NON-STATIONARY PROCESSES IN THE ATMOSPHERE OF THE SUPERGIANT HD 208501 (B8 IB)

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By using the spectrograms obtained at the 2-m telescope of the Shamakhy Astrophysical Observatory for the period of 2013±2018 the variation of a profile and spectral parameters of Hα and of the sodium NaI D lines of the supergiant HD208501 have been investigated. It was revealed that in the spectrum of this star, the radial velocity and the equivalent width of the absorption component of the Hα and of the sodium NaI D lines vary with time these variations occur in antiphase.It was proposed that the antiphase variation of radial velocity and the equivalent width of the absorption component Hα and sodium NaI D lines could be connected with the pulsation of this star and with the interaction star and its shell.

Keywords: stars supergiants–the profile of Hα line– sodium Na I D lines–radial velocities

1. INTRODUCTION

The star 13Cep=HD208501=HR8371 spectral class B8 Ib, V = $5^m.46$ and behaves like a pulsating variable star. 13 Cephei brightness ranges from a magnitude of 5.935 to a magnitude of 5.865 over its variable period. The star is located at a galactic latitude $b = b = +1°.68$ and longitude $l = 100°.39$. The distance to the star is 700ps [1]. According to model method McErlean [2] determined the atmospheric parameters of the star as T_{eff} =13000K, logg=1.8, $logL/L_\odot$ =4.33, vsini = 40km/s, for the distance modulus (m-M) =8.9 (r=602.56ps, M_v=-3.1). Leitherer [3] calculated the mass, radius, brightness and mass loss of the star according to Hα line: $M/M_\odot$ = 10, $R/R_\odot$=54, $log(L/L_\odot)$ = 4.62, $log[(M/M_\odot)yr^{-1})] = -7.35$.

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2. OBSERVATIONAL MATERIAL AND ITS PROCESSING

Spectral observations of HD 208501 star were obtained in 2013-2018 by CCD camera installed in classic spectrograph of diffractional grating (UAGS) which was done by using Escelle spectrometer at the Cassegrain focus of 2- meter telescope of Shamakhy Astrophysical Observatory named after N. Tusi. Since 2015, 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. Spectrum of the day sky was used in order to set up the dispersion curve. The work on spectrums have been conducted by DECH-20 and DECH-20T packet programs presented by [4]. The mean error of determining the equivalent widths was 5%. The error of the radial velocity measurements did not exceed 2 km/s.

21 spectrums of the HD 208501 star were obtained during the years of 2013-2018. According to the comparative study of emission of the profiles of Hα line which were observed in spectrums, absorbing components, as well as NaI D doublet lines, which are formed in the circumstellar envelope, it was determined that Hα line profile's shape, structure and the value of spectral parameters that characterize the profile show frequency in changing and it is observed in following situations (fig.1):

a) Full absorbing profile;

b) Normal P Cyg type profile:-absorbing and emission component in red wing;

c) Inverse P Cyg type profile:- absorbing and emission component in violet wing;

d) In the red and violet wings, the absorption profiles of the Hα line have a weak emission component.

e) The profile of the Hα line is observed in full emission;

f) Decline of the intensity of absorbing and emission components to the level of continuous spectrum;

According to the calculations, a graph (fig.2) has been set up indicating the dependence of the radial velocity of Hα and NaI D2 absorbing components on time. Looking at graph, fig.1 and fig.2, we can say that Hα line's profile shape and spectral parameters change during one-week period or even shorter. For example, from fig.1 we can see that between the dates of 11.08.2015-19.08.2015 emission component in Hα line decreased to the level of continuous spectrum. At fig.2, we can see that Hα absorbing component and NaI D2 doublet line's radial velocity changes depending on time in reflexive space. In star with B type spectral classification, Hα and NaI D2 doublet lines form in different places. Hα line forms in the atmosphere of a star, while NaI D2 line forms in the circumstellar envelope. Absorbing component of Hα line and changes in the radial velocity of NaI D2

