ACTIVITES DU GROUPE EN SEPTEMBRE 1999

1. BILAN DES ESTIMATIONS VISUELLES

ESTIMATIONS		NUITS	OBSERVATEURS	NOMBRE D'ESTIMATIONS ET D'ETOILES		
1999	SEPT.			PRIORITAIRES	PROSPECTION	ROUTINE
3862	957	12	VERROT (VRR)	126/5	323/12	508/14
2243	517	10	VANDENBROERE (VBR)	89/7	223/30	205/14
1347	242	16	MISSON (MIS)			242/21
2055	237	10	DUMONT (DMT)		48/12	189/29
1081	232	14	FERNANDEZ (FDZ)		46/4	186/20
1607	216	9	CHECCUCCI (CHC)		6/1	210/40
754	170	11	KUCHTO (KCH)		35/5	135/22
542	65	6	FADDA(FDD)		6 /1	59/17
670	55	5	EYRAUD (EYR)		22/6	33/9
68	39	3	BONINSEGNA (BNN)		2/1	37/3
128	11	3	FUMAGALLI (FMG)		8/1	3/1

PROGRAMME DE RECHERCHE PRIORITAIRE

DI And : VRR 35
IP Cep : VBR 33
V 620 Cyg : VRR 21
V 1141 Cyg : VBR 22
V 501 Her : VRR 30
V 1125 Oph : VRR 30
NSV 223 Psc : VRR 10 ; VBR 10
DL Sge :

PROSPECTION

NSV 1012 Cas : VRR 16
NSV 513 Cas : VRR 15
NSV 87 Cas : VRR 17
NSV 93 Cas : VRR 21
NSV 13565 Cep : FDZ 15
NSV 14566 Cep : KCH 12
NSV 7366 CrB : VRR 69
NSV 12026 Cyg : VBR 24
NSV 12255 Cyg : VBR 18
NSV 11436 Dra : VBR 32
NSV 12223 Dra : VBR 10
NSV 8579 Her : VRR 22
NSV 10263 Her : VBR 31 ; VRR 18
NSV 11345 Her : VBR 20
NSV 10998 Lyr : VBR 15
NSV 9234 Oph : VRR 85
VZ Sge : FDZ 14 ; DMT 11

2. TRIBUNE LIBRE

VBR : chiedo a FDD non inviare il suo 'bilan mensuel' per lettera raccomandata. Per favore, Maurizio.

BEL : Here is the paper I wrote for the proceedings of the Toronto meeting which has been submitted to the ASP conference series.

CONTRIBUTION TO VARIABLE STAR RESEARCH BY GEOS

(Groupe Européen d'Observation Stellaires)

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The GEOS (Groupe Européen d'Observation Stellaires), a group more than twenty-years-old, is composed by observers belonging to France, Italy, Spain, Belgium, and Switzerland. The group's main purpose is to observe variable stars and process the data thus collected with research work as a final objective. The priority given to research over the mere contribution with visual estimates or photoelectric/CCD measurements is the main characteristic of the GEOS. As already happened in the past, the GEOS approach to the study of variable star can help amateur observers to enter some aspects of the professional research.

In the past years, GEOS applied an original approach to the analysis of visual estimates of variable stars (Ralincourt et al. 1987), obtaining accurate light curves on red semiregulars. More recently, the collaboration with teams of professional researchers allowed the group to obtain interesting results on the double-mode Cepheid EW Sct (Figer et al. 1991) and on the Be star OT Gem (Arellano Ferro et al., 1998).

Here we present a paper carried out by GEOS members, arose from an amateur-professional partnership. We discuss the case of the eclipsing binary V753 Cyg.

V753 Cyg, A PROBABLE NEW RS CVn TYPE STAR WITH AN UNCOMMON BV COLOUR INDEX

Abstract

V753 Cyg is an eclipsing binary EA type discovered in 1949 by G. Hoffemeister. The period proposed is 0.47 days, but the double period 0.95 days hypothesis has been mentioned in the GCVS '85. A more precise ephemeride has been subsequently proposed by F. Agerer in 1994, still the possibility that the double period might be the correct one has not been considered.

We collected 405 Geneva BV photoelectric measurements on V753 Cyg using the T76-cm reflector of the Jungfraujoch in the Swiss Alps, operated by the Geneva observatory. Here we present the precise photoelectric light curve of V753 Cyg, and demonstrate that the correct period is 0.95 days. The primary and secondary minima differ in their deepness of only few hundreds of magnitudes out of 0.70 magnitudes amplitude. From the light curve and the spectral class we were able to associate this star to the chromospherically active RS CVn type binaries. The B-V colour index shows that during the minima there is only a faint reddening, however the timing of the reddening does not coincide with the V light curve.

