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ANS OBSERVATIONS OF DH Cep, CV Vel, AND RS Vul

The three close binary systems DH Cep, CV Vel, and RS Vul were observed with the spectrophotometer system aboard the ANS satellite (van Dunien et al. 1975) in 1974 and 1975. Aside from twenty observations of CV Vel, all data were obtained for phases outside eclipse. Table 1 lists the observed average magnitudes out of eclipse for the three systems. These numbers are $m_\lambda = -2.5\log f_{\lambda\odot} + C$ where the constant C has been chosen to make the magnitude zero at $f = 3.64 \times 10^{-9}$ ergs/cm^2/s/Å. The V magnitudes have been taken from the literature. For DH Cep we used the photometry of Hill, Hilditch, and Pfannenschmidt (1976), for CV Vel, the V magnitude of Cousins and Stoy (1963), and for RS Vul, an average between the determination of Popper (1957) and Hilditch and Hill (1975).

TABLE 1

Out-Of-Eclipse Magnitudes

Band	DH Cep	CV Vel	RS Vul
V	8.59	6.69	6.80
3300Å	8.012	5.570	6.339
2500	8.270	4.875	6.273
2200	9.289	4.533	6.495
1800	7.828	4.146	5.680
1550	7.908	3.908	5.466

Photometric data have been deposited in the IAU Commission No. 27 photometric data center (Breger 1979) as File 81.

DH Cep (HD 215835) is a double-lined spectroscopic binary consisting of a pair of ~O5 stars in a very close orbit (Pearce 1949). Its relatively large minimum masses (23 and 19$M_\odot$) suggest that the inclination should be large enough for modest eclipses to occur. Although Pearce predicted eclipses ~0.1 mag deep from his radial velocity study, the ground based photometry of Hill, Hilditch, and Pfannenschmidt (1976) and the unpublished

photometry of A. M. Heiser (private comm.) indicate that the system is only an ellipsoidal variable of 0.05 mag amplitude. The ANS data (Figure 1) reaffirms this result: No eclipses and low-amplitude ellipsoidal variation.

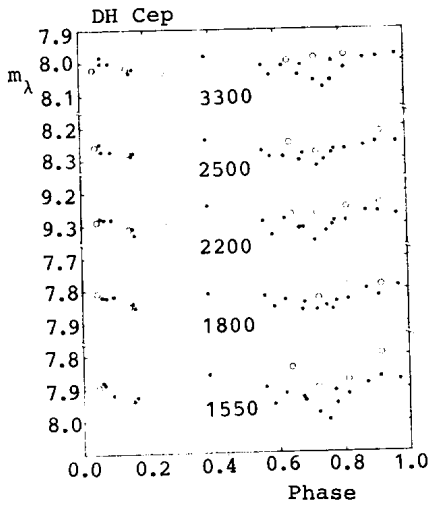

Figure 1. ANS observations of DH Cep. Circles are data for 1975.0; dots, those for 1975.5. Phases were calculated with the elements JD(Hel.) = 2432759.807 + 2.11104·Phase.

This star is especially interesting in that it is a member of the heavily reddened open cluster NGC7380 (Pearce 1949). We are fortunate that photometry defining the upper main sequence exists for this cluster (Hoag et al. 1961, Hoag and Applequist 1965), although Underhill (1969) has determined that the cluster field is severely contaminated with foreground and background stars. DH Cep appears to have the bluest colors in the cluster, and the spectral type corresponding to its UBV colors as derived from the Q-method (Johnson and Morgan 1953) is at least as early as B0.5. The ANS ultraviolet colors are not completely consistent with those of a O5-type star reddened by the Galactic mean reddening law. Wesselius et al. (1980) have published a mean extinction curve for the ANS passbands which can be used to relate the relative strength of the 2200-Å absorption bump to the mean color excess in (B-V): ΔBump = 2.15*E(B-V). For our photometry of DH Cep, ΔBump = 1.208 implies E(B-V) = 0.56. However, the (λ-V) color excesses derived by assuuming DH Cep has the colors of an O5-6 star correspond to E(B-V) = 0.70.

Although the photometric studies of Hoag et al. find a mean color excess for the cluster of E(B-V) = 0.58, the probable members isolated by Underhill exhibit greater reddening. The color excess of DH Cep is thus consistent with the cluster reddening and its O5.5 + O6.5 spectral type (Conti and Alschuler 1971), although the strength of the 2200-Å bump is relatively weak for the total reddening.

