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FUNDAMENTAL PARAMETERS OF SUPERGIANT STAR HD 187982 (A2 Ia)

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The atmosphere of the HD 187982 (A2 Ia) supergiant star was studied using the model and parallax methods. The effective temperature T_{eff} and the surface gravity g of the star were determined based on a comparison of the observed and theoretically calculated values of the photometric quantities $[c_1]\,, Q$ and the equivalent widths of the spectral lines of the hydrogen Balmer series and the using of parallax. Based on the $FeII$ lines the microturbulence ξ_t and the metallicity [Fe/H] were determined. In the atmosphere of the star, the metallicity is close to the metallicity of the Sun.

Keywords: A spectral class supergiant star – fundamental parameters of star

1. INTRODUCTION

In this work, the fundamental parameters of star HD 187982 (A2 Ia) effective temperature T_{eff}, the surface gravity g, microturbulent velocity ξ_t, and metallicity [Fe/H] were determined.

Knowing the effective temperature T_{eff} and surface gravity g the models of stellar atmospheres are calculated and on the basis of these models the chemical composition of stars is determined, also the evolutionary parameters of stars: masses, radii, luminosities, and ages are calculated.

In astrophysics, microturbulence is considered a mechanism for broadening spectral lines. The equivalent width of the spectral line depends on microturbu-

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lence, therefore, to determine the chemical composition, it is necessary to know the microturbulent velocity.

Metallicity is one of the main fundamental parameters of stars. According to the definition of this parameter, it is determined that the star and the Sun are formed from the same or different metallicity matter, the problem of the correctness of the provisions of the modern theory of the chemical evolution of stars is solved.

2. OBSERVATION MATERIAL

The spectra of the star were obtained with the spectrograph of the CCD matrix of the 2-meter telescope of the Shamakhi Astrophysical Observatory of ANAS (R = 56000, S/N = 150 ÷ 400). Two spectra of the target star were obtained during the 19.08.2021 night of observation. These spectra were summed up before. The spectra were developed by the DECH program. The equivalent widths of spectral lines were measured. The equivalent widths of the lines of FeII used are given in Table 1.

3. EFFECTIVE TEMPERATURE AND SURFACE GRAVITY

The effective temperature T_{eff} and the surface gravity g of the stars were determined by the model and the parallax method. This method is described in detail in [1, 2]. The effective temperature and surface gravity were determined by comparing the observed and theoretically calculated values of the photometric quantities $[c_1], Q$, and the equivalent widths of the spectral lines of the hydrogen Balmer series and the use of the parallax method. The parallax method is completely new and does not depend on models.

The index $[c_1]$ is defined as $[c_1] = c_1 - 0.2(b - y)$, in the uvby photometric system, and the Q index is defined as $Q = (U - B) - 0.72(B - V)$ in the UBV system.

These indices are released from the absorption effect in interstellar space. The observation values of the quantities $[\mathrm{c}_1]$ and Q are determined from the catalog [3]. The theoretically calculated values of the equivalent widths of the Balmer series are given in [4], theoretically calculated values of quantities $[\mathrm{c}_1]$, and Q in [5]. The parallax of stars was measured in [6]. The diagram defining T_{eff} and $\log g$ is shown in Figure 1. Based on this diagram, HD 187982 (A2 Ia) is assigned to the star: $T_{eff} = 9500 \pm 200K, \log g = 1.5 \pm 0.1$

Other authors have obtained the values: $T_{eff} = 9300K, logg = 1,6$ [7].

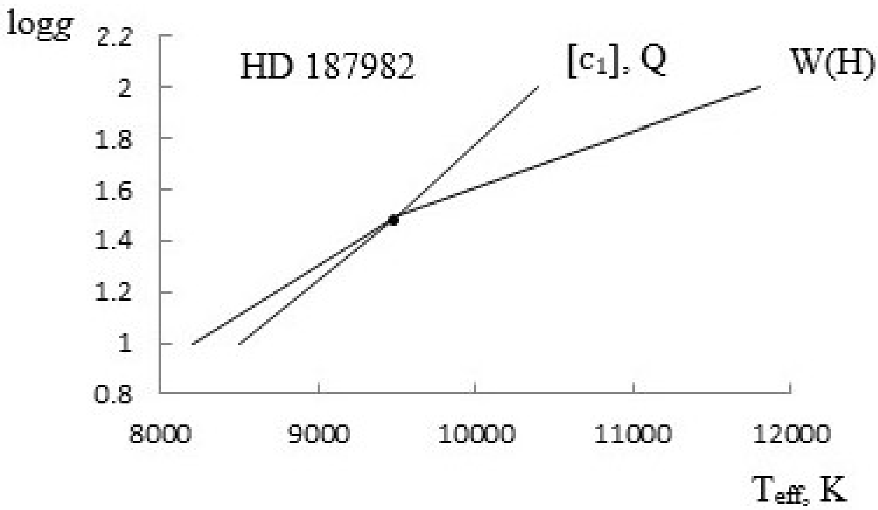

Fig. 1. logg - T_{eff} diagram

4. THE MICROTURBULENT VELOCITY

The main parameters are effective temperature $T_{eff} = 9500 \pm 200K$ and the surface of gravity $logg = 1.5 \pm 0.1$. Knowing the star's effective temperature and surface gravity, we calculate their models using Kurucz ATLAS 9 program.

