The Preliminary Atmospheric Parameters of HD 154713 and HD 137928

Aslı Elmaslı, Şeyma Çalışkan, and Kübraözge Ünal
Ankara University, Department of Astronomy and Space Sciences, 06100, Tandoğan, Ankara, Turkey
E-mail: elmasli@ankara.edu.tr

Abstract.
We determined the preliminary atmospheric parameters of the two A type stars HD 154713 and HD 137928. These stars' high resolution echelle spectra, covering a wavelength range of 3800-7900 Å, were obtained from the Coude Echelle Spectrograph attached to the 1.5 m telescope at the TÜBİTAK National Observatory on the 24th of April 2018. We derived the fundamental parameters by making use of photometric calibrations and profiles of hydrogen Balmer lines in our observed spectra. We estimated the metallicity ([Fe/H]) of HD 154713 as 0.41 and HD 137928 0.29. The metallicity value of HD 154713 may indicate it to be an Am star candidate.

1. Introduction
The accurate determination of stellar atmospheric parameters play an important role in understanding the photospheric chemical structures of A-type stars. In general the elemental abundance patterns of normal A-type stars are close to solar abundances, except for the ones heavier than iron-peak elements which may show over/underabundance within 0.4 dex relative to the Sun [1]. There are also A-type stars that show abundance anomalies, such as; Ca and Sc underabundances, followed by Fe peak elements’ overabundances would indicate a metallic-lined Am star. Or, particularly weak Mg II line with underabundant metal and solar C, N, O and S pattern would point to λ Boo stars.

There are only a few studies of both target stars up-to-date. The effective temperature of HD 154713 was derived as 7954 K by comparing BT-SETTL model atmospheres to spectral energy distributions (SEDs) created from Hipparcos, Tycho, Sloan Digital Sky Survey, DENIS, Two Micron All Sky Survey, MSX, AKARI, IRAS and Wide-field Infrared Survey Explorer data [2]. Gaia DR2 [3] measured the distance of HD 154713 as 158.8 pc and estimated $T_{\text{eff}}=8453$ K. The effective temperature of HD 137928 was calculated as 8637 K by [2]. The distance of HD 137928 measured by Gaia DR2 [3] is 122.8 pc.
The Preliminary Atmospheric Parameters of HD 154713 and HD 137928

In this study we determine the stellar atmospheric parameters of the neglected stars HD 154713 and HD 137928. The observations and data reductions are described briefly in Section 2. The analysis of atmospheric parameters is given in Section 3. Finally, we present the derived parameters and conclusion in Section 4.

2. Observations and Data Reduction

The spectra of HD 154713 and HD 137928 were obtained using the Coude Echelle Spectrograph mounted on the 1.5 m Russian-Turkish Telescope at the TÜBİTAK National Observatory (Antalya, Turkey) on the 24th of April, 2018. The spectra covers a wavelength range from 3800 to 7900 Å. The resolution of the spectra are 53,000. We present the observed stars’ properties and observation log in Table 1. The calibration frames (bias, flat fielding) and arc spectra (Th-Ar) were taken at the beginning of the observation run. We applied classical reduction procedures (bias subtraction, flat fielding, subtraction of background scattered light, extraction, and wavelength calibration using ThAr lamp spectra to the observed data) to the observed data by using the IRAF code [4]. After the reduction and extraction, a barycentric correction was applied to the spectra, and the spectra were continuum normalised.

3. Atmospheric Parameters of HD 154713 and HD 137928

Hydrogen Balmer lines are sensitive to temperature and surface gravity therefore they are powerful tools for deriving stellar atmospheric parameters. These neglected stars do not have any atmospheric parameters determined from high resolution spectra. Thus, we determined their initial atmospheric parameters from the calibrations of [8] using the Strömgren photometric data given by [9], listed in Table 2. By using these photometrically set of parameters, we generated model atmospheres for each star with the ATLAS9 code [10, 11, 12]. Later, we produced synthetic H$_\beta$ line profiles with the SYNTHE code [13, 11] for each model atmosphere and compared it with their observed spectra. As seen in Figure 1 and 2, the photometrically set of parameters (indicated as p) do not fit the H$_\beta$ line wings, therefore, we refined the effective temperature from the excitation equilibrium of Fe I spectroscopic lines. To do this, we adopted the iron ion lists from Kurucz line database and Vienna Atomic Line Database [5, 6, 7] to identify the absorption lines on the normalised spectra. The equivalent widths were measured by fitting gaussian profiles to the observed lines. The WIDTH9 code [11, 12] was used to determine the iron abundances of each star, listed in Table 3. Furthermore, the surface gravity was adjusted from the equilibrium of Fe I/II. Consequently, we determined the
The Preliminary Atmospheric Parameters of HD 154713 and HD 137928

![Normalized Intensity vs Wavelength plot](image)

**Figure 1.** The observed data of HD 154713 compared to the synthetic spectra.

**Table 2.** Photometric atmospheric parameters of the target stars obtained from Strömgren calibrations [8].

| Star name | $T_{\text{eff}}$ [K] | log $g$ | $V_{\text{mag}}$ |
|-----------|---------------------|---------|-----------------|
| HD 154713 | 8217                | 3.6     | 6.441           |
| HD 137928 | 8241                | 3.7     | 6.433           |

**Table 3.** List of the iron abundances, number of lines used to calculate the abundances, and microturbulence velocity of each star.

| Star name | [Fe/H] | $N$ | $\xi$ [km s$^{-1}$] |
|-----------|--------|-----|-------------------|
| HD 154713 | 0.41   | 27  | 4.2               |
| HD 137928 | 0.29   | 18  | 4.2               |

effective temperature spectroscopically for HD 154713 as $8500 \pm 150$ K and $8600 \pm 150$ K for HD 137928. The surface gravity of the target star HD 154713 was derived as $3.6 \pm 0.1$ and $3.8 \pm 0.1$ for HD 137928. For the microturbulence velocities, we used the balance between equivalent widths of the iron lines and calculated the iron abundance values presented in Table 3. As can be seen from Figure 1 and 2, the spectroscopic atmosphere parameters are in good agreement with the observational $H_{\beta}$ line profile. We preferred the spectroscopically derived atmospheric parameter sets because as seen in Figure 1 and 2, the synthetic atmospheric model of the error bars, which are presented as dashed green and blue lines in both figures, are well within the observed spectra.
4. Conclusion

The high resolution spectra of HD 154713 and HD 137928 were obtained at the TÜBİTAK National Observatory. We derived the fundamental parameters by making use of Strömgren photometry and spectral hydrogen Balmer line profiles. For HD 154713 the adopted set of parameters is $T_{\text{eff}}=8500 \pm 150$ K, $\log g=3.6 \pm 0.1$, $\xi=4.2$ km s$^{-1}$, and $[\text{Fe/H}]=0.41$ for HD 137928 it is $T_{\text{eff}}=8600 \pm 150$K, $\log g=3.8 \pm 0.1$, $\xi=4.2$ km s$^{-1}$, and $[\text{Fe/H}]=0.29$. The iron metallicity of both stars are abundant relative to the Sun and the value for HD 154713 seems to be close to Am stars. Our further work of HD 154713 and HD 137928, will be to perform detailed spectral abundance analysis to their spectra and specify any abundance anomalies. Our study will shed light to understand the physical processes and distrubution of the elements inside the atmospheres of A-type stars.

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The Preliminary Atmospheric Parameters of HD 154713 and HD 137928

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