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NSV 04411, A NEW ECLIPSING BINARY SYSTEM IN CANCER

Light variations of NSV 04411 (=CSV 006694) were initially observed by Rigollet (1953), who reported that this object was an RR Lyrae star. According to his measurements NSV 04411 showed a photographic magnitude variation from $13^{\rm m}_{.}1$ to $13^{\rm m}_{.}7$.

From 9 March to 23 May 1996, NSV 04411 was observed for 14 nights in the V band from Monegrillo Observatory (Spain). A 0.4-m telescope and a Starlight Xpress CCD camera were utilized. Differential photometry was performed using GSC 1954.0153 as the comparison star and GSC 1954.0574 as check the star.

Observational data show that NSV 04411 is not an RR Lyrae object but an eclipsing binary system with a period over 10 hours. It can be unambiguously identified with GSC 1954.0180, a star with a photovisual magnitude (PAL-V1 filter) of 12.4. The light curve shows both minima to be partial, with depths of $0^{\rm m}_{.}88$ and $0^{\rm m}_{.}79$ for the primary and secondary minima respectively. There is also detectable an O'Connell effect (O'Connell, 1951) that amounts to Δm=Max. I$-$Max. II=$-0^{\rm m}_{.}035\pm0.005$. Max. I is at phase 0.25 and Max. II at phase 0.75.

From the timing of seven minima (see Table 1) obtained according to the Kwee–Van Woerden (1956) method, the following ephemeris was derived:

$$\begin{array}{rl} \text{Min. I.} = \text{HJD}\,2450154.2091 & +\ 0^{\rm d}_{.}42228 \times \text{E} \\ \pm 0.0005 & \pm\ 0.00002 \end{array}$$

Table 1

HJD 24500000+	Minimum	Epoch	O−C
154.4206	II	0.5	0.0004
159.4876	II	12.5	0.0000
164.3426	I	24.0	−0.0011
165.3996	II	26.5	0.0002
207.4174	I	120.0	0.0016
218.3948	I	152.0	−0.0001
226.4173	I	171.0	−0.0009

The light-curve suggests that NSV 04411 is a near contact binary system whose components have very similar luminosity. The light-curve was preliminarily solved using Binary Maker 2.0 (Bradstreet, 1993). Although the O'Connell effect was modeled as a dark spot on one of the components, an initial solution was computed with no spots, and then a final spotted solution was obtained. There was no information about spectral type, for this reason it was not possible, a priori, to choose between a convective or radiative model.

Nevertheless, a better fit was achieved with a convective model. Additional photometric and spectroscopic data should clarify this point. The solution was then computed on a convective model assuming a spectral type of F5, where a mean surface temperature a convective model T_1=6500K, gravity darkening coefficients $g_1=g_2=0.32$, bolometric albedos $A_1=A_2=0.5$, and limb darkening coefficients $x_1=x_2=0.6$ were adopted.

Elements of the best solution are given in Table 2, where Ω_1 and Ω_2 are the modified surface potentials, L_1 and L_2 are the normalized luminosities, and a, b, c, and d are, respectively, the fractional back, side, polar, and point radii, where the unit distance is defined as the distance between star centers.

Once the unspotted solution was reached, it was refined invoking a single spot. No further attempt was made to introduce more spots to improve light curve fit. It was found that a dark area on the primary component might be responsible for the observed O'Connell effect. Spot radii between 30° and 50° yielded very similar solutions. The intermediate value of 40° was finally chosen. The rest of spot parameters, spot's colatitude and colongitude were fixed to 90° and 270° respectively. Table 3 lists the spot parameters, where T_f is the effective temperature coefficient. Figure 1 shows the light-curve of NSV 04411 superimposed on the theoretical one.

Table 2

mass ratio = 0.90 ± 0.10	
i = 86.°0 ± 1°	
Ω_1=3.59 ±0.20	Ω_2=3.65 ±0.20
a_g=0.413 ±0.010	a_s=0.382 ±0.025
b_g=0.383 ±0.010	b_s=0.355 ±0.025
c_g=0.364 ±0.010	c_s=0.339 ±0.020
d_g=0.494 ±0.010	d_s=0.427 ±0.070
$g_1=g_2$=0.32	
T_1=6500K	T_2=6350K ±50K
L_1=0.558 ±0.040	L_2=0.442 ±0.040

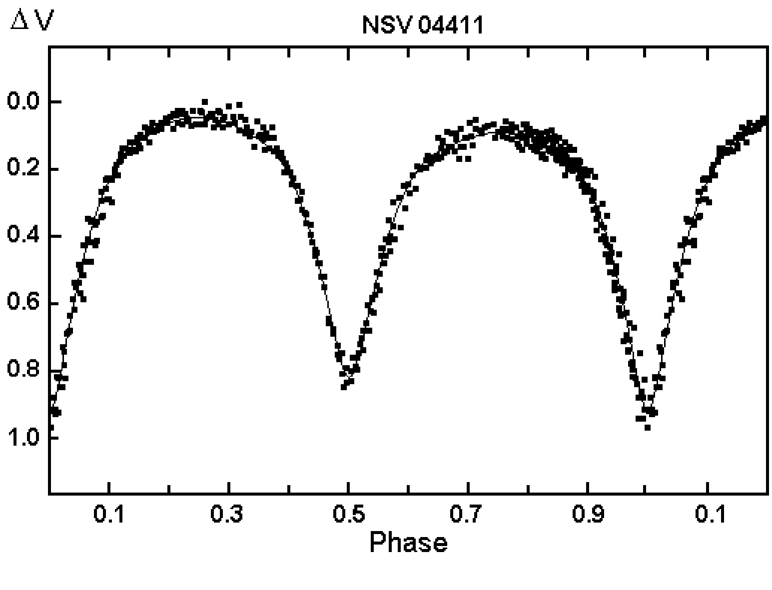

Figure 1

Table 3

Colatitude	=	90°
Colongitude	=	270°
Spot Radius	=	40°
T_f	=	0.96
Spot is on primary star		

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