A critical appraisal of ATLAS9 and NextGen 5 model atmospheres

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Abstract. The fitting atmosphere parameters ($T_{\rm eff}$, g, and [Fe/H]) for over 300 stars in the Gunn & Striker (1983) and Jacoby *et al.* (1984) catalogs have been obtained relying on the Kurucz (1992) ATLAS9 and Hauschildt *et al.* (1999) NextGen5 synthesis models. The output results are compared, and a critical appraisal of both theoretical codes is performed.

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As a major improvement over the standard ATLAS9 code for model atmospheres by Kurucz (1992), the new NextGen5 synthesis code of Hauschildt *et al.* (1999) adopts a more refined treatment of molecular opacity, and includes spherical simmetry in the atmosphere layers for low-gravity models. In order to assess the main differences between the two theoretical codes, it is of special interest to investigate the theoretical temperature calibration for stars of different spectral type.

In this sense, we devised a procedure to determine the fundamental parameters of a star ($T_{\rm eff}$, $\log g$, [M/H]) by comparing its observed spectral energy distribution with a grid of synthetic spectra. The fiducial best model is identified by minimizing the $\Delta \log(\mathrm{flux})$ standard deviation, $\sigma(f)$, over the full wavelength range of the observations.

An application to the Gunn & Stryker (1983, hereafter "GS") and Jacoby *et al.* (1984, "JHC") atlases provided the fitting parameters for over 300 stars by matching with the solar metallicity model grids of ATLAS9 ($3500 \leq T_{\rm eff} \leq 50\,000$ K, $0.0 \leq \log g \leq 5.0$) and NextGen5 ($2000 \leq T_{\rm eff} \leq 10\,000$ K, $0.0 \leq \log g \leq 5.5$).

As shown in Figure 1, when comparing the fiducial temperature for GS and JHC class V stars, the NextGen5 fit results in a significantly warmer value of $T_{\rm eff}$ with respect to ATLAS9, especially at the extreme edges of the $T_{\rm eff}$ range.

Figure 2 is an example of our best-fit procedure for a star in the JHC atlas comparing with both ATLAS9 and NextGen5 models. Equigravity envelope curves for the standard deviation $\sigma(f)$ across the temperature range are reported searching for the absolute minimum that marks the fitting $T_{\rm eff}$ and $\log g$. A more univocal and "sharper" solution is in general reached by the ATLAS9 fit, while NextGen5

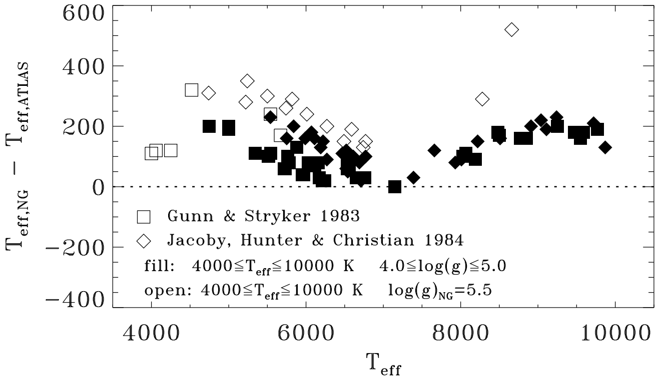

Figure 1. The difference in the fitting value of $T_{\rm eff}$ for the GS and JHC stars as derived from the ATLAS9 and Nextgen5 best-fit models.

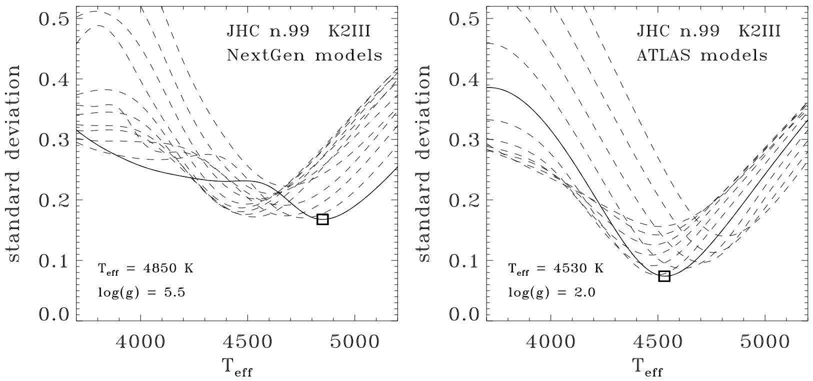

Figure 2. An example of the fitting procedure for star no. 99 in the JHC sample. For ATLAS9 and Nextgen5 models, the open square marks the optimum fit among the different $\sigma(f)$ equi-gravity envelope curves. A solar metallicity is assumed.

models display a more entangled trend for the $\sigma(f)$ function, especially as far as cool stars (Sp. type K and M) are concerned.

References

Hauschildt, P.H., Allard, F. and Baron, E. The NextGen Model Atmosphere Grid for $3000 \leq T_{\rm eff} \leq 10\,000$ K, *ApJ*, 512:377-385, 1999

Kurucz, R.L. Model Atmospheres for Population Synthesis In B. Barbuy and A. Renzini, editors, *The Stellar Populations of Galaxies.* Kluwer Academic, Dordrecht, p. 225, 1992

Gunn, J. E. and Stryker, L. L. Stellar Spectrophotometric Atlas, Wavelengths from 3130 to 10800 Å, *ApJS*, 52:121-153, 1983

Jacoby, G. H., Hunter, D. A. and Christian, C. A. A library of Stellar Spectra, *ApJS*, 56:257-281, 1984