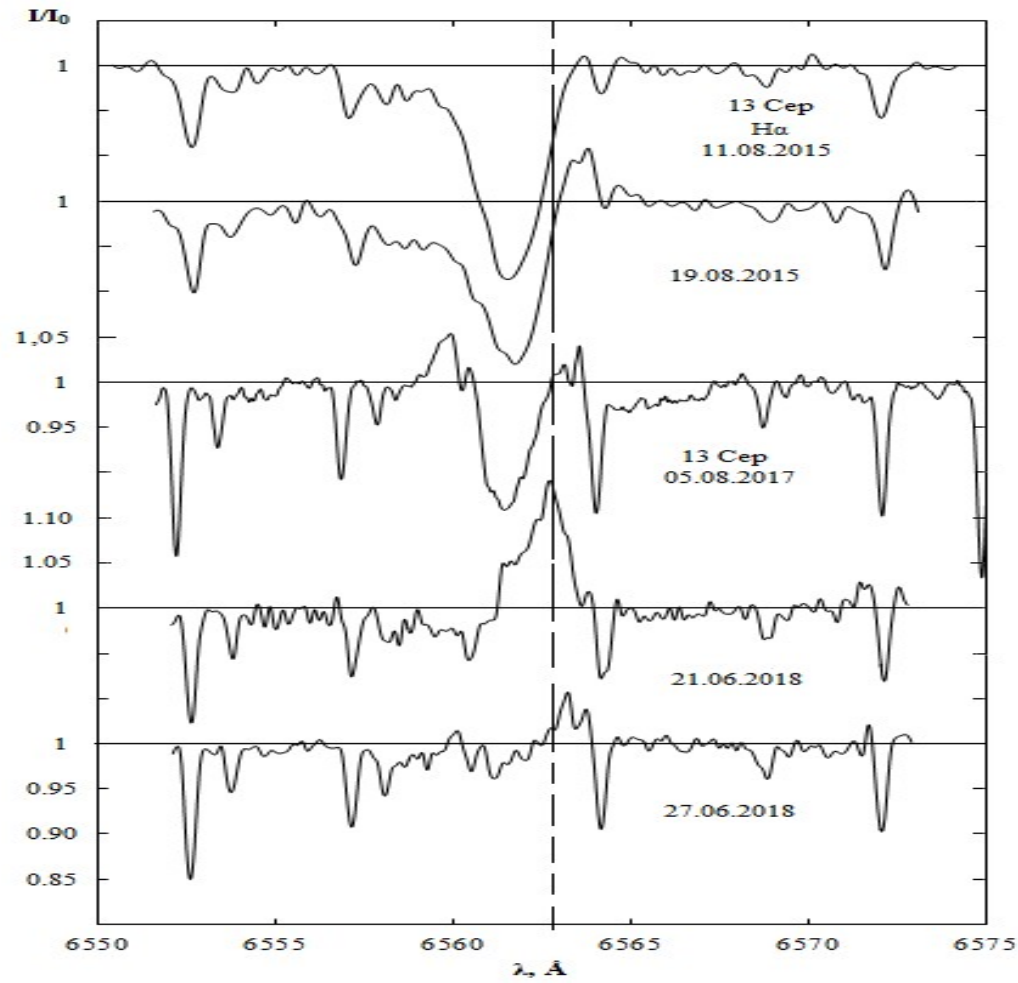

Fig. 1. The profiles of Hα lines observed in the spectrum of HD 208501 supergiant star. Dash line λ (Hα) =6562.816 Åis compatible to wavelength.

doublet line in reflexive space are the evidences indicating a strong relationship between a star and circumstellar envelope. Probably, the change in radial velocity occurs under the same mechanism's impact. It is estimated that, the changes in profile's shape, radial velocity and other parameters can occur due to pulsating of a star, and interaction between a star and a circumstellar envelope.

3. CONCLUSION

According to comparative study of the profiles of Hα and NaI D lines obtained from the spectrums of HD208501 stars in the years of 2013-2018 we can conclude

