

The Preliminary Results for Atmospheric Parameters of the Candidate Ap Stars HD 90763 and HD 92728

Asli ELMASLI
Ankara University

Seyma CALISKAN
Ankara University

Kubraozge UNAL
Ankara University

Abstract: Chemical peculiar Ap stars show overabundances of some metals, such as strontium, chromium, europium, praseodymium, and neodymium. The rotations of these stars are much slower than those of normal A-type stars. Another characteristic of Ap stars is that they have stronger magnetic fields compared to classical A-type stars. We have selected the A-type stars HD 90763 and HD 92728 to derive their atmospheric parameters. Both stars' high-resolution spectra were obtained using the Coude Echelle Spectrograph mounted on the 1.5 m Russian-Turkish Telescope at the TÜBİTAK National Observatory, on the 23rd of February, 2017. The wavelength range of the spectra is from 3900 to 7900 Å. We followed the standard reduction procedures for both stars and normalised the order covering the hydrogen beta profile. We used ATLAS9 model atmospheres. The strontium 4215.519 Å line seen in the spectra of HD 90763 and the neodymium 5102.428 Å line of HD 92728 were compared to the same lines of the normal A-type star HD 187983. Sr line in HD 90763 and Nd line in HD 92728 are much stronger than those of the normal A-type star. Thus, we suggest that HD 90763 and HD 92728 may be chemically peculiar Ap star candidates.

Keywords: Ap stars, HD 90763, HD 92728

Introduction

A-type stars are remarkable objects in their unusual abundance pattern. Among them the chemically peculiar Ap stars are intermediate mass main sequence objects with strong magnetic fields.

The spectral classes of HD 90763 and HD 92728 are given by Cowley et al. (1969) as A1p (Sr) and A0Vs (Si). McDonald et al. (2012) computed the effective temperatures and luminosities using their infrared photometric data. The effective temperature and luminosity of HD 92728 are 9894 K and 61.6 L_{\odot} , the values are 9011 and 20.4 L_{\odot} for HD 90763. Martin et al. (2004) determined the atmospheric parameters of HD 92728, using the star's photometric data and high-resolution spectrum. They used ATLAS9 and BALMER9 codes for the analysis. The effective temperature, surface gravity, and microturbulence of HD 92728 were derived as 10250 K, 4.25, and 3.8 km/s. The projected velocity is 20 km/s. Mg and Fe abundances are given as 7.54 and 7.5 in the same study. We present the atmospheric parameters of HD 90763 and HD 92728 in this study.

Observations

The high-resolution spectra of HD 90763 and HD 92728 were obtained using the Coude Echelle Spectrograph mounted on the 1.5 m Russian-Turkish Telescope at the TÜBİTAK National Observatory, on the 23rd of

- This is an Open Access article distributed under the terms of the Creative Commons Attribution-Noncommercial 4.0 Unported License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

- Selection and peer-review under responsibility of the Organizing Committee of the Conference

February, 2017. The spectral wavelength range is from 3900 to 7900 Å with a resolution of 40,000. The observed stars properties as well as the observation log is presented 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 to the observed data by using IRAF code.

Table 1. The properties and observations log of HD 90763 and HD 92728

Star Name	RA [h m s]	DEC [° ' "]	Exposure Time [s]	S/N (@5000 Å)	v_{helio} [km s ⁻¹]	$v \sin i$ [km s ⁻¹]
HD 90763	10 28 43.96	-03 44 32.58 +57 11	4500	193	3.16 ± 2	38 ± 5.70
HD 92728	10 43 43.33	57.11	3600	193	-6.65 ± 2	25 ± 2.52

Atmospheric Parameters of HD 90763 and HD 92728

The initial model atmospheres of both stars were derived from narrow band Strömgren photometry. The surface gravity and effective temperature values were determined from the calibrations of Napiwotzki et al. (1993) using the uvbyβ data adopted from Hog et. al. (2000). These values are listed in Table 2, and were used for calculating the initial model atmosphere of the star with ATLAS9 code (Kurucz, 1993a; 2005; Sbordone et al., 2004).

Table 2. Initial atmospheric parameters of the target stars

Star Name	Strömgren		Johnson			References
	T_{eff} (K)	logg	T_{eff} (K)	logg	m_v m_b	
HD 90763	8315	3.99	8932	4.24	6.032 6.079	Hog et. al. (2000)
HD 92728	10011	3.96	10587	4.26	5.782 5.744	Hog et. al. (2000)

We produced synthetic H_{β} line profiles for these initial atmospheric parameters by using the SYNTHE code (Kurucz, 1993b; 2005). These synthetic H_{β} line profiles did not fit the observed spectrum of each star. Thereby, we refined the atmospheric parameters of both stars and generated new synthetic spectra. These new synthetic H_{β} line profiles were compared to the observed spectrum. A good agreement of the effective temperature was achieved for HD 90763 at 8900 K and for HD 92728 at 8900 K, while the surface gravity was fixed to 4.0 for both star.

