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# Hα and Hβ Profile Variations in the Spectra of Early Supergiants HD198478 and HD187982

**Y. M. Maharramov[1*], A. R. Hasanova[1], A. M. Khalilov[1], A. Sh. Baloglanov[1] and G. M. Haciyeva[1]**

*[1]Shamakhy Astrophysical Observatory named after N.Tusi, Azerbaijan National Academy of Sciences, Yu. Mammadaliyev Settlement, Shamakhy District, Republic of Azerbaijan.*

***Authors' contributions***

*This work was carried out in collaboration between all authors. Author YMM designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors ARH and AMK managed the literature searches and analyses of the study, performed the spectroscopy analysis. Authors ASB and GMH managed the experimental process. All authors read and approved the final manuscript.*

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## ABSTRACT

Profile variations in the Hα and Hβ lines in the spectra of the stars HD198478 and HD187982 are investigated from spectroscopic observations acquired in 2010-2011, 2013-2015 at the Cassegrain focus of the 2-m telescope at the Shamakhy Astrophysical Observatory. The spectral resolution is approximately 15000.

The emission and absorption components of the Hα profile are found to disappear on some observational days in the spectra of HD198478. It is suggested that the observational evidence for the non-stationary atmosphere of HD198478 can be associated in part with non-spherical stellar wind.

It has been revealed that absorption in the line of Hα has variable structure in the spectrum of the star HD187982 depending on the activity phase of the atmosphere. The profile of the line has normal P Cyg type in the active phase of the star atmosphere. The emission component in the red wing of the profile forms and disappears. It is supposed that such variations may be due to non-stationary and strong flow substance in the atmosphere of this star.

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**Corresponding author: E-mail: y_meherremov@rambler.ru;*

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## 1. INTRODUCTION

The study of supergiants, the most luminous stars, is of great interest in terms of the stellar and chemical evolution of galaxies. Almost all of the early supergiants are observed to show spectral and photometric variability. Due to the variable stellar wind and mass-loss rate, the spectra of the supergiants exhibit variations in the intensity, radial velocities, and P Cyg profiles of the lines of hydrogen, helium, and ions with a high degree of ionization.

In adition, a significant mass-loss rate is typical of the highest luminosity stars. In the optical region of the spectra, a particularly sensitive indicator of the rate of outflow of matter is the emission line Hα. The Hα line in the spectra of these supergiants has a clear P Cyg type profile.

The objects of these studies, the stars HD198478 (B4Ia) and HD187982 (A2Ia), are the supergiants with the following parameters, respectively [1-7]:

> $m_v$=4.86, $T_{eff}$=17500K, $M/M_{\odot}$=34±4, $R_*/R_{\odot}$=49, logg= 2.10, vsini =61 km/s, and $m_v$=5.58, $T_{eff}$=(9300±250)K, $M_*/M_{\odot}$=15, $R_*/R_{\odot}$=78, logg=1.60±0.15, vsini = (15±6) km/s.

The supergiant HD198478 belongs to the CygOB7 associations [8]. By analyzing spectroscopic observations of the star of HD198478, Underhill discovered large-scale irregular motions in its atmosphere [9]. By exploring the spectra obtained in 1937-1959, she found evidence of the rapid variability of the Hα profiles in the spectrum of this star.

On the basis of spectroscopic observations for 15 consecutive nights, Granes reported a variable pattern of the Hα profile [10]. The time curves of the radial velocities of the hydrogen lines gave evidence of repetitive motions of the atmosphere inside the stellar envelope. The author came to the conclusion that, apart from the 15-day variability cycles, the stellar atmosphere exhibits repetitive 4 to 5-day periodic changes.

The supergiant HD187982 belongs to the VulOB4 associations [4-5]. Some spectral lines Hα, Hγ, MgII (4481 Å), and FeII (4924 Å, 5018 Å, 5169 Å) are observed in the atmospheres of HD187982 [4,5,11,12]. It is noted that generally the profiles of the Hα line are observed in absorption. Sometimes in the red wing of the profile of Hα line is observed weak emission component. A more complete explanation of appearance and disappearance of these components require additional observations.

We note that the main characteristic feature of the stars HD198478 and HD187982 are the significant variability of the spectra. The main purpose of this paper is to study the observed components of the Hα and Hβ profiles in the spectra of these stars.

We believe our results will be of interest for further studies of these remarkable stars.

## 2. OBSERVATIONS AND PROCESSING

Spectral observations of the supergiants HD198478 and HD187982 in 2010-2011 and 2013-2015 were carried out using a CCD detector in the echelle spectrometer mounted at the Cassegrain focus of the 2-m telescope of the Shamakhy Astrophysical Observatory [13]. The spectral resolution was R=15000 and the spectral range is λλ4700-6700 Å.

Two to three spectra of the target stars were obtained on each night. The signal-to-noise ratio was S/N=150-200. The average exposure was 600-900 s, depending on the weather conditions.

In addition to the observations of the target stars, in order to check the stability of the instrument we also obtained numerous spectra of standard stars, the day and night background, and comparison spectra. The Echelle spectra were processed with the standard technique using the DECH20 and DECH20t software [14]. The reduction of the spectra, which included the continuum placement, the construction of dispersion curves (from the spectra of a hollow-cathode Th+Ar lamp or radial velocity standard stars), spectrophotometric and position measurements was performed using this package.

