COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5188

Konkoly Observatory
Budapest
19 October 2001

HU ISSN 0374 – 0676

FURTHER IMPROVEMENT OF THE PERIOD AND NEW R LIGHT CURVE OF CQ UMa

MIKULÁŠEK, Z.[1,2], ŽIŽŇOVSKÝ, J.[3]

[1] Institute of Theoretical Physics and Astrophysics, Masaryk University in Brno, Kotlářská 2, 611 37 Brno, Czech Republic, e-mail: mikulas@ics.muni.cz

[2] Nicolaus Copernicus Observatory and Planetarium, Kraví Hora 2, 616 00 Brno, Czech Republic

[3] Astronomical Institute, Slovak Academy of Sciences, 059 60 Tatranská Lomnica, Slovak Republic e-mail: ziga@ta3.sk

The cool chemically peculiar SrCrEu star CQ UMa = HR 5153 = HD 119213 (m_V = 6.28) belongs to the best photometrically monitored stars of its type. The star exhibits relatively large light variations in the blue (namely in Strömgren's v colour) and smaller antiphased ones in the red. While in the blue and yellow regions hundreds of reliable photometric measurements exist, our knowledge about the light behaviour of the star in the red and near infrared only reposed on several measurements done by Musielok et al. (1980) as a part of their intermediate band ten-colour photometry.

The requirement of reliable red data and need for enlargement of the time base of light variation measurements essential for further improvement of the period of the star induced us to start with systematic observations of CQ UMa in Strömgren's v filter and Johnson's R filter.

The detailed history of the CQ UMa period determination is published in Mikulášek (1987). The latest improvement of light elements based on 215 B and 102 v measurements referred to the more or less symmetrical minimum of light in v colour were published by Žižňovský & Mikulášek (1995):

$$\mathrm{JD_{hel}(Min}\ v) = 2445349.7263(47) + (E - 1878) \times 2\overset{\mathrm{d}}{.}4499141(38).$$

In this paper we present 54 measurements in R and 30 new measurements in v taken in 56 individual moments in the time interval from March 1994 to May 2000. All photometric measurements were done by the red sensitive photometer attached to the 0.6-m telescope of the Skalnaté Pleso Observatory. HD 120874 = HR 5216 (m_V = 6.46) was used as a comparison star. All new data obtained were used for the improvement of the period of CQ UMa.

The comprehensive examination of all currently available photometric data (including our new data — see Figs. 1 and 2) particularly confirmed that each of the observed light curves in the region at least 350 nm to 800 nm can be well enough represented by the linear combination of a constant and two basic harmonic polynomials of the second order (Mikulášek, 1994). Hence we could apply our newly developed method for an improvement of period of periodically variable stars (Mikulášek, in preparation) to all

accessible photometric data with sufficient amplitude of variations/noise ratio. In the total we have used 884 measurements of nine authors (Burke & Howard, 1972; ESA, 1997; Jetsu et al., 1992; Mikulášek et al., 1978; Musielok et al., 1980; Pavlovski, 1979; Pyper & Adelman, 1985; Winzer, 1974; Wolff & Morrison, 1975; this paper) obtained in the u, v, b, U, B, R and H colours, the last being the instrumental colour of the Hipparcos satellite. The whole material more or less uniformly covers the time interval of thirty years or 4457 stellar revolutions.

