NON-STATIONARY PROCESSES IN THE ATMOSPHERE OF THE SUPERGIANT HD 190603 (B1.5IA)

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By using the spectrograms obtained at the 2-m telescope of the Shamakhy Astrophysical Observatory for the period of 2010÷2019 the variation of a profile and spectral parameters of Hα and H_β lines of the supergiant HD190603 have been investigated.
It was found that the profiles, radial velocities and equivalent widths of the Hα and H_β lines in the spectrum of the supergiant star HD190603 vary in time.
The Hα line profile consists of an absorption and an emission component. The emission component, depending on time, consists of one, two or three components. It was assumed the absorption and emission components radial velocity and equivalent width of the Hα and Hβ line vary in time with a quasi-period approximately of 100 - 120 days.

Keywords: stars supergiants–the profile of Hα line, radial velocities

1. INTRODUCTION

Hot supergiants are among the brightest stars in our Galaxy, as well as in other galaxies. These stars are young and mostly located in the Galactic plane. The supergiant stars are bright, they are indicators of the distribution of chemical elements at large distances from the Sun and the distance to it. Supergiants help study the distribution of chemical elements in the Galaxy and therefore test models of the chemical evolution of the Galaxy. These stars are widely used in determining the spiral structure, shape and size of a galaxy.
Therefore, the study of a typical representative of such supergiant stars as the stars HD190603 (B1.5Ia) is of great importance from the point of view of evolu-

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tion. For this purpose, we have received spectra of supergiant HD190603. Based on the received spectra, were studied changes in the profiles and spectral parameters of the Hα, Hβ and HeI (λ5875.618) lines.

The apparent magnitude of the supergiant star HD190603=HR 7678 varies between $5^m.56 \div 5^m.70$, the spectral class is B1.5Ia [1]. Its absolute stellar magnitude $M_V = -7.5$ [2]. Mass $M/M_\odot$=27, radius $R/R_\odot = 44$, luminosity $\log(L/L_\odot) = 5.41$, logg=2.38, temperature $T_{eff} = 19500K$. The mass loss rate of the star is estimated at $\dot{M} = 2.4 \times (10^{-6} M_\odot yr^{-1})$ [3]. It's a blue supergiant star. The star is located at a galactic latitude $b = b = +0°.4$ and longitude $l = 69°.5$ [4]. The distance to the star is 1961.5 ps [5].

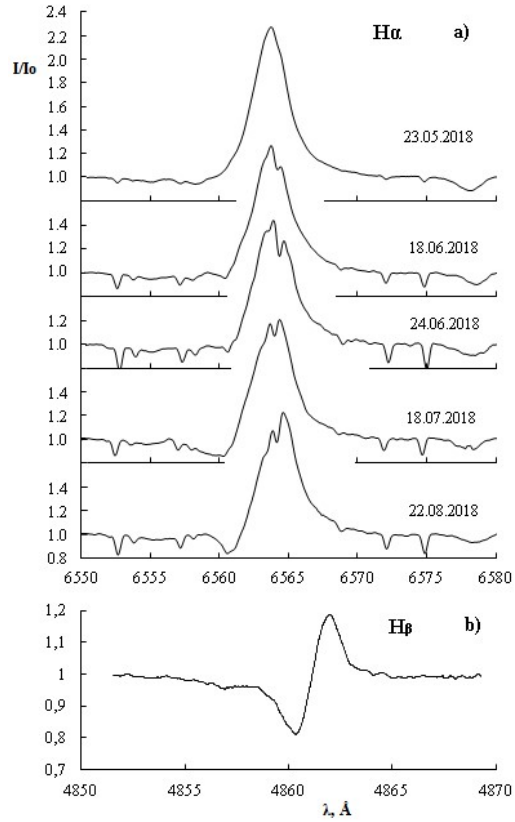

Fig. 1. Line profiles of the Hα (a) and Hβ (b) obtained in 2018.

2. OBSERVATIONAL MATERIAL AND ITS PROCESSING

Spectral observations of HD 190603 star were obtained in 2010-2019 by CCD camera installed in classic spectrograph of diffraction grating (UAGS) which was

Table 1. Values of some parameters of the $H\alpha$ lines in the spectrum of the supergiant HD190603.

