INVESTIGATION OF CHEMICAL COMPOSITION OF GIANTS IN THE HYADES

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ABSTRACT. This paper has presented the results of abundance analysis of three giants in the Hyades. The study based on the spectra which were obtained on 1.93 telescope of the Haute-Provence Observatory (France) equipped ELODIE spectrometer, spectral resolution is 40 000, in the spectral range of 4400 – 6800 AA, the main parameters - the effective temperature $T_{\rm eff}$, the surface gravity $\lg g$, microturbulent velocity V_t and elemental abundances of Fe, Na, Mg, Al, Si, Ca, Ti, V, Cr, Co, Ni were determined. The determination errors were presented. The studied stars shown the homogeneity of chemical composition and Na overabundance.

1. Introduction

Hyades is a stellar open cluster, which located in Taurus. It has a mass of about 300-400 $M_\odot$ and the age of approximately 625 = ± 50 Myr, It’s known the importance of the Hyades cluster in the study of Galactic structure and understanding the chemical evolution of the Galaxy (De Silva et al., 2006), and determining the distance scale that based on the distance of the Hyades, etc. However, there are some questions were connected with this cluster. So, photometric study shows higher metallicity of giants compared to the dwarfs, while the Hyades stars have the same origin and therefore should have similar chemical composition.

2. Observations

Spectra for the studied stars were obtained on 1.93 telescope of the Haute-Provence Observatory (France) equipped ELODIE spectrometer. Spectral resolution is 40 000, in the spectral range of 5100 – 6800 AA. Spectra processing (continuum level location, measured of equivalent widths etc). was performed using DECH 20 software (Galazudinov, 1992) Equivalent widths EWs of lines where measured by means of a Gaussian fitting.

3. Stellar parameters

The temperature was determined by the method. (Kovtyuh et al., 2003), which basic on different response of a line with different excitation potentials of the lower level to the temperature. The internal precision of this method is about 10 K.

Surface gravity g is defined using the star‘s parallax and the temperature by the standard formula:

$$\lg g = 4 \lg T_{\rm eff} + 0.4 M_{\rm bol} + \lg (M/M_\odot) - 12.5.$$

The data on the parallax π'', stellar magnitude V were taken from database SIMBAD, the bolomrtric correction BC was taken from paper Flower (1996).

Microturbulent velocity V_t was determined from the condition of independence of the abundance of iron obtained with of neutral iron, line from the equivalent width of this line. Table 1 shows the main parameters of the studied stars.

4. Abundance Analysis

The chemical composition was determined in the assumption of LTE. We used the model atmospheres of Kurucz (1993) . Determination of Fe, Na , Mg, Al , Si , Ca , Sc, Ti , V , Cr, Mn, Co, Ni of abundances was performed on the measured equivalent widths using solar oscillator strengths (Kovtyuh and Andrievsky, 1999), by Kurucz’s WIDTH9 software. Error in determining the individual values of chemical elements (σ) does not exceed 0,1 dex - for Fe I, 0,14 dex - to Fe II, Na I, Mg I, Al I, Si I, Ca I, Ti I, VI, Cr I, Mn I, Co I, Ni I. Most of the elements shows a small overabundances, which corresponds to a given age of the cluster and the previously obtained data.

Figure 1 shows the contents of chemical elements for the cluster giant. In the figure 1 shows the average value of the content elements by the line. The figure demonstrats the relative uniformity of content of the elements in the atmospheres of giants.

Table 1: Main parameters of the studied giants.

HD	Sp	π''	V	T_{eff}	V_t	$\lg g$	[Fe/H]	M_v	M_{bol}
27371	K0III	0,02117	3,654	4945	1,6	2,26	-0,04	-0,38	-0,05
28307	K0IIIb	0,02066	3,847	4946	1,4	2,32	0,03	-0,23	0,1
28305	G9.5III	0,02104	3,54	4912	1,6	2,19	-0,04	-0,53	-0,19

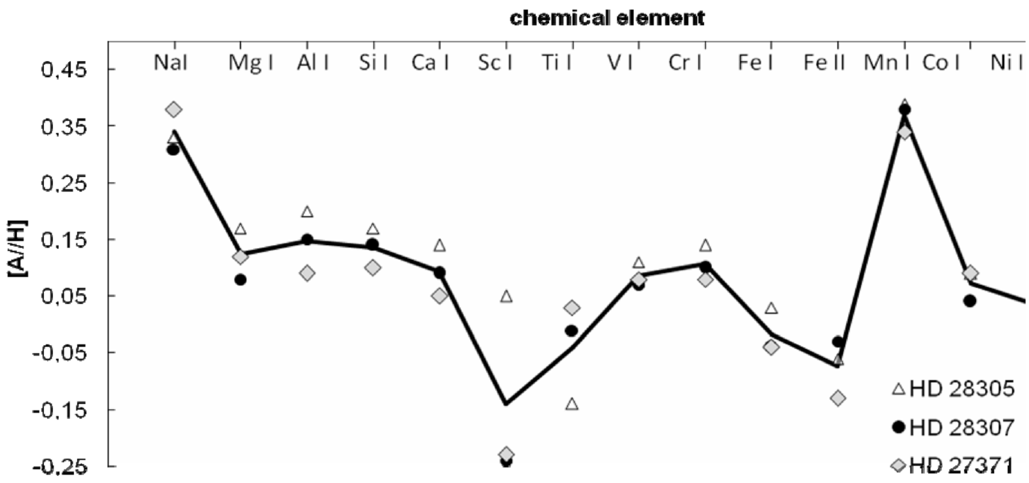

Figure 1: Chemical composition of te stellar atmosphere in giants of the Hyades. A - Species

5. Error Analysis

Error in the determination of element content is due to errors in determining of the effective temperature, surface gravity, turbulent velocity, and choice of the models. In the approximation of local thermodynamic equilibrium, so there may be errors associated with deviation from LTE. NLTE effects are specific in relation to the atom and influence act on each element separately, so the error for different elements due to NLTE manifestation will be different. Error is also associated with the uncertainty of the oscillator strength and continum level location. Since giant stars are in almost identical conditions and have similar parameters, their errors of the chemical composition determination did not differ significantly. Table 2 shows the error for each of the chemical elements for the star HD28307.

Table 2: Error in the determination of chemical elements for the star HD28307.

Element	Δ T_{eff}	Δ lg *g*	Δ V_t	*Total*
Fe I	0,02	0,04	0,02	0,05
Fe II	0,01	0,03	0,01	0,03
Na I	0,28	0,03	0,23	0,36
Mg I	0,01	0,08	0,05	0,09
Al I	0,01	0,15	0,15	0,21
Si I	0,01	0,14	0,11	0,18
Ca I	0,01	0,09	0,08	0,12
Sc II	0,01	0,24	0,01	0,24
Ti I	0,01	0,01	0,19	0,19
V I	0,01	0,07	0,08	0,11
Cr I	0,01	0,10	0,1	0,14
Mn I	0,05	0,38	0,45	0,59
Co I	0,01	0,04	0,05	0,06
Ni I	0,01	0,01	0,02	0,02

6. Conclusions

The parameters of the atmospheres: the effective temperature $T_{\rm eff}$, the surface gravity lg *g*, microturbulent velocity V_t and the metallicity [Fe / H] for the stars HD028305, HD28307, HD27371 were found. The following elements Fe, C, Na, Mg, Al, Si, Ca, Ti, V, Ni, Co show a small overabundances, which is close to that obtained previously for the stars of the Hyades cluster. Excess of sodium Na in the giants due to removal of material from deeper layers, formed in a chain of hydrogen burning NeNa-cycle was determined.

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