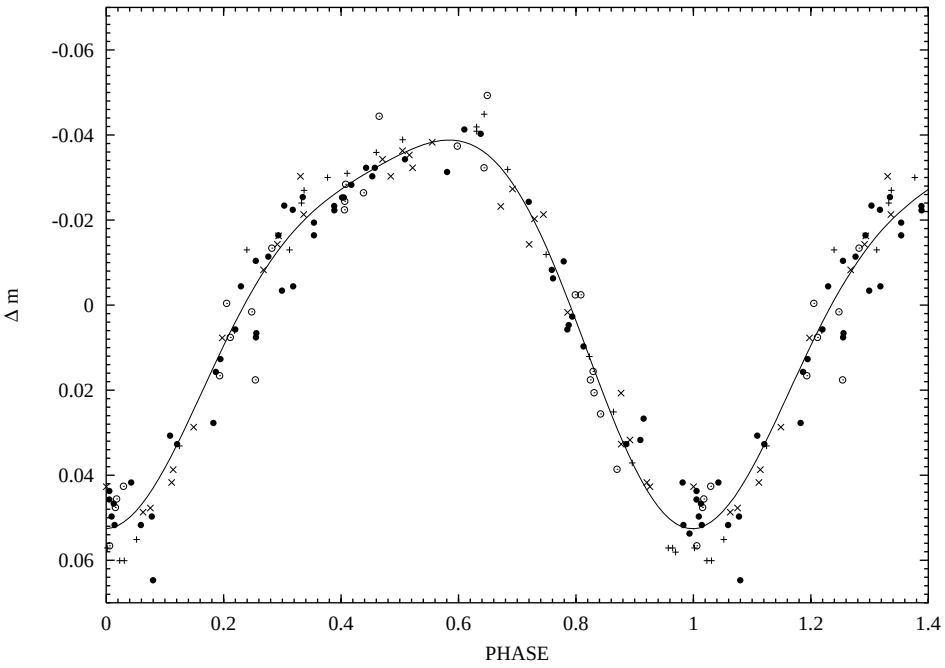

Figure 1. The v light curve of CQ UMa. Smooth line: the fitted light curve. Symbols: ∘ Pyper & Adelman (1985), × Musielok et al. (1980), + Wolff & Morrison (1975), • this paper

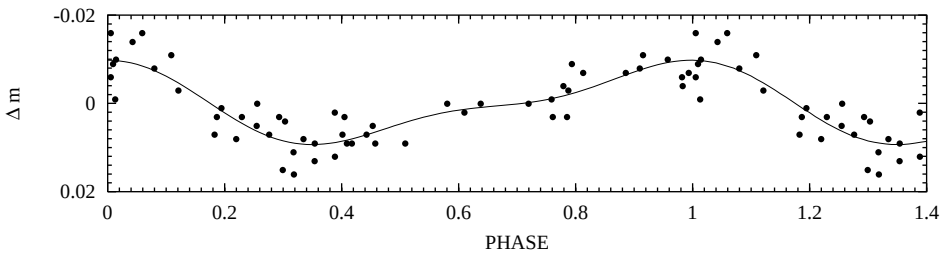

Figure 2. The R light curve of CQ UMa. Dots: observations, smooth line: the fitted light curve

The times of v minima are given by the relation:

$$\mathrm{JD_{hel}(Min}\ v) = 2445925.4255(37) + (E - 2113) \times 2\overset{\mathrm{d}}{.}4499117(29),$$

the initial epoch ($E = 0$) corresponds to the v colour light minimum immediately preceding the first photometric observation of CQ UMa. The reliability of this ephemeris is extreme, the standard uncertainty of the phase determination being 0.002.

Our new photometry indicates that the period of light variations of the star was stable within the last 30 years, which confirms an incredible stability of photometric patterns on the stellar surface responsible for the light variability.

This work was supported by VEGA grant No. 7107.

References:

Burke, E. W., Howard, J. T., 1972, *ApJ*, **178**, 491
ESA, 1997, in *The Hipparcos and Tycho Catalogues*, ESA SP-1200
Jetsu, L., Kokko, M., Tuominen, I., 1992, *A&A*, **256**, 547
Mikulášek, Z., Harmanec, P., Grygar, J., Ždárský, F., 1978, *Bull. Astron. Inst. Czechosl.*, **29**, 44
Mikulášek, Z., 1987, *IBVS*, No. 3010
Mikulášek, Z., 1994, in: *Chemically Peculiar and Magnetic Stars,* J. Zverko and J. Žižňovský (eds.), Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, p. 165
Musielok, B., Lange, D., Schöneich W., Hildebrandt G., Zelwanova E., Hempelmann, A., 1980, *AN*, **301**, 71
Pavlovski, K., 1979, *A&A*, **76**, 362
Pyper, D. M., Adelman, S. J., 1985, *A&AS*, **59**, 369
Schöneich, W., Staude, J., 1976, in: *Physics of Ap Stars*, W. W. Weiss, H. Jenkner and H. J. Wood (eds.), Universitätssternwarte, Wien, p. 387
Winzer, J. E., 1974, (unpubl.) Thesis, Univ. of Toronto
Wolff, S. C., Morrison, N. D., 1975, *PASP*, **87**, 231
Žižňovský, J., Mikulášek, Z., 1995, *IBVS*, No. 4259