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AUTUMN 1981 PHOTOELECTRIC OBSERVATIONS OF THE STARSPOT ACTIVITY ON UX ARIETIS

UX Arietis (BD +28° 0532, HD 21242; <V> = +6.50 mag) is an active, non-eclipsing RS CVn-type binary which, along with V711 Tauri (HR 1099), II Pegasi, and DM Ursae Majoris, always exhibits Hα in emission. This double-line spectroscopic binary (K0 IV + G5 V) was observed photoelectrically on 13 nights from October 10 UT through December 01 UT 1981 at Villanova University Observatory using the 38 cm Cassegrain telescope. A photoelectric photometer equipped with a refrigerated RCA C31034A gallium-arsenide photocell was used and the data were recorded on a microprocessor controlled digital integrating system. The characteristics of the intermediate band blue (λ4530), red (λ6585), far red (λ7790), and narrow band red (λ6568) filters, as well as a description of the observing procedure, data reduction method, and explanation of the differential color and Hα indices, is given elsewhere (Dorren, Guinan, and McCook 1984). The comparison star was 62 Ari (BD +27° 500, HR 1012; G5 III, V = +5.52 mag), which previous photometric studies have demonstrated is constant in light. Nightly mean differential magnitudes were computed, in the sense variable minus comparison, for the observations in each of the four filters, from which nightly mean differential color and Hα indices were determined. The average seasonal errors for the nightly $\lambda\lambda$4530, 6585, 6568, 7790, Δ(b-r)', and $\Delta\alpha$(V-C) data sets are, respectively: 0.010, 0.005, 0.007, 0.006, 0.012, and 0.009 mag.

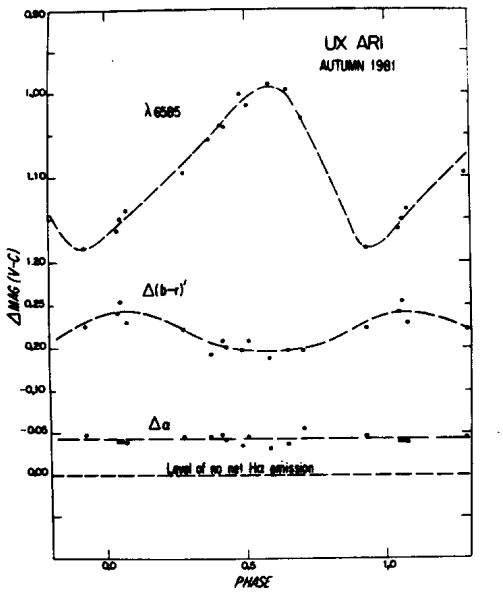

Figure 1

Figure 1 : The autumn 1981 photoelectric observations of UX Ari, made with respect to the comparison star 62 Ari, are presented. The upper panel is a plot of the nightly mean differential red magnitudes. The middle panel is a plot of the differential color index formed from the blue and red observations. The lower panel is a plot of the differential H-alpha index, where more negative values indicate greater net H-alpha emission.

The top panel of Figure 1 presents the autumn 1981 light curve of UX Ari formed by the intermediate band red observations. The orbital phases were computed according to the ephemeris quoted by Hall, Montle, and Atkins (1975):

$$HJD = 2440133.76 + 6^{d}.43791E$$

which is taken from the spectroscopic study of Carlos and Popper (1971), where zero phase coincides with the more active (K0 IV) component nearest to the earth. The amplitude of the red light curve is about 0.20 mag, with maximum light occurring around 0.61P and minimum light occurring in the vicinity of 0.94P.

Maximum, mean, and minimum light have, respectively, the following approximate values (measured differentially relative to 62 Ari): +0.99, 1.09, and 1.19 mag. The shapes of the λλ4530 and 7790 light curves (not shown) are similar to the red light curve. The light variation is wavelength dependent, with the blue light amplitude ≈ 0.15 mag (the λ7790 light amplitude is essentially the same as for the λ6585 curve).

The middle panel of Figure 1 displays the differential color index, $\Delta(b-r)'$, computed from the intermediate band blue (λ4530) and red (λ6585) differential magnitudes. Inspection of the color curve shows a definite phase dependency, with the index being reddest when the light curve is brightest. The same correlation exists for the color index formed from the λλ4530 and 7790 observations. The mean value of the $\Delta(b-r)'$ data set = -0.215 mag.

The bottom panel of Figure 1 displays the differential Hα index, Δα(V-C). No apparent phase correlation exists, and the Hα emission is present at all orbital phases. Based upon the spectral types of the variable and comparison stars, Δα(V-C) = 0.00± 0.01 mag corresponds to the level of zero net Hα emission. The mean value for the Δα(V-C) data set = -0.044 mag which indicates the presence of weak to moderate Hα emission during the observing interval.

Two photometric studies of UX Ari were undertaken contemporaneously with our observations by independent investigating teams (Zeilik et al. 1982, Sarma and Prakasa Rao 1984). The shape of the light curves, in particular the phase of minimum light, determined by Zeilik et al., Sarma and Prakasa Rao, and this study, are all in accord. Furthermore, the UBVR light curves of Zeilik, et al. confirm the phase dependency of the color curve and the wavelength dependency of the light amplitudes of our observations. This wavelength dependence is unusual since most RS CVn-type stars show the opposite behavior in which they are typically reddest when they are faintest, and vice versa. In the case of UX Ari, the observed decrease in light amplitude with decreasing wavelength is explicable from the increased contribution to the total systemic light at short wavelengths from the hotter (G5 V) component.

Unfortunately, at the present time the fractional contribution of the light of the hotter component to the total light of the binary is not well known. Until this is better determined, the light curves cannot be satisfactorily modeled to determine the properties of the starspots most likely present on the surface of the active, cooler component.

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