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INVESTIGATION OF THE ATMOSPHERE OF HR382 (*Φ CAS, F0 IA*) STAR

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ABSTRACT

The atmosphere of the HR382 (*φCas, F0Ia*) star is studied by the atmosphere model. The effective temperature *Teff* of the star and the surface gravity *g* are determined by comparing the observational and theoretical estimates of *β*, $[c_1]$ and *Q* photometric indexes: *Teff* = 6800±200*K*, *logg* =1.2 ± 0.2. Based on *FeII* lines the microturbulent velocity is determined: *ξt* = 6*km/sec*. In the atmosphere of the star the iron and carbon abundances are calculated and compared with the abundance in the Sun. The iron and carbon abundances are determined by the comparison of measured from observation and theoretically calculated values of equivalent width correspondingly *FeII*, and *CI* lines. The iron abundance is close to the abundance in the Sun and the carbon abundance is less than the abundance in the Sun: *logε* (*FeII*) = 7.48 ± 0.05; *logε* (*C*) = 8.01± 0.2.

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INTRODUCTION

In this work the atmosphere of the HR382 (*F*0*Ia*) star is studied by the atmosphere model. The effective temperature *Teff* of the star, the surface gravity *g* in the atmosphere, the micro turbulent velocity *ξt*, iron and carbon abundances are determined. The synthesis reactions of Hydrogen to Helium are mostly *CNO* cycles in the the main sequence stars with the temperature $T \geq 15 \cdot 10^6 K$ in the nucleus. Evolutionary calculations of stars show that these stars turn into giant, supergiant stars with spectral classes *A, F,G* after their departure from the main sequence. According to the theory of modern evolution of stars, the process of mixing deep substances occurred in giant, supergiant stars with spectral classes *A, F,G*. As a result, the products of the *C,N,O* cycles reaction must be delivered to the atmosphere, and the abundance of elements *C,N,O* in the atmosphere of these stars should be changed, i.e., the abundance of light elements in giant, supergiant stars with the spectral classes *A, F,G* should be differ from the abundance of light elements found in matter that are formed by these stars. Thus, the determination of the chemical composition of the atmosphere of giant, supergiant stars with *A, F,G* spectral classes is an actual problem from the point of view of the evolution of stars. The HR382(*F*0*Ia*) star is one of the luminous stars in our Galaxy: $Mv = -9.16^m$ (Kovtyukh 2012). This star is located in the galactic width *b* = −4◦ and galactic length *l* = 120◦ (Rufener 1976). The HR382(*F*0*Ia*) star has been investigated by various authors. Patterson (Patterson 1990) conducted spectrophotometric observations of up to 20 *F, G,K* spectral classes giant and super giant stars. On the base of comparison of the observation and theoretical radiation flood the effective temperature *Teff* of the star and surface gravity *g* were determined *Teff* = 7625*K*, *logg* =2.5. Kovtyukh (Kovtyukh 2007) was determined *Teff* = 7340*K* by analysis of depth of the spectral lines, Schmidt (Schmidt 1972) was determined *Teff* = 6700*K* based on the comparison of the experimental and theoretical estimates of energy in the continuous spectrum. Rosenzweig (Rosenzweig 1993) set out the LTT depletion model and was determined on the basis of comparison of the experimental and theoretical

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estimates of energy in the continuous spectrum: *Teff* = 7200*K*, *logg* = 0.4. Ferro (Ferro *et al.* 1988) was determined *Teff* = 7300*K*, *logg* = 0.9 from *UBVRI* and *uvby* photometry. Luck (Luck 2014) was determined the following estimations for the fundamental parameters of stars: *Teff* = 7160*K*, *logg* = 2.0. The following values were determined for the microturbulent velocity: ξt = 8.7*km/sec* (Kovtyukh 2007), 15.1*km/sec* (Glebocki 1973). As we have seen, different results have been obtained for the fundamental parameters of the HR382(*F*0*Ia*) star, since it is important to redefine the fundamental parameters of the star. Kovtyukh (Kovtyukh 2007) defined the iron abundance in the atmosphere of the star and compared it with the abundance in the Sun: [*Fe/H*] = $\Delta log\varepsilon = -0.24$. The observation material of the star was obtained from the Kude focus of the 2m telescope in the wavelength range $\lambda\lambda 3700 \div 6900 AA^{\circ}$, the atlas was established and the equivalent width of the spectral lines was measured (Khalilov et al. 2001).

Atmosphere parameters: effective temperature, surface gravity

The effective temperature and the surface gravity of the star is determined by model method. The following criteria have been used:

- Comparison of the measured from observation and theoretically calculated values of the β index;
- Comparison of the measured from observation and theoretically calculated values of the [c_1] index;
- Comparison of the measured from observation and theoretically calculated values of the Q index.

