# Written in the stars: spectral synthesis on CARMENES GTO M-dwarf spectra

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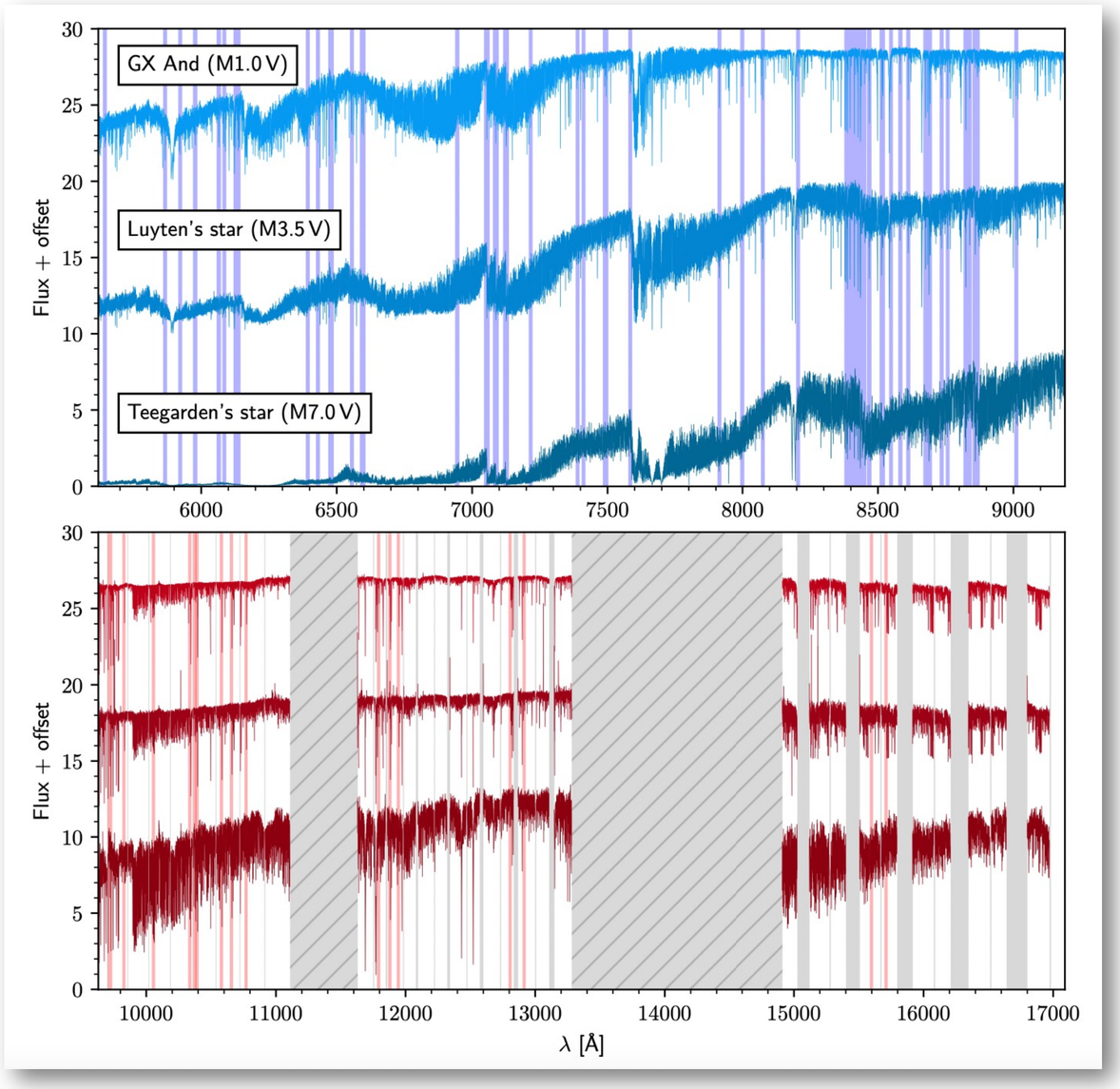
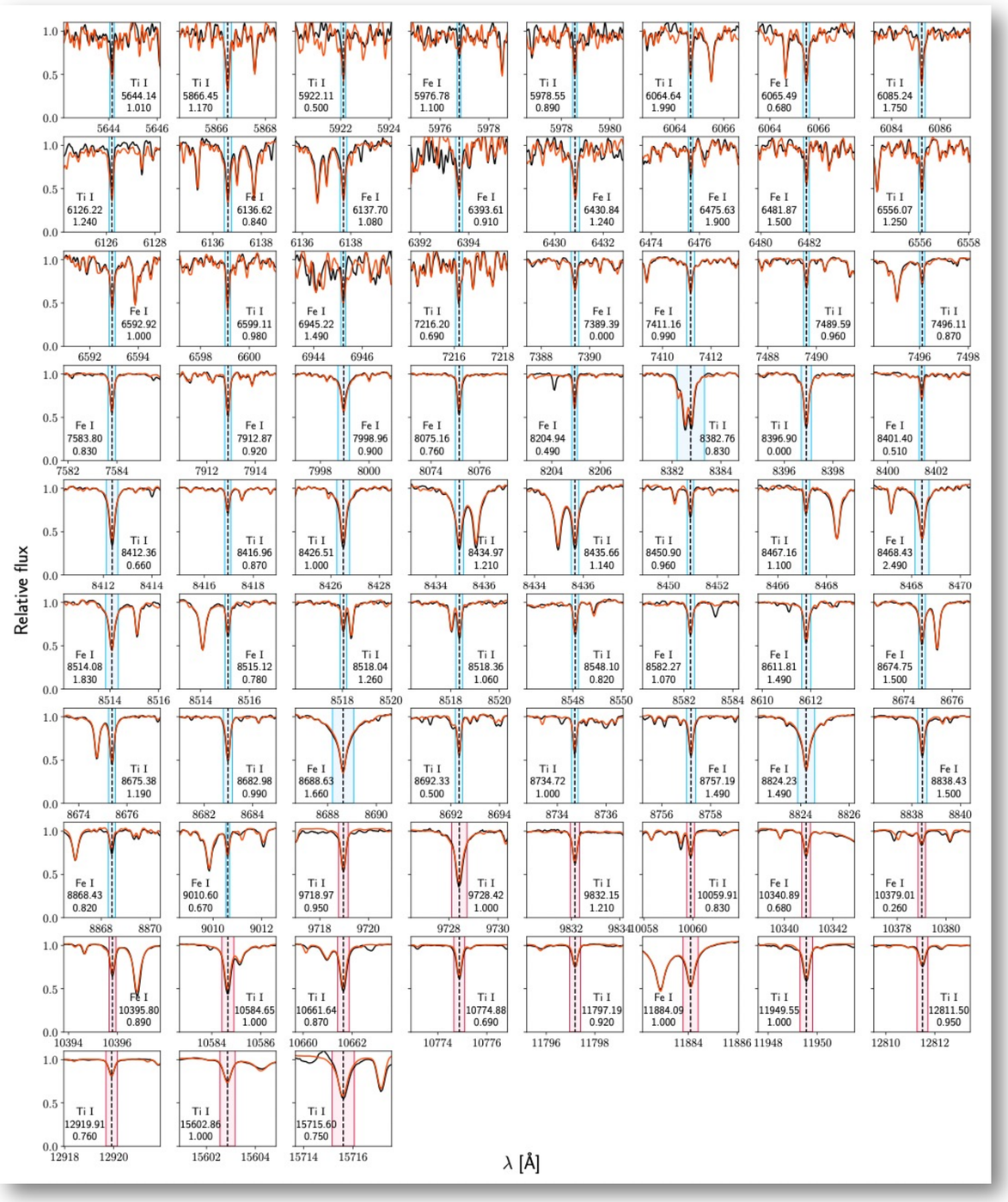
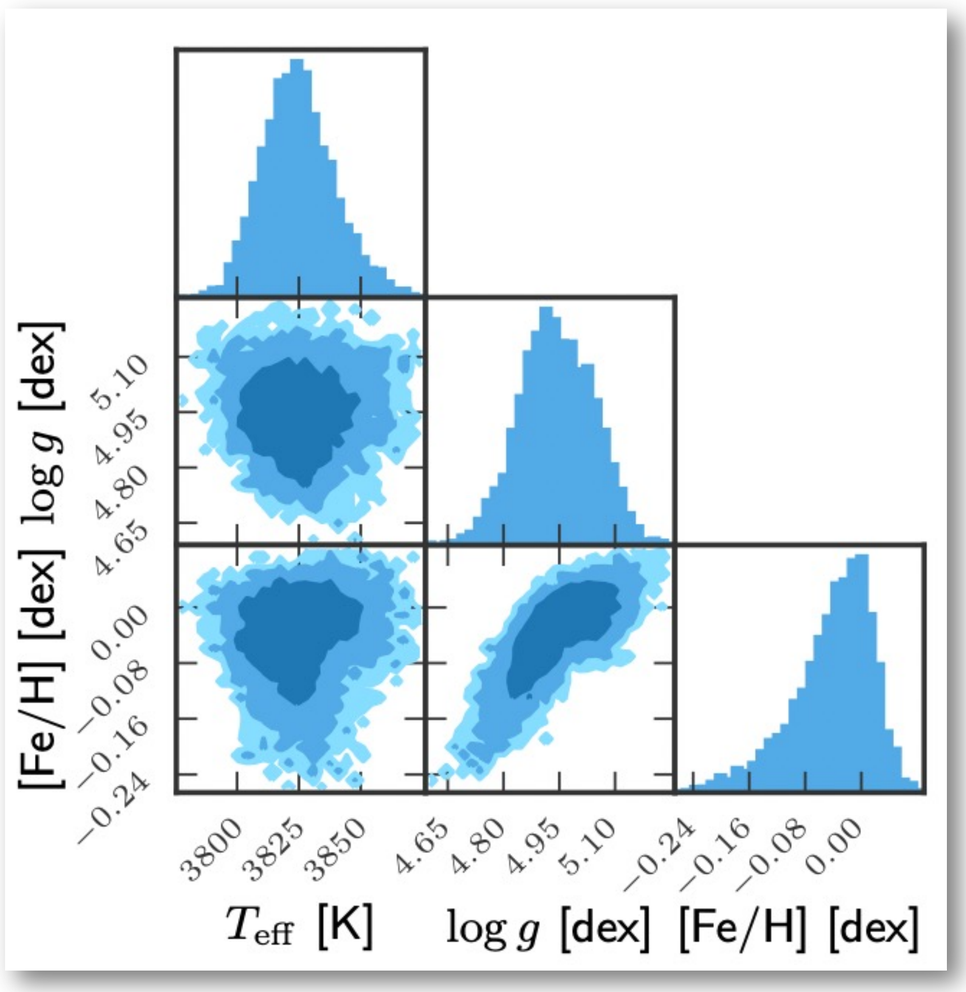
**Abstract.** We present the results recently published by Marfil et al. (2021), A&A, 656, A162 regarding the determination of the stellar atmospheric parameters ($T_{\rm eff}$, log $g$, and [Fe/H]) of 343 M dwarfs observed with CARMENES. We employed SteParSyn, a Bayesian spectral synthesis implementation particularly designed to infer the stellar atmospheric parameters of late-type stars following a Markov chain Monte Carlo approach. We made use of the BT-Settl model atmospheres and the radiative transfer code Turbospectrum to compute a grid of synthetic spectra around 75 magnetically insensitive Fe I and Ti I lines plus the TiO γ and ε bands. To avoid any potential degeneracy in the parameter space, we imposed Bayesian priors based on the photometric data available for the sample. We find that this methodology is suitable down to M7.0 V, where refractory metals such as Ti are expected to condense in the stellar photospheres. Although our $T_{\rm eff}$ scale is in good agreement with the literature, we report large discrepancies in the [Fe/H] scales, which might arise from the different methodologies and sets of lines considered. However, our [Fe/H] is in agreement with the metallicity distribution of FGK-type stars in the solar neighbourhood and correlates well with the kinematic membership of the targets in the Galactic populations. Lastly, excellent agreement in $T_{\rm eff}$ is found for M dwarfs with interferometric angular diameter measurements, as well as in the [Fe/H] between the components in the wide physical FGK+M and M+M systems included in our sample.



