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Atmospheric Stellar Parameters from Numerical CCFs

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Abstract

We present a new technique for the determination of atmospheric stellar parameters for low signal-to-noise spectra, based on the determination of several *numerical* Cross Correlation Functions (CCFs).

From a qualitative point of view it is well know that the shape of the CCF depends somehow by the characteristics of the spectrum under analysis, but the interplay between temperature, metallicity and gravity in line formation affects a direct determination from a single CCF. Taking inspiration by the well-experimented approach in temperature determination with equivalent widths, we use several CCFs to break the temperature-metallicity degeneracy by including lines selected according to their excitation potential. The use of neutral Iron lines ensures a reduced effected from gravity, which is in turn determined using ionized species. Atmosphere parameters as function of the CCFs properties are calibrated using a set of stars with equivalent width (EW)-derived parameters from high signal-to-noise spectra (Adibekyan et al. 2012). First preliminary results are shown in 1, where the difference between the atmosphere parameters determined with our technique on individual observations are compared with the EW-based ones (on co-added spectra) as functions of the signal-to-noise for 1111 FGK stars.

The aim of this technique is to provide a quick and reliable atmosphere parameters determination right after the first spectrum acquisition. In particular the project has started after the installation of HARPS-N at the Telescopio Nazionale Galileo (Cosentino et al. 2012) for confirmation and follow-up of Kepler super-Earth and hot-Neptunes candidates.

The expected radial velocity semi-amplitude K induced by the transiting planet and the precision of the radial-velocity measurements depend strongly on the atmospheric parameters of the host stars. An under-estimated expected K would cause the exclusion from the target list of a star with a detectable planet, while in the opposite situation an extended fraction of telescope time would be allocated to detect a signal that is actually out of the reach of the instrument.

With the collaboration of the Exoplanet Group at Observatory of Geneva, we plan to include the atmosphere parameters determination from CCFs into the HARPS/HARPS-N pipelines within a few months. The ability to quickly determine the atmospheric parameters and hence perform a judicious target selection will dramatically optimize the use of telescope time, thus improving the scientific output.

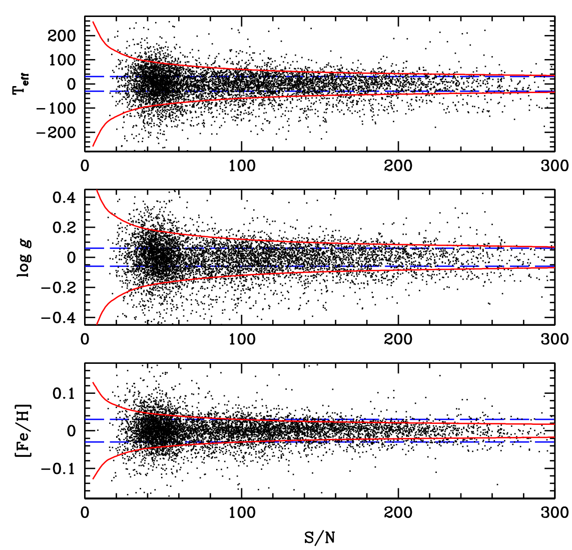

Figure 1: Difference between the atmospheric parameters derived using our technique on individual exposures (ten for each stars) and the EW-based ones (using coadded spectra) for 1111 FGK stars from [1]. The red line represents the precision obtained with our technique, the blu line the nominal precision for EW-based measurements.

Acknowledgements

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