

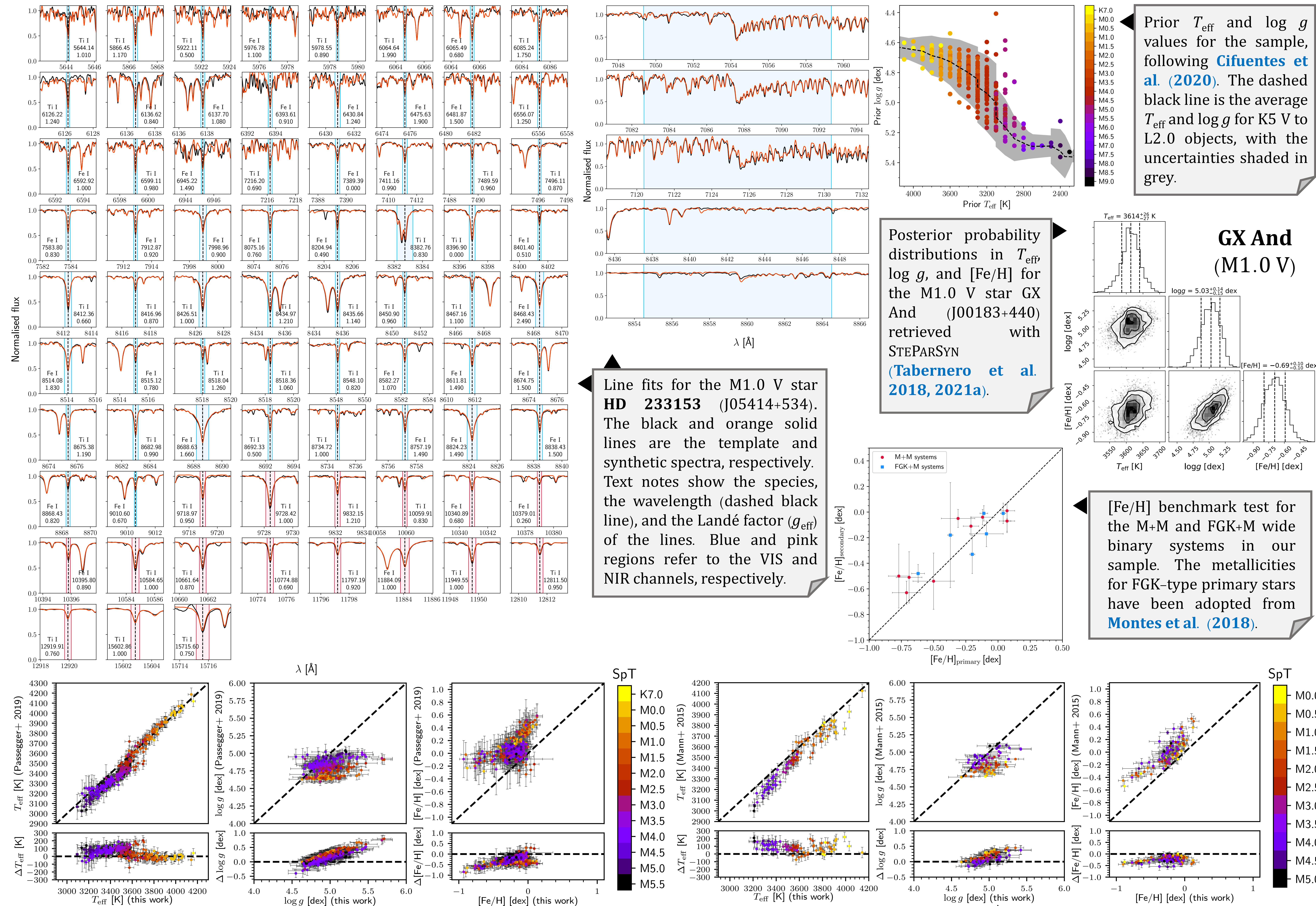
STELLAR ATMOSPHERIC PARAMETERS OF CARMENES GTO M DWARFS WITH SPECTRAL SYNTHESIS AND STEPARSYN



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Abstract. We aim to review the spectral synthesis technique to derive the stellar atmospheric parameters (T_{eff} , $\log g$, and $[\text{Fe}/\text{H}]$) of 348 M dwarfs in light of the optical and near-infrared spectra obtained with CARMENES, the high-resolution, double-channel spectrograph installed at the 3.5 m telescope at the Calar Alto observatory (Spain). The analysis relies on the STEPARSYN code as the preferred MCMC implementation of the spectral synthesis technique, along with 75 carefully selected, magnetically insensitive, Fe I and Ti I lines plus the γ - and ϵ -TiO bands synthesised with a grid of BT-Settl model atmospheres and the turbospectrum code. To avoid potential degeneracies in the parameter space, we impose a Bayesian prior on T_{eff} and $\log g$ based on comprehensive, multi-band photometric data available for the sample. As a benchmark test in T_{eff} , $\log g$, and $[\text{Fe}/\text{H}]$ we place special emphasis on three special subsets in our sample, namely 14 M dwarfs with interferometric angular diameter measurements, 15 M+M systems, and 7 wide physical binaries harbouring an FGK-type primary with known metallicity.



Prior T_{eff} and $\log g$ values for the sample, following Cifuentes et al. (2020). The dashed black line is the average T_{eff} and $\log g$ for K5 V to L2.0 objects, with the uncertainties shaded in grey.

Posterior probability distributions in T_{eff} , $\log g$, and $[\text{Fe}/\text{H}]$ for the M1.0 V star GX And (J00183+440) retrieved with STEPARSYN (Tabernero et al. 2018, 2021a).

Line fits for the M1.0 V star HD 233153 (J05414+534). The black and orange solid lines are the template and synthetic spectra, respectively. Text notes show the species, the wavelength (dashed black line), and the Landé factor (g_{eff}) of the lines. Blue and pink regions refer to the VIS and NIR channels, respectively.

$[\text{Fe}/\text{H}]$ benchmark test for the M+M and FGK+M wide binary systems in our sample. The metallicities for FGK-type primary stars have been adopted from Montes et al. (2018).

Comparison with Passegger et al. (2019) (VIS + NIR analysis).

Comparison with Mann et al. (2015).

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