Using Binmaker 2.0 we were able to plot a simplified model of the V753 Cyg system. The predicted position of the starspots could explain the observed asymmetrical behaviour of the B-V colour index.

1. Introduction

V753 Cyg was discovered in 1949 by C. Hoffmeister, and has been classified in the GCVS (Kholopov *et al.* 1985) as a short period Algol type eclipsing binary (EA).

The ephemeris given is the following:

JD = 2433804.47 + 0.476187 (x2?)
D = 30% d = 12% of the period sp. class: F8

We decided to follow this star intensively since one of us observed (visually) that:

1. O-C were increasing (+0.03 +0.06 days)
2. The stationary phase of the minima ("d") was very short or non existing
3. If the double period taken in consideration in the GCVS is correct, then the difference between the two minima was not detectable by visual estimates.

2. Results

This star was subsequently followed photoelectrically using the T76 at the Jungfraujoch Observatory during the last four years in order to construct a complete photoelectric light curve. We collected 405 BV "All Sky" measurements.

In order to construct the composite we used the ephemeride published by F. Agerer (1994), which is:

JDH = 2433804.4651 + 0.47618853*E (ph)
+/- 0.0010 +/- 0.00000004

The photoelectric light curve is shown here:

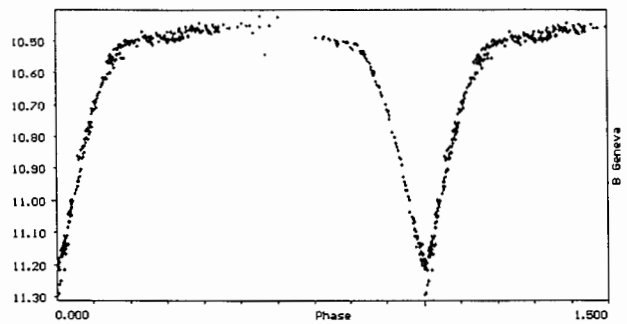

Figure 1
B band light curve of V753 Cyg. Different type of dots indicate measurements taken during different nights.

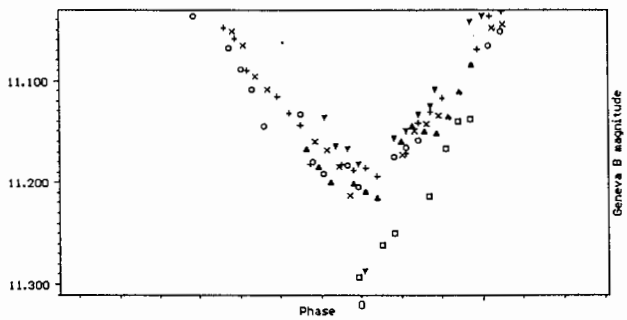

Figure 1B
Detail of the miniumum. Open squares and the inverse open triangle represent measurements taken during two nights, with a considerably weaker magnitude compared to the other measurements.

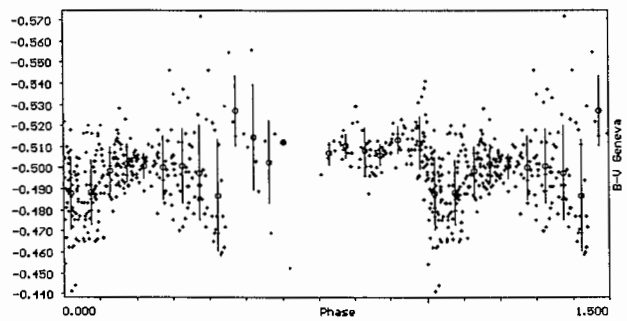

Figure 2
BV colour index. Open circles represent mean values every 0.05 phase, and error bars represent the mean square error.

We can already observe that there is no stationary phase of the minimum, contrasting the proposed d = 12% of the period. The "D", considering the orbital period of V753 Cyg being 0.47 days is 30%, as reported in the GCVS. This "D" value is however an unusual high fraction of the period for an Algol type eclipsing binary. Moreover this binary should have an accretion disk, according to the orbital parameters determined by Brancevics and Dworak (1980), however a survey carried out by Katichuck et al. (1985) failed to detect any disc around this system.

The primary minimum is 0.70 magn. deep, in B. The secondary minimum is not detectable. Considering the accuracy of the measurements, the secondary minimum should have an amplitude less than 0.05 magn. Looking at the minimum in detail (Figure 1B), we can observe that during two nights (open squares and open inverse triangles), the minimum was deeper of 0.10 magn, raising the possibility that the orbital period might be twice longer.