JD	H_α, abs.			H_α, emis.				
2400000+	W, mÅ	Vr, km/s	R	W, mÅ	Vr 1-komp km/s	Vr 2-komp km/s	R_1	R_2
58261.51	79	-190	0,06	79	59		2.27	
58276.44	249	-156	0,11	249	63	86	2.10	1.99
58288.39	37	-98	0,05	37	56	87	2.07	1.88
58291.39	146	-128	0,09	146	56	84	2.02	1.89
58294.25	49	-98	0,06	49	56	91	2.05	1.87
58304.38	205	-115	0,14	205	56	85	2.06	1.96
58318.36	110	-105	0,10	110	46	78	1.96	2.00
58347.38	110	-119	0,10	110	39	72	2.02	2.13
58353.20	209	-107	0,17	209	41	76	1.86	2.02
58360.26	197	-145	0,10	197	41	74	1.91	2.02

Table 2. Values of some parameters of the H_β lines in the spectrum of the supergiant HD190603.

JD	H_β, abs.			H_β, emis.		
2400000+	W, mÅ	Vr, km/s	R	W, mÅ	Vr km/s	R
58261.51	372	-44	0.19	228	58	1.19
58276.44	410	-46	0.18	195		1.17
58288.39	413	-57	0.19	146	54	1.15
58291.39	543	-57	0.25	173	62	1.14
58294.25	439	-49	0.25	145	54	1.14
58304.38	494	-55	0.22	159	62	1.15
58318.36	511	-68	0.26	178	67	1.16
58347.38	655	-56	0.26	195	63	1.18
58353.20	467	-52	0.26	190	69	1.16
58360.26	451	-31	0.20	181	68	1.14

done by using Escelle spectrometer at the Cassegrain focus of 2- meter telescope of Shamakhy Astrophysical Observatory named after N. Tusi. Since 2016, spectrums have been obtained by CCD camera with sizes of 4000×4000 pixels that are installed at the Cassegrain focus with spectral resolution of R=28000 and

R=56000 and wavelength range of the spectrum (λ9000-3600 Å) at the same time in -1 frame. Spectrum of the day sky was used in order to set up the dispersion curve. DECH-20 and DECH-20T and DECH-30 packet programs presented by [6] have conducted the processing of spectrums. Two or three spectra of the star were recorded on each observational night. No rapid variations throughout the night were discovered. For this reason, the profiles obtained during one or several consecutive nights were averaged. The dispersion curves were constructed using the sky spectrum. A detailed description of the observational material and its processing is given in our previous studies [7,8]. The presented work mainly uses the spectra of the star obtained in 2018. In 2018, the spectra of the star were

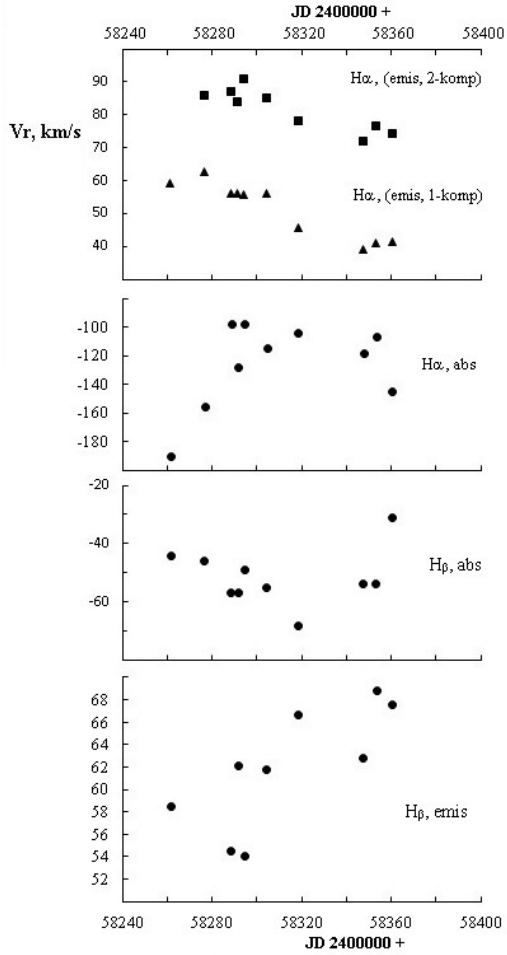

Fig. 2. Time variations of the radial velocity of the absorption and emission components in the $H\alpha$ and H_β line profiles obtained in the spectra 2018.