In the *uvbyβ* photometric system the index [*c*1] is determined by the expression $[c_1] = c_1 - 0.2\ (b - y)$, the intensity of the parameter β measures in the $H\beta$ line. In the *UBV* photometric system the Q is determined by the expression $Q = (U - B) - 0.72(B - V)$. The parameters [$c_1$] , β, Q are exempt from the effects of the interstellar space and the observing values of these parameters are determined from catalog (Hauck & Mermilliod 1998). For calculation of the theoretical values of the parameters [c_1] , Q the work (Castelli et al. 2003) are used . Theoretical values of parameter β are calculated in (Castelli & Kurucz 2006). The *logg* − *Teff* diagram is constructed on the base of above mentioned criteria (Figure1).

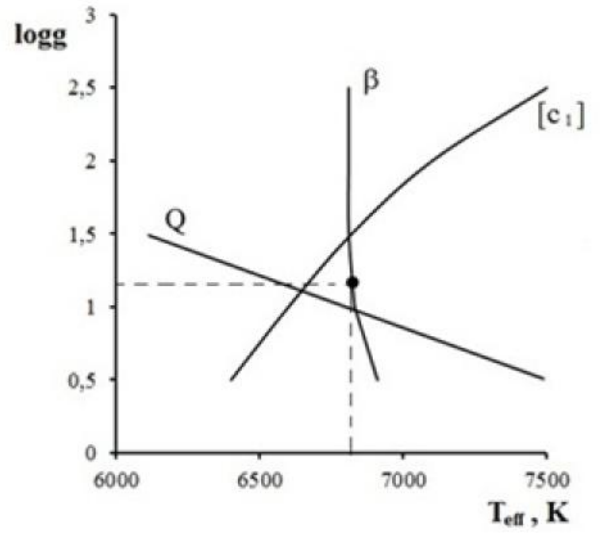

Figure 1. A diagram determined the T_{eff} and *log g* parameters of the *HR*382 star

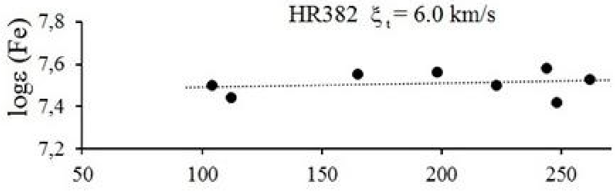

Figure 2. Determination of the micro turbulent velocity ξ_t

From this diagram the star's parameters are defined: *Teff* = 6800 ± 200*K*, *logg* = 1.2± 0.2. In (Lyubimkov 2009) the applying method is described in detail and the accuracy of this method is justified. Therefore, the determined values in this paper is perfect from the results obtained of other authors.

Microturbulent velocity, chemical composition: To determine the microturbulent velocity ξt it must be a plurality of lines that contain a wide equivalent widths *W* range of the atoms or ions of any given element. The microturbulent velocity ξt is chosen such that the abundance of elements determined by the different lines does not change with the increasing of the equivalent widths *W*. The most lines in the studied spectrum are the *FeI* and then the *FeII* lines. However, the effect of the LTT extremes to the neutral iron lines is significant. If the calculations are carried out in LTT, the abundance determined on the *FeI* lines is less than the abundance when refused from LTT (Boyarchuk et al. 1985; Thevenin & Idiart 1999) Unlike *FeI* lines there is no effect of the LTT extremes to the the *FeII* lines. Therefore, in the atmosphere of the star, the microturbulent velocity ξt and the iron abundance are determined on *FeII* lines. As is shown in Lyubimkov and Samedov (Lyubimkov & Samedov 1990) that the velocity ξt increases with the altitude of the height in the the atmosphere of spectral classes stars *F*. The effect is more effective if the line is stronger. For weak lines, this dependence is not taken into account and it is assumed that the microturbulent velocity ξt is constant in the atmosphere of star. Only the weak lines are used when determining the microturbulent velocity ξt.

