The Effective Temperature Scale of Galactic Red Supergiants: Cool, But Not As Cool As We Thought

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We use moderate-resolution optical spectroscopy and the new MARCS stellar atmosphere models to determine the effective temperaturesof 74 Galactic red supergiants (RSGs). The stars are mostly members of OB assocations or clusters with known distances, allowing a critical comparison with modern stellar evolutionary tracks. We find we can achieve excellent matches between the observations and the reddened model fluxes and molecular transitions, although the atomic lines Ca I 4226 and CA II H and K are found to be unrealistically strong in the models. Our new effective temperature scale is significantly warmer than those in the literature, with the differences amounting to 400 K for the latest-type M supergiants (i.e., M5 I). We show that the newly derived temperatures and bolometric corrections give much better agreement with stellar evolutionary tracks. This agreement provides a completely independent verification of our new temperature scale. The combination of effective temperature and bolometric luminosities allows us to calculate stellar radii; the coolest and most luminous stars (KW Sgr, Case 75, KY Cyg, HD 206936=mu Cep) have radii of roughly 1500 solar radii (7 AU) in excellent accordance with the largest stellar radii predicted from current evolutionary theory, although smaller than that found by others for the binary VV Cep and for the peculiar star VY CMa. We find that similar results are obtained for the effective temperatures and bolometric luminosities using only the de-reddened $V-K$ colors, providing a powerful demonstration of the self-consistency of the MARCS models.

Reference: Levesque et al. 2005, ApJ 628, in press
Status: Manuscript has been accepted

Weblink: ftp://ftp.lowell.edu/pub/massey/RSGMW.pdf

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