Based on these models, the iron abundance is $log\varepsilon$ (FeII) calculated by giving different values to the microturbulent velocity ξ_t in the atmosphere of the star. The iron abundance is determined by comparison of the measured from observation and theoretically calculated values of the equivalent width of lines. The atomic data of spectral lines are taken from the VALD 3 [vald.astro.uu.se].

FeII lines used are given in Table 1. The first column of the table shows the wavelength of the spectral lines, the second column the oscillator strengths, the third column the equivalent widths of the lines, and the fourth column the quantity assigned to each spectral line. $\xi_t = 5.8 \pm 1.0$ km/sec was chosen for the speed of microturbulent velocity ξ_t.

Fig.2 are shown the dependence graph of the abundance $log\varepsilon(Fe)$ determined based on the different equivalent widths of FeII on the equivalent widths W_λ - in the atmospheres of the studied star.

As can be seen from Figure 2 there is no correlation between and, for the star HD 187982 (A2 Ia) at 5.8 km/sec. Other authors have determined the values

Table 1. List of lines of FeII studied in the spectrum of the star HD 187982

λ,Å	$\log gf$	W, mÅ	$\log \varepsilon$
4124.78	-4.38	15	7.35
4314.30	-3.55	73	7.43
4361.25	-6.80	17	7.22
4369.40	-4.05	27	7.40
4385.38	-2.58	162	7.28
4489.18	-3.67	72	7.59
4534.16	-3.25	127	7.59
4549.47	-1.98	241	7.38
4583.84	-1.81	255	7.35
4635.31	-1.48	73	7.21
4670.17	-4.07	24	7.30
4731.47	-3.50	59	7.34
5019.47	-2.77	18	7.49
5100.66	-4.22	32	7.58
5127.86	-2.40	18	7.27
5197.57	-2.23	187	7.35
5264.81	-3.41	60	7.47
5284.81	-2.98	43	7.43
5325.56	-3.19	75	7.39
5337.74	-3.99	21	7.48
6247.56	-2.34	82	7.32
6385.44	-2.66	10	7.22
6446.41	-2.02	16	7.25
7711.73	-2.54	77	7.28
			7.37 ± 0.09

of 7 km/sec in the stellar atmosphere HD 187982 [7]. The method used by us explained in [1, 2] detail, and the accuracy of this method is justified. Therefore, we accept that the obtained results by us are superior.

When analyzing the microturbulence on the basis of FeII lines, the abundance of the iron element $\log \varepsilon(Fe)$ is simultaneously determined: $\log \varepsilon(Fe) = 7.37 \pm 0.09$. The abundance of iron in the sun is $\log \varepsilon(Fe) = 7.47$ [8].

As is shown the metallicity of the studied stars and the Sun is practically the same. The coincidence between the iron abundance of young nearby stars and

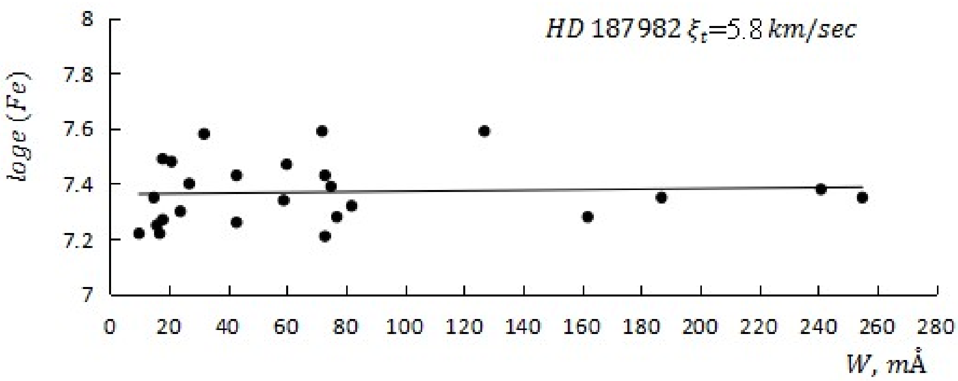

Fig. 2. Determination of microturbulent velocity

that of the 4.5 Gyr old Sun is interesting from the viewpoint of models of galactic chemical evolution (GCE).The question arises: may these results be reconciled with models of GCE? One may cite the recent work of Spitoni et al. [9], where an enrichment of the solar neighbourhood by various metals is studied, in particular, by Fe. One sees from these results that during the Sun's life the Fe abundances in its neighbourhood are predicted to increase by about 0.15dex. The ordinary accuracy of observed abundances in stars seems to be insufficient to detect such a small enrichment.

The microturbulence is investigated by Samedov [10] in the atmospheres of F-spectral class stars using a model method. The dependence graph of the microturbulent velocity (ξ_t) on the surface of gravity (g) for the F-spectral class, stars is plotted. It was found that the microturbulent velocity (ξ_t) on the surface of gravity (g) in stellar atmospheres: decreases with increasing g.

5. MAIN RESULTS

1. The effective temperature and the surface gravity of star HD 187982 have been determined by model and parallax methods: $T_{eff} = 9500 \pm 200K; logg = 1,5 \pm 01$.

2. The microturbulent velocity has been determined in the atmospheres of the star: $\xi_t = 5.8 \pm 1.0$ km/sec.

3. The metallicity was calculated in the atmospheres of the star. It has been found that iron abundance is close to the abundance in the Sun.

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