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

Number 4616

Konkoly Observatory
Budapest
27 July 1998

HU ISSN 0374 – 0676

UBV OBSERVATIONS OF THE SOLAR-TYPE NEAR CONTACT BINARY, CN ANDROMEDAE

RONALD G. SAMEC[1,3], HEIDI LAIRD[1], MATTHIAS MUTZKE[1] AND DANNY R. FAULKNER[2,3]

[1] Department of Physics, Bob Jones University, Greenville, SC 29614 USA, rsamec@bju.edu

[2] University of South Carolina, Lancaster, SC 29721 USA, faulkner@gwm.sc.edu

[3] Visiting Astronomer, Lowell Observatory, Flagstaff, Arizona

CN And (BD+39°59, GSC 2787-1815, PPM 42831) is one of the shortest period eclipsing binaries with an unmistakable EB-type light curve. Its eclipse depths differ by some 0.3 mags in V. It is also an active solar type binary with components of spectral type in the F5 to G5 range. Due to these factors it was included as a target object in a recent observing run at Lowell Observatory. The variable was discovered by Hoffmeister (1949). Löchel (1960) was the first to correctly determine the period, ∼0.4628 days. Photoelectric observations have been made by Bozkurt et al. (1976), Seeds and Abernathy (1982), Kaluzny (1983), Michaels et al. (1984), and Evren et al. (1987). The curves are characterized by interesting asymmetries (Rafert et al. 1985) similar to V1010 Ophiuchi binaries (Shaw, 1994). Its high level of activity is attested by two flares seen by Yu-Lan and Qing-Yao (1985), as well as its X-ray luminosity of log $L_x = 30.55$ (Shaw et al. 1996).

Our present observations were taken with the Lowell 0.79m reflecting telescope in conjunction with a cooled S-13 type PMT on September 4-10, 1997. Standard U, B, and V filters were used. The comparison (HIP#1442, GSC 02786-00787, spectral type G9), and check stars, (GSC 02787-01843) are given as C, and K in Figure 1 along with the variable, V. Over 1200 observations were taken in each pass band. Three mean epochs of minimum light were determined from one primary, and two secondary eclipses using the bisection of chords method. One additional timing of minimum light, observed on November 25, 1997 was determined by DRF using the David F. Irons 0.41-m reflector of the Charlotte Amateur Astronomy Club using an SSP-5 PMT. The Hertzsprung technique (1928) was used in its determination. The precision epochs of minimum light are given in Table 1 along with their standard errors of the last digits in parentheses. Linear and quadratic ephemerides were calculated using the available 60 epochs of minimum light:

$$\text{J.D. Hel Min I} = 2450698.9591(18) + 0.46279372(13) \times E. \quad (1)$$

$$\text{J.D. Hel Min I} = 2450698.9447(14) + 0.46279092(19) \times E - 9.8(6) \times 10^{-11} \times E^2. \quad (2)$$

Equations 1 and 2 were used to calculate the O−C1 and O−C2 residuals, respectively, in Table 1. The linear and quadratic residuals are given in Figure 2 and 3, respectively.

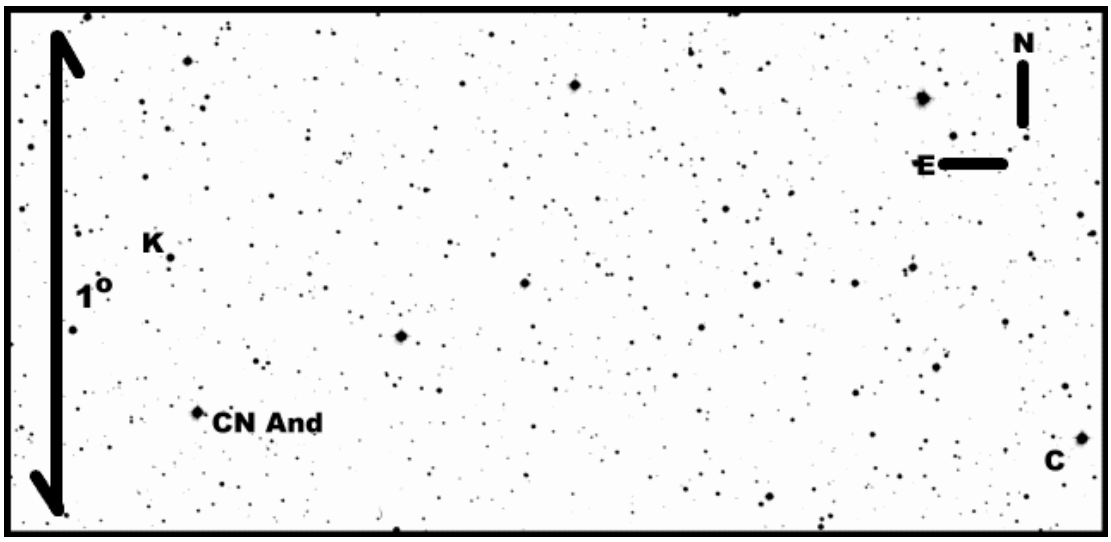

Figure 1. Finding chart made from Real Sky of the Variable, CN And, V, the comparison star, C, and the check star, K.

