Absolute Dimensions and Evolutionary State of RS Vulpeculae

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RS Vul (HD 180939, V_{max} = 7.0, B5V+G1III) is a semi-detached eclipsing binary with a period of 4.4776635 days. High signal-to-noise (S/N ≃ 100) spectra have been obtained with the 1.2m telescope and coudé Reticon spectrograph of the Dominion Astrophysical Observatory. The FeI 4045Å, 4227Å (blend of CaI, FeI and TiII) lines and G-band (4300Å) of the secondary are weakly visible on the spectra. Radial velocities measured from the spectra using a digital cross-correlation technique (Hill, 1982) have been used to compute a new spectroscopic orbit for the system. The primary and secondary semi-amplitudes are 54.0 ± 1.0 kms^{-1} and 204 ± 2 kms^{-1} respectively, assuming a circular orbit. The primary and secondary orbits are "decoupled" in the sense that velocities for the components can be measured separately on the same spectrum by using B5V and G0V template spectra. The secondary semi-amplitude is 17% larger than that found by Popper (1982), but the mass ratio (3.7) is identical to that found by Hutchings and Hill (1971). The equivalent widths of the neutral helium and MgII lines of the hot star, corrected for the light ratio, confirm its B5V classification. Light curve synthesis (LIGHT2) solutions of the published light curves of RS Vul give radii of 4.71±0.48 $R_\odot$ and 5.84±0.23 $R_\odot$ for the primary and secondary respectively. The primary and secondary masses are 6.59±0.15 $M_\odot$ and 1.76±0.05 $M_\odot$. Analysis of the heating effect on the cool star shows that its backside temperature is that of a G1III star. Comparison with mass-transfer models by de Greve (1986) and Plavec̆ et al (1968) show that (via either case A or case B transfer) the progenitor of RS Vul was a system containing a 5-6 $M_\odot$ primary and a 3.5 $m_\odot$ secondary.

References

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