

ANOTHER PERIOD FOR GR VIR

Summary: visual estimates of GR Vir seem to remark the need for a shorter period in respect with that one given by Cereda in 1987. Besides, a mean light curve is reported in this work too, which confirms some features of the photoelectric light curve as well as the total eclipse occurring at the secondary minimum.

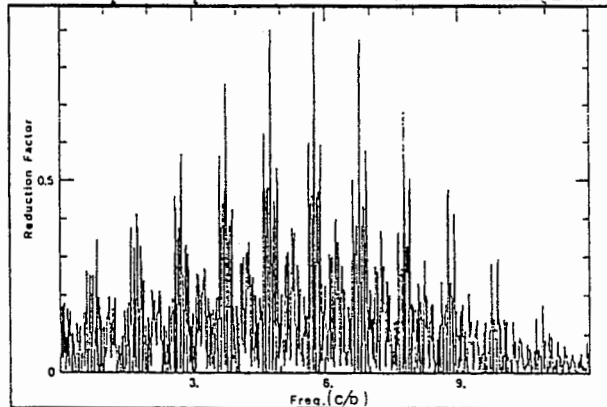
Introduction

GR Vir is a variable star discovered by Strohmeier et al. in 1965. In 1979 Harris, on the basis of 42 photoelectric measurements, demonstrated the star was an eclipsing binary with a period of 0.347 day and an amplitude of 0.4 mag. In 1983 a photoelectric minimum was determined by Hoffmann, who proposed a different period of 0.419757 day. In the fourth edition of GCVS, GR Vir is classified as an eclipsing binary of EW/KW type, variable in the range 7.8-8.25 mag, with the following light elements:

$$\text{Min. I (Hel.JD)} = 45116.381 + 0.419757 * E \quad (\text{GCVS 85}) \quad (1)$$

In 1987 Cereda et al.⁽¹⁾ photoelectrically observed GR Vir obtaining 239 V measurements in order to have an independent confirmation of the period proposed by Harris. So, by frequencies analysis in the power spectrum reported below, they remarked the highest peak at $f = 5.765$ C/D:

Fig.1 : GR Vir's power spectrum of 239 V measurements (Cereda et al., 1987)

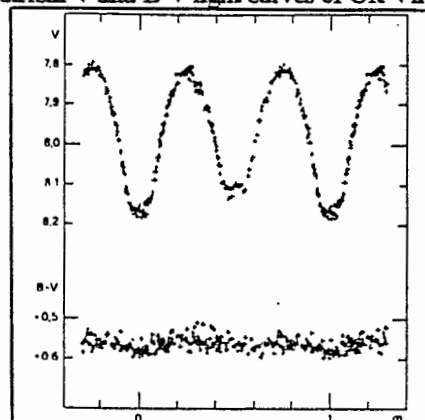


This value corresponds to the half period proposed by Harris, while the value reported by Hoffmann, and by the GCVS 85, corresponds to the alias at 4.76 C/D. Therefore, these authors proposed new light elements for GR Vir:

$$\text{Min. I (Hel.JD)} = 45665.6415 + 0.3469788 * E \quad (\text{Cereda et al.}) \quad (2)$$

About period, Halbedel found a shorter one of 0.346975 day in 1988, while 23 visual minima of the GEOS observers gave a value of 0.346980 day in years from 1981 to 1984. The light curve obtained by Cereda et al., phased according to light elements (2), is reported below:

Fig.2 : the photoelectrical V and B-V light curves of GR Vir (Cereda et al., 1987)



The range of light variation was found 7.81 to 8.18 (min II 8.12) in V. Besides, the V light curve suggested a phase of totality during secondary eclipse⁽²⁾.

