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IMPROVEMENT OF THE PERIOD OF CQ UMa

CQ UMa (HD 119 213, HR 5153) is a cool CP2 star demonstrating strong periodic light and spectrum variations caused by the presence of large spectroscopic and photometric spots on the surface of the rotating star. The first correct value of the period: P = 2.451 days, was found by Wolff & Morrison (1975) on the basis of their Strömgren *uvby* photometry. Shapes and amplitudes of light curves are wavelength-dependent. The largest variations (about 0.1 mag) take place in the *v* color. Longwards of 520 nm light variations are in the antiphase with variations in the blue region exceeding the amplitude of 0.02 mag.

Modelling of photometric spots on the stellar surface requires very good knowledge of light curves in various colors (Mikulášek, 1994). As the published measurements of the star brightness taken by many authors were obtained within the time interval of 25 years, their exploitation is possible only if the period of the star is known with satisfying accuracy.

In the search for the precise period of CQ UMa we have used all the available photometric observations in Johnson's B, Strömgren's *v* and the Shemakha Observatory's X filters, in which the S/N ratio is the best. The last of the filters is very similar to that of Strömgren's *v* filter (Schöneich & Staude, (1976), Musielok et al. (1980)). Nine sets of photometry used, cover 3720 revolutions of the star – see the list in the Table. The last set of photometry taken in the *v* filter was recently obtained by the team involving one of us (J. Ž.) by means of the photoelectric photometer attached to the 0.6 m telescope of the Skalnaté Pleso Observatory.

Source	col	N	cycles	Mean Epoch	$(O–C)_{new}$
Burke & Howard (1972)	B	26	0 – 158	84	+0.007 ± 0.036
Winzer (1974)	B	18	145 – 291	198	+0.006 ± 0.016
Wolff & Morrison (1975)	*v*	25	401 – 443	427	–0.007 ± 0.015
Musielok et al. (1980)	X	29	604 – 894	761	+0.003 ± 0.008
Mikulášek et al. (1978) + Pavlovski (1979)	B	28	441 – 1215	969	+0.011 ± 0.017
Pyper & Adelman (1985)	*v*	24	1465 – 2057	1834	–0.005 ± 0.015
Jetsu et al. (1991)	B	143	2954 – 3138	3029	–0.001 ± 0.007
This paper	*v*	24	3638 – 3720	3670	+0.012 ± 0.018

The period improvement has been carried out using special iterative least squares method (details in Mikulášek et al., 1995). The basic assumptions of the analysis of data were: the light curves in B and *v* colors are constant (but generally unequal) and the periods of these variations are the same. On the contrary to the previous papers dealing