The measurement error for the equivalent widths $W_{\lambda}$ was about 5%, and for the radial velocity $V_r$ was ±2 km/s. Appropriate heliocentric corrections were included during data processing.

First, we present preliminary results of a long-term spectroscopic monitoring of a sample of bright B supergiants. Dramatic line-profile variations operating on a daily (and in some cases on a hourly) timescale are observed.

***HD198478.*** According to the numerous spectroscopic observations, the spectra of this star display the most variable Hα line intensities and profiles. Thus, the following Hα profile variations are observed [9-10,15]:

a) Hα is in pure absorption,
b) Hα exhibits a normal P Cyg profile,
c) Hα is in pure emission,
d) Hα exhibits an inverse P Cyg profile and
e) Hα exhibiting a three-component shape: the emission profiles on both sides of central absorption component, or vise versa, the absorption profiles on both sides of central emission component.

We spectroscopically monitored HD198478 between 2010-2011 and 2013-2015. We obtained a total of 204 spectra, distributed over 102 nights.

We present the fragments of the resulting spectra covering the Hα region (Fig. 1). It is revealed that in the spectra of June 27-30, 2010, the Hα line has an ordinary P Cyg-type profile, but the radial velocities ($V_r$) and the equivalent widths ($W_\lambda$) of Hα in emission and absorption and the lines of other elements change over time [16]. The emission component of the Hα profile shows the greatest variations, which indicates changes in the physical conditions inside the expanding stellar envelope.

But more interesting spectra were obtained on July 2-4, 2010 [16]. They appear to have no Hα line, with no spectral components apart from weak atmospheric lines and noises being observed at its wavelength (λ=6562.816 Å). At the same time, in the vicinity of the Hα line at λλ6400-6600 Å, there are two visible carbon lines CII (λ6578.05 Å, λ6582.88 Å) and weak stellar and atmospheric lines (λ6542.31 Å, 6543.91 Å, 6552.63 Å, 6557.17Å, 6558.15Å, 6561.11Å, 6564.20Å, etc.).

Interestingly, in these same spectra, all other lines typical for hot supergiants such as HD198478, apart from Hα, are observed, including Hβ.

On July 5 and 6, 2010, the emission component increases, completely outshining the absorption component. Therefore, the Hα profiles of these dates display no absorption component. A similar pattern was observed later, on July 8-9, 2010. And on July 18, 2010, the Hα line shows an ordinary normal P Cyg-type profile again.

Next observations of this star were carried out in 2011, 2013, 2014 and 2015.

It is noted that on July 07, 13, 2011, and on August 17, 2011, the intensities of absorption and emission components of the Hα line became weaker ($r_v$~ 0.96 and $r_v$ ~ 1.04).

In 2013 and 2015 all shapes of the Hα profile in the spectra of the star HD198478 show classical P-Cyg-profile.

But on September 07, 2014, the profile of the Hα line is absent from the spectrum again. Further, on September 08-11, 2014, vice versa, first the absorption component became stronger unlike than in 2010. Some nights later we already observed the emission component of the Hα line (Fig. 1a).

An attempt to explain the disappearance of the Hα profile in the spectra obtained before and after July 2-4, 2010, and September 07, 2014, was made by processing the lines of Hβ and other elements. Table 1 presents some measurements in the Hα and Hβ lines in the spectra of HD198478 star obtained in 2010 and 2014. We have determined that when the components of Hα line were observed the radial velocity and the equivalent width of the absorption and emission of Hα line varied between -97km/s÷-16km/s, 0.09Å÷0.37Å and 2km/s÷118km/s, 0.02Å÷0.48Å, respectively. But the radial velocity and the equivalent width of the Hβ line vary within -44 km/s÷-4km/s and 1.03Å÷1.31Å.

As can be seen the spectral parameters and the profiles of the Hβ line were found to change significantly. Fig. 1b shows that as an example, the Hβ line profiles obtained in 2010 and 2014. It is evident from Table 1 that the equivalent width of Hβ increases when Hα disappears. On the other hand, as is evident from Table 1 and Fig. 1b, the Hβ line is redshifted when there is no Hα profile.

