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EF CANCRI: A NEW RRc STAR

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EF Cnc (= WR 100 = AN 2.1954 = NSV 4187 = GSC 1942.1380; $\alpha = 08^{\rm h}40^{\rm m}39^{\rm s}$, $\delta = +23°15'51''$ [J2000]) was included in the NSV catalogue as a suspected rapid variable with a range of $10\overset{\rm m}{.}7$–$11\overset{\rm m}{.}9$ (pg) based on a study by Kippenhahn (1955). Further observations were made visually by Locher (1983) over 17 nights in February and March 1983. He found that the amplitude is smaller than in the NSV catalogue and determined the type of variability to be that of a W UMa type star with a period of $0\overset{\rm d}{.}5912$. A lot of the visual minima of EF Cnc in the BAV database come from that time.

EF Cnc was chosen for CCD monitoring on the basis of the PROSPEKTOR catalogue which contains eclipsing binaries lacking precise elements in the literature (Haltuf 2001). We obtained a total of 1171 CCD frames of EF Cnc on four nights (2001 February 14/15 and 16/17, April 5/6 and May 10/11) using an SBIG ST-7 CCD camera and Johnson V filter attached to the 0.4-m Newtonian telescope of the Nicholas Copernicus Observatory and Planetarium in Brno, Czech Republic. All exposures were 60 seconds in duration. GSC 1942.2816 ($V = 13\overset{\rm m}{.}06$) was used as the comparison star and its constancy up to $0\overset{\rm m}{.}05$ was checked by using the stars GSC 1942.2271 ($V = 12\overset{\rm m}{.}33$) and GSC 1942.1620 ($V = 13\overset{\rm m}{.}83$). Magnitudes of comparison and check stars were obtained using the nearby GSPC sequences P368 and P367 (Lasker et al. 1988); the errors of the zero-points are thought to be up to $0\overset{\rm m}{.}1$. The frames were processed using the package MUNIDOS 2.11 (Hroch & Novák 2000). All data are available from the authors upon request.

After close inspection of the light curves it was realised that it is impossible to confirm the eclipsing binary nature of EF Cnc. Assuming an asymmetric light curve ($\Delta\phi_{\rm rise} = 0.41$), a small hump just before the main maximum and the periodicity of variability, we conclude that EF Cnc belongs to the RRc stars. EF Cnc varies between $11\overset{\rm m}{.}18$ and $11\overset{\rm m}{.}73$ in V band. We determined three maxima seen in Table 1. Past maxima are shown in Table 2. All maxima by Locher (1983) in Table 2 are visual minima recalculated to maxima using formula Max = Min+0.41P. The only maximum by B. Krobusek in Table 2 was made with unfiltered CCD. Our phased light curve according to our ephemeris (see below) is in Figure 1.

We obtained approximate value of period using visual minima from the BAV database and one CCD maximum observed by Bruce Krobusek (NY, USA). The period change, most probably period decrease, is occurring in EF Cnc. Unfortunately, due to the scarcity