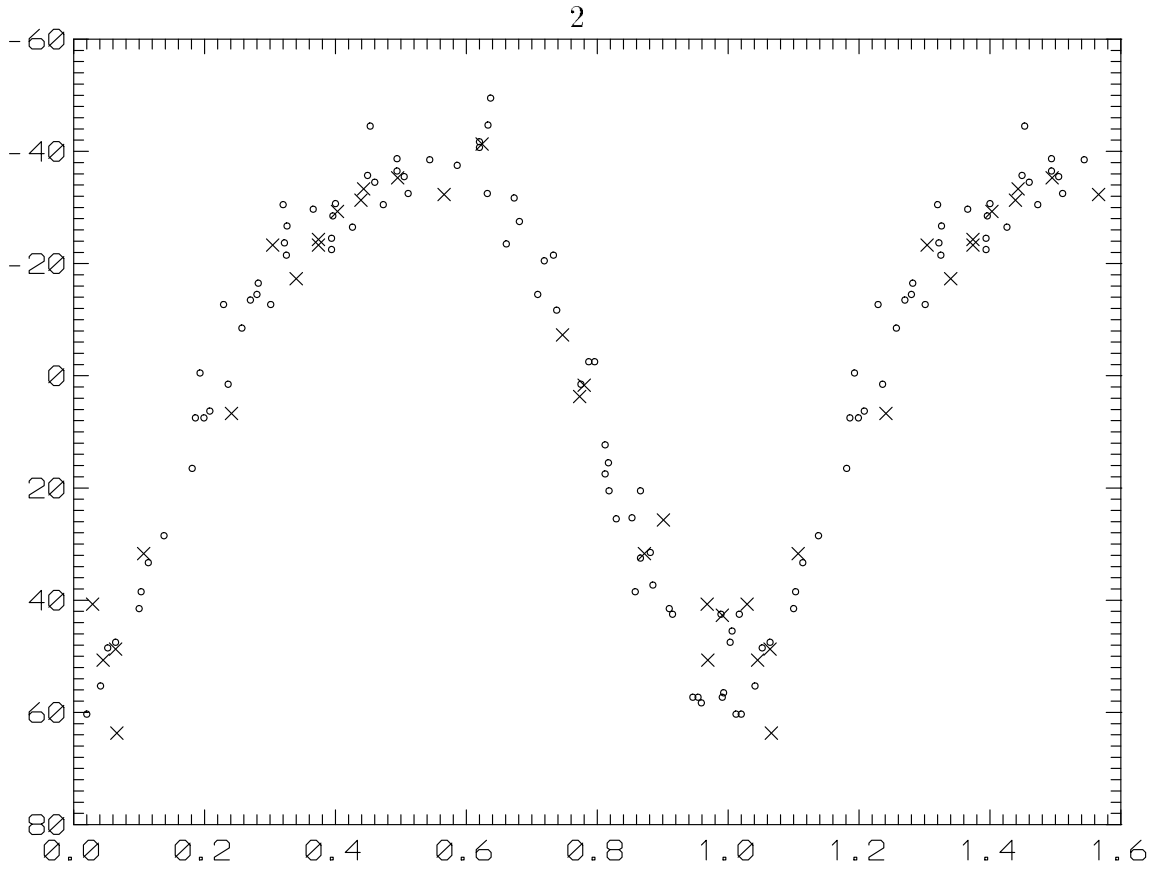

Figure 1. Light curve of CQ UMa in X and v filters. Circles – data from literature, crosses – this paper, brightness in millimagnitudes relative to the mean value. Phases were calculated according to the ephemeris given in this paper.

with the CQ UMa light elements, we put the beginning of counting of cycles at the light minimum of the v color. The minimum of the v light curve is sharp, symmetric and so well defined, while the maximum in both colors used before is both flat and asymmetric.

Altogether 215 measurements in B and 102 in v colors were used and the following ephemeris has been derived:

$$\begin{array}{rr} \mathrm{JD_{hel}(Min}\ v) = 2\ 445\ 349.7263 + (\mathrm{E}{-}1878)\ 2\overset{\mathrm{d}}{.}4499141 \\ \pm 0.0047 \qquad\qquad \pm 0.0000038 \end{array}$$

where the epoch E was chosen so, that E = 0 corresponds to the v light minimum immediately preceding the first of published photometric observations of CQ UMa.

(O–C) values listed in the Table indicate that the period of the variations of the star was stable within the last 25 years, what confirms the expected extreme stability of photometric patterns on the stellar surface. Accuracy of the period determination enables one to find the phase of observations during the last 25 years with an uncertainty not exceeding 0.003, what is the basic requirement for further light curve analysis and mapping of the star's atmosphere. The phase ϕ can be computed according to the following relation:

$$\phi = \mathrm{frac}[(\mathrm{JD_{hel}} - 2\ 440\ 748.7876)/2.4499141]$$

The observed v light curve minimum is at the phase $\phi = 0.000 \pm 0.007$, but in the B one finds the minimum at $\phi = -0.021 \pm 0.006$(!). On the contrary, the flat maxima of light curves occur at the same phases: 0.581 ± 0.011 and 0.574 ± 0.023 in v and B colors, respectively (see Figure 1). Detailed analysis of light curves will be published elsewhere. Photometric observations from Skalnaté Pleso Observatory would be at your disposal via e-mail: ziga@ta3.sk.

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