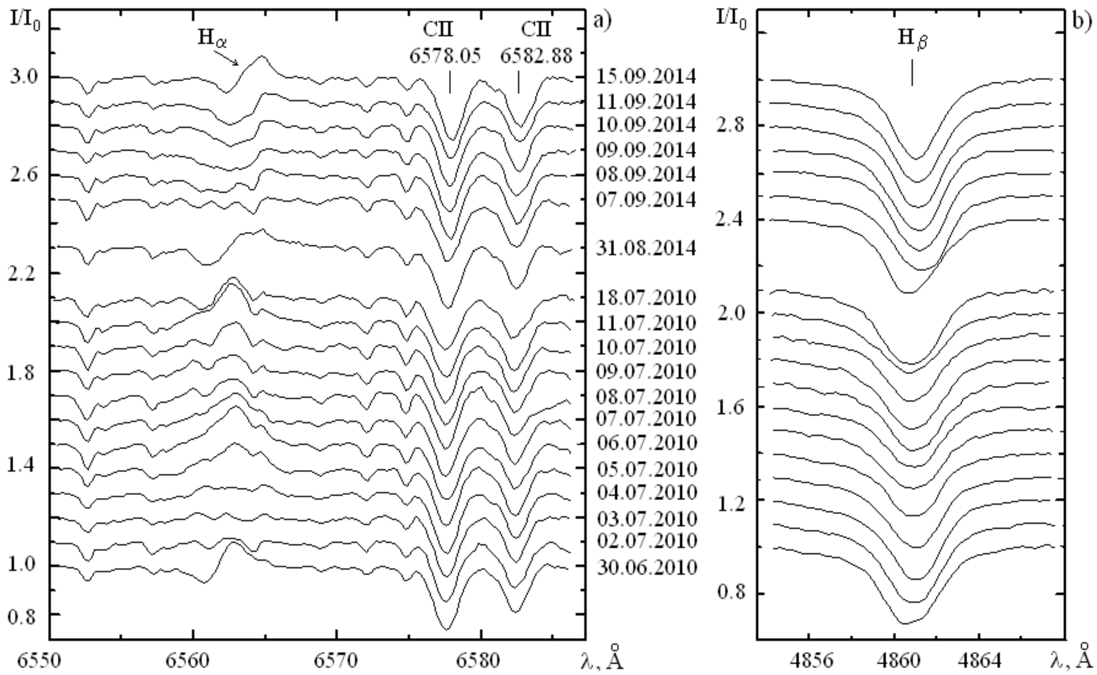


**Fig. 1. Profiles of the Hα and Hβ lines in the spectra of HD198478 observed in 2010 and 2014**

***HD187982.*** Profile of the Hα line is P Cyg type. On the basis of the observed spectra the profiles of the Hα and Hβ lines were investigated. The radial velocities and equivalent widths of the studied lines are determined. In the spectra of HD187982 observed on 01.09 and on 06.09.2014 the profiles of the Hα lines consist of a strong absorption component and a weak emission component which is observed on the red wing of the Hα line (Fig. 2a). It is also found that from emission component of the Hα line to longer wavelength there is a weak absorption component again. But in the spectra of 02.10.2013 and 03.10.2013 the Hα line is visible only in absorption and there are no accompanying components.

Apparently from Fig. 2b, in all cases, in the profiles of the Hβ line structural changes aren't observed. If we follow the radial velocities of Hα and Hβ lines, we will see that the radial velocity of Hα line changes.

It was revealed that change of the radial velocity in the Hβ line shows interesting similarity to the form of Hα profile. As it was underlined above, in the spectra of HD187982 star the profile of the Hα line is observed in two following forms:

I. The profile of the Hα line consists of a strong absorption component and a weak emission component which is observed on the red wing of the Hα line.
II. The profile of the Hα line is observed in pure absorption.
On 01.09.2013, 06.09.2013, 02.10.2013 and 03.10.2013 dates in the spectra of HD187982 star the radial velocity of the Hβ line there were -33 km/s, -33 km/s, -18 km/s and -19 km/s, respectively.

Table 2 presents some measurements in the Hα and Hβ lines in the spectra of HD187982 star obtained in 2010 and 2014.

Apparently, upon transition of the Hα profile from I to II form, the Hβ line moves to the red side, that is, the radial velocity changes sharply, but at the equivalent width of Hβ line no significant variability was observed (Table 2). But upon such transition the equivalent width of the Hα increases.

The further spectra of this star are observed between June 21, 2014, and August 09, 2014 dates. In the spectra observed from June 21 to August 09, 2014 dates the radial velocity of Hα and Hβ changed on average on ±4 km/s.

