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

Number 4172

Konkoly Observatory
Budapest
16 March 1995

HU ISSN 0374 – 0676

NEW MINIMA TIMES AND PERIOD BEHAVIOUR FOR THE ECLIPSING VARIABLES RT ANDROMEDAE, 44i BOOTIS AND GO CYGNI

In the present report new photoelectric minima times of RT And, 44i Boo and GO Cyg are given as they were derived from our observations made either in Greece or in Romania.

The photoelectric observations of RT And and 44i Boo were made during 1989 and 1994, respectively with the two-beam, multi-mode, nebular-stellar photometer of the National Observatory of Athens, attached to the 48-inch Cassegrain reflector at the Kryonerion Astronomical Station. While those of GO Cyg were made during 1994 with an EMI 9502 B type photocell, attached to the 50 cm Cassegrain telescope of the Bucharest Observatory. The filters used in both cases are in close accordance with the standard UBV and the reduction of the observations has been made in the usual way (Hardie, 1962).

RT Andromedae

The short period variable RT And (BD +52°3383A, HD 218915) is a very interesting eclipsing binary with many peculiarities in its light curve. It is classified as an RS CVn-type system with both components to be main-sequence stars in contrast to the main group, which contains active sub-giant stars (Budding and Zeilik, 1987).

From our observations made during 1989, 5 new minima times were derived and given in Table I. The O−C diagram of the system based on all minima times found in the literature (614 points) is presented in Figure 1; a quadratic least squares fitting applied to all of them, improves Williamon's (1974) ephemeris formula to:

$$\text{Min I} = 2441141.6401 + 0^{\text{d}}.62893928 \times \text{E} - 1^{\text{d}}.16 \times 10^{-10} \times \text{E}^2$$

showing that its orbital period is decreasing.

A detailed analysis of the period variations of RT And has been recently made (Rovithis-Livaniou et al., 1994). Moreover our new 5 minima times together with the last photoelectric ones yield the following linear ephemeris:

$$\begin{aligned} \text{Min I} = 2447756.3385 &+ 0^{\text{d}}.628929355 \times \text{E} \\ &\pm .0003 \pm \quad .000000010 \end{aligned} \qquad (1)$$

which is proposed for the future observations of RT Andromedae.

Table I. Photoelectric Minima Times of RT And

Hel. JD 2440000+	$(\text{O}-\text{C})_I$ days	$(\text{O}-\text{C})_{II}$ days	$(\text{O}-\text{C})_{III}$ days
7756.3385	−.0056	−.0022	.0000
7758.5390	−.0062	−.0029	+.0008
7759.4832	−.0054	−.0021	+.0001
7760.4256	−.0064	−.0031	−.0009
7763.5711	−.0052	−.0023	−.0001

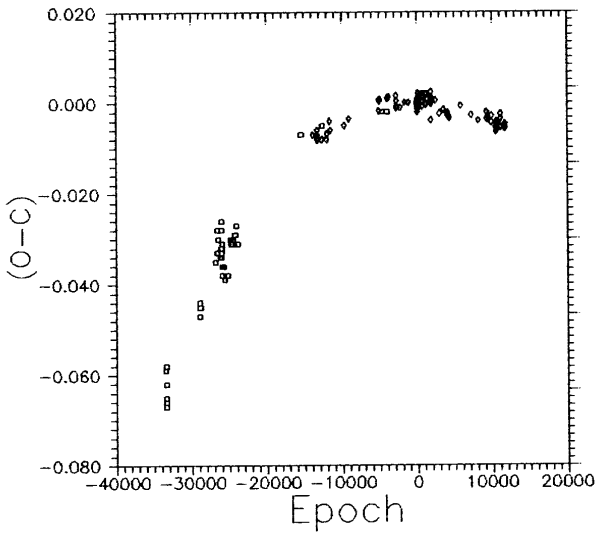

Figure 1. The O−C diagram of RT And based on 44 photographic (squares) and 84 photoelectric (diamonds) minima times. The C values have been calculated using Williamon's (1974) linear ephemeris.

In Table I the residuals $(O-C)_I$, $(O-C)_{II}$ and $(O-C)_{III}$ have been calculated according to Williamon's (1974) ephemeris formula:

$$\text{Min I} = 2441141.8888 + 0^{\text{d}}.62892984 \times \text{E}$$

Kholopov's (1985):

$$\text{Min I} = 2241141.88902 + 0^{\text{d}}.628929513 \times \text{E}$$

and our new one, given by equation (1), respectively. They are the mean values of our B and V observations and have been computed using Kwee & Van Woerden's (1956) method.

44i Bootis

The eclipsing binary 44i Boo is the fainter companion (B+C) of the close visual binary ADS 9494. It is one of the mostly observed systems, since its light curves exhibit "active" and "quiet" periods and its period is variable (e.g. Bergeat et al., 1972; Rovithis et al., 1990; Oprescu et al., 1989 & 1991; Gherega et al., 1994).

From our recent photoelectric observations of 44i Boo, two new minima times have been found and given in Table II.