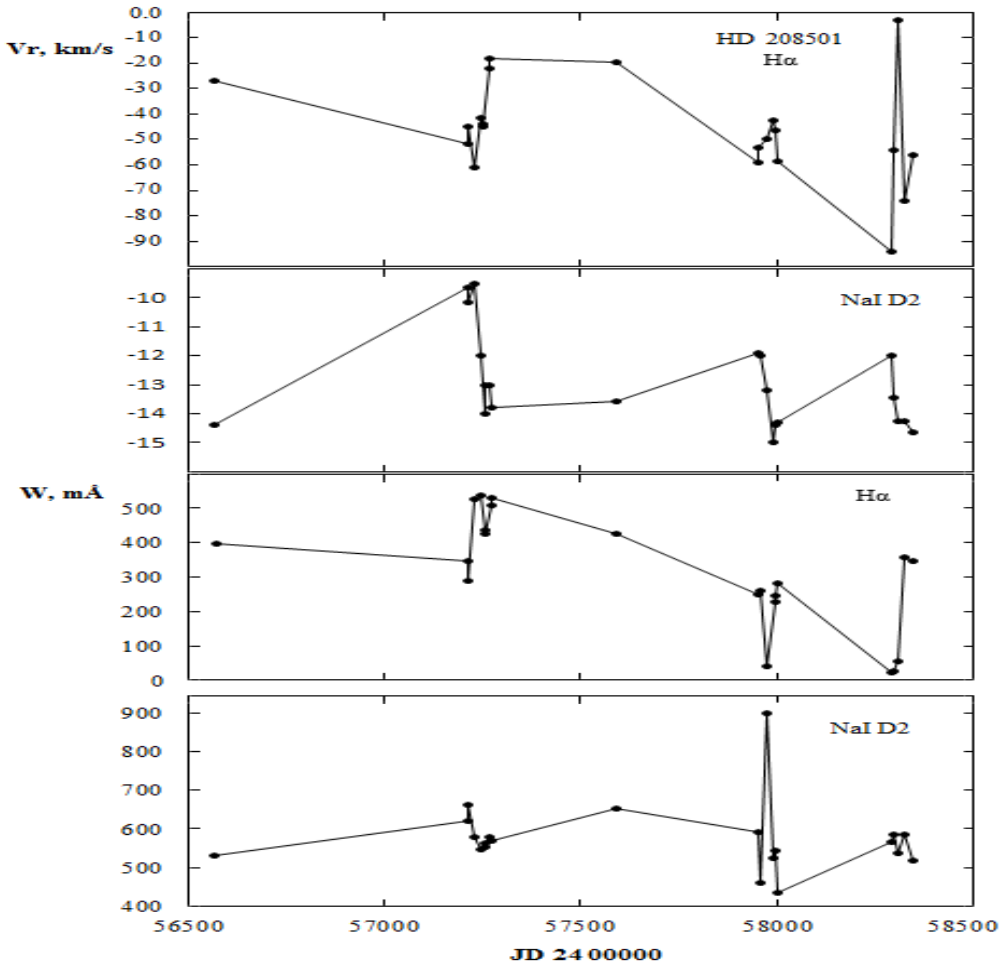

Fig. 2. The varies in the radial velocity and equivalent width in Hα and NaI D2 lines observed in the spectrum of HD 208501 supergiant star depending with time.

that:

1. It has been revealed that, depending on the active phase of the atmosphere of HD21389 star's spectrum Hα lines profile has a complex structure. During different phases of atmospheric varies, the profile of Hα line can be observed in following shapes, figure1:

a) Full absorbing profile;

b) Normal P Cyg type profile:-absorbing and emission component in red wing;

c) Inverse P Cyg type profile:- absorbing and emission component in violet wing;

d) In the red and violet wings, the absorption profiles of the Hα line have a weak emission component;

e) The profile of the Hα line is observed in pure absorption;

f) Decline of the intensity of absorbing and emission components to the level of continuous spectrum;

2. The radial velocity and equivalent width of Hα and NaI D doublet lines' profiles exhibit variability during over several week or shorter time intervals.

3. It was revealed that, absorbing component of Hα line's profile and NaI D lines' radial velocity and equivalent width varies in antiphase, figure2.

It is estimated that, variations in the profile of Hα line can occur due to the varies in absorbing component of Hα lines and variations in the value of the radial velocity and equivalent width of NaI D doublet lines in antiphase depending on time: the pulsating of the star and as a result of interaction between star and circumstellar envelope.

REFERENCES

1. K.Pan, S.R.Federman, K.Cunha, V.V.Smith, D.E.Welty. Cloud Structure and Physical Conditions in Star-forming Regions from Optical Observations. I. Data and Component Structure, The Astrophysical Journal Supplement Series, 151, (2004), 313–343.

2. N.D.McErlean, D.J.Lennon, and P.L.Dufton. Galactic B-supergiants: A non-LTE model atmosphere analysