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THE FUNDAMENTAL PARAMETERS OF THE STAR HR 6725(F2 III)

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The atmosphere of HR 6725 (F2 III) giant star of F spectral class was studied using the model and parallax methods. The effective temperature (T_{eff}) and surface of gravity g on the surface 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 (ξt) and the metallicity [Fe/H] were determined. In the atmosphere of the star, the metallicity is close to the metallicity of the Sun. This shows that the star we are studying and the Sun are formed from the same metallicity matter.

Keywords: F spectral class–giant stars–fundamental parameters of stars

1. INTRODUCTION

In this work, the fundamental parameters of the star–effective temperatures (T_{eff}), surface of gravity (g), microturbulent velocity (ξt) and metallicity [Fe/H] were determined.

Knowing the effective temperature and surface gravity 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 star – mass, radii, luminosity, age are calculated.

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In astrophysics, microturbulence is considered as a mechanism broadening of the spectral line. The equivalent width of the spectral line depends on microturbulence, 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 the same or different metallicity matter, the problem of the correctness of the provisions of the modern theory of chemical evolution of stars is solved.

It should be noted that from the considered star, only the metallicities of the star HR 6725 (F2 III) are determined by other authors [1]. The surface of gravity (g) on the surface of the star, the microturbulence (ξt), and the metallicity [Fe/H] were determined by us.

2. OBSERVATION MATERIAL

The spectra of the star were obtained with the spectrograph of the CCD-matrix of the 2-meter telescope of the Shamakhy Astrophysical Observatory (R=56000, S/N=150-400). The spectra were processed by the DECH program. The equivalent widths of spectral lines were measured. The equivalent widths of the lines of FeII atoms used are given in Table 1.

3. EFFECTIVE TEMPERATURE AND SURFACE OF GRAVITY

The effective temperature (T_{eff}) and the surface gravity (g) of the star were determined by the model and the parallax method. This method is described in detail in [2]. We have studied the atmospheres of several A, F ,G-spectral class giants and supergiantstars using the model method [3–7]. The effective temperature and surface of gravity 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 use of the parallax method. The parallax method is a completely new method and does not depend on models.

The index [c_1] is defined as [c_1]=c1-0.2(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 [c_1], Q are determined from the catalog [8]. The theoretically calculated values of the equivalent widths of the Balmer series are given in [9], theoretically calculated values of quantities [c_1], Q in [10]. The parallax of the star was measured in [11]. The diagram defining T_{eff} and logg

Table 1. List of the used FeII lines

λ (Å)	$E_{\rm low}$ (eV)	$\log gf$	W(mÅ)	$\log \epsilon$
4122.64	2.57	-3.67	103	7.25
4233.16	2.57	-1.88	237	7.40
4258.15	2.69	-3.93	103	7.60
4296.57	2.69	-3.32	148	7.60
4416.82	2.77	-2.57	168	7.28
4446.25	5.93	-2.12	27	7.34
4508.29	2.84	-2.33	183	7.30
4515.33	2.83	-2.50	215	7.26
4520.22	2.79	-3.17	206	7.56
4541.52	2.84	-2.83	87	7.26
4663.70	2.88	-4.42	54	7.60
5100.66	2.79	-4.22	63	7.46
5234.62	3.21	-2.14	177	7.22
5256.93	2.88	-4.33	36	7.27
5276.00	3.19	-2.06	184	7.20
5337.72	3.22	-3.99	58	7.52
5362.86	3.19	-2.84	149	7.47
5425.27	3.19	-3.35	85	7.20
5534.84	3.23	-2.92	86	7.25
6113.32	3.21	-4.20	29	7.25
6147.73	3.87	-2.73	110	7.37
6238.38	3.87	-2.64	117	7.36
6239.95	3.87	-3.44	35	7.20
6247.56	3.87	-2.34	132	7.25
6416.91	3.87	-2.75	106	7.33
6432.67	2.88	-1.11	87	7.26
6456.38	3.89	-2.09	165	7.44
6482.19	6.19	-1.84	41	7.54

is shown in Figure 1. Based on this diagram, HR 6725 (F2 III) is assigned to the star: T_{eff} = 6800K, logg = 2.6. Other authors have obtained the value: T_{eff}=6874K [1] for star HR 6725 (F2 III). As can be seen, the value determined in [1] corresponds to the value determined by us.

