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Microturbulent Velocity in the Atmospheres of G Spectral Classes Star

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Abstract

The microturbulence is investigated in the atmospheres of some G spectral classes stars by the atmosphere model. The microturbulent velocities are determined on the basis of comparison of the values measured from observation and theoretically calculated equivalent widths of lines FeII. It has been found that the microturbulent velocity *(ξ_t)* depends on the surface gravity (g) in the atmospheres of the star: ξ_t decreases with increasing g. The microturbulent velocity is less in the stars with intense atmosphere.

Keywords: Stars; Microturbulence; Fundamental parameters; Chemical composition

Introduction

As is known that even though all expansion mechanisms are taken into account, it is not possible to explain the observed profiles of spectral lines in the spectrum of the star. Thus, it is assumed that in addition to the thermal (heat) movements of the atoms there are also non-thermal (non-heat) movements in the star atmospheres, which are called turbulent movements. Turbulence is assumed as one of the mechanisms that extend the spectral line in astrophysics.

It was empirically found that the observed Doppler width of the spectral lines cannot be explained by the thermal (heat) movement of atoms.

Through the expression

$$\Delta\lambda_D = \frac{\lambda}{c}\sqrt{\frac{2RT}{M} + {\xi_t}^2}$$

it needs to introduce the parameters ξ_t. The paremeter ξ_t is expressed as the microturbulence parameter

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Let's note that there is no generalized physical theory of the microturbulence. The investigation of the microturbulence in the atmospheres of the star is important for two reasons: First, to determine the chemical composition, and second, to understand the nature of this event.

Determination of Microturbulent Velocity

The microturbulent velocity is determined in the atmospheres of the stars using the atmosphere model for the G-spectral classes HR8304 (G8II), HR8179 (G5II), HR8778 (G8IV) stars.

The observations materials of the stars were obtained on a 2-meter telescope of Shamakhi Astrophysical Observatory of ANAS.

The determination of the microturbulent velocity using the model method is based on the study of the equivalent widths in a wide range of neutral atoms or ions spectral lines of any element. The equivalent widths W_λ of the spectral lines of the considered element is calculated by giving different values to the microturbulent velocity and and it is compared with the equivalent widths measured from observation. The abundance of element $lg\varepsilon$ is calculated for the different values of the mikroturbulent velocity ξ_t in each spectral line, The abundance of element lgε does not depend on the equivalent widths W_λ of its spectral lines. ξ_t is determine the atmosphere of the investigated star which corresponds to the graph.

The most lines in the studied spectrum of the stars are the FeI and then $FeII$ 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 [1]. Unlike FeI lines there is no effect of the LTT extremes to the $FeII$ lines. Therefore, in the atmosphere of the star, the microturbulent velocity ξ_t and the iron abundance are determined on $FeII$ lines.

Only the weak lines are used when determining the microturbulent velocity ξ_t. These lines are formed in deep layers of the atmosphere, these layers are parallel and in LTT form.

The fundamental parameters of the stars-effective temperature T_{eff} and surface gravity $logg$ are determined on the basis of comparison of observed and theoretical values of some spectral and photometric quantities [2,3]. The obtained values are shown in **TABLE 1**.

Knowing the effective temperature and surface gravity of the stars are calculated their models.

The iron abundance $log\varepsilon(Fe)$ is calculated by giving different values to the microturbulent velocity ξ_t in the atmosphere of each star on these models. The iron abundance is determined on the basis of comparison of the values measured from observation and theoretically calculated equivalent width of the lines $FeII$. Theoretically equivalent width of spectral lines is calculated by DASA programs. The atomic data of the spectral lines are taken from the database VALD 2 [4]

The determined abundance $log\varepsilon(Fe)$ on the different equivalent widths of $FeII$ the dependence graphs from W_λ are shown in **FIG. 1** in the studied atmospheres of the stars.

As seen from **FIG. 1** there is no correlation between $log\varepsilon(Fe)$ and W_λ when

ξ_t = 3.2 km/s for the star HR8304 (G8II)
ξ_t = 2.0 km/s for the star HR8179 (G5II)
ξ_t = 1.8 km/ s for the star HR690 (G8IV)