These lines are formed in deep layers of the atmosphere, these layers are parallel and in LTT form. The iron abundance *logε*(*FeII*) is calculated by giving different values to the microturbulent velocity ξt based on the Kurucz model (Kurucz 1993) with the parameter *Teff* = 6800*K*, *logg* =1.2. The iron abundance is determined on the basis of comparison of the values measured from observation and theoretically calculated equivalent width of lines *FeII*. The atomic data of the spectral lines were taken from the database VALD-2 (Kupka et al. 1999). There is no correlation between *logε*(*FeII*) and *W*, when ξt = 6*km/sec* (Figure 2). Thus, in the the atmosphere of star the value for the microturbulent velocity ξt = 6*km/sec* is determined. At the same time, the iron abundance is determined too: *logε* (*Fe*) = 7.48± 0.05. The parameter [*Fe/H*] = $\Delta log\varepsilon = log\varepsilon\ (Fe) - log\varepsilon_{\odot}\ (Fe)$ is called the metallicity indicator of the star. Here *logε* (*Fe*) = 7.45 is the iron abundance in the Sun: (Scott et al. 2015).From the chemical evolution elements only the lines of element *C* are visible in the spectrum of the HR382 (*φCas*, *F*0*Ia*) star. On the base of these lines for the abundance of element *C* the following value *logε* (*C*) = 8.01± 0.2 is determined [*C/H*] = $\Delta log\varepsilon = log\varepsilon\ (C) - log\varepsilon_{\odot}\ (C) = 8.01 - 8.61 = -0.6$. Thus, in the atmosphere of the *F* spectral classes HR382 star the carbon abundance is less than that of the Sun, and the accuracy of the theory of modern evolution is confirmed on the basis of observations. The parameters of the star are: $Teff$ = 6800±200K, $logg$ = 1.2±0.2, ξt = 6*km/sec*, $log\varepsilon$ (Fe) = 7.48±0.05, [Fe/H] = 0.03, $log\varepsilon$ (C) = 8.01±0.2, [C/H] = −0.6. The abundance of metals in the star is almost equal to the abundance in the Sun, and the carbon abundance is smaller. The HR382 (*F*0*Ia*) star and the Sun have the same chemical composition, and in the evolution process the mixing deep substances process occurred in HR382(*F*0*Ia*) supergiants. As a result, the products of the *C*,*N*,*O* cycles reaction is delivered to the atmosphere and in the abundance of the elements *C*,*N*,*O* has been changed in the atmosphere of this star. This result is an important in the point of view of the Galactic chemical evolution.

MAIN RESULTS

- Using the model method the effective temperature *Teff* of the HR382 (*F*0*Ia*) star and
- and the surface gravity *g* are determined: *Teff* = 6800±200*K*, *logg* = 1.2± 0.2.
- Based on the *FeII* lines the microturbulent velocity ξt is determined: ξt = 6*km/sec*.
- In the atmosphere of the star the iron and carbon abundances are calculated and compared with the abundance in the Sun. It has been found that the iron abundance is close to abundance in the Sun, but the carbon abundance is less.

REFERENCES

Boyarchuk A.A., Lyubimkov L.S., Sakhibullin N.A., *Ap J.* 1985. Volume 22, 203 (in Russian).

Castelli F., Kurucz R.L., Piskunov N.E., Weiss W.W., Gray D.F., 2003. eds, Proc. IAU Symp. 210, Modelling of Stellar Atmospheres, Poster A20. *Astron. Soc. Pac., San Francisco,* p. A20.

Castelli F., Kurucz R.L., Astron. and Astrophys., 2006.Volume 454, 333.

Ferro A.A., Parrao L., and. Giridhar L., 1988,Publ. Astron. Soc. Pacific, 100, 993.

Glebocki R., Acta Astronomica, 1973.Volume 23, 135

Hauck B., Mermilliod M., Astron. Astrophys, Suppl. Ser., 1998, Volume 129, 431.

Khalilov A.M., Hasanova A.R., Rzayev A.H., 2001. Astronomichesky Jurnal Azerbaijana, Volume 102, 21(in Russian)

Kovtyukh V.V., 2012. *Monthly Notices the Royal Astron*. Soc., Volume 423, 3268.

Kovtyukh V.V., 2007, *Monthly Notices the Royal Astron*. Soc., Volume 378, 617.

Kurucz L.S., CD-ROM 13, 1993. ATLAS9 Stellar Atmosphere Programs and 2km/s grid. Cambridge, Mass., Smithsonian Astrophys. Obs.

Kupka F.N., Piskunov T, Ryabchikova T., Stempels H.C., Weiss W.W., 1999. Astron. *And Astrophys, Suppl.Ser.*, Volume 138, 119.

Lyubimkov L.S., Rachkovskaya T.M., Poklad D.B., 2009. ApJ., Volume 52, 237 (in Russian).

Lyubimkov L.S., Samedov Z.A., 1990. *ApJ.,* Volume 32, 49 (in Russian).

Luck R.E., 2014. *Astronomical J.,* Volume 147, 4.

Patterson R.S., *Astron. J.,* 1990. Volume 99, 1953 .

Rosenzweig P. and Anderson L.S., *Astrophys*. J., 1993. Volume 411, 207.

Rufener F., 1976. Astron. *Astrophys, Suppl. Ser.,* Volume 26, 275.

Schmidt E. G., 1972. *Astrophys. J.,* Volume 174, 605.

Scott. P., Asplund M., Grevesse N., Bergemann M., and Sauval M., 2015. Astron. and Astrophys., Volume 26, 573.

Thevenin F., Idiart T.P., 1999. *Astrophys. J.*, Volume 521, 753.

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