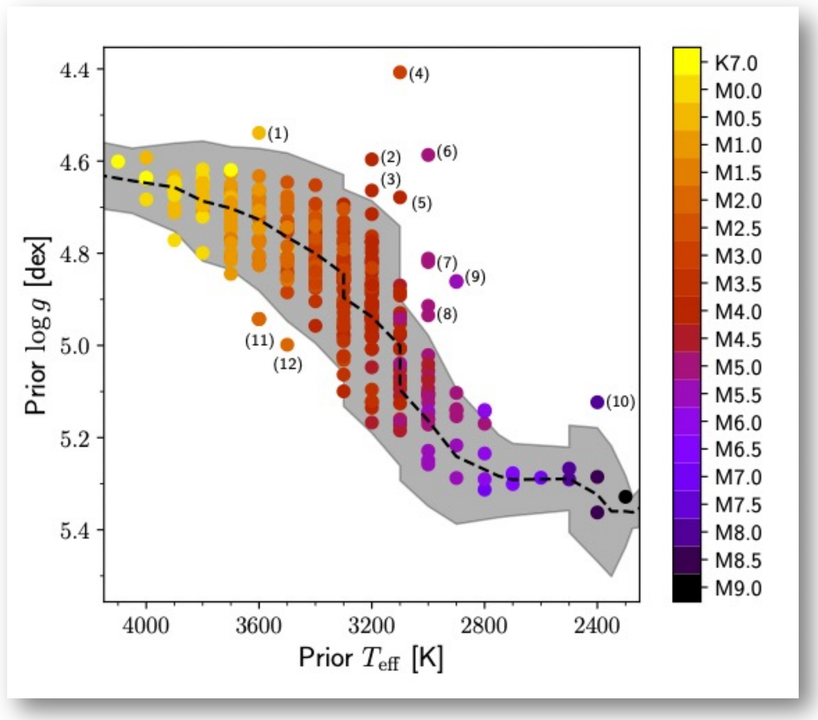

▲ CARMENES template spectra of GX And (M1.0 V), Luyten's star (M3.5 V), and Teegarden's star (M7.0 V) in the optical (upper panel) and near-infrared (lower panel) channels. Blue- and red-shaded regions denote the ranges synthesised for SteParSyn. Grey-shaded regions mark telluric-affected regions and CARMENES spectral gaps.




▲ Line fits for the M1.0 V star HD 233153. The black and orange solid lines are the template and synthetic spectra, respectively. Annotations indicate the species, the central wavelength (dashed black line), and the Landé factor ($g_{\rm eff}$) of the lines. Blue- and pink-shaded regions denote the VIS and NIR wavelength regions, respectively.




◀ Posterior distributions in $T_{\rm eff}$, log $g$, and [Fe/H] for the M1.0 V star HD 233153.




Central $T_{\rm eff}$ and log $g$ values of the prior distributions based on the photometric data available for the M-dwarf sample ▶

## References

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Marfil et al. (2021), A&A
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