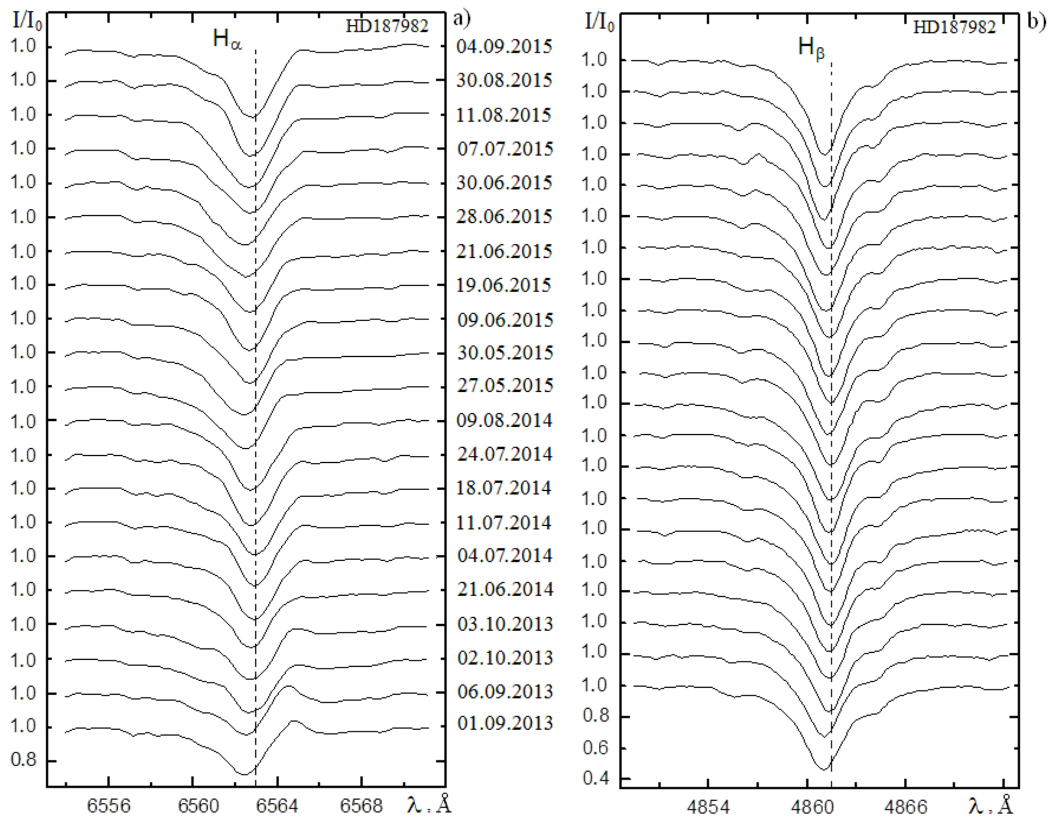


**Fig. 2. Profiles of the Hα and Hβ lines in the spectra of the star HD187982 observed in 2013-2015**

Next observations of this star were carried out from May 27, 2015 to September 04, 2015. The radial velocities of Hα and Hβ lines changed between -30 km/s÷-14 km/s and -33 km/s÷-5 km/s. Table 2 also shows that the equivalent widths of Hα and Hβ lines changed with time significantly in the observation periods. However, we didn't find periodicity in such changes. Therefore we suggest that to reveal periodicity additional observational materials are necessary.

So, investigations above showed that HD198478 and HD187982 are spectroscopically variable, especially RVs changes differently with time. Therefore we also investigated other numerous spectral lines in the considered spectra. We estimated the radial velocities of the strong and basically weak absorption lines formed in deeper layers of atmosphere. All measurements were presented in the Table 3 and Table 4. We averaged the values of velocities of all photospheric absorption lines and determined the mean velocities, $V_r^{'}$=-8.5 km/s and $V_r^{''}$=-3.0 km/s, respectively. As seen these values are close to the velocities of the mass centers of HD198478 and HD187982 stars ($V_r$=-7.2 km/s and $V_r$=-2.9 km/s) which are presented in SIMBAD Astronomical Database.

On the other hand we constructed dependences of radial velocities on residual intensities $V_r$(r) for these lines (Fig. 3). If the dependence of $V_r$ on r exists, it can be considered as "kinematic slice" of the atmosphere. Fig. 3 shows that approximately from r=0.75 to r→1 and from r=0.55 to r→1, these changes are almost close to the horizontal straight line with a sharp break. Such forms of the curves $V_r$(r) are characteristic of the majority of the B and A supergiants.

## 3. RESULTS AND DISCUSSION

The analysis of the emission and absorption components of the Hα lines showed that the radial velocities change rapidly with time. These changes may be an indication of complex motions in the atmosphere of the star HD198478. Observations showed that Hα disappears on July 02-04, 2010 and on September 07, 2014 (Fig. 1a).

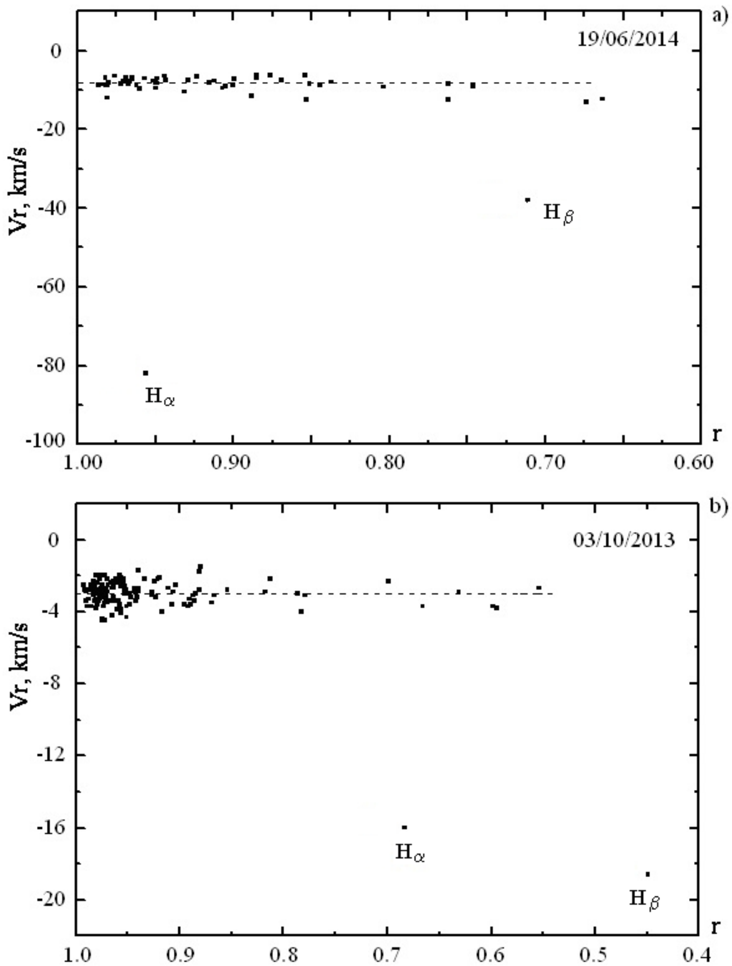


**Fig. 3. Kinematic slices: a) for HD198478 and b) for HD187982**

A possible explanation is that when the stellar wind matter is moving away from the observer, the central frequencies of the emission and absorption components can be the same and compensate for each other, which may lead to the disappearance of the Hα profiles. The Hβ line is known to form in deeper atmospheric layers than Hα. It follows from Table 2 that, on July 02-04, 2010, and on September 07, 2014, the Hβ line was shifted to longer wavelengths. These observational facts could be an argument for the possible movement of stellar wind matter away from the observer up to the Hβ line formation layers at the time of the disappearance of the Hα lines.

