GEOS
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GEOS CIRCULAR ON ECLIPSING BINARIES

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LARGE O-C NOTED FOR RT URSAE MINORIS

ABSTRACT - The eclipsing binary star RT UMi was observed after its discoverer STROHMEIER (1958) only by DE SANTIS and TEMPESTI (1977). It has been included since 1981 in the GEOS programme for understudied eclipsing binaries. The star was followed in 1981 and 1982 by several observers who collected more than 700 visual estimates. From 13 times of minimum light, a mean minimum was determined at HJD 2445045.531 ± 0.011 d. (at the 95 % level of confidence). The mean O-C's, referred to the two previously published ephemerides, are : $O-C_1$ = - 0.086 d. and $O-C_2$ = + 0.058 d. (± 0.011 d.). Both ephemerides are therefore no longer valid.

RESUME - La binaire à éclipses RT UMi n'a été observée après son découvreur STROHMEIER (1958) que par DE SANTIS et TEMPESTI (1977). Depuis 1981, elle fait partie du programme du GEOS pour éclipsantes sous-étudiées. Elle a été suivie en 1981 et 1982 par plusieurs observateurs qui ont réuni plus de 700 estimations visuelles. A partir de 13 déterminations de minimum, on a obtenu le minimum moyen : JJHel. 2445045.531 ± 0.011 j. (au niveau de confiance 95 %). Les O-C moyens, par rapport aux deux éphémérides précédemment publiées, sont : $O-C_1$ = - 0.086 j. et $O-C_2$ = + 0.058 j. (± 0.011 j.). Ces deux éphémérides ne sont donc plus valables.

RESUMEN - La binaria a eclipses RT UMi no ha sido observada después de su descubridor STROHMEIER (1958) más que por DE SANTIS y TEMPESTI (1977). Desde 1981, pertenece al programa del GEOS para eclipsantes sub-estudiadas. Fue seguida en 1981 y 1982 por varios observadores que reunierón más de 700 estimaciones visuales. A partir de 13 determinaciones de mínimo, se obtuvo el mínimo medio : DJHel. 2445045.531 ± 0.011 d. (al nivel del 95 % de confianza). Los O-C medios, respecto a las dos efemerides precedentemente publicadas, son : $O-C_1$ = - 0.086 d; $O-C_2$ = + 0.058 d (± 0.011 d.). Por tanto, estas dos efemerides no son ya válidas.

RIASSUNTO - La binaria a eclisse RT UMi non ha ricevuto osservazioni dopo suo scopritore STROHMEIER (1958) salvo che da DE SANTIS e TEMPESTI (1977). Essa fà parte dal 1981 del programma GEOS su le variabili ad eclisse insufficentemente studiate ed è stata seguita nel 1981 e 1982 da diversi osservatori, collezionando più di 700 stime visuali. Partendo da 13 determinazioni di minimi, si è ottenuto il minimo medio : GGElio. 2445045.531 ± 0.011 g. (con livello di affidabilità 95 %). Gli O-C medi rispetto alle due effemeridi precedentemente pubblicate in letteratura risultano : $O-C_1$ = - 0.086 g; $O-C_2$ = + 0.058 g (± 0.011 g). Le due effemeridi appaiono dunque non più valide.

1. INTRODUCTION.

RT UMi (R.A. 17 h 7.9 mn ; D. + 80º 24'; 1950.0) was discovered and classified as an eclipsing binary by STROHMEIER (1958) from photographic plates taken from 1930 onward. He gave a range of variation of m_{pg} 11.1 to 11.9 and a period of 1.841982d. His light curve does not show any secondary minimum and the primary minimum is apparently flat. It does not appear that RT UMi was ever observed for over ten years after this paper.

It was reobserved by DE SANTIS and TEMPESTI (1977) : their photoelectric measures from 1971 to 1973 yielded a period of 1.841962 d. and a V amplitude of 10.79 to 11.47. They observed a secondary minimum (amplitude : 0.07), thus dismissing the hypothesis of a possible double value for the period. Finally, they showed that the eclipse was not total, in contradiction with what STROHMEIER's curve seemed to establish.

The observations of DE SANTIS and TEMPESTI have recently been reexamined by MILANO and al. (1981), and by MARDIROSSIAN and GIURICIN (1981), who propose different models for RT UMi. Their conclusions only agree on the existence of a semi-detached system, with a main star of spectral type F0 and a K3 or K4 secondary which fills its Roche lobe.