Table II. Photoelectric Minima Times of 44i Boo

Hel. JD 2440000+	Min	Fil.	$(O-C)_I$ days	$(O-C)_{II}$ days	$(O-C)_{III}$ days
9489.3479	I	V	0.0393	0.0028	−0.0173
9489.3490	I	B	0.0414	0.0039	−0.0162
9489.4832	II	V	0.0407	0.0042	−0.0159
9489.4825	II	B	0.0400	0.0035	−0.0166

In Table II the residuals $(O-C)_I$, $(O-C)_{II}$ and $(O-C)_{III}$ have been calculated using Kwee & Van Woerden's method (1956) and according to the following ephemeris formulae:

$$\text{Min I} = 2439852.4903 + 0^{\text{d}}.2678159 \times \text{E}$$

(Duerbeck, 1975)

$$\text{Min I} = 2439852.4644 + 0^{\text{d}}.2678176 \times \text{E}$$
(Rovithis et al., 1990)

and
$$\text{Min I} = 2443604.5880 + 0^{\text{d}}.26781856 \times \text{E}$$
(Oprescu et al., 1991)

They fit pretty well the last (O−C) diagram for 44i Bootis (Gherega et al., 1994) – based on Oprescu's et al. (1991) ephemeris formula – showing that the period of the system continues to increase.

GO Cygni

The eclipsing binary GO Cyg (BD +34°4095) has been observed photoelectrically many times after its discovery and many minima times can been found in the literature from which its period was found to be variable (e.g. Purgathofer and Prochazka, 1967; Sezer et al. 1985, Hall and Louth, 1990).

From our recent observations of GO Cyg three new minima times were derived and are presented in Table III.

Table III. Photoelectric Minima Times of GO Cyg

Hel. JD 2440000+	Min	Fil.	$(O-C)_I$ days	$(O-C)_{II}$ days	$(O-C)_{III}$ days
9605.34526	II	B	0.0546	0.0143	0.0377
9605.34585	II	V	0.0552	0.0149	0.0383
9623.29007	II	V	0.0555	0.0149	0.0386

In Table III the residuals $(O-C)_I$, $(O-C)_{II}$ and $(O-C)_{III}$ have been calculated using Kwee & Van Woerden's method (1956) and according to formulae:

$$\text{Min I} = 2433930.40561 + 0^{\text{d}}.71776382 \times \text{E}$$
(Kholopov, 1985)

$$\text{Min I} = 2445865.4056 + 0^{\text{d}}.71776707 \times \text{E}$$
(Sezer et al., 1985)

and

$$\text{Min I} = 2446351.328 + 0^{\text{d}}.7177632 \times \text{E}$$
(SAC, 1989)

The newly observed minima times are in accordance with the O−C diagram of GO Cyg (Sezer et al., 1985) showing that the period of the system continues increasing. A detailed analysis of the period variations of GO Cyg – based on the new method developed by Kalimeris et al., (1994) – will be done later.

Acknowledgement: This work was partly supported by NATO, grant No. 921208/1993.

H. ROVITHIS-LIVANIOU
P. ROVITHIS
Section of Astrophysics
Astronomy & Mechanics
Dept. of Physics
Athens University
157 84 Zografos
Greece

G. OPRESCU
A. DUMITRESCU
Astronomical Institute
Academia Romana
Street Cutitul d'Argint 5
75212 Bucharest 28
Romania

References:

Bergeat J., Lunel M., Sibile F. & Van't Veer F.: 1972, *A&A*, **17**, 215
Budding E. & Zeilik M.: 1987, *ApJ*, **319**, 827
Duerbeck H. W.: 1975, *IBVS*, No. 1023
Gherega O., Farkas L. and Horvath A.: 1994, *IBVS*, No. 4045
Hall D. and Louth H.: 1990, *J. A&A*, **11**, 271
Hardie R. H.: 1962, in W.A. Hiltner (Ed.) Stars and Stellar Systems Vol. II, Astronomical Techniques, The University of Chicago Press, Chicago
Kalimeris A., Rovithis-Livaniou H. & Rovithis P.: 1994, *A&A*, **82**, 775
Kholopov P.N.: 1985, General Cataloque of Variable Stars, Moscow
Kwee K.K. & Van Woerden H.: 1956, *Bull. A. I. Neth.*, **12**, 327
Oprescu G., Suran M.D. & Popescu N.: 1989, *IBVS*, No. 3368
Oprescu G., Suran M.D. & Popescu N.: 1991, *IBVS*, No. 3560
Purgathofer A. & Prochazka F.: 1967, *Mitt. Un. Stern Wien*, **13**, 151
Rovithis P. & Rovithis-Livaniou, H.: 1990, *A&ASS*, **86**, 523
Rovithis-Livaniou H., Rovithis P., Kalimeris A., Oprescu G., Dumitrescu A. & Suran M.D.: 1994, *Rom. Astron. J.* (in press)
SAC 1989: Rocznik Astronomiczny Observatorium Krakowskiego, No. 60
Sezer C., Gülmen O. & Güdür N.: 1985, *IBVS*, No. 2743
Williamon R.M.: 1974, *PASP*, **86**, 924