Note the asymmetric behaviour of the BV light curve. The slight reddening during the primary minimum appears only after phase "0", which is unexpected of an EA type variable.

Following these observations we decided to consider that the possibility that the period might be twice longer.

In the following table are reported the time of all the photoelectric minima, phased with the following ephemeris:

JDH = 2433804.4651 + 0.95237706*E

Table I

Times of minima of V753 Cyg

Minima	JJ HEL	K12	Magn. V	Magn. B	B-V
I	2449923.4479	0.1988	11.747	11.293	-0.454
I*	2451045.3488	0.1970	11.762	11.287	-0.475
II	2449810.5907	0.0917	11.686	11.188	-0.498
II	2450311.5416	0.1543	11.709	11.204	-0.505
II	2450313.4486	0.1345	11.705	11.215	-0.490
II*	2450692.4914	0.1387	11.717	11.213	-0.504
II	2451055.3480	0.2545	11.704	11.182	-0.522

* these minima were measured by differential photometry

The two primary minima are the deepest ones, both in the V and B bands, and correspond to the deepest dots shown in the Figure 1B. Also the BV colour index shows a slight difference between primary and secondary minima.

Note that two minima were followed using the method of differential photometry, increasing the accuracy of the measurements. We plotted again the light curves using the double period (0.95237706 days):

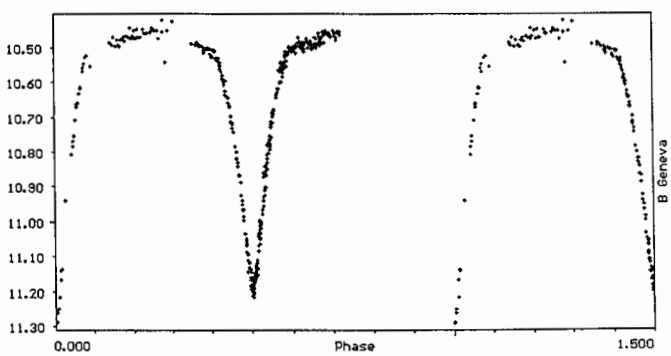

Figure 3
B band light curve of V753 Cyg, using the double period. Different type of dots indicate measurements taken during different nights.

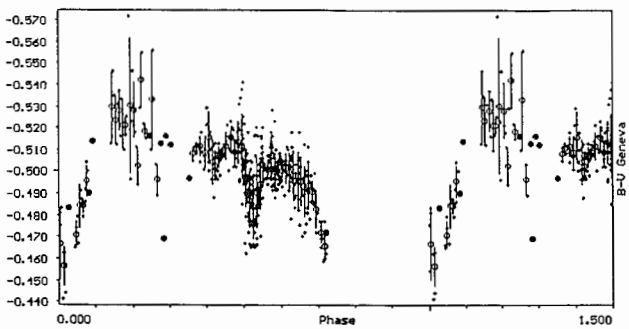

Figure 4
BV colour index. Open circles represent mean values every 0.02 phase, and error bars represent the mean square error.

In this case the slight reproducible difference in the depth of the two minima in the B and V bands is not a coincidence, but correspond to primary and secondary minima. Also the B-V light curve shows differences between the two minima.

The B-V light curve shows again the asymmetric (secondary) minimum. However being the light curve incomplete we cannot ascertain if this asymmetric behaviour is also present in the primary minimum.

We can conclude without doubts that the correct orbital period of V753 Cyg is 0.95237706 days. From the light curve we can assign this star to the chromospherically active, short-period RS CVn class of binaries. The light curve of V753 Cyg is very similar to that of BH Vir (Kaitchuck *et al.* 1985).

3. Model

We constructed a three dimensional model of this system, using Binmaker 2.0 (Bradstreet, 1993), assuming the temperature of the large star to be 6350K.

The data are best fitted with an inclination of 87.5°, a mass ratio of 1.076, and a fillout factor of -2.19. The temperature of the small star was adjusted to 6430K. The fit is shown below.

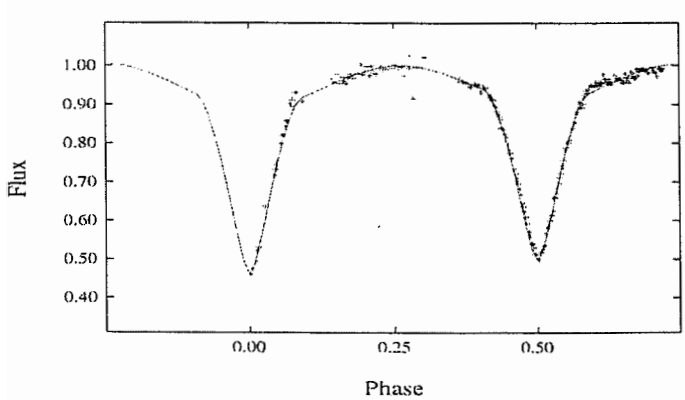

Figure 5
B band light curve (points) with example model (line) of the eclipsing system