The short spectroscopic period (2.111 days) and large minimum masses derived by Pearce suggest that the system should be a massive contact binary. The radii expected for main-sequence components having the masses derived by Pearce are comparable to the mean radii of the Roche lobes regardless of the inclination. Ruciński's (1973) family of light curves for contact binaries indicates that it is not possible to obtain the low amplitudes of the observed light curves with a contact binary having a reasonable inclination. Thus, we infer that the components are considerably smaller than expected for their apparent masses and spectral types. We suspect that there are systematic errors in the spectroscopic analysis in the sense that the radial velocity amplitudes are too large. The large eccentricity quoted by Pearce (e = 0.13) suggests this is likely. We were disappointed not to find a larger light amplitude of variation for this star.

CV Vel (HD 77464) is a pair of main-sequence stars in a 6.89-day eclipsing binary (Andersen 1975; Clausen and Gronbech 1977). Both components are early B-type stars, B2.5V according to Clausen and Gronbech. We observed two occurrences of the primary eclipse exactly one year apart for which we derive a mean time of minimum: $JD_{\odot}$ 2 442 572.281 + 0.001. The star is little reddened. No 2200-Å extinction bump is apparent in the ultraviolet photometry. Andersen (1975) adopted a (B-V) color excess of only 0.03 mag. The ultraviolet colors of the binary out eclipse are those of an unredened B4V star on the calibration of Wu et al. (1980). A color excess of only a few hundredths of a magnitude in (B-V), which our ultraviolet data cannot exclude, would make these colors consistent with the B2.5V spectral type of Clausen and Gronbech.

RS Vul is an Algol binary with a B5-type hotter component (Hutchings and Hill 1971). Although we observed neither eclipse, we have obtained colors of this star for a wide range of wavelength by combining our photometry with the ground-based data of Hilditch and Hill (1975), V = 6.80, (b-y) = 0.14 out of eclipse. The colors out of eclipse are those of a moderately reddened B5 star. The 2200-Å extinction feature is readily apparent in the photometry.

Its strength, ΔBump = 0.48, corresponds to E(B-V) = 0.22. This is the same color excess derived from the observed (λ-V) colors by assuming the Galactic mean extinction curve and the mean colors of a B5V star (Wu et al. 1980).

CHI-CHAO WU
Computer Sciences Corp.
NASA-GSFC, Code 685
Greenbelt, Maryland 20771
U.S.A.

JOEL A. EATON
Dyer Observatory
Vanderbilt University
Nashville, Tennessee 37235
U.S.A.

References:

Andersen, J. 1975, Astr. Ap., 44, 355.
Breger, M. 1979, I.B.V.S., No. 1659.
Clausen, J. V., and Gronbech, B. 1977, Astr. Ap., 58, 131.
Conti, P. S., and Alschuler, W. R. 1971, Ap. J., 170, 325.
Cousins, A. W. J., and Stoy, R. H. 1963, Roy. Obs. Bull., No. 64.
Hilditch, R. W., and Hill, G. 1975, Mem. R.A.S., 79, 101.
Hill, G., Hilditch, R. W., and Pfannenschmidt, E. L. 1976, Pub. Dom. Ap. Obs., 15, 1.
Hoag, A. A., and Applequist, N. L. 1965, Ap. J. Suppl., 12, 215.
Hoag, A. A., Johnson, H. L., Iriarte, B., Mitchell, R. I., Hallum, K. L., and Sharpless, S. 1961, Pub. U.S. Naval Obs., Ser. 2, 17, 345.
Hutchings, J. B., and Hill, G. 1971, Ap. J., 166, 373.
Johnson, H. L., and Morgan, W. W. 1953, Ap. J., 117, 313.
Pearce, J. A. 1949, A. J., 54, 135.
Popper, D. M. 1957, Ap. J. Suppl., 3, 107.
Ruciński, S. M. 1973, Acta. Astr., 23, 79.
Underhill, A. B. 1969, Astr. Ap., 1, 356.
van Duinen, R. J., Aalders, J. W. G., Wesselius, P. R., Wildeman, K. J., Wu, C.-C., and Snel, D. 1975, Astr. Ap., 39, 159.
Wesselius, P. R., van Duinen, R. J., Aalders, J. W. G., and Kester, D. 1980, Astr. Ap., 85, 221.
Wu, C.-C., Faber, S. M., Gallagher, J. S., Peck, M., and Tinsley, B. M. 1980, Ap. J., 237, 290.