

Deriving atmospheric parameters of M dwarfs with SPIRou

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ABSTRACT

Context M dwarfs are the most numerous stars in the solar vicinity, and are obvious targets for the hunt of planets in the habitable zone. To detect and characterize planets, we need to study the properties of the host stars.

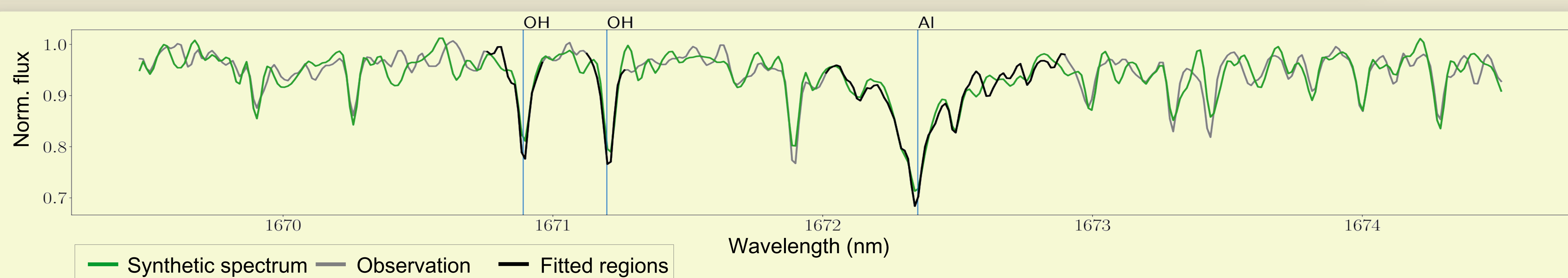
Method We look at high-resolution near-infrared (nIR) stellar spectra recorded with SPIRou, the spectropolarimètre infrarouge installé at the Canadian French Hawaii Telescope (CFHT), and compare them to synthetic spectra computed from model atmospheres.

Results We derive the effective temperature (T_{eff}), surface gravity ($\log(g)$), metallicity ($[M/H]$) and alpha-enhancement ($[\alpha/Fe]$) of 44 M dwarfs in good agreement with reference literature studies.