The ephemerides used for this paper are :

STROHMEIER : Min. I = JD Hel. 2426631.320 + 1.84198232 E (1)

DE SANTIS & TEMPESTI : Min. I = JD Hel. 2441306.2902 + 1.841962 E (2)

2. OBSERVATIONS.

RT UMi was included in 1981 in the GEOS observing programme for understudied eclipsing binaries. It was observed during the summer camps held at Casinos (Valencia, Spain) in July and August 1981, and Bédarieux (Hérault, France) in July 1982. 200mm and 250mm reflectors were used to observe RT UMi for which a sumtotal of over 700 visual estimates was collected. Table 1 gives the contribution of each observer for each year. Figure 1 shows RT UMi and its comparison stars. As their magnitudes are not known, the calculations were made and the curves were plotted using an arbitrary scale, suitable for each series of measures.

Observer		Place	1981	1982
A. FIGER	FGR	F - Paris	83	54
P. RALINCOURT	RAL	F - Nantes	69	32
J. BUSQUETS	BSQ	E - Valencia	45	41
P. GUIRAUDOU	GUI	F - Montpellier	55	31
P. MATAGNE	MAT	B - Bruxelles	85	0
J. FABREGAT	FBG	E - Valencia	35	24
M. BENUCCI	BEN	I - Firenze	0	45
E. NEZRY	NZY	F - Toulouse	38	0
R. BONINSEGNA	BNN	B - Dourbes	0	35
J.F.LE BORGNE	FLB	F - Toulouse	26	0
S. FERRAND	FND	F - Bougival	0	26

Tab.1 : List of observers and number of measures.

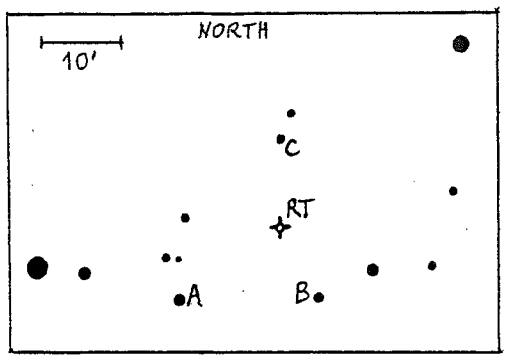

Fig.1 : RT UMi and its comparison stars.

3. MINIMA.

The eclipses of RT UMi are relatively long (over 6 hours) related to a night in summer, and the minimum, as a rule, no occurs in the middle. So, each series of observations, even when continued for a whole night, can show only a part of the phenomenon. It was possible, however, to determine a minimum on the nights of 1981 July 27/28 and 1982 July 23/24. Fig. 2 gives an example of an individual light curve, each point representing a visual estimate. The minima were determined by the tracing-paper method, and the results are listed in Table 2 with the O-C's referred to the two ephemerides given above.

Date	Geoc.UT	Obs.	Helioc.JD	$O-C_1$	$O-C_2$
27/7/81	22.40	FBG	44813.443	-0.084	+0.057
	22.41	FGR	44813.444	-0.083	+0.058
	22.53	RAL	44813.452	-0.075	+0.066
	23.09	BSQ	44813.463	-0.064	+0.077
	23.20	MAT	44813.471	-0.056	+0.085
23/7/82	22.34	BNN	45174.439	-0.117	+0.029
	22.55	FGR	45174.454	-0.102	+0.044
	23.03	BEN	45174.459	-0.097	+0.049
	23.03	FBG	45174.459	-0.097	+0.049
	23.07	RAL	45174.462	-0.094	+0.052
	23.17	FND	45174.469	-0.087	+0.059
	23.26	GUI	45174.475	-0.081	+0.065
	23.29	BSQ	45174.477	-0.079	+0.067

Tab.2 : Minima observed.

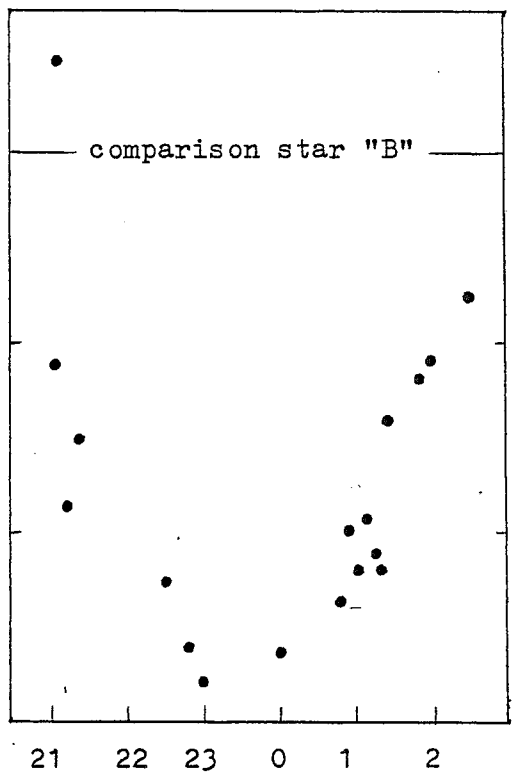

Fig.2 : RT UMi as observed by J. BUSQUETS on 1982 July 23/24. Each dot is an individual estimate.