Results and discussion

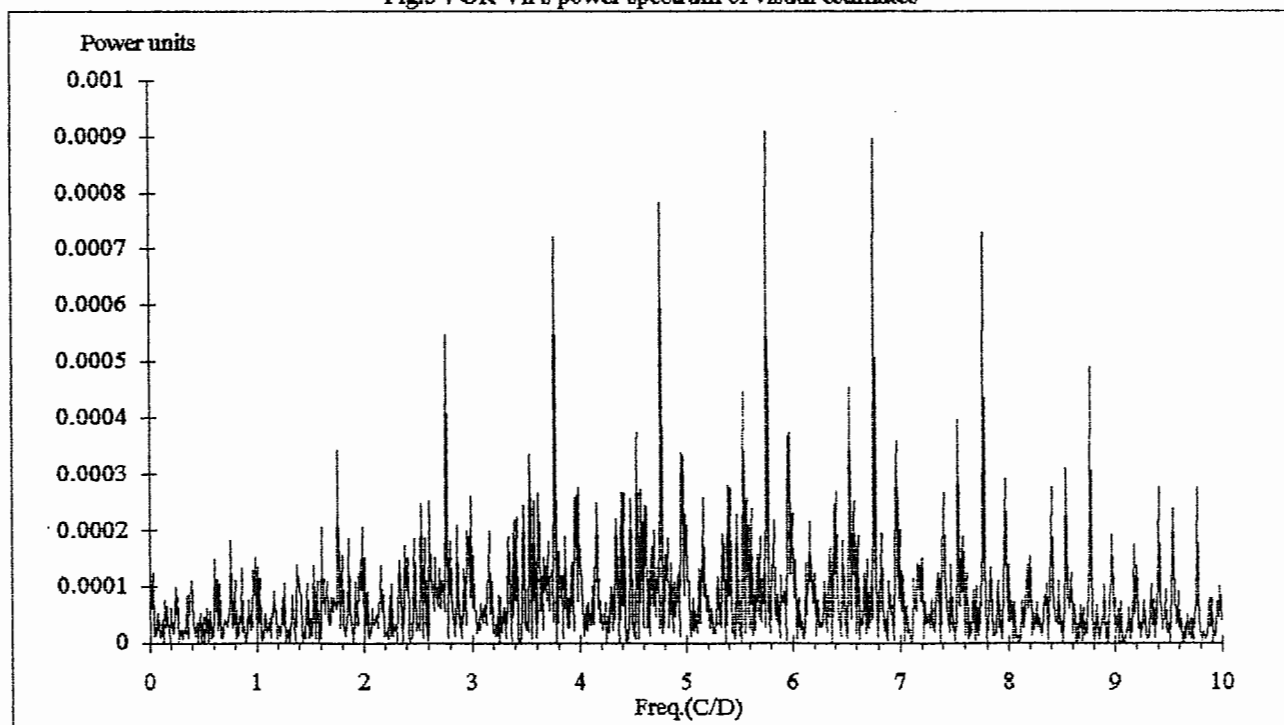
In 1995 I carried out about 250 visual estimates of GR Vir using GEOS finding chart C164. By SOP⁽³⁾ program I obtained 10 times of heliocentric light minimum, which are reported in table 1 together with the O-Cs according to light elements (2) and the type of minimum:

Tab.1 : GR Vir's times of minimum in 1995

DATE	U.T.	HJD	O-C(2)	TYPE
3 May	23.18	49841.471 ± 0.019	- 0.060	I
5 May	20.33	49843.356 ± 0.006	- 0.084	II
9 May	20.28	49847.353 ± 0.012	- 0.077	I
21 May	19.54	49859.329 ± 0.008	- 0.072	II
30 May	20.07	49868.338 ± 0.002	- 0.084	II
4 Jun	20.33	49873.356 ± 0.007	- 0.097	I
5 Jun	21.47	49874.408 ± 0.035	- 0.086	I
8 Jun	20.44	49877.364 ± 0.024	- 0.080	II
13 Jun	21.09	49882.381 ± 0.005	- 0.094	I
21 Jun	20.33	49890.356 ± 0.007	- 0.099	I

First of all, I checked the period by Fourier power spectrum analysis. Thus, observative data were processed by RCFM⁽⁴⁾ program to afford the next spectrum:

Fig.3 : GR Vir's power spectrum of visual estimates



Again, the highest peak is at frequency 5.766 C/D, indicating a light variation period of 0.3469 day.