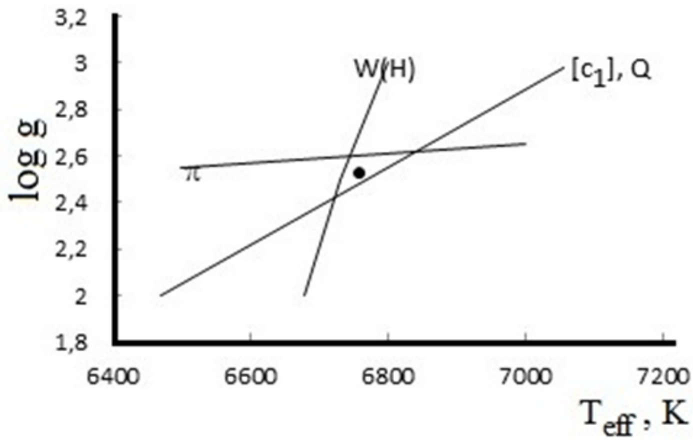

Fig. 1. lg g –T_{eff} diagram

4. THE MICROTURBULENT VELOCITY

The determination of the microturbulent velocity by the model method is based on the study of equivalent widths in a wide range of spectral lines of a neutral atom or ion of any element. Several values are given to the microturbulent velocity (ξ_t), the equivalent widths (W_λ) of the spectral lines of the considered element are calculated and compared with the equivalent widths measured from observation. Based on each spectral line, the abundance of the element logε is calculated for different values of the microturbulent velocity (ξ_t), the abundance of the element (logε) determines the microturbulent velocity (ξ_t) in the atmosphere of the studied star according to the graph does not depend on the equivalent widths (W_λ) of its spectral lines. Note that the deviation from LTT does not affect the FeII line. Therefore, the microturbulent velocity (ξ_t) and the iron abundance are determined by FeII lines in the stellar atmosphere. Only the fairly weak lines are used when determining the microturbulent velocity (ξ_t). These lines are formed in deep layers of the atmosphere, these layers are plane-parallel and in the LTT form.

The main parameters-effective temperature T_{eff}=6800K and surface of gravity logg=2.6. Knowing the effective temperature and surface of gravity of the star, we calculate its model using Kurucz ATLAS 9 program.

Based on these models, the iron abundance logε(FeII) is calculated by giving different values to the microturbulent velocity ξ_t in the atmosphere of each star. The iron abundance is determined on comparison of the measured from observation and theoretically calculated values of the equivalent width of lines FeII. The atomic data of spectral lines are taken from the VALD 3 [12].

In Fig.2 is shown the dependence graph of the abundance logε(Fe) determined based on the different equivalent widths of FeII on the equivalent widths W_λ- in the atmospheres of HR 6725 star.

As can be seen from Fig.2 there is no correlation between logε(Fe) and W_λ for the star HR 6725 (F2 III) at ξ_t=3 km/sec. When analyzing the microturbulence

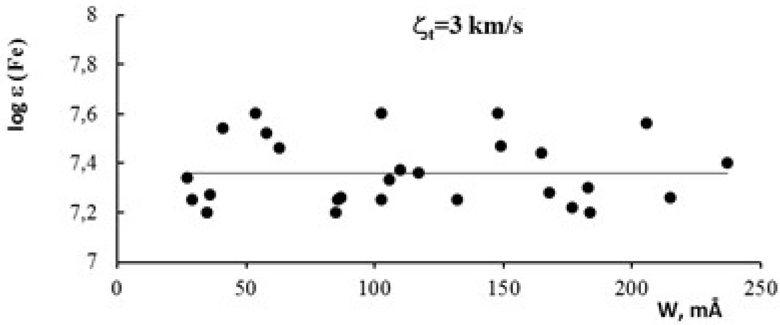

Fig. 2. Determination of microturbulent velocity. When ξ_t=3 km/sec is no correlation between the iron abundance logε(Fe) and the observed equivalent width (W_λ) of Fe II lines

on the basis of FeII lines, the abundance of the iron element logε (Fe) is simultaneously determined: logε (Fe)=7.36±0.12. The abundance of iron in the sun is logε (Fe) =7.47 [13]. As is shown the metallicity of the studied star and the Sun is practically the same. This shows that the star is studied and the Sun is formed from the same metallicity matter .

Main results:

1. The effective temperatures and the surface of gravity of F spectral class HR 6725 (F2 III) star have been determined by model and parallax methods.
2. The microturbulent velocity has been determined in the atmospheres of the star: ξ_t = 3 km/sec.
3. The metallicity was calculated in the atmosphere of the HR 6725 (F2 III) star. It has been found that the iron abundance is close to the abundance in the Sun. This shows that the star is studied and the Sun is formed from the same metallicity matter.

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