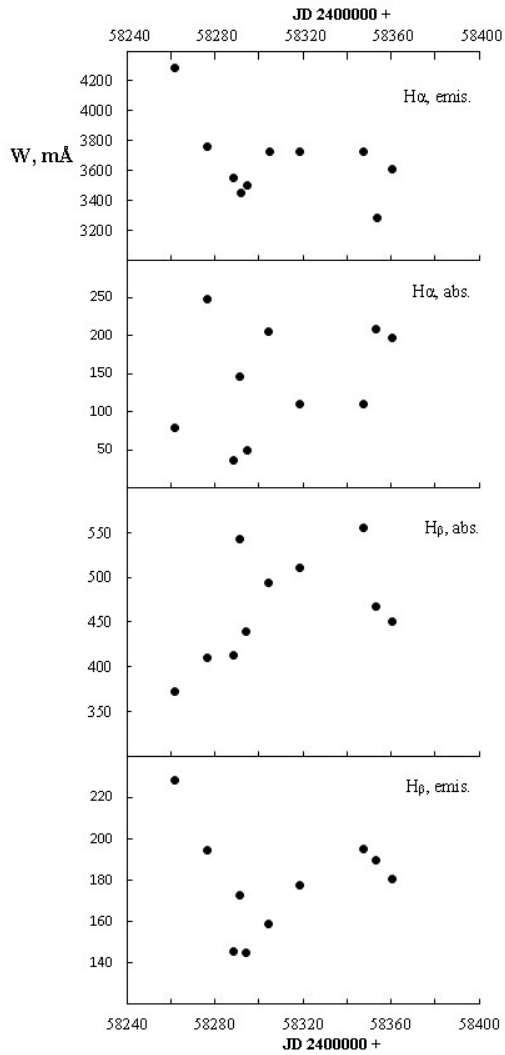

Fig. 3. Time variations of the equivalent width of the absorption and emission components in the Hα and H_β line profiles obtained in the spectra 2018.

obtained over 10 nights. In these spectra were measured, the equivalent width (W) of the Hα and Hβ lines, the central line depth (R), and the radial velocity (Vr). The results obtained are shown in Table 1 and Table 2. The mean error of determining the equivalent widths was 1-5%. The error of the radial velocity measurements did not exceed 50 – 100 m/s. All radial velocities heliocentric.

Figure 1 shows that the Hα line profile consists of an absorption and an emission component. In the profile of the emission component are observed one, two and sometimes three components. The Hβ line profile consists of one absorption

and one emission component, figure 1 (b). Figure 1 shows clearly the P Cygni character of Hα and Hβ. The profile and parameters of the absorption and emission components of the Hα line change with time. Figure 2 and 3 shows time variations of the radial velocity values Vr of the absorption and emission components of the Hα and Hβ lines. It can be seen that a 100 - 120-day quasi-period in 2018 is observed in the change in the radial velocity and equivalent width of the absorption and emission components of the Hα and Hβ lines. It should be noted that in the Hα and Hβ lines, the change in the radial velocity and equivalent width in the absorption and emission components occurs in antiphase.

3. CONCLUSION

Spectral observations of HD 190603 star were obtained 2010-2019 in of 2- meter telescope of Shamakhy Astrophysical Observatory named after N. Tusi. Based on the obtained spectra, in 2018, changes in the profiles and spectral parameters of the $H\alpha$ and $H\beta$ lines were investigated. The following results were obtained:
1. It was assumed that the radial velocity and equivalent width of the absorption and emission components of the $H\alpha$ and $H\beta$ lines varies with time with a approximately quasi-period of about 100-120 days.
2. The change in the radial velocity and equivalent widths of the absorption and emission components of the profiles of the $H\alpha$ and $H\beta$ lines with time occurs in antiphase. However, variations in time of the value's equivalent widths of the lines of the absorption and emission components of Hα and Hβ occur synchronously.
3. It is estimated that, variations in the radial velocity and the equivalent width of the absorption and emission components in the $H\alpha$ and $H\beta$ lines a result by the pulsating of the stellar atmosphere.

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