

The Impact of Reflection Effects on the Parameters of the Old Pre-Cataclysmic Variables MS Peg and LM Com

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Abstract

We have determined the main parameters of the old precataclysmic variable stars MS Peg and LM Com. The radial velocities of the components, reflection effects in the spectra, and light curves of the systems are studied based on model stellar atmospheres subject to external irradiation. Forty-seven moderate-resolution spectra for MS Peg and 57 for LM Com obtained with the 6-m telescope of the Special Astrophysical Observatory are used to derive the refined orbital periods of 0.1736660 days and 0.2586873 days, respectively; the orbital eccentricities do not exceed $e = 0.04$. The mass ($M_w = 0.49 M_\odot$) and radius ($R_w = 0.015 R_\odot$) of the MS Peg primary calculated using the gravitational redshift correspond to those for a cooling carbon white dwarf with a thin hydrogen envelope. The parameters of the red dwarf ($M_r = 0.19 M_\odot$, $T_{\text{eff}} = 3560$ K, $R_r = 0.18 R_\odot$) are close to those derived from evolutionary tracks for main-sequence M stars with solar chemical composition. The radius ($R_r = 0.22 R_\odot$) and temperature ($T_{\text{eff}} = 3650$ K) of the LM Com secondary exceed theoretical estimates for main-sequence stars with masses of $M_r = 0.17 M_\odot$. The luminosity excess of the red dwarf in LM Com can be explained by a prolonged ($T > 5 > 10^6$ yrs) relaxation of the M star to its normal state after the binary leaves the common-envelope stage. For both systems, theoretical U, B, V, and R light curves and spectra calculated using the adopted sets of parameters are generally consistent with the observations. This confirms the radiative origin of the hot spots, the unimportance of horizontal radiative transport, and the absence of largescale velocity fields with high values ($V_{\text{trans}} > 50$ km/s) at the surfaces of the secondaries. Most of the emission lines in the spectra of these objects are formed under conditions close to thermalization, enabling modeling of their profiles in an LTE approximation. A strong $\lambda 3905$ Å emission line has been identified as the $3s\ 23p4s\ 1P0-3s23p2\ 1S\ \text{Si I } \lambda 3905.52$ Å line formed in the atmosphere of the hot spot. The observed intensity can be explained by non-LTE "superionization" of Si I atoms by soft UV radiation from the white dwarf. We suggest a technique for identifying binaries whose cool components are subject to UV irradiation based on observations of $\lambda 3905$ Å emission in their spectra. © 2005 MAIK "Nauka/Interperiodica".

<http://dx.doi.org/10.1134/1.1611217>
