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Spectroscopic survey of *Kepler* stars: high-resolution observations of A- and F-type stars

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Abstract. Basic stellar parameters such as effective temperature, surface gravity, chemical composition, and projected rotational velocity, are important to classify stars and are crucial for successful asteroseismic modelling. However, the *Kepler* space data do not provide such information. Therefore, ground-based spectral and multi-colour observations of *Kepler* asteroseismic targets are necessary to complement the space data. For this purpose, in coordination with the KASC ground-based observational Working Groups, high-resolution spectroscopic data for more than 500 B, A, F and G-type stars were collected.

Keywords. stars: abundances, stars: chemically peculiar, stars: fundamental parameters

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The NASA space mission *Kepler* was successfully launched on 7th March 2009. Since then, *Kepler* produced long photometric time series of an exceptional precision, which provide a unique opportunity to study the pulsational variability of thousands of stars across the H-R diagram in detail (Kjeldsen *et al.* 2010). We determined atmospheric parameters such as effective temperature $T_{\rm eff}$, surface gravity $\log g$, microturbulence $V_{\rm turb}$, rotational velocity $V \sin i$ and abundances of the chemical elements for more then 100 A-F stars from the *Kepler* field-of-view, for which we collected the high-resolution HERMES@Mercator spectra (Raskin *et al.* 2011). The pipeline-reduced spectra were normalised by the standard IRAF procedures. Spectrum classification was performed on the HERMES spectra smoothed to the appropriate low-resolution using the program SPECTRUM (Gray 1999). The classification process revealed over a dozen Am and other chemically peculiar stars in our sample. The atmospheric parameters were determined in two different ways.

The first method consists of spectral synthesis based on a least-squares optimisation algorithm (e.g. Niemczura *et al.* 2009). This method allows for the simultaneous determination of various parameters involved with stellar spectra. The synthetic spectrum depends on $T_{\rm eff}$, $\log g$, $V_{\rm turb}$, $V \sin i$ and abundances of chemical elements. The atmospheric models and synthetic spectra were computed with the LTE ATLAS9 and SYNTHE codes (Kurucz 1993). We derived $T_{\rm eff}$ using the sensitivity of Balmer line wings to temperature. Additionally, we adjust $T_{\rm eff}$, $\log g$, and $V_{\rm turb}$ from the comparison of iron abundances determined from various Fe I and Fe II lines. The derived $T_{\rm eff}$ is considered accurate when there is no correlation between the iron abundances and excitation potentials of the atomic levels causing Fe I lines. The gravity is obtained by requiring the same abundances from both Fe I and Fe II lines.

In the second method, $T_{\rm eff}$ was determined from the spectral energy distribution (SED). These were constructed from literature photometry, e.g. 2MASS (Skrutskie *et al.* 2006), Tycho B and V magnitudes (Høg *et al.* 1997) supplemented with *TD-1* UV flux measurements (Carnochan 1979) where available. The interstellar reddenings were estimated from interstellar Na D lines (Munari & Zwitter 1997). These $E(B-V)$ values were used for the de-reddening of the SEDs. The stellar $T_{\rm eff}$ were determined by fitting Kurucz (1993) model flux to the de-reddened SEDs. The synthetic fluxes were convolved with photometric filter response functions. A Levenberg-Marquardt nonlinear least-squares procedure was used to find the solution that minimized the difference between the observed and model fluxes.

For most of the stars we have obtained consistent effective temperatures from all applied methods. The projected rotational velocities, $V \sin i$, have values ranging from 6 to 280 km s^{-1}. The average value of $V \sin i$, $\sim$100 km s^{-1}, is typical for A-type stars. The obtained microturbulence velocities for normal A-F stars equal to $2-4$ km s^{-1}, which is again typical for this kind of object. Our analysis allowed us to discover many interesting slowly rotating chemically peculiar stars:

- KIC 4768731 is one of a few rapidly oscillating Ap (roAp) stars known in the field-of-view of the *Kepler* satellite. It was classified as A5 Vp (SrCrEu) star. The roAp stars are the subgroup of CP2 stars (chemically peculiar stars with a global magnetic field). The discussion of global stellar parameters and pulsational properties of this object will be presented by Smalley *et al.* (in preparation).
- We analysed more than 10 metallic-line A stars (Am). All of them have typical abundance pattern characterized by underabundances of Ca and Sc, and overabundances of Sr and Y. These stars also have surface deficiencies in helium, which is why their pulsational driving is inefficient. All of the investigated Am stars lie in the δ Scuti instability strip (Murphy *et al.*, in preparation).

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