The discovered observational evidence suggests that the non-stationary atmosphere of the star HD198478 may partly be due to the non-spherical stellar wind [17-19].

The profile of the Hα line observed in the atmosphere of the HD187982 supergiant indicates also variable structure. The radial velocities of the Hα and Hβ lines change with time.

As seen from Fig. 2a the absorption in the line of Hα has variable structure in the spectrum of the star HD187982 depending on the activity phase of the atmosphere. The profile of the line has normal P Cyg type in the active phase of the star atmosphere. The emission component in the red wing of the profile forms and disappears. It is supposed that such variations may be due to non-stationary and strong flow substance in the atmosphere of this star. The radial velocity and spectral parameters of Hβ line changes with time too. We can see from Table 3 and Table 4 on June 19, 2014, and on October 03, 2013, the radial velocities of lines Hα and Hβ lines which they are -82 km/s, -38 km/s and -16 km/s, -18.6 km/s, respectively. But the average velocities of the most photospheric absorption lines are approximately same with the velocities of mass centers (See Fig. 3). From these observational facts we can also conclude about the dynamical stability of the very deeper layers in which photospheric absorption lines are formed.

As seen the radial velocities of only Hα and Hβ lines differ sharply from the velocity of the mass center of the star HD198478 (~73 km/s and ~29 km/s). But for HD187982 those changes are ~13 km/s and ~16 km/s.

So, we can conclude that at that time there is an increasing rate of movement to the upper layers of the atmosphere i.e. there is outflow of matter from the star HD198478. In this case, especially the upper layers of the atmosphere of the star HD198478 is expanding. These observational facts suggest that at this phase the atmosphere of the star has an activity.

The upper layers of the atmosphere of HD187982 star is also expansion phase, but the velocity of expansion is very slow than HD198478 star.

It is known that the Hα and Hβ lines form in the upper layers of the stellar atmosphere, in the region of generation of stellar wind [20]. The variable wind and its accelerated motion in supergiants is caused by the strong flux of radiation from the star. Outer atmospheres of supergiant stars are exposed to more intense changes than internal.

Thus, the stellar radiation flux and the variable stellar wind lead to corresponding changes in the outer layers of the atmosphere and the star envelope. As a result, we observe variable absorption and emission components of different forms of the Hα line P Cyg-profile of the star.

On the other hand as is known, the variable stellar wind in the supergiants is caused by the pulsation [21]. If these changes in the stars HD198478 and HD187982 are associated with the pulsation, they should occur periodically. But the amount of obtained data and their inconsistency in observation time does not make it possible to make such far-reaching conclusions in this paper.

For detailed investigation of these events, additional systematic observations of these stars with high resolution are planned at the Shamakhy Astrophysical Observatory in the near future.

**Table 1. Measurement of the radial velocities and equivalent widths**

| HD198478 Date, JD | Hα, Vr(abs) km/s | Hα, W(abs) Å | Hα, Vr(em) km/s | Hα, W(em) Å | Hβ, Vr(abs) km/s | Hβ, W(abs) Å |
|---|---|---|---|---|---|---|
| 2455378.30 | -97 | 0.17 | 23 | 0.22 | -22 | 1.27 |
| 2455380.34 | ? | ? | ? | ? | -15 | 1.31 |
| 2455381.38 | ? | ? | ? | ? | -13 | 1.31 |
| 2455382.33 | ? | ? | ? | ? | -14 | 1.17 |
| 2455383.30 | - | - | 13 | 0.32 | -20 | 1.04 |
| 2455384.33 | - | - | 23 | 0.46 | -23 | 1.03 |
| 2455385.38 | - | - | 5 | 0.34 | -20 | 1.10 |
| 2455386.37 | - | - | 2 | 0.12 | -16 | 1.17 |
| 2455387.37 | - | - | 3 | 0.18 | -17 | 1.18 |
| 2455388.33 | - | - | 6 | 0.23 | -23 | 1.06 |
| 2455389.33 | - | - | 6 | 0.48 | -29 | 1.04 |
| 2455396.32 | -90 | 0.07 | 6 | 0.14 | -29 | 1.22 |
| 2456901.22 | -89 | 0.15 | 88 | 0.20 | -44 | 1.09 |
| 2456908.21 | ? | ? | ? | ? | -4 | 1.30 |
| 2456909.26 | -30 | 0.29 | - | - | -13 | 1.05 |
| 2456910.16 | -21 | 0.37 | 106 | 0.02 | -14 | 1.16 |
| 2456911.10 | -16 | 0.23 | 94 | 0.03 | -17 | 1.19 |
| 2456912.13 | -21 | 0.27 | 118 | 0.06 | -19 | 1.14 |
| 2456916.26 | -29 | 0.09 | 84 | 0.15 | -21 | 1.09 |