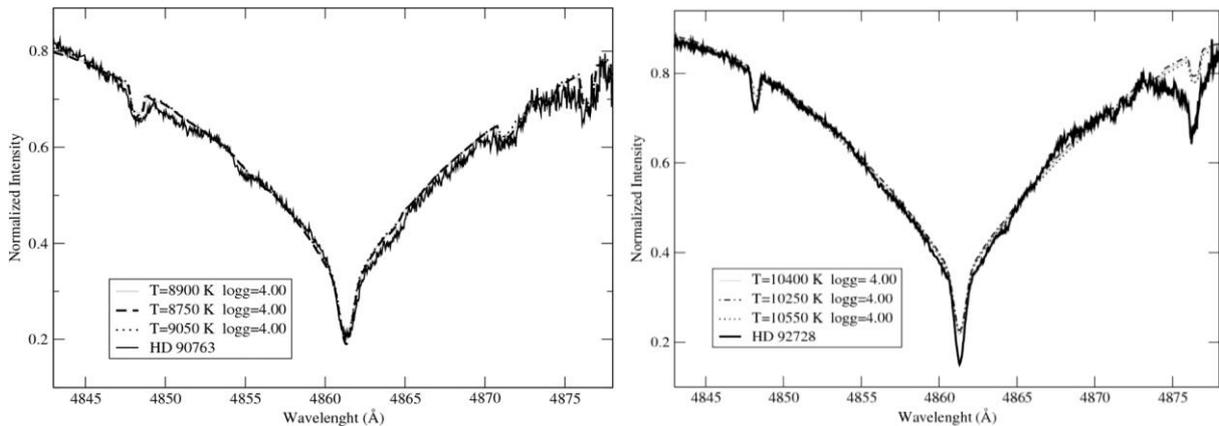


Figure 1. Synthetic and observed H_{β} profiles of HD 90763 and HD 92728

Metal Lines of HD 90763 and HD 92728

Among Ap stars some metallic lines such as strontium, neodymium, and praseodymium are abundant compared to the Sun. We searched for the Sr II at 4215.519 Å, Nd III at 5102.428 Å, and Pr II at 5129.54 Å ions in both of the stars observed spectra. The Sr II at 4215.519 Å line of HD 90763 can be seen in the left side of Figure 2. It is compared to the normal A-type star HD 187983. From this figure we can see that Sr is overabundant compared to the normal A-type star. The 4215.519 Å line of strontium in HD 92728 could not be seen on the spectra due to noise.

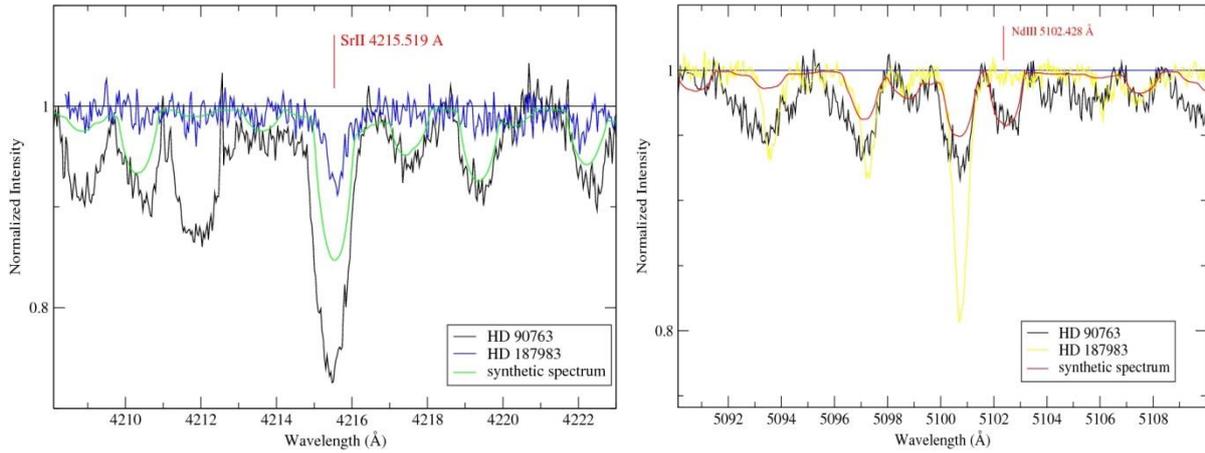


Figure 2. The strontium and neodymium atomic lines of HD 90763 are compared to a normal A-star (HD 187983).

In the observed spectrum of HD 92728, left figure of Figure 3, both strontium and praseodymium lines can be seen. The Pr II line at 5129.54 Å is not observed in HD 90763 spectrum. In the right figure in Figure 3 we compared the Nd III 5102.428 Å line with the normal A-type star HD 187983. This line in HD 90763 is stronger than that of the normal A-type star.

