Bringing VY Canis Majoris Down to Size: An Improved Determination of Its Effective Temperature

Philip Massey (1), Emily M. Levesque (2), and Bertrand Plez (3)

1--Lowell Observatory; 2--MIT; 3--GRAAL CNRS UMR5024, Universite de Montpellier II

The star VY CMa is a late-type M supergiant with many peculiarities, mostly related to the intense circumstellar environment due to the star's high mass-loss rate. Claims have been made that would suggest this star is considerably more luminous ($L\sim 5 \times 10^5 L_\odot$) and larger ($R\sim 2800 R_\odot$) than other Galactic red supergiants (RSGs). Indeed, such a location in the H-R diagram would be well in the ``Hayashi forbidden zone'' where stars cannot be in hydrostatic equilibrium. These extraordinary properties, however, rest upon an assumed effective temperature of 2800-3000 K, far cooler than recent work have shown RSGs to be. To obtain a better estimate, we fit newly obtained spectrophotometry in the optical and NIR with the same MARCS models used for our recent determination of the physical properties of other RSGs; we also use $V-K$ and $V-J$ from the literature to derive an effective temperatures. We find that the star likely has a temperature of 3650 K, a luminosity $L\sim 6 \times 10^4 L_\odot$, and a radius of $\sim 600R_\odot$ These values are consistent with VY CMa being an ordinary evolved $15 M_\odot$ RSG, and agree well with the Geneva evolutionary tracks. We find that the circumstellar dust region has a temperature of 760~K, and an effective radius $\si $130 AU, if spherical geometry is assumed for the latter. What causes this star to have such a high mass-loss, and large variations in brightness (but with little change in color), remains a mystery at present, although we speculate that perhaps this star (and NML Cyg) are simply normal RSGs caught during an unusually unstable time.

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Comments:

Email: Phil.Massey@lowell.edu