CoolGrid: Modeling the Right Half of the Hertzsprung-Russell Diagram

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Abstract. We evaluate the ability of PHOENIX LTE models to fit spectrophotometry throughout the visible and near-UV bands for late-type stars of a wide range of stellar parameters.

1. Results

We present a grid of LTE atmospheric models and synthetic spectra that cover the spectral class range from mid-G to mid-K, and luminosity classes from V to III, that is dense in $T_{\text{eff}}$ sampling ($\Delta T_{\text{eff}} = 62.5$ K), for stars of solar metallicity and of moderately metal-poor scaled solar abundance ($[\text{A/}H] = 0.0$ and $-0.5$).

All models have been computed with two choices of atomic line list: (a) the “big” line lists of Kurucz (1992) that best reproduce the broad-band solar blue and near-UV $f_{\lambda}$ level, and (b) the “small” lists of Kurucz \& Peytremann (1975) that provide the best fit to the high-resolution solar blue and near-UV spectrum. We compare our model SEDs to a sample of stars carefully selected from the large catalog of uniformly re-calibrated spectrophotometry of Burnashev (1985) with the goal of determining how the quality of fit varies with stellar parameters, especially in the historically troublesome blue and near-UV bands.

We confirm that our models computed with the “big” line list recover the derived $T_{\text{eff}}$ values of the PHOENIX NextGen grid, but find that the models computed with the “small” line list provide greater internal self-consistency among different spectral bands and closer agreement with the empirical $T_{\text{eff}}$ scale of Ramírez \& Meléndez (2005), but not to the interferometrically-derived $T_{\text{eff}}$ values of Baines et al. (2010). We find no evidence that the near UV band discrepancy between models and observations for Arcturus ($\alpha$ Boo) reported by Short \& Hauschildt (2003, 2009) is pervasive, and we suggest that Arcturus may be peculiar in this regard.

Our $T_{\text{eff}}$ scale is compared to other $T_{\text{eff}}$ calibrations in Figure 1.
Figure 1. Comparison of our best fit $T_{\text{eff}}$ values with other $T_{\text{eff}}$ calibrations. Squares: Series 1 models; Crosses: Series 2 models. Black symbols: Fit to the blue band; Gray symbols: fit to the red band. Upper panel: the dotted line is the empirical calibration of Ramírez & Meléndez (2005). Lower panel: the dotted line represents PHOENIX NextGen models fitted to stellar spectral libraries (Bertone et al. 2004). In the lower panel, triangles are $T_{\text{eff}}$ values of Baines et al. (2010).

References