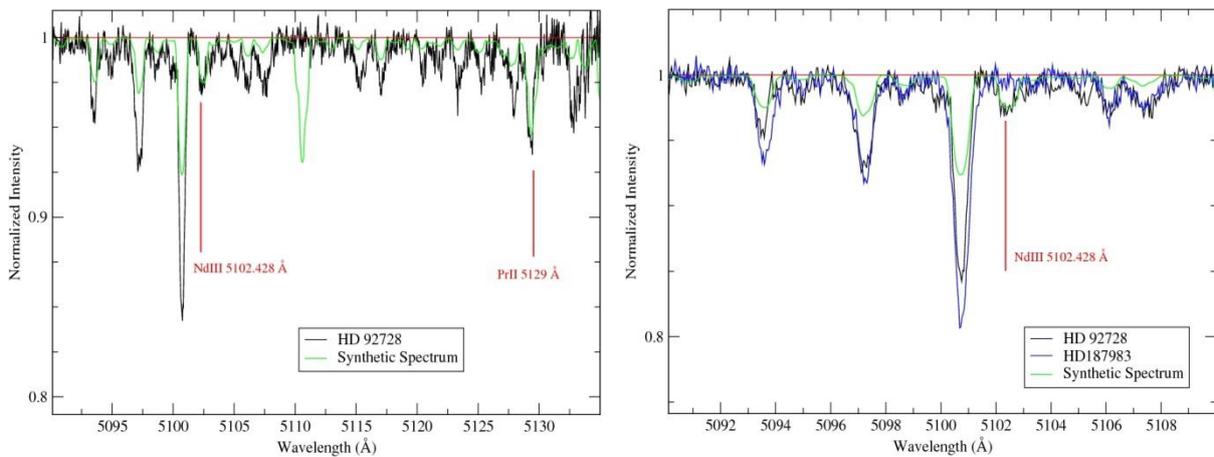


Figure 3. The neodymium and praseodymium atomic lines of HD 92728 (left). The Nd III ion at 5102.428 Å is compared to a normal A type star (HD 187983) spectra. The synthetic spectrum is given in solar abundance.

Conclusion

We derived the atmospheric parameters of HD 90763 and HD 92728 from their high resolution spectra obtained at the TÜBİTAK National Observatory. We searched for specific metallic lines, which are indicators of Ap stars, in the target stars spectra. In the spectra of each star we found the elements strontium, neodymium, and praseodymium. We compared these ions with a normal A-type star and saw that these elements are abundant in HD 90763 and HD 92728. We conclude that HD 90763 and HD 92728 may be Ap star candidates.

Acknowledgements

We thank to TÜBİTAK for a partial support in using T150 telescope with project number 14BR1150-671.

References

- Cowley, A., Cowley, C., Jaschek, M., Jaschek, C. (1969). A study of the bright A stars. I. A catalogue of spectral classifications. *Astronomical Journal*, 74, 375- 406.
- Hog E., Fabricius C., Makarov V.V., Urban S., Corbin T., Wycoff G., Bastian U., Schwkendiek P., Wicenc A. (2000). The Tycho-2 catalogue of the 2.5 million brightest stars. *Astronomy and Astrophysics*, 355, 27-30.
- Kurucz, R. L. (1993a). ATLAS9 Stellar Atmosphere Programs and 2 km/s grid. *Kurucz CD-ROM No. 13. Cambridge, Mass.: Smithsonian Astrophysical Observatory*, 1993.
- Kurucz, R. L. (1993b). SYNTHES Spectrum Synthesis Programs and Line Data. *Kurucz CD-ROM No. 18. Cambridge, Mass.: Smithsonian Astrophysical Observatory*, 1993.
- Kurucz, R.L., (2005). ATLAS12, SYNTHES, ATLAS9, WIDTH9, et cetera. *Mem. Soc. Astron. Ital. Suppl.* 8, 14
- Martin, J.C. (2004). The Origins and Evolutionary Status of B Stars Found Far from the Galactic Plane. I. Composition and Spectral Features. *The Astronomical Journal*, 128, 2474-2500.
- McDonald, I., Zijlstra A.A., Boyer M.L. (2012). Fundamental parameters and infrared excesses of Hipparcos stars. *Monthly Notices of the Royal Astronomical Society*, 427, 343-357.
- Napiwotzki, R., Schoenberner, D., Wenske, V. (1993). On the determination of effective temperature and surface gravity of B, A, and F stars using Stromgren UVBY beta photometry. *Astronomy and Astrophysics*, 268, 653-666.
- Sbordone, L., Bonifacio, P., Castelli, F., Kurucz, R. L. (2004). ATLAS and SYNTHES under Linux. *Memorie della Società Astronomica Italiana Supplement*, 5, 93.

Author Information

Asli Elmasli

Ankara University
Department of Astronomy and Space Sciences, Ankara
University, Tandoğan, Ankara 06100, Turkey
Contact e-mail: elmasli@ankara.edu.tr

Seyma Caliskan

Ankara University
Department of Astronomy and Space Sciences, Ankara
University, Tandoğan, Ankara 06100, Turkey

Kubraozge Unal

Ankara University
Department of Astronomy and Space Sciences, Ankara
University, Tandoğan, Ankara 06100, Turkey
