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SPECTROSCOPIC OBSERVATIONS OF THE COOL ECLIPSING X-RAY BINARY HD155638

The determination by Bloomer et al. (1983) of the orbital period and eclipse epoch of the cool active X-ray source, HD155638 (Stern et al. 1981), permits evaluation of the phases of my spectrograms obtained at the Lick Observatory on 14 nights. The spectrum is dominated by the lines of the cooler component, for which my estimate of the spectral type is in agreement with the G8IV estimated by Stern et al. The distribution of phases is poor for orbit determination, and on only 6 of the nights are the weaker lines of the hotter component seen in the photographic or D-line region of the spectrum. Even at maximum separation, the lines of the components are not well resolved, and velocities of the hotter component are uncertain. The strong emission lines of CaII give velocities in agreement with those of the cooler component. The lines of the hotter star are too weak and poorly resolved for an evaluation of its spectral type, although from the relative appearance of the D lines and FeI lines, it must be an F star.

No evidence is seen of hydrogen lines in this star.

The values of K, the velocity amplitudes, are 46 km s^{-1} for the cooler star and a roughly estimated 50 for the hotter. These values, together with the period, $27^{d}.55$, lead to masses 1.3 and 1.2 $m_{\odot}$, typical for double-lined RS CVn systems. The radii, for $i=90^{\circ}$, obtained from the widths of eclipse, are 8.2 and 2.5 $R_{\odot}$. The latter is somewhat larger and the former much larger than for the components in other RS CVn eclipsing binaries (e.g., Popper 1980), and this system appears more evolved than the others. For the shorter periods, the more massive, cooler components cannot become as large as 8 $R_{\odot}$ because of Roche lobe constraints. HD155638 may be considered an RS CVn system intermediate between typical double-lined systems such as RS CVn and WW Dra, with their cooler components subgiants having radii about 4 $R_{\odot}$, and single-lined systems such as λ And, in which the cooler component has evolved into a larger giant (15-20 $R_{\odot}$?) so luminous that lines of the hotter component are not seen in the spectrum.

The photometry of Bloomer _et al_. (1983) leads to some contradictions. From the depths of total eclipse in V, 0.23 mag, the magnitude difference between the components at the time of conjunction is $\Delta M_V=1.6$ mag, the cooler component being more luminous. The magnitude difference at this phase can also be computed from the ratio of the radii and the ratio of luminous surface fluxes. The former, obtained from the phases of inner and outer eclipse contacts, is ≤ 3.3, the upper limit being for $i=90^{\circ}$. The ratio of surfaee fluxes in V may be evaluated as follows. From the reported depths of total eclipse in V, B, and U (0.23, 0.43, and 0.76 mags), the color differences are $\Delta(B-V)=0.79$, $\Delta(U-B)=0.80$. It is difficult to match these color differences with the estimated spectral types. If the types were, for example, G8IV and F5, as estimated, the differences would be only 0.38 and 0.47 mags. The observed color differences would be matched approximately by F0 and K1III or IV, although both these types appear somewhat outside the range admitted by the appearance of the spectrograms. Combining the fluxes corresponding to the latter types (e.g., Popper 1980, Table 1) with the ratio of the radii leads to $\Delta M_V \gtrsim 0.0$, far from the value 1.6 obtained from the eclipse depth in V. To match the latter, the ratio of radii would have to be much greater than the upper limit or the difference in spectral type would have to be considerably less than required by the depths in V, B, and U. In order to achieve $\Delta M_V=1.6$ with $R_c/R_h=3.3$, a flux ratio corresponding to types G0V and G8IV, for example, would be required. But types this close together are completely outside the range permitted by the color differences derived from the eclipse depths in the three wavelength bands.

Thus there are two apparent contradictions: The differences between the components in B-V and U-B are greater than would be expected from the appearance of the spectra, and, perhaps more serious, the difference in absolute magnitude between the components is in serious disagreement when evaluated in two different ways, namely from the depth of total eclipse on the one hand and from the ratio of the radii and ratio of surface fluxes, the latter derived from the difference in color index, on the other. Improved photometry leading to better values of the widths and depths of eclipse, and perhaps scanner spectrophotometry as well, would be required to examine these matters further.

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