Considering the change in the chromospheric activity from cycle to cycle, this is a satisfactory fit. The three dimensional model, and the roche lobes with the Lagrangian points L1 and L2 are reported here:

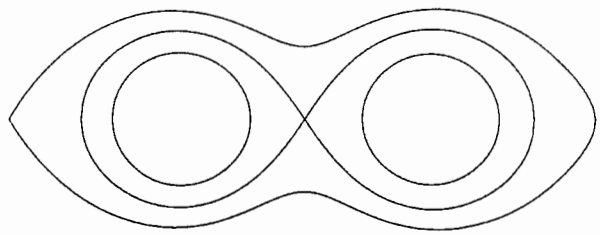

Figure 6
Roches lobes and Lagrangian points of the V753 Cyg binary system at phase 0.25

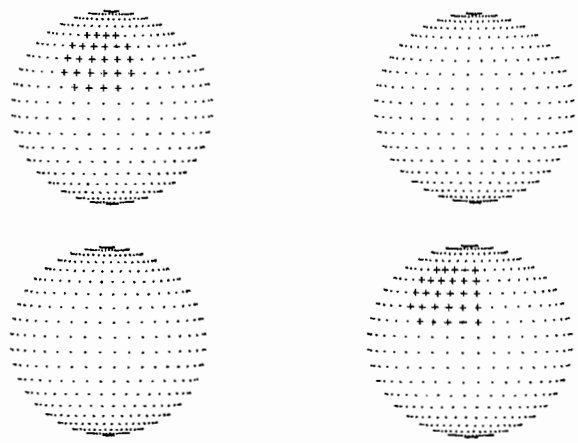

Figure 7
Three dimensional model of the contact system at phase 0.25 (top) and phase 0.75 (bottom). Two large starspots are visible in the secondary star.

Table II

Output from Binary Maker

mass ratio input = 1.076	mass ratio < 1 = 0.929
Omega 1 = 4.75	Omega 2 = 4.46
Omega inner = 3.87	Omega outer = 3.32
C 1 = 5.16	C 2 = 4.86
C inner = 4.00	C outer = 3.47
Fillout 1 = -2.19	Fillout 2 = -1.62
Lagrangian L1 = 0.51	Lagrangian L2 = 1.69
AG = r1(back) = 0.27	AS = r2(back) = 0.28
BG = r1(side) = 0.26	BS = r2(side) = 0.27
CG = r1(pole) = 0.26	CS = r2(pole) = 0.27
DG = r1(point) = 0.27	DS = r2(point) = 0.29
Surface area 1 = 0.88	Surface area 2 = 0.95
Mean radius 1 = 0.26	Mean radius 2 = 0.28
inclination = 87.5	wavelength = 4400
temperature 1 = 6350	temperature 2 = 6430
luminosity 1 = 0.44	luminosity 2 = 0.56
gravity coefficient 1 = 0.32	gravity coefficient 2 = 0.32
limb darkening 1 = 0.60	limb darkening 2 = 0.600
reflection 1 = 0.50	reflection 2 = 0.50
Third light = 0.00	

Star	Co-Lat.	Long.	Spot Rad.	Temp. Factor
2	60.0	100.0	25.0	1.15
2	60.0	270.0	11.2	1.46

The "deformation" of light curve, from a theoretical one, could be fitted with the model by adding the two starspots shown in Figure 7. Assuming that V753 is an RS CVn system, is not a surprise that two large spots were found, since the existence of starspots is typical of such systems.

To note that being one of the spot eclipsed during part of the secondary minimum, this might explain the asymmetric B-V colour index, shown in the Figure 4.

4. Conclusions

V753 Cyg has been reported to be an EA type binary of 0.47days period, not excluding the possibility that the period might be double. Here we have shown the first BV photoelectric light curve of V753 Cyg, and demonstrated that the correct period is 0.95 days. From the characteristics of the light curve and its spectral class we could assign V753 cyg to the chromospherically active RS CVn class of binaries. Using Binmaker 2.0 we were able to show a simplified model of this system, which contains a large spot on the largest star. The spot might explain the asymmetric behaviour of the B-V colour index.

Acknowledgements: Special thanks to Frans Van't Veer, for very useful discussions and model proposal of V753 Cyg, Joseph Remis, Francesco Acerbi, Andrea Manna, Jacqueline Vandenbroere, Carlo Barani, Gilles Allenbach and Julie Guignard for their contribution in this study.

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