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High resolution near-IR spectroscopy of Arcturus and HD010853

Refining a near-IR iron line list

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ABSTRACT

Context. Effective temperature, surface gravity, and metallicity are basic spectroscopic stellar parameters necessary to characterize a star or a planetary system. Reliable atmospheric parameters for FGK stars have been obtained mostly from methods that relay on high resolution and high signal-to-noise optical spectroscopy. The advent of a new generation of high resolution near-IR spectrographs opens the possibility of using classic spectroscopic methods with high resolution and high signal-to-noise in the NIR spectral window.
Aims. We aim to compile a new iron line list in the NIR from a solar spectrum to derive precise stellar atmospheric parameters, comparable to the ones already obtained from high resolution optical spectra. The spectral range covers 10 000 Å to 25 000 Å, which is equivalent to the Y, J, H, and K bands.
Methods. Our spectroscopic analysis is based on the iron excitation and ionization balance done in LTE. We use a high resolution and high signal-to-noise ratio spectrum of the Sun from the Kitt Peak telescope as a starting point to compile the iron line list. The oscillator strengths ($\log gf$) of the iron lines were calibrated for the Sun. The abundance analysis was done using the MOOG code after measuring equivalent widths of 357 solar iron lines.
Results. We successfully derived stellar atmospheric parameters for the Sun. Furthermore, we analysed HD20010, a F8IV star, from which we derived stellar atmospheric parameters using the same line list as for the Sun. The spectrum was obtained from the CRIRES-POP database. The results are compatible with the ones found in the literature, confirming the reliability of our line list. However, due to the quality of the data we obtain large errors.

Key words. data reduction: high resolution spectra – stars individual: HD20010 – stars individual: Sun

1. Introduction

2. Results

2.1. Arcturus

Arcturus is one of the brightest stars on the night sky with a V magnitude of -0.05 (Ducati 2002). Hence it has been subject to numerous observations (add some nice references here...) and is therefore a prime target for testing the line list by Andreasen et al. (2016).

We use the atlas from Hinkle et al. (2003) which covers the spectral range of interest. We identify the spectral lines with plot_fits also presented in Andreasen et al. (2016), where we also correct for RV by comparing to to a synthetic spectrum from the PHOENIX library (Husser et al. 2013). Similarly, strong telluric features were identified with a spectrum from the TAPAS web page (Bertaux et al. 2014). Lines blended with telluric were ommited from the analysis. The EW of rest of the lines were measure by hand using the splot function in IRAF. In the atlas there exist both a summer observation set and a winter observation set. This is in order to minimize the effect of tellurics at different spectral regions. As many lines as possible were measured in both sets, and combined to the final measure line list. The results can be seen in Table 1 and shows excellent agreement with the literature. Note, that due to the few Fe ii lines we have to fix the surface gravity. The value was a mean of many literature values

The derivation of the parameters follow exactly the same procedure as used in Andreasen et al. (2016).

2.2. HD010853 (Katie)

3. Conclusion

Being able to successfully determine parameters for Arcturus, a K0 giant, and Katie, a K3 dwarf, we are now making the bridge for the line list towards cooler temperatures. The obvious next step is the even colder M stars. Particular interesting are the M dwarfs known to be prone forming rocky planets.

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Table 1. The derived parameters for Arcturus with fixed surface gravity cut after 3σ outlier removal. linelist: arcturus2Cut4ol.moog

	T_{eff} (K)	$\log g$ (dex)	ξ_{micro} (km/s)	[Fe/H] (dex)
Literature	6131 ± 255	4.01 ± 0.60	1.90 ± 1.08	−0.23 ± 0.14
	4363 ± 75	1.59 (fixed)	1.25 ± 0.07	−0.34 ± 0.03

References

Andreasen, D. T., Sousa, S. G., Delgado Mena, E., et al. 2016, A&A, 585, A143

Bertaux, J. L., Lallement, R., Ferron, S., Boonne, C., & Bodichon, R. 2014, A&A, 564, A46

Ducati, J. R. 2002, VizieR Online Data Catalog, 2237

Hinkle, K., Wallace, L., Livingston, W., et al. 2003, in Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Vol. 12, The Future of Cool-Star Astrophysics: 12th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, ed. A. Brown, G. M. Harper, & T. R. Ayres, 851–856

Husser, T.-O., Wende-von Berg, S., Dreizler, S., et al. 2013, A&A, 553, A6

Appendix A: An appendix