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NEW PHOTOELECTRIC OBSERVATIONS OF CY AQUARII

CY Aquarii (=BD+0°4900) is one of the most thoroughly observed SX Phe type stars. Because of its short period (0.061 day≈1h 28m) and large amplitude (about 0.9 mag and 0.7 mag in B and V, respectively) CY Aqr has attracted considerable attention in the past fifty years. All the observations published up to 1980 have been summarized by Mahdy and Szeidl (1980). New photoelectric observations were obtained by Bohusz and Udalski (1980), Purgathofer and Schnell (1984), Peña et al. (1985) and Rolland et al. (1986).

The changes in the period of CY Aqr have been investigated in several papers and the results are contradictory. Percy (1975) and Mahdy and Szeidl (1980) came to the conclusion that the perios of the star changed abruptly around 1951-1952 by about $-18 \cdot 10^{-8}$ day = -16 ms. Kämper (1985) stated that during the past fifty years the star was subjected to three abrupt period changes, two sudden decreases and one sudden increase: $-173 \cdot 10^{-9}$ day = -15 ms in 1953, $-43 \cdot 10^{-9}$ day = -4 ms in 1967 and $+27 \cdot 10^{-9}$ day = +2 ms in 1977. Zissell (1968) also claimed that the star's period was essentially constant, at least between 1953 and 1966. Bohusz and Udalski (1980) tried to check the constancy of the period of CY Aqr until 1978. They found that the period between 1966 and 1971 was the same as in the years 1973-1978, although a small shift of moments of maxima of about 0.003 day after 1973 suggests that the period was slightly shorter between 1971 and 1973.

Detre and Chang (1960) noticed that the O-C diagram could not be approximated by a linear formula and they derived an ephemeris with a quadratic term of $\beta/2 = -7.42 \times 10^{-13}$ days. Hardie and Tolbert (1961) also found the period gradually decreasing and a second-degree solution seemed to have appeared to them as being satisfactory with $\beta/2 = -6.0 \times 10^{-13}$ days. A continuously decreasing period was assumed by Karetnikov and Medvedev (1966), too. They derived the new elements with a quadratic term $\beta/2 = -6.35 \times 10^{-13}$ days. A detailed study of the period changes in CY Aqr was carried out by Rolland et al. (1986). They found that the ephemeris with a quadratic term of -4.58×10^{-13} days (a parabolic fit to the O-C values) explains the observations better. Soon after this

result had been achieved, Peña et al. (1985) obtained three new moments of maximum light, and made a new quadratic fit to the O-C values, using Purgathofer and Schnell's (1984) observations, too. This new fit resulted in the ephemeris:

$$T_{max} = 2440892.63705 + 0^d.0610\ 3832\ 01 E - 4^d.45 \times 10^{-13} E^2$$

Because the residuals from this fit seemed to be fairly large we decided to observe the star again in order to obtain new times of maximum light and to reinvestigate its period changes.

The photoelectric observations were carried aout at Kottamia Observatory by the 74 inch telescope in two colours (B and V) during the nights of July 23 and 24 and August 19 and 20, 1985. The photoelectric photometers attached to the f/18 Cassegrain focus had an EMI 9558B tube with an S-20 photocatode.

The observations yielded 16 light curves, eight in each colour which are reproduced in Figure 1. It is clear from this figure that the light curves of CY Aqr are characterized by a more or less constant shape but noticeable changes in the shape and height of maximum light do occur from cycle to cycle. This effect was interpreted as double mode pulsation by Elst (1972) and by Fitch (1973) but further studies denied this possibility.

Eight times of maximum light could be determined from our observations. These new light maxima are listed in Table I. (Each is a mean of the blue and yellow maximum).

In this study of period changes of CY Aqr all the published 261 photographic and photoelectric maxima have been used. The list of maxima given in the paper of Mahdy and Szeidl (1980) has been supplemented by the maxima published by Bohusz and Udalski (1980), Purgathofer and Schnell (1984), Rolland et al. (1986) and Peña et al. (1985). The O-C residuals have been computed by the formula

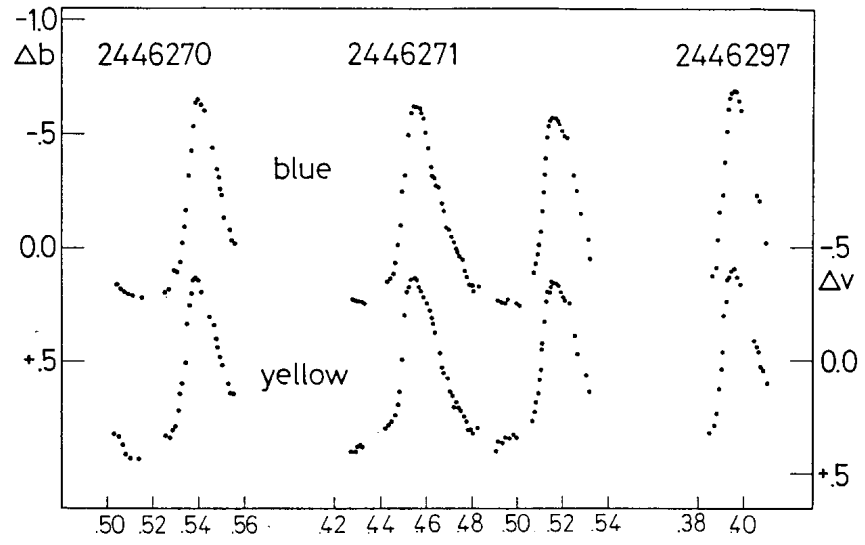
$$C = 2434308.4310 + 0^d.0610\ 3839\ 5 \cdot E$$

and are plotted against epoch numbers in Figure 2.

