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AN IMPROVEMENT OF THE ROTATIONAL PERIOD OF CQ UMa

CQ UMa = HR 5153 = HD 119 213 is an SrCrEu Ap star which exhibits light, spectral and magnetic variations with the period of about 2.450 days. All the variations can be explained by the oblique rotator model with extensive "photometric" and "spectroscopic" spots or belts (Mikulášek 1980) and nearly dipole magnetic field (Mikulášek et al. 1984). To build a realistic model of the distribution of these spots on the surface and their relation with magnetic field geometry, we need to know the rotational period with sufficient accuracy.

All the previous determinations of the period of variations of CQ UMa were based on the analysis of photometric data. Light variations of the star in the B and U colours were found by Burke and Howard (1972) on the basis of their UBV observations carried out in the years 1970 and 1971. They obtained a period of 1.706 days. Winzer (1974) derived a period of 1.6980 days from his own UBV measurements. Both periods are incorrect (s. the discussion in Mikulášek et al. 1978). Wolff and Morrison (1975) derived the period of 2.451 days, Mikulášek (1975) 2.45002 days, Mikulášek et al. (1978) 2.449967 days not excluding the double value: 4.899934 days. The double period was then rejected as it is incompatible with the observed projection of the rotational velocity (33 $km.s^{-1}$) and the expected radius of star (2.0 $R_\odot$)(Pavlovski 1979, Mikulášek 1980). Gathering all UBV observations Pavlovski (1979) arrived at the period of 2.449981 days. Musielok et al. (1980) presented the period 2.44988 days based on their 10-colour photometry and ubvy photometry of Wolff and Morrison (1975).

A new set of 25 ubvy measurements of CQ UMa obtained by Pyper and Adelman (1985) substantially enlarges the time interval covered by photoelectric observations of the star to 14 years, that induced us to improve the period of CQ UMa. In our paper we submit the period based on the whole available photometric data which span more than 2000 revolutions of the star. There is impossible to use all the photometric data directly, as they were obtained in various photometric systems (see Table I).

Table I

Authors	Type of photometry	N	Mean epoch	(O - C)
Burke, Howard (1972)	rel.UBV	28(2excl)	86	0.001 ± 0.036
Winzer (1974)	rel.UBV	18	197	0.000 ± 0.015
Wolff, Morrison (1975)	rel.uvby	25	427	0.000 ± 0.009
Mikulášek et al. (1978)	abs.UBV	9	585	-0.012 ± 0.036
Musielok et al. (1980)	rel.10col.+	29	755	-0.005 ± 0.011
Pavlovski (1979)	abs.UBV	19	1089	0.020 ± 0.019
Pyper,Adelman (1985)	abs.uvby	25	1843	-0.002 ± 0.015

+ see in Schöneich, Staude (1976), N - number of nights

Nevertheless, it follows from the analysis of light curves in the blue region where light variations are most pronounced that light curves here are similar. Light variations may be then expressed in the from:

$$m_i(\varphi) = \overline{m_i} - A_i\, f(\varphi), \qquad (1)$$

where φ is the phase, $m_i(\varphi)$ magnitude in the particular colour, $\overline{m_i}$ - the mean value of the magnitude in i - colour, A_i - the amplitude of variations. $f(\varphi)$ is the normalized mean light curve in the blue region with an unit amplitude and zero mean value.

For the determination of light elements and mean light curve $f(\varphi)$ measurements in B (UBV photometry), b and v (ubvy photometry), X and Y colours (in 10-colour photometry) have been used. Using the least squares method we have obtained the following approximation for $f(\varphi)$:

$$f(\varphi) = 0.486 \cos 2\pi\,(\varphi + 0.067) + 0.102 \cos 4\pi(\varphi - 0.142) \qquad (2)$$

The mean light curve is rather asymmetric with a flat maximum occurring at $\varphi = 0.000 \pm 0.009$ and a deeper minimum at $\varphi = 0.416 \pm 0.004$. The zero points of the function are situated at the phases 0.207 ± 0.003 and 0.649 ± 0.004. $f_{max}/(-f_{min}) = 0.72 \pm 0.04$.

The phase will be given by the relation:

$$\varphi = \mathrm{FRAC}\ (JD_{hel} - 2\ 440\ 747.746)/2.449909 \qquad (3)$$

The ephemeris for the moments of maxima in the blue region has been calculated by the least squares method, too.

$$JD_{Bmax} = \underset{\pm 7}{2\ 442\ 487.181} + \underset{\pm 11}{2.449909}\ (E - 710), \qquad (4)$$

where 2 442 487.181 is the moment of the basic maximum, 2.449909 days is present improved rotational period. The beginning of counting of cycles (E = 0) has been put just before the first observation of CQ UMa.

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