Nevertheless, the $O-C(2)$'s value seems to be very high to confirm light elements (2)! In order to explain this advance in the observed minimum we need a shorter period than that one given in light elements (2). Since about 12112 cycles elapsed from the time indicated in equation (2), and since the mean $O-C(2)$ is:

$$O-C(2)_{\text{mean}} = -0.083 \pm 0.012 \text{ day}$$

we can estimate a new period of:

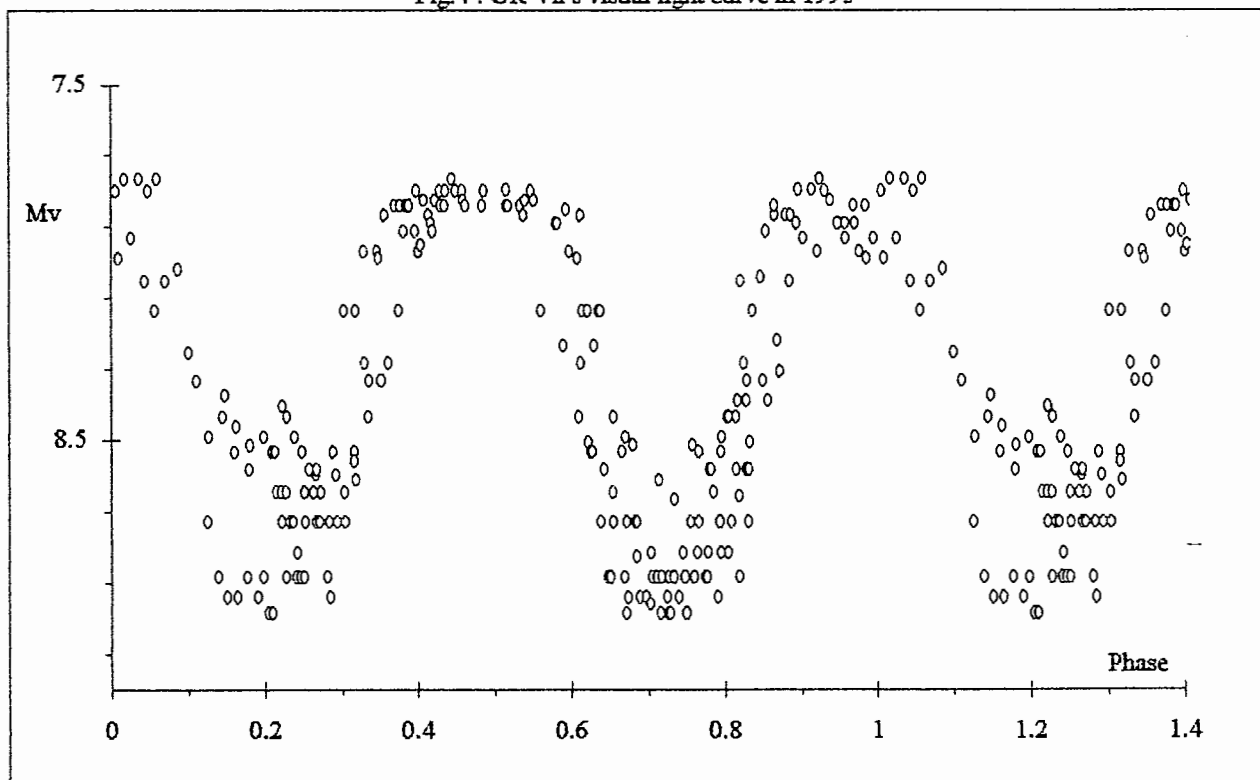
$$P = 0.346972 \pm 0.000001 \text{ day}$$

This period is rather different from that one given by Cereda et al. after photoelectric observations analysis in 1987.