A second order least squares fit was carried out to the 261 observed light maxima and our results are:

$$T_o = 2434\ 308.42804$$
$$P_o = 0.0610\ 3842\ 21 \text{ day} \qquad (1)$$
$$\beta/2 = -4.637 \times 10^{-13} \text{ day}$$

The parabolic fit is drawn in Figure 2. The O-C versus epoch number diagram with the new quadratic ephemeris (1) is shown in Figure 3. This figure convincingly proves that there are some significant deviations from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Δb
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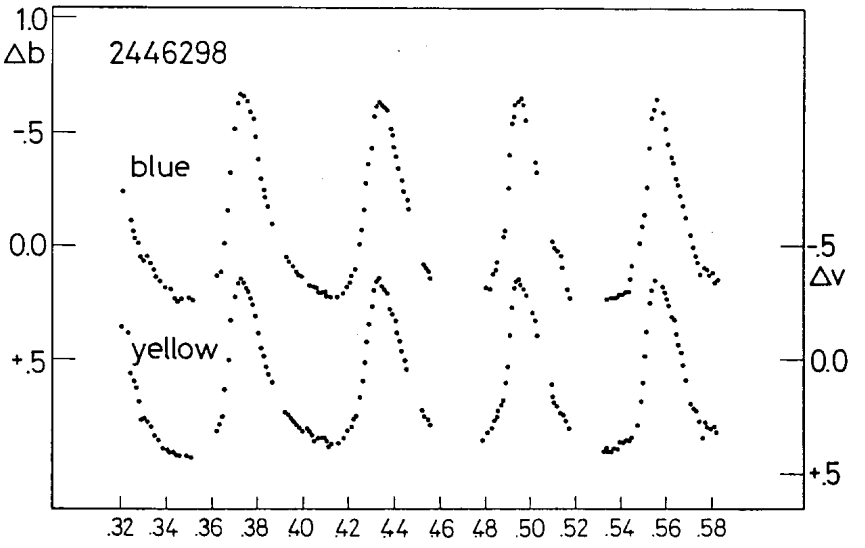
2446271
2446297
-.5
blue
0.0
+.5
yellow
-.5
Δv
0.0
+.5
.50 .52 .54 .56
.42 .44 .46 .48 .50 .52 .54
.38 .40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Δb
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-.5
blue
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Δv
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.32 .34 .36 .38 .40 .42 .44 .46 .48 .50 .52 .54 .56 .58

Figure 1

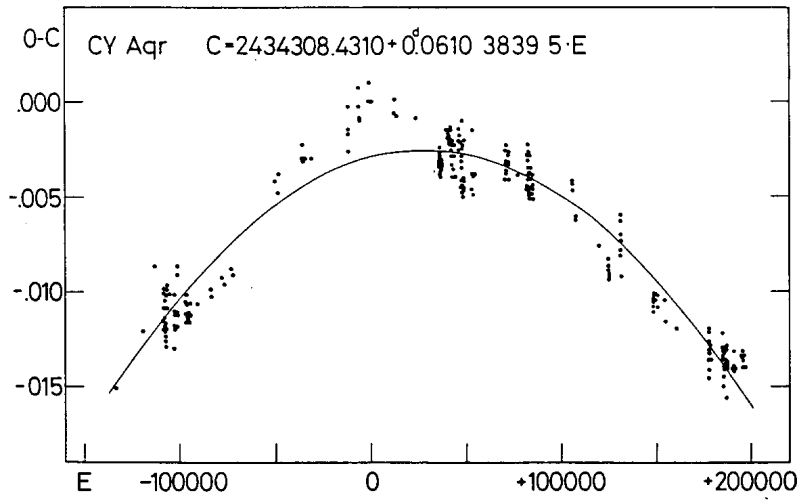

Figure 2

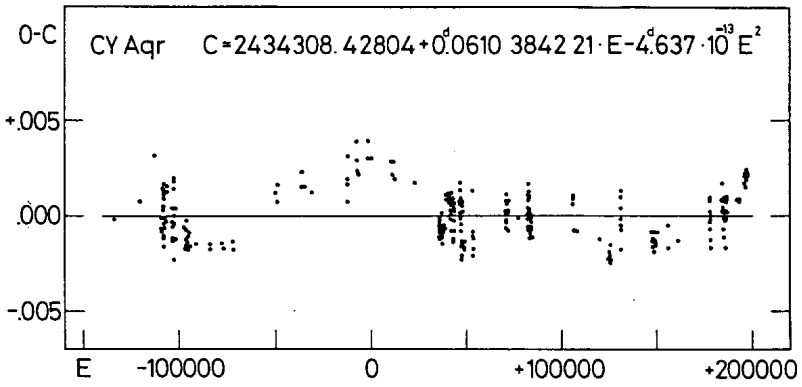

Figure 3

Table I

New times of light maximum of CY Aqr

J.D.	J.D.
2446 270.5393	2446 298.3726
2446 271.4541	.4335
.5154	.4949
2446 297.3960	.5557

the parabolic fit. These systematic deviations suggest that the decrease of the period of CY Aqr.is not smooth and may not be continuous. At present the period changes of CY Aqr can also be interpreted in such a way that the constant period is subjected to abrupt decreases and increases (Kämper, 1985). Further observations can only clear up to the character of the period changes of CY Aqr.

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