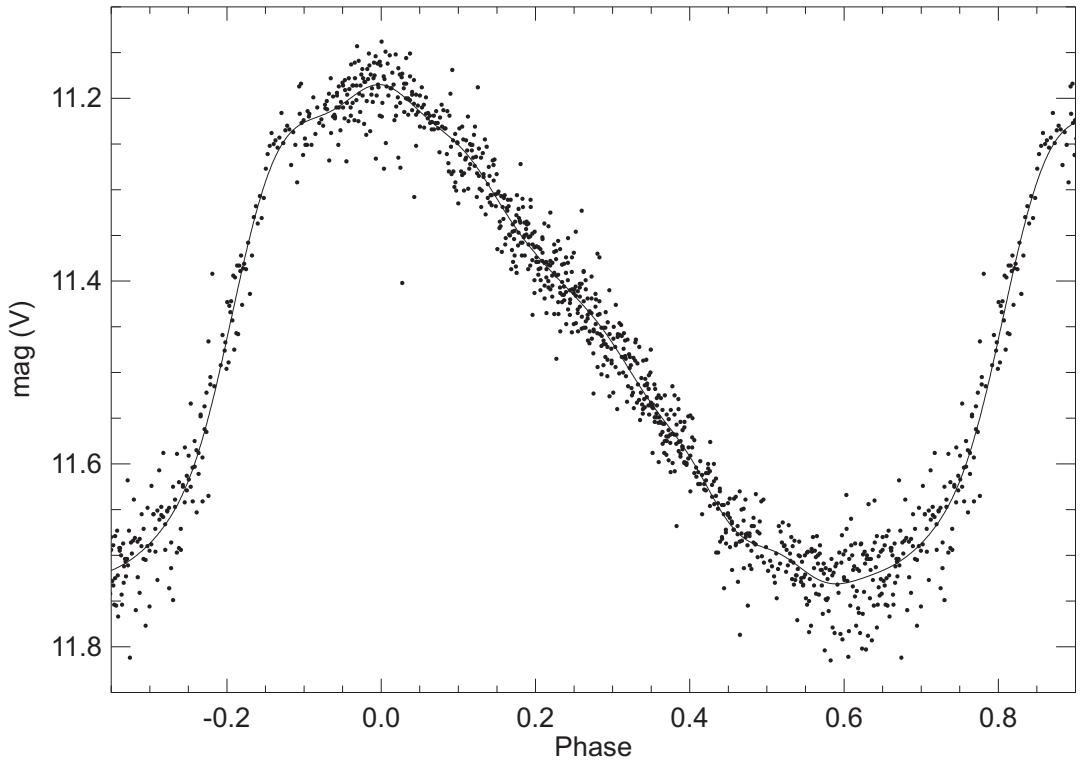

Figure 1. Phased V light curve of EF Cnc (small circles) and 10th order Fourier fit (solid line). Higher scatter both in maximum and minimum is due to instrumental effects

of observations we are not able to give any detailed analysis. Thus, we determined the following ephemerides using only our three times of maxima:

$$\begin{array}{c} \mathrm{Max} = \mathrm{HJD}\ 2451955.529 + 0.2956885 \times E. \\ \pm 0.004\ \ \pm 0.0000036 \end{array} \quad (1)$$

We have made a standard 10th order Fourier decomposition of the light curve as described for example by Kaluzny et al. (2000). The fit is shown along with normal data in Figure 1. Residuals of the fit are on the $0\overset{\mathrm{m}}{.}03$ level. Fourier and physical parameters with corresponding errors (from standard error propagation law) obtained using the equations of Simon & Clement (1993) are presented in Table 3. Physical parameters place EF Cnc near the blue edge of the first overtone instability strip of Kolláth et al. (2000).

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Table 1: Our maxima timings of EF Cnc according to the ephemeris (2)

Hel. JD	Error	Epoch	$O-C$
2451955.529	0.004	0	0.000
2451957.302	0.004	6	−0.001
2452040.392	0.004	287	0.000

Table 2: Past maxima of EF Cnc

Hel. JD	Observer	Hel. JD	Observer
2445379.449	K. Locher	2445694.471	K. Locher
2445382.410	”	2445697.706	”
2445383.560	”	2445698.595	”
2445384.453	”	2445700.666	”
2445384.740	”	2445702.711	”
2445385.631	”	2445710.733	”
2445387.695	”	2445711.628	”
2445388.587	”	2445730.525	”
2445397.473	”	2445764.549	”
2445399.530	”	2445765.440	”
2445401.620	”	2445768.673	”
2445402.493	”	2445782.590	”
2445406.636	”	2445783.482	”
2445407.497	”	2445785.536	”
2445428.520	”	2445822.489	”
2445430.568	”	2446032.801	”
2445436.542	”	2446033.698	”
2445437.407	”	2446054.710	”
2445460.476	”	2446134.525	”
2445592.716	”	2446145.493	”
2445594.755	”	2446148.459	”
2445617.816	”	2446163.521	”
2445660.687	”	2446166.509	”
2445670.765	”	2446168.560	”
2445680.529	”	2446352.804	”
2445686.747	”	2446376.786	”
2445693.850	”	2450515.821	B. Krobusek

Table 3: Fourier and physical parameters of EF Cnc

	Value	Error
A_1	0.268	0.001
R_{21}	0.209	0.005
R_{31}	0.075	0.005
R_{41}	0.057	0.005
ϕ_{21}	3.066	0.028
ϕ_{31}	5.858	0.071
ϕ_{41}	3.220	0.094
Mass	0.655	0.012
$\log L$	1.702	0.004
$T_{\rm eff}$	7356	29
Y	0.272	0.005

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This work made use of the SIMBAD database, operated at CDS, Strasbourg, France. The NASA ADS Abstract Service was used to access data and references.

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