pg	34571.4600(0.0050)	−42409.0	−0.0019	−0.0013
1	I	pg	34572.3340(0.0050)	−42406.0	−0.0050	−0.0045
1	II	pg	34572.4830(0.0050)	−42405.5	−0.0022	−0.0017
1	II	pg	34573.3550(0.0050)	−42402.5	−0.0074	−0.0068
1	I	pg	34573.5130(0.0050)	−42402.0	0.0044	0.0050
2	I	U	45434.7866(0.0012)	−5256.0	0.0019	−0.0032
2	I	B	45434.7862(0.0010)	−5256.0	0.0015	−0.0036
2	I	V	45434.7864(0.0010)	−5256.0	0.0017	−0.0034
2	I	U	45435.6633(0.0009)	−5253.0	0.0014	−0.0037
2	I	B	45435.6634(0.0009)	−5253.0	0.0015	−0.0036
2	I	V	45435.6636(0.0010)	−5253.0	0.0017	−0.0034
3	II	pe	46965.6195(0.0010)	−20.5	0.0048	0.0028
3	II	pe	46965.6199(0.0010)	−20.5	0.0052	0.0032
3	II	pe	46965.6167(0.0050)	−20.5	0.0020	0.0000
3	I	pe	46971.6167(0.0020)	0.0	0.0080	0.0060
3	I	pe	46971.6167(0.0020)	0.0	0.0080	0.0060
3	I	pe	46971.6155(0.0010)	0.0	0.0068	0.0048
3	II	pe	46973.5174(0.0020)	6.5	0.0081	0.0061
3	II	pe	46973.5163(0.0010)	6.5	0.0070	0.0050
3	II	pe	46973.5184(0.0020)	6.5	0.0091	0.0071
3	II	pe	46975.5618(0.0010)	13.5	0.0057	0.0038
3	II	pe	46975.5607(0.0020)	13.5	0.0046	0.0027
3	II	pe	46975.5617(0.0020)	13.5	0.0056	0.0037
3	II	pe	46978.4869(0.0010)	23.5	0.0069	0.0049
3	II	pe	46978.4867(0.0010)	23.5	0.0067	0.0047
3	II	pe	46978.4858(0.0010)	23.5	0.0058	0.0038
3	I	pe	47007.5860(0.0050)	123.0	0.0128	0.0109
3	I	pe	47007.5814(0.0010)	123.0	0.0082	0.0063
3	II	pe	47008.6001(0.0050)	126.5	0.0035	0.0016
3	II	pe	47008.6011(0.0050)	126.5	0.0045	0.0026
4	I	BVRI	48393.5174(0.0001)	4863.0	−0.0045	−0.0027
4	I	BVRI	48394.6872(0.0001)	4867.0	−0.0043	−0.0025
5	I	V	49961.6375(0.0015)	10226.0	0.0054	0.0123
5	I	R	49961.6310(0.0025)	10226.0	−0.0011	0.0058
5	I	I	49961.6350(0.0025)	10226.0	0.0029	0.0098

References: 1) Hoffmeister; 2) 1983 minima; 3) GL minima; 4) GWS minima; 5) 1995 minimum.

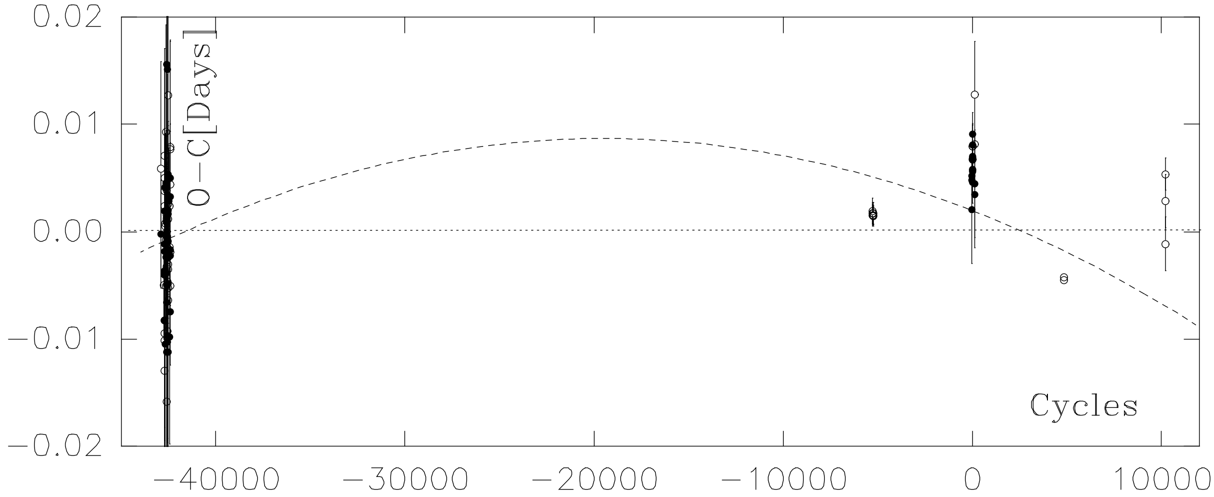

Figure 1. Behavior of the O−C residuals for V676 Cen from Formula (1). Hollow circles stand for primary minima

As can be seen in the pe residuals of Figure 1 there appears to be a modulation of semi-amplitude of $0^{d}\!.003$ and a period of about 10 years. This might be explained on one hand by a third-body light-time effect (Mayer 1990). On the other hand, as noted in GWS, the O'Connell effect present in their light curves at phase 0.25 is interchanged in GL (phase 0.75), so some mechanism, in particular related to magnetic activity in this late type star, might be responsible for the period modulation (van't Veer 1991, Applegate 1992). However, due to the scanty material analyzed here, new pe times of minima will only give a conclusive answer about this point. The author would like to thank the staff and Director of CTIO for their hospitality.

Miguel Angel CERRUTI
I.A.F.E.
CC 67 Suc. 28
1428 Buenos Aires
Argentina
miguelan@iafe.uba.ar

References:

Applegate J.H., 1992, *Astrophys J.*, **385**, 621
Ghedini S., 1981, *Mem. Soc. astr. Ital.*, **52**, 633, SIA
Gómez M., Lapasset E. 1988, *Inf. Bull. Var. Stars*, No. 3162, GL
Gray J.D., Woissol S., Samec R.G., 1996a, *Inf. Bull. Var. Stars*, No. 4359, GWS
Gray J.D., Woissol S., Samec R.G., 1996b, *Inf. Bull. Var. Stars*, No. 4390, ERRATUM
Hoffmeister, C., 1956, *Veröff. Sonneberg*, **3**, Part 1, 43
Mayer, P., 1990, *Bull. Astron. Inst. Czechosl.*, **41**, 231
Szafraniec, R., 1948, *Acta Astron. Serie c*, **4**, 81
van't Veer, F., 1991, *Astron. Astrophys.*, **250**, 84
Wood D.B., Forbes J.E., 1963, *Astron J.*, **68**, 257