ECLIPSING BINARY FX DRACONIS

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Abstract. The paper presents the first ground-based photometric observations of the newly discovered eclipsing binary FX Dra. The observations were carried out with a SBIG STL11000 CCD camera attached to the 50cm Cassegrain reflector of the Bucharest Observatory. The light curves in B and V colors are presented. The light solution is given. The system is a detached one, close to the contact configuration.

Key words: CCD photometry – eclipsing variable systems.

1. INTRODUCTION

The HIPPARCOS/TYCHO space mission found FX Dra (HIP 77037, HD 141020) to be a variable star. The variability Annex of the Hipparcos Catalogue (ESA, 1997) reports FX Dra to have a period of 0.816599 days with Hp magnitude ranging from 9.228 to 9.592. The star was classified as an EB eclipsing binary type. The spectral type is listed as A2.

2. OBSERVATIONS

Up to present our observations are the first ones performed from the ground. The observations were carried out at the Bucharest Observatory between 26 April and 8 May 2010. The differential observations were made with a SBIG STL11000 CCD camera attached to the 50cm Cassegrain reflector. The filters used (B and V) are in close accordance with the standard UBV system and the reduction of the observations was made in the usual way. 556 and 564 individual points were obtained in filters V and B, respectively.

As comparison and check stars HD 238498 (V = 10.18, B = 10.73) and, respectively, HD 238497 (V = 10.27, B = 10.65) were used.

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One primary minimum timing was determined during our observation campaign. The phase light curves were obtained according to the ephemeris:

$$Min\,I = HJD\,2455314.41992 + 0.816599E \pm 0.000056\,. \qquad (1)$$

An analysis of light curve maxima reveals a small O'Connell effect ($Max_{II} - Max_{I} \cong 0.01\,\mathrm{mag}$) in both colors. Fig. 1 shows the differential light curve of the system. The phased color index is presented in Fig. 2.

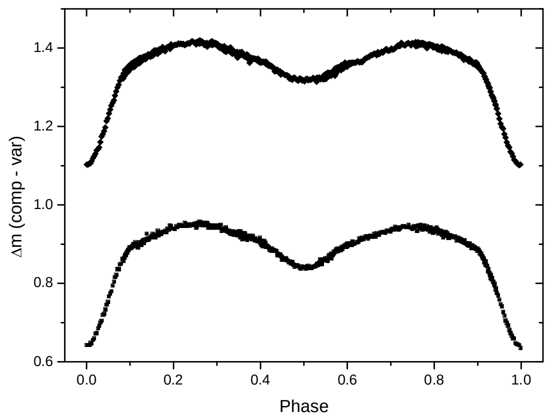

Fig. 1 – FX Draconis light curves observed in B (top, with diamonds) and V filters (bottom, with squares).

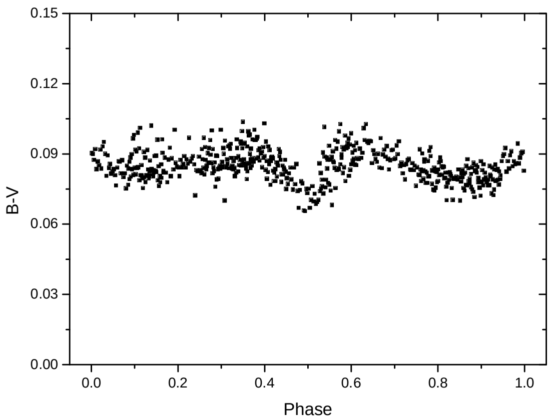

Fig. 2 – FX Draconis phased color index.

3. LIGHT CURVE ANALYSIS

In order to obtain the photometric elements we used a home code based on Djurašević (1992) method. Because the lack of spectroscopic information we tried a set of discrete values for the mass ratio q.