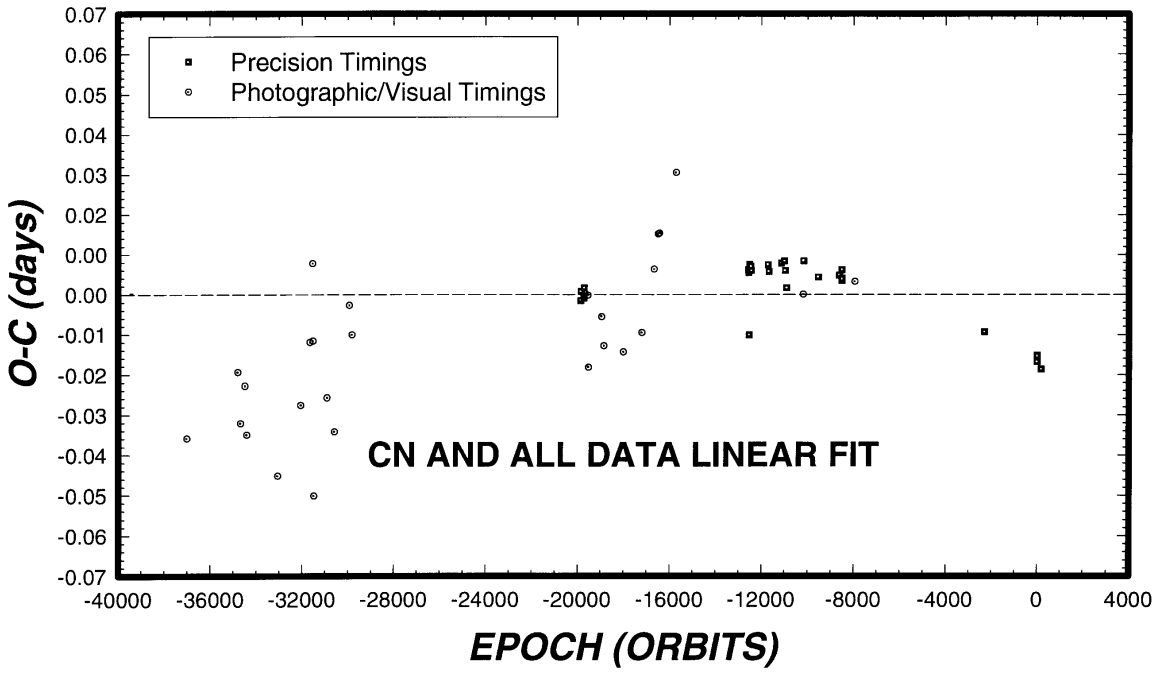

Figure 2. O–C residuals for all available timings of minimum light as calculated from equation 1.

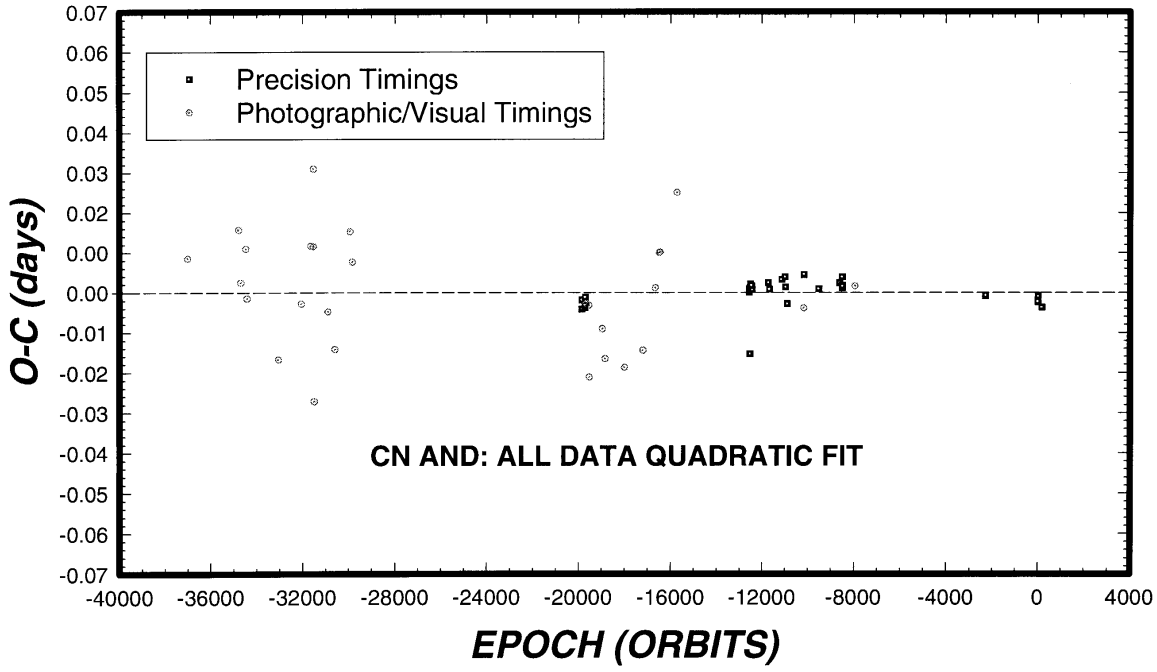

Figure 3. O–C residuals for all available timings of minimum light as calculated from equation 2.

