

Synthetic JHK Colors for M Dwarfs, M Giants, and Carbon Stars

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Using model atmospheres computed with the MARCS code and filter functions for the near-infrared J , H , and K filters from Bessell & Brett (*PASP*, 100, 1134, 1988), we have computed synthetic $J-H$ and $H-K$ colors for giants ($\log g = 0$) and dwarfs ($\log g = +5$) of effective temperature 3000 – 5000 K, both for solar composition and for a carbon-enriched composition ($C/O = 1.07$). The three molecules which have the greatest effects on near-infrared spectra — CO, CN, and H₂O — were individually turned on and off when computing the synthetic spectra in order to investigate their separate effects.

For solar-composition models, we reproduce the observed bifurcation of the giant and dwarf sequences in the $J-H$, $H-K$ color-color diagram. Absorption by H₂O has an important effect on the colors of dwarfs, starting at temperatures as high as 4000 K; CO has a noticeable effect on giant colors. However, a major portion (more than half) of the observed bifurcation is present in the model sequences even when no molecules at all are included in the synthetic spectra; this effect is attributed to the differing effects of H⁻ opacity on models having different temperature structures.

In carbon-rich giants the combined effect of CO and C₂ is to change the $J-H$ and $H-K$ colors considerably from the corresponding continuum colors. For the coolest models C₂H₂ and C₃ have a strong effect in the K filter. In carbon dwarfs CO and C₂ have small and opposite effects on the JHK colors, and the colors of the dwarfs are therefore similar to those of the continuum alone.