**Table 2. Measurement of the radial velocities and spectral parameters**

| HD187982 Date, JD | Hα, Vr(abs) km/s | Hα, W(abs) Å | Hα, Vr(em) km/s | Hα, W(em) Å | Hβ, Vr(abs) km/s | Hβ, W(abs) Å |
|---|---|---|---|---|---|---|
| 2456537.21 | -29 | 0.89 | 79 | 0.20 | -33 | 2.46 |
| 2456542.20 | -23 | 0.77 | 70 | 0.30 | -33 | 2.26 |
| 2456568.21 | -18 | 1.29 | - | - | -18 | 2.40 |
| 2456569.23 | -17 | 1.33 | - | - | -19 | 2.42 |
| 2456830.36 | -11 | 1.06 | - | - | -16 | 2.35 |
| 2456843.34 | -5 | 1.15 | - | - | -9 | 2.53 |
| 2456850.29 | -6 | 1.10 | - | - | -13 | 2.41 |
| 2456857.38 | -5 | 1.33 | - | - | -8 | 2.57 |
| 2456863.30 | -12 | 1.36 | - | - | -14 | 2.41 |
| 2456879.29 | -13 | 1.38 | - | - | -12 | 2.80 |
| 2457170.36 | -24 | 1.30 | - | - | -6 | 2.31 |
| 2457173.35 | -30 | 1.29 | - | - | -14 | 2.28 |
| 2457183.47 | -17 | 1.23 | - | - | -5 | 2.20 |
| 2457193.45 | -19 | 1.15 | - | - | -15 | 2.42 |
| 2457195.43 | -16 | 1.22 | - | - | -14 | 2.34 |
| 2457202.36 | -25 | 1.29 | - | - | -23 | 2.45 |
| 2457204.31 | -27 | 1.36 | - | - | -25 | 2.31 |
| 2457211.34 | -16 | 1.48 | - | - | -18 | 2.13 |
| 2457246.29 | -19 | 1.59 | - | - | -33 | 1.98 |
| 2457265.40 | -14 | 1.39 | - | - | -30 | 2.23 |
| 2457270.39 | -14 | 1.70 | - | - | -30 | 2.23 |

**Table 3. The identification of lines, residual intensities (r) and heliocentric radial velocities (Vr) in spectra HD198478**

| 19.06.2014 | | | | | |
|---|---|---|---|---|---|
| **Elements, λ, Å** | **Vr, km/s** | **rν** | **Elements, λ, Å** | **Vr, km/s** | **rν** |
| CII 6582.88 | -9.2 | 0.804 | SII 5606.15 | -8 | 0.966 |
| CII 6578.05 | -9 | 0.746 | NII 5495.67 | -7.1 | 0.957 |
| Hα 6562.816 | -82 | 0.956 | SII 5473.62 | -6.8 | 0.969 |
| NeI 6506.53 | -7 | 0.965 | SII 5453.83 | -8.7 | 0.900 |
| NII 6482.05 | -7.7 | 0.912 | SII 5432.82 | -10.5 | 0.931 |
| NeI 6402.25 | -7.5 | 0.929 | SII 5428.67 | -9.6 | 0.960 |
| NeI 6382.99 | -12 | 0.981 | SII 5345.72 | -7.9 | 0.969 |
| SiII 6371.36 | -8.2 | 0.915 | SII 5320.73 | -7.4 | 0.965 |
| SiII 6347.10 | -11.5 | 0.888 | FeII 5316.65 | -8.8 | 0.982 |
| SiII 6312.66 | -8.8 | 0.981 | FeIII 5193.89 | -7.7 | 0.970 |
| NeI 6163.59 | -8.6 | 0.984 | FeII 5169.03 | -7.1 | 0.949 |
| NeI 6143.06 | -9.5 | 0.950 | OII 5160.02 | -8.8 | 0.986 |
| NeI 6074.34 | -8.7 | 0.981 | FeIII 5156.12 | -6.7 | 0.923 |
| HeI 5875.72 | -13 | 0.674 | CII 5145.16 | -8.7 | 0.962 |
| NaI D1 | -11.6 | 0.356 | CII 5133.12 | -6.5 | 0.976 |
| NaI D2 | -10.6 | 0.408 | HeI 5047.74 | -12.4 | 0.853 |
| FeIII 5833.93 | -6.4 | 0.944 | NII 5045.10 | -6.3 | 0.876 |
| NII 5747.30 | -8.5 | 0.967 | SII 5027.22 | -8.2 | 0.980 |
| SiIII 5739.73 | -6.2 | 0.854 | FeII 5018.44 | -8.3 | 0.949 |
| AlIII 5722.73 | -9 | 0.905 | HeI 5015.68 | -12.6 | 0.762 |
| NII 5710.77 | -7.3 | 0.899 | NII 5007.33 | -7.5 | 0.943 |
| AlIII 5696.60 | -8.5 | 0.851 | NII 5005.15 | -6.2 | 0.885 |
| NII 5686.21 | -7 | 0.885 | NII 5001.4 | -8.8 | 0.844 |
| NII 5679.56 | -8.4 | 0.762 | SII 4994.36 | -7.7 | 0.951 |
| NII 5676.02 | -7.5 | 0.869 | SII 4991.97 | -6.9 | 0.982 |
| NII 5666.63 | -8 | 0.837 | OII 4941.12 | -8.3 | 0.980 |
| SII 5659.99 | -8.4 | 0.972 | HeI 4921.93 | -12.3 | 0.663 |
| SII 5647.03 | -8.2 | 0.950 | SII 4917.21 | -7.9 | 0.968 |
| SII 5639.97 | -9.5 | 0.907 | Hβ 4861.337 | -38 | 0.711 |

