Baku State University: Journal of Physics & Space Sciences, **2024**, v1 (4), p. 70-74

journal homepage: http://bsuj.bsu.edu.az/en

Metallicity of the star HR 4294 (A5III)

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Received 18-Nov-2024; Accepted 12-Dec-2024
DOI: https://doi.org/10.30546/209501.2024.01.4.077

Abstract

The atmosphere of HR4294(HD95382, A5III) star was studied using the model and parallax methods. The effective temperatures T_{eff} and the surface gravity g of star was determined based on a comparison of the observed and theoretically calculated values of the photometric quantities [c_1], β, Q, and the using of parallax. Based on the FeII lines the microturbulence ξ_t and the metallicity [Fe/H] were determined. In the atmospheres of the stars, the metallicity is close to the metallicity in the Sun. This shows that the stars we are studied, and the Sun are formed from the same metallicity matter. This result is important from the point of view of the chemical evolution theory of the stars.

Keywords: *A-type stars, fundamental parameters*
PACS: *97.20.-w; 97.10.Ri; 97.10.Tk*

1. Introduction

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

Knowing the effective temperature and the surface gravity the models of stellar

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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, ages are calculated.

In astrophysics, microturbulence is considered as a mechanism broadening of 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.

The 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.

2. Observational material

Spectra of this star was recorded with the help of spectrograph equipped with CCD fed by 2-m telescope of the Shamakhi Astrophysical Observatory of ANAS (resolving power R=56000, signal-to-noise ratio S/N=150─400). The spectra of HR4294 was processed with DECH program [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 [2, 3]. We have studied the atmospheres of several A, F, G-spectral class giants and supergiant stars using the model method (for example, [4, 5, 6]). The effective temperature and the surface gravity were determined based on a comparison of the observed and theoretically calculated values of the photometric quantities $[c_1]$, Q, β and the using of parallax method.

The observation values of the quantities $[c_1]$, Q and β are determined from the catalog [7]. The theoretically calculated values of quantities $[c_1]$, Q in [8] and theoretically calculated values of quantity β [9]. The parallax of star was measured in [10]. The diagrams defining T_{eff} və logg are shown in Figure 1.

The center of gravity of every point where the graphs in logg–T_{eff} diagram cross each other determine the effective temperature of the star and surface gravity: T_{eff}=8300±150K, logg=4.0±0.1.

Other authors have obtained the values: T_{eff}=8017K, logg=3,95 [11], T_{eff}=8180K, logg=3,98 [12]

4. The microturbulent velocity

Therefore, when determining microturbulent velocity in the stellar atmosphere we used FeII lines. When determining ξ_t we use only FeII lines with equivalent width

W<290mÅ. These lines are formed in the deep layers of the atmosphere which can be considered plane-parallel layers in the LTE state.

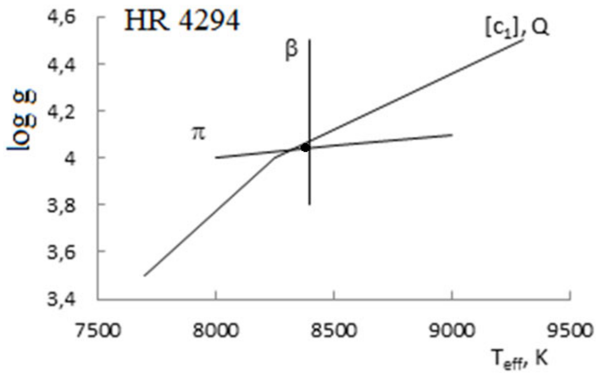

Fig. 1. T_{eff} – log g diagram

Based on the found parameters T_{eff} and logg we calculated the corresponding model of the atmosphere; for this Kurucz's ATLAS 9 program was used 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 FeII. Several values are given to the microturbulent velocity, and the equivalent widths (W_λ) of the spectral lines of FeII are calculated and compared with the equivalent widths measured from observation We used atomic data for the spectral lines from the database VALD−3 [13].

Figure 2 presents the determination of the microturbulence parameter in the atmosphere of HR4294(A5III) star. As can be seen from Fig.2 there is no correlation between logε(FeII) and W_λ at ξ_t=2.2 km/s. Thus, we define for this star: ξ_t=2.2±0.5 кm/s.

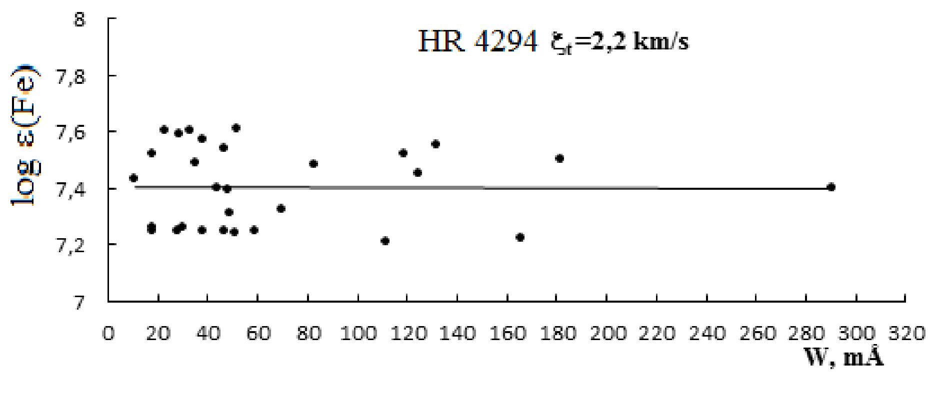

Fig. 2. Determination of microturbulent velocity

Other authors have determined the values $\xi_t = 4$ km/sec in the stellar atmosphere HR4294 [11]. The method used by us is explained in [2,3] in 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 *logε (Fe)* is simultaneously determined. The abundance of iron in the sun is logε(Fe) =7.47 [14]. The metallicity was determined in the atmosphere of the star HR 4294: [Fe / H] = -0.07. As is shown the metallicity of the studied stars and the Sun is practically the same. This shows that the stars we are studying and the Sun are formed from the same metallicity matter and this result is important from the point of view of the theory of the chemical evolution of stars.

The coincidence between the iron abundance in young nearby stars and that of the 4.5 Gyr old Sun, is interesting from the viewpoint of models of the Galactic chemical evalution (GCE). The question arises: may this result be compatible with models of GCE? One may cite the recent work of Spitoni et al. [15], where an enrichment of the solar neighbourhood by various metals is studied, in particular, by Fe. One sees from those results that during the Sun's lifetime the Fe abundances in its neighbourhood are predicted to be incresed by about 0.15 dex. The ususal accuracy of the derived abundances in stars seem to be insufficient to detect such a small enrichment.

5. Conclusion

1. The effective temperature and surface gravity of HR4294 (A5III) star are determined by the method of atmospheric model. The following values of effective temperature and surface of gravity were found: T_{eff}=8300±150 К, logg=4.0±0.1.

2. The microturbulence parameter was found as ξ_t=2.2±0.5 кm/s on the basis of studies of FeII lines.

3. The metallicity was calculated in the atmospheres of the star. It has been found that the iron abundance is close to the abundance in the Sun. This shows that the star we are studied and the Sun are formed from the same metallicity matter. This result is important from the point of view of the chemical evolution theory of the stars.

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