(Abscisse : hour UT ; ordinate : brightness in degrees).

On the average, the results are, for the 1981 minimum :
$O-C_1$ = -0.072 d. $O-C_2$ = +0.069 d. (±0.013 d. at the 95 % level of confidence)
and for the 1982 minimum :
$O-C_1$ = -0.094 d. $O-C_2$ = +0.052 d. (±0.013 d.)
There seems to be a discrepancy between the results of 1981 and 1982, but the measures are not numerous and accurate enough for this difference to be significant. It is therefore quite licit to determine a mean O-C for both years :
$O-C_1$ = -0.086 d. $O-C_2$ = +0.058 d. (±0.011 d.)

4. COMPOSITE CURVES.

In order to confirm the minima thus determined, all the measures by each observer were combined into the same single period, and the mean brightness was calculated for intervals of 0.01 period around minimum light. This could be done only for those observers who had collected a sufficient number of measures distributed over several eclipses of RT UMi. Table 3 gives the results, and Fig.3 shows the general composite curve, plotting the means of the measures made by the four most active observers.

Obs.	$Phase_1$ Min.	$O-C_1$
FGR	0.944	-0.103
RAL	0.955	-0.083
BSQ	0.957	-0.079
GUI	0.949	-0.094

Tab.3 - Combination of measures according to period (1) : phase at minimum read on the composite curves and corresponding O-C.

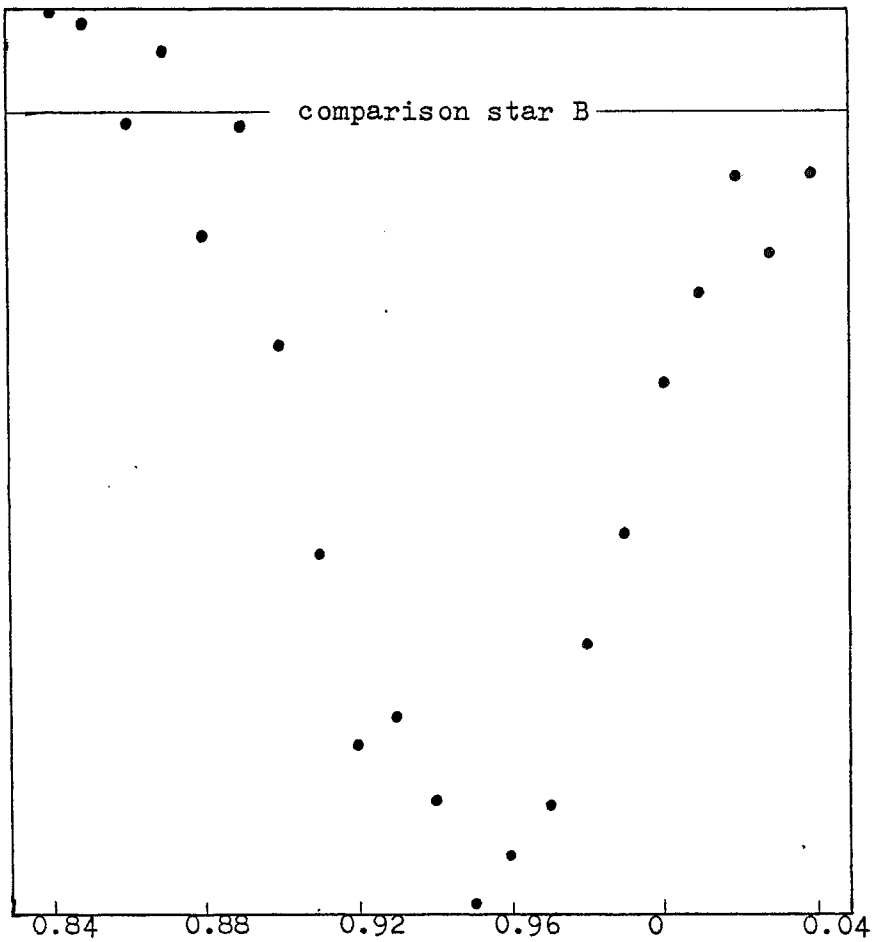

Fig.3 - Composite curve : 1981/82 measures by FGR, RAL, BSQ, GUI. Each dot is a mean for 0.01 period. (Phase / Brightness in degrees)

5. RESULTS.

Finally, the following values are adopted :
Mean minimum : HJD 2445045.531 ± 0.011
$O-C_1$ = -0.086 ± 0.011 ; $O-C_2$ = +0.058 ± 0.011
The two ephemerides used in this paper are therefore not valid. More numerous observations will allow the determination of a new ephemeris. This will be one of the aims of the GEOS mission at the Pic-du-Midi Observatory in August 1983.

P. RALINCOURT

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