**Table 4. The identification of lines, residual intensities (r) and heliocentric radial velocities (Vr) in spectra HD187982**

| 03.10.2013 | | | | | |
|---|---|---|---|---|---|
| **Elements, λ, Å** | **Vr, km/s** | **rν** | **Elements, λ, Å** | **Vr, km/s** | **rν** |
| Hα 6562.816 | -16 | 0.683 | SII 5432.82 | -2.7 | 0.940 |
| NeI 6506.53 | -7.4 | 0.970 | FeII 5425.25 | -2.9 | 0.926 |
| FeII 6456.38 | -3.0 | 0.786 | CrII 5420.93 | -2.9 | 0.981 |
| FeII 6446.41 | -3.4 | 0.968 | CrII 5407.62 | -3.3 | 0.980 |
| FeII 6432.68 | -1.7 | 0.940 | FeII 5395.96 | -2.9 | 0.973 |
| FeII 6416.93 | -2.1 | 0.919 | FeII 5393.85 | -2.7 | 0.984 |
| NeI 6402.25 | -3.2 | 0.977 | FeII 5387.07 | -2.8 | 0.952 |
| SiII 6371.36 | -2.9 | 0.631 | FeII 5375.84 | -3.3 | 0.981 |
| SiII 6347.10 | -2.7 | 0.554 | FeII 5370.30 | -3.0 | 0.978 |
| FeII 6331.96 | -2.2 | 0.954 | FeII 5362.87 | -2.9 | 0.818 |
| FeII 6317.99 | -2.2 | 0.934 | FeII 5339.59 | -2.0 | 0.958 |
| AlII 6243.37 | -2.2 | 0.970 | FeII 5337.73 | -3.1 | 0.973 |
| FeII 6238.39 | -2.5 | 0.904 | FeII 5325.56 | -2.1 | 0.919 |
| FeII 6175.16 | -3.9 | 0.956 | FeII 5316.66 | -3.7 | 0.666 |
| OI 6158.18 | -12.0 | 0.925 | CrII 5313.58 | -3.2 | 0.941 |
| OI 6156.77 | -17.0 | 0.932 | CrII 5310.69 | -2.9 | 0.983 |
| FeII 6149.25 | -4.0 | 0.917 | CrII 5308.42 | -3.3 | 0.971 |
| FeII 6147.74 | -2.7 | 0.911 | CrII 5305.86 | -2.6 | 0.957 |
| FeII 6103.54 | -4.4 | 0.974 | MnII 5302.32 | -2.8 | 0.980 |
| FeII 6084.10 | -2.0 | 0.972 | FeII 5291.67 | -3.0 | 0.953 |
| PII 6043.12 | -2.4 | 0.960 | FeII 5284.10 | -2.2 | 0.921 |
| FeII 5991.37 | -2.2 | 0.961 | CrII 5279.86 | -2.6 | 0.974 |
| SiII 5978.93 | -1.8 | 0.881 | FeII 5276.00 | -2.8 | 0.854 |
| FeII 5961.71 | -2.6 | 0.953 | FeII 5272.39 | -2.1 | 0.956 |
| SiII 5957.56 | -2.8 | 0.881 | FeII 5264.80 | -3.4 | 0.886 |
| NaI 5895.92 | -2.5 | 0.565 | FeII 5260.26 | -3.7 | 0.892 |
| NaI 5889.95 | -3.8 | 0.523 | FeII 5257.11 | -2.4 | 0.966 |
| HeI 5875.72 | -1.5 | 0.880 | FeII 5254.93 | -3.1 | 0.926 |
| SiII 5868.40 | -2.5 | 0.992 | FeII 5251.24 | -2.9 | 0.943 |
| FeII 5835.49 | -3.3 | 0.987 | CrII 5249.43 | -2.3 | 0.983 |
| FeII 5813.67 | -3.2 | 0.974 | CrII 5237.32 | -2.9 | 0.906 |
| FeII 5726.56 | -2.9 | 0.979 | FeII 5234.62 | -4.0 | 0.783 |
| SII 5606.15 | -2.0 | 0.977 | FeII 5227.49 | -3.3 | 0.891 |
| FeII 5588.21 | -3.5 | 0.970 | FeII 5216.85 | -2.7 | 0.943 |
| FeII 5577.92 | -4.5 | 0.975 | CrII 5210.85 | -3.7 | 0.985 |
| FeII 5544.76 | -4.3 | 0.951 | CrI 5206.04 | -2.8 | 0.988 |
| FeII 5534.84 | -3.1 | 0.867 | FeII 5203.64 | -2.0 | 0.981 |
| FeII 5510.78 | -2.2 | 0.977 | FeII 5197.58 | -3.1 | 0.779 |
| CrII 5508.62 | -2.7 | 0.976 | TiII 5188.69 | -3.7 | 0.951 |
| FeII 5506.20 | -3.2 | 0.923 | SiII 5185.54 | -2.5 | 0.969 |
| FeII 5503.22 | -3.6 | 0.958 | MgI 5183.61 | -3.6 | 0.907 |
| FeII 5487.63 | -3.6 | 0.948 | FeII 5180.32 | -3.1 | 0.983 |
| FeII 5482.32 | -2.5 | 0.963 | FeII 5177.39 | -2.9 | 0.970 |
| CrII 5478.37 | -3.9 | 0.960 | MgI 5172.69 | -3.0 | 0.948 |
| FeII 5466.92 | -3.4 | 0.942 | FeII 5169.03 | -2.3 | 0.699 |
| SII 5453.83 | -3.0 | 0.976 | FeII 5149.46 | -2.8 | 0.953 |
| FeII 5146.12 | -2.7 | 0.965 | HeI 5015.68 | -2.8 | 0.971 |
| FeII 5144.36 | -3.2 | 0.963 | SII 5009.56 | -4.5 | 0.972 |
| FeII 5136.80 | -3.0 | 0.978 | FeII 5007.45 | -3.1 | 0.971 |
| FeII 5132.67 | -2.8 | 0.977 | FeII 5004.20 | -2.3 | 0.924 |
| FeII 5127.86 | -2.4 | 0.957 | FeII 5001.92 | -3.6 | 0.895 |
| FeII 5120.34 | -2.8 | 0.991 | FeII 4993.35 | -3.2 | 0.947 |
| FeII 5117.03 | -2.8 | 0.988 | FeII 4990.50 | -2.4 | 0.955 |
| FeII 5106.11 | -2.5 | 0.985 | FeII 4984.50 | -2.3 | 0.964 |
| FeII 5100.74 | -3.6 | 0.889 | FeII 4977.03 | -2.7 | 0.971 |