The value finally adopted corresponds to the minimum appearing into the $(q, \sum (O-C)^2)$ plane. In deriving the photometric solution the following parameters were adopted: temperature of primary component, gravity darkening coefficients and bolometric albedos. The temperature of the primary is 9070K, in accordance with the spectral type A2 (Morton and Adams 1968). We assumed the coefficients of the gravity darkening and the albedos appropriate for radiative envelopes ($T_{\mathrm{eff}} \geq 7500\mathrm{K}$).

We considered $g_1 = g_2 = 1.0$ and $A_1 = A_2 = 1.0$. The limb darkening coefficients $u(\lambda, T)$ were approximated by sixth order polynomials given by Djurašević (1992).

From the beginning, we used trials to derive a set of parameters which, marginally, represented the observed light curve. The adjustable parameters were: mass ratio, inclination, temperatures of the secondary and surface potentials of the stars. After a few runs, the solution converged to a detached configuration. With these ones serving as starting values, differential corrections of the elements were calculated. The solution is given in Table 1 (where the notation is the usual one).

The theoretical light curves according to the solution are drawn among the reflected observed points in V filter (Fig. 3) and in B filter (Fig. 4).

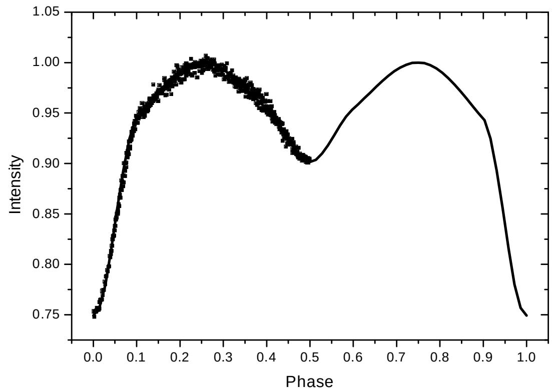

Fig. 3 – FX Draconis: observed (squares) and theoretical l.c. (solid line) in V filter.

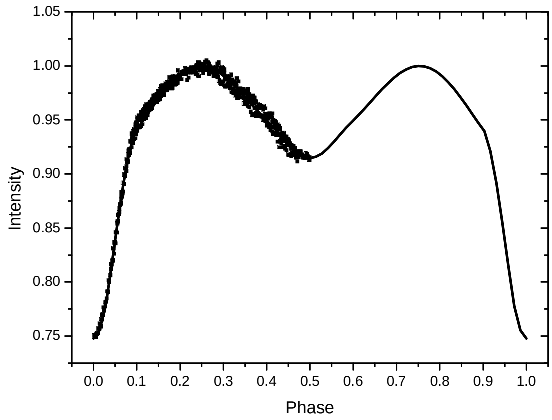

Fig. 4 – FX Draconis: observed (squares) and theoretical l.c. (solid line) in B filter.

Table 1

FX Draconis solutions

Parameter	V filter	B filter
q	0.482	0.480
i	68.3°	67.5°
T_1*	9070*	9070*
T_2	5750	5300
u_1	0.45	0.55
u_2	0.66	0.87
u_g*	1.0	1.0
A_1*=A_2*	1.0	1.0
C_1	4.5694	4.5691
$r_{1,\text{pole}}$	0.3505	0.3508
$r_{1,\text{point}}$	0.3846	0.3849
$r_{1,\text{side}}$	0.3627	0.3630
$r_{1,\text{back}}$	0.3737	0.3740
C_2	4.1936	4.1646
$r_{2,\text{pole}}$	0.2672	0.2699
$r_{2,\text{point}}$	0.3087	0.3144
$r_{2,\text{side}}$	0.2755	0.2785
$r_{2,\text{back}}$	0.2934	0.2975
L_1	0.8384	0.9253
L_2	0.1616	0.0747

Note: * denoted adopted value

4. CONCLUSIONS

The photometric elements given in this paper are the first ones obtained for FX Dra. A convenient star spot distribution on star surfaces could explain the small O'Connell effect observed in our light curves. The results indicate that the primary star is more massive and hotter. The system is a detached one, but it is close to the contact configuration.

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