The light curve

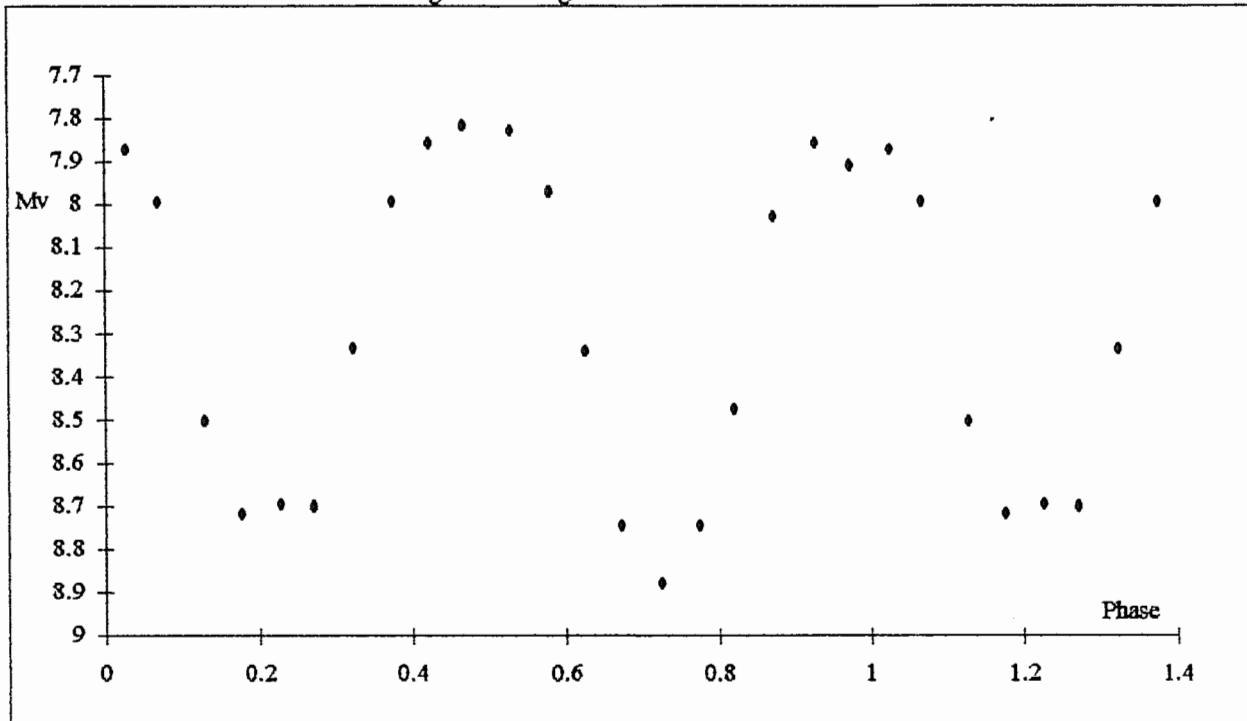
All visual observations carried out in 1995 on GR Vir were phased according to light elements (2). The resulting light curve is shown in the next graph:

Fig.4 : GR Vir's visual light curve in 1995



Following, a mean light curve is reported, obtained grouping data in ranges of 0.05 phase, then making the mean value of both phase and magnitude of each group:

Fig.5 : mean light curve of GR Vir in 1995



It is important to observe the similarity between this latter and the photoelectric light curve. The "mean" difference in depth of the two minima and the probable total eclipse in the secondary minimum remain confirmed.

Conclusions

GR Vir seems to have decreased its period. Infact visual observations in 1995 revealed marked O-Cs value in respect with light elements given by Cereda et al. in 1987. In this work was examined the possibility of a different period, but the hypothesis of a sudden period change hasn't to be excluded. Instead, the mean visual light curve confirmed some features already noted in the past, that are the difference between the two minima and the probable total eclipse occurring in the secondary minimum.

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References:

- (1) L.CEREDA et al., *Astron. Astrophys. Suppl. Ser.*, **76**, 255-261 (1988)
- (2) A.GASPANI, *Note Circulaire GEOS, NC 690* (1992)
- (3) A.GASPANI, *Stochastic Optimization Program*, **5** (priv. comm.)
- (4) A.GASPANI, *Spectrum Estimation via Recursive Fourier Transform Technique*, (priv. comm.)