| 03.10.2013 | | | | | |
|---|---|---|---|---|---|
| **Elements, λ, Å** | **Vr, km/s** | **rν** | **Elements, λ, Å** | **Vr, km/s** | **rν** |
| FeII 5097.27 | -3.9 | 0.957 | FeII 4969.36 | -3.3 | 0.977 |
| FeII 5093.57 | -2.3 | 0.954 | FeI 4957.59 | -3.4 | 0.978 |
| FeII 5089.22 | -3.0 | 0.976 | FeII 4951.59 | -2.4 | 0.956 |
| FeII 5087.26 | -2.4 | 0.979 | FeII 4948.10 | -2.6 | 0.981 |
| FeII 5082.23 | -2.8 | 0.981 | FeII 4923.92 | -8.3 | 0.595 |
| FeII 5075.77 | -2.7 | 0.964 | SII 4917.21 | -3.4 | 0.982 |
| FeII 5074.05 | -3.0 | 0.975 | FeII 4913.30 | -3.7 | 0.973 |
| TiII 5072.30 | -2.9 | 0.990 | TiII 4911.19 | -3.8 | 0.980 |
| FeII 5070.90 | -3.5 | 0.972 | FeII 4908.15 | -3.4 | 0.990 |
| FeII 5061.72 | -2.5 | 0.974 | FeII 4893.81 | -2.2 | 0.977 |
| SiII 5056.06 | -3.0 | 0.884 | CrII 4876.40 | -3.1 | 0.887 |
| FeII 5047.64 | -2.6 | 0.956 | Hβ 4861.34 | -18.6 | 0.449 |
| FeII 5045.11 | -2.7 | 0.983 | CrII 4848.25 | -3.0 | 0.885 |
| SiII 5041.03 | -2.2 | 0.813 | CrII 4836.24 | -3.4 | 0.963 |
| FeII 5035.71 | -2.9 | 0.940 | CrII 4824.14 | -3.5 | 0.869 |
| FeII 5032.71 | -4.1 | 0.956 | SII 4815.55 | -3.6 | 0.979 |
| FeII 5022.79 | -3.4 | 0.959 | TiII 4779.98 | -4.2 | 0.965 |
| FeII 5018.44 | -5.7 | 0.598 | MnII 4764.70 | -3.7 | 0.989 |

## 4. CONCLUSION

1. The Hα profile of the hydrogen presented a complicated structure and a time variation for HD198478 star.
   For the first time a P Cyg type profile of the Hα line has been found to occasionally disappear in the spectra of this supergiant star in 2010. This behavior has repeated in 2014 again.
   This event may be a manifestation of a non-stationary atmosphere of the star or a non-spherical stellar wind. It is the result of the interaction of the variable stellar wind with the flux of material directed away from the observer. This time the emission line is compensated by the shifted toward the red side absorption line in the Hα profile.
2. When the Hα line disappears or becomes faint the Hβ line is displaced to the relatively longer wavelengths.
3. It has been revealed that absorption in the line of Hα has variable structure in the spectrum of the star HD187982 depending on the activity phase of the atmosphere.
4. The profile of the line has normal P Cyg type in the active phase of the star atmosphere. The emission component in the red wing of the profile forms and disappears. It is supposed that such variations may be due to non-stationary and strong flow substance in the atmosphere of this star.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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