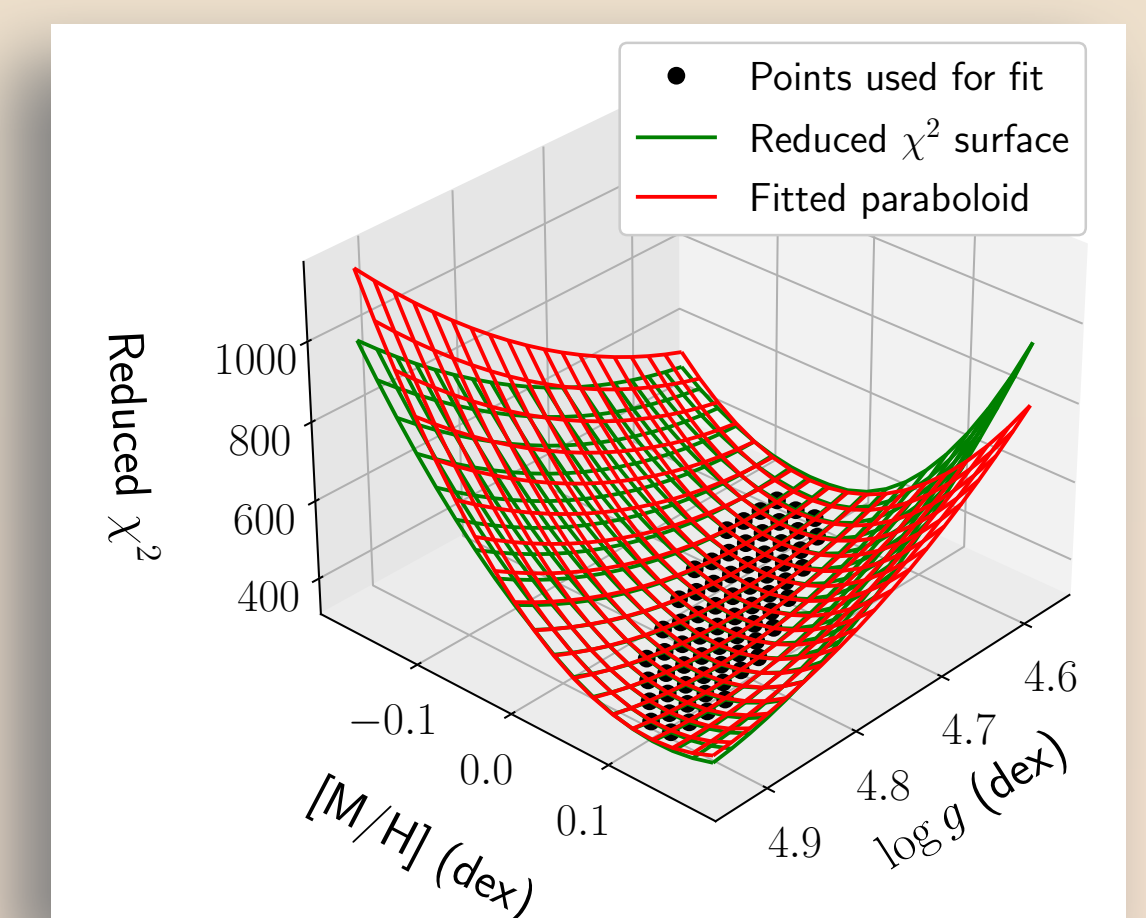
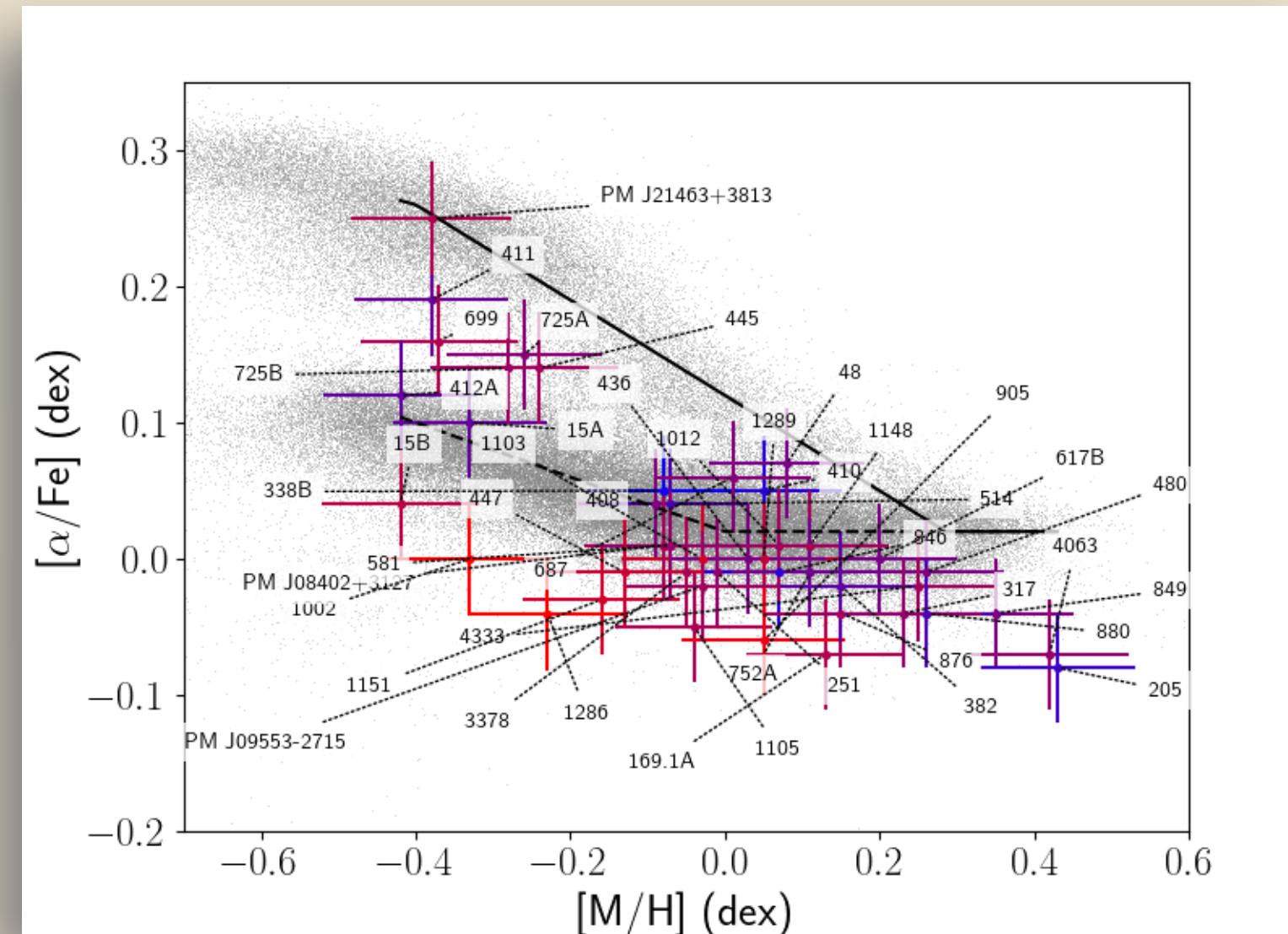
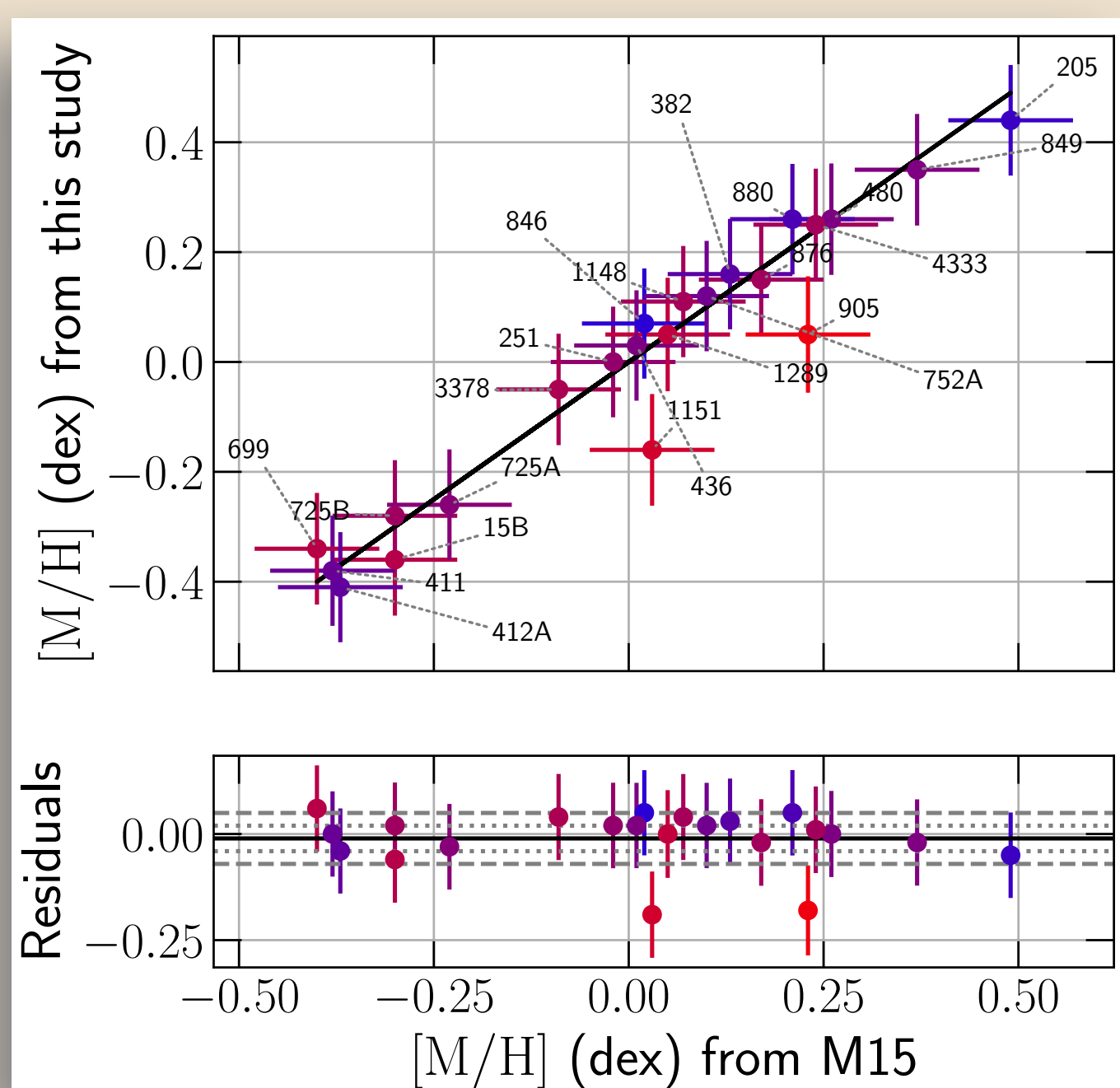
The analysis process to derive atmospheric parameters