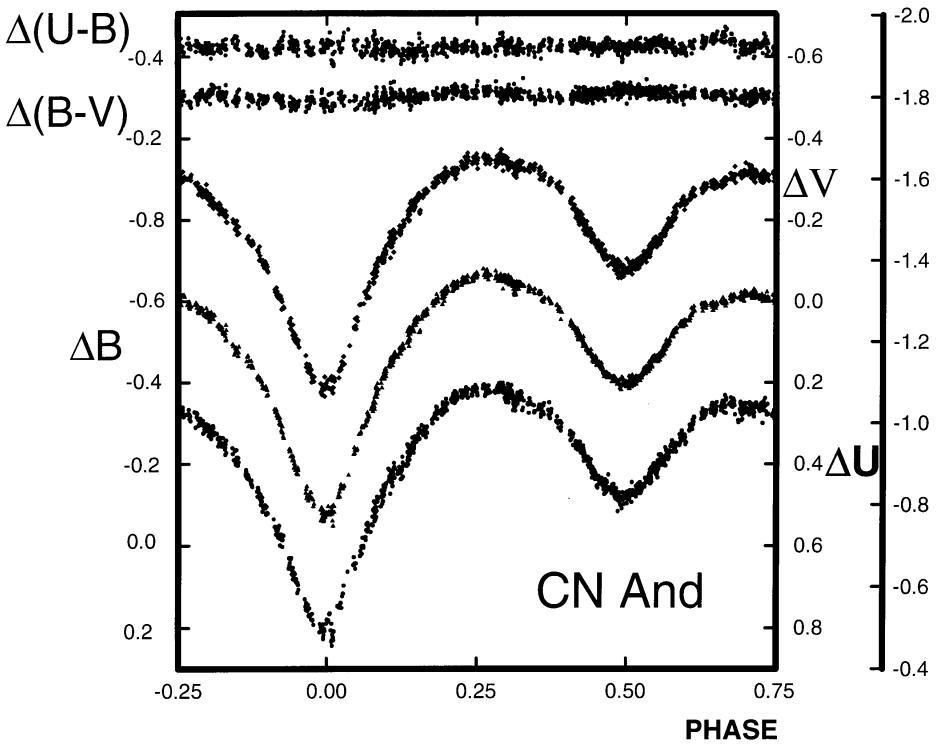

Figure 4. U, B, V light curves and U–B, B–V color curves for CN And as magnitude differences, variable minus comparison star.

Table 1: New Epochs of Minimum Light, CN And

JD Hel. 2450000+	Min	Cycles	O−C1	O−C2
698.9423(9)	I	0.0	−0.0168	−0.0024
701.9521(5)	II	6.5	−0.0151	−0.0007
702.8775(5)	II	8.5	−0.0153	−0.0010
778.5410(10)	II	172.0	−0.0186	−0.0037
Std. error of all residuals:			0.0176	0.0100

The quadratic term is statistically valid at the 16 s level. Also, the O−C residuals yield a much better fit to the timings of minimum light as evidenced by the standard errors.

This gives strong evidence that the period decrease is a real one. The period behavior may be due to mass transfer with the secondary component as the accretor and/or magnetic breaking due to the strong magnetic activity. UBV light curves and the B−V and U−B color curves of the variable are shown as Figure 4 as differential standard magnitudes (variable–comparison) versus phase. The probable error of a single observation was 0.4% in B, 0.5% in V and 1.8% in U. The analysis of these difficult light curves is underway. A spotted semi-detached light curve synthesis solution has been calculated.

We wish to thank Lowell Observatory for their allocation of observing time for the travel support from both the University of South Carolina and Bob Jones University.

This research was partially supported by a grant from NASA administered by the American Astronomical Society.

References:

Bozkurt, S., Ibanoglu, C., Gülmen, O., Güdür, N., 1976, IBVS No. 1087
Evren, S., Ibanoglu, C., Tunca, Z., Akan, M. C., Keskin, V., 1987, IBVS No. 3109
Hertzsprung, E., 1928, Bull. Astron. Inst. Neth. 4, 179
Hoffmeister, C., 1949, AN 12, 1
Kaluzny, J., 1983, AA 33, 345
Löchel, K., 1960, MVS 457 & 458
Michaels, E.J., Markworth N.L., and Rafert, J.B., 1984, IBVS No. 2472
Rafert, J.B., Markworth N.L., and Michaels, E.J., 1985, PASP 97, 310
Seeds, M. A., 1982, and Abernathy D. K., PASP 94, 1001
Shaw J.S., 1994, Soc. Astron. Ital. 65, 1, 95
Shaw, J. S., Caillault, J.-P., Schmitt, J.H.M.M., 1996, ApJ 461, 951
Yu-Lan, Y., Qing-Yao, L., 1985, IBVS No. 2705