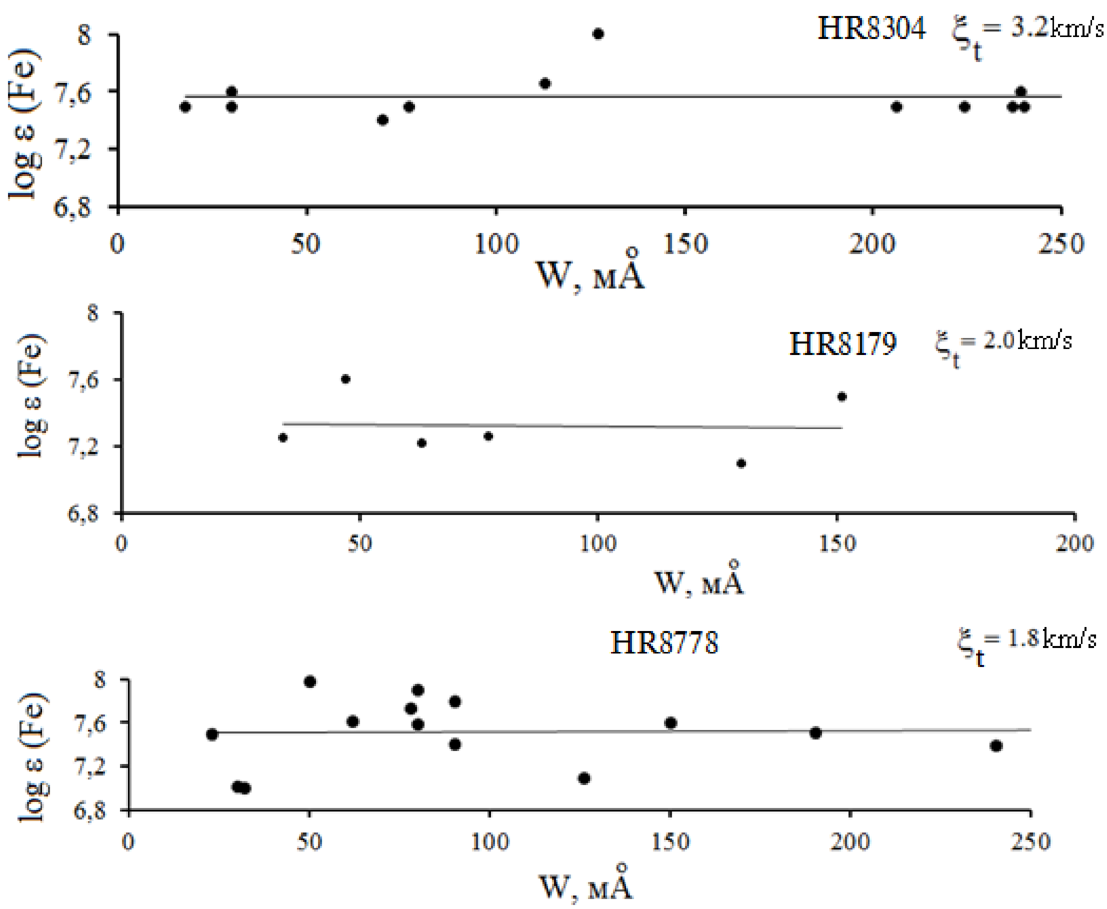

FIG. 1. **Determination of the microturbulent velocity in the atmosphere of stars.**

The value of the microturbulent ξ_t = 1.1 km/s in the solar atmosphere is determined in [5].

TABLE 1 shows the investigated parameters $T_{eff}, logg, \xi_t, log\varepsilon(Fe)$ for the studied stars.

TABLE 1. $T_{eff}, logg, \xi_t, log\varepsilon(Fe)$ **parameters of the stars.**

HR	Sp	T_{eff}, K	$logg$	ξ_t, km/s	$log\varepsilon\ (Fe)$
HR8304	G8II	5010	2.1	3.2	7.56
HR8179	G5III	5200	2.7	2.0	7.32
HR8778	G8IV	5300	3.2	1.8	7.51

The dependence graphic of the microturbulent velocity ξ_t from surface gravity log 'g' on the star surface (**FIG. 2**) is plotted.

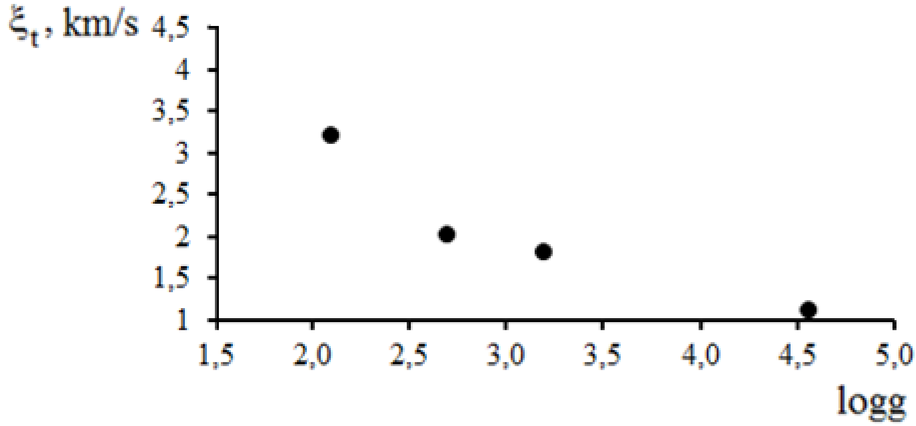

FIG. 2. **The dependence of the microturbulent velocity on the surface gravity in the atmospheres of the stars. As is shown in the figure the ξ_t depends on $logg$: the ξ_t decreases when $logg$ increases. The microturbulent velocity is less in the stars with an intense atmosphere.**

Main results

1. The microturbulence velocities are determined using the atmosphere model method:

For the HR8304 (G8II) star, $\xi_t = 3.2$ km/s

For the HR8179 (G5III) star, $\xi_t = 2.0$ km/s

For the HR8778 (G8IV) star, $\xi_t = 1.8$ km/s

2. It has been found that the microturbulent velocity *(ξ_t)* depends on the surface gravity (g) in the atmospheres of the star: ξ_t decreases with increasing "g". The microturbulent velocity is less in the stars with an intense atmosphere

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