- We compute synthetic spectra from MARCS⁽¹⁾ model atmospheres.
- We pick the best modeled lines and adjust their Van Der Waals or oscillator strength coefficients if needed.
- We fit a paraboloid on a χ^2 grid computed by comparing observation to models for various T_{eff} , $\log(g)$, $[M/H]$ and $[\alpha/Fe]$.
- We search for the minimum to find the best fitting values.

METHOD



RESULTS



What do we get?

- We retrieve parameters in good agreement with reference studies (here M15⁽²⁾, for 28 stars).
- T_{eff} and $[M/H]$ are recovered with dispersions of about 30 K and 0.1 dex respectively. We derive $\log(g)$ with a dispersion of about 0.1 dex.
- We derive $[\alpha/Fe]$ that are compatible with APOGEE results for giants (gray pixels) with an estimated uncertainty of 0.04 dex.

CONCLUSIONS

Where are we at? We have a reliable process to derive the atmospheric parameters of M dwarfs⁽³⁾. We show that the estimated T_{eff} , $\log(g)$ and $[M/H]$ are very sensitive to $[\alpha/Fe]$. We recovered parameters for 44 M dwarfs observed in the context of the SPIRou Legacy Survey.

What's next?

Short term: We will take into account magnetic fields to model spectra of active M dwarfs and low-mass PMS stars.

Long term: We aim at providing the community with a versatile and reliable tool for characterizing M dwarfs from their nIR spectrum.

REFERENCES

- (1) Gustafsson B., Edvardsson B., Eriksson K., Jørgensen U. G., Nordlund Å., Plez B., 2008, A&A, 486, 951
- (2) Mann A. W., Feiden G. A., Gaidos E., Boyajian T., von Braun K., 2015, ApJ, 804, 64
- (3) Cristofari P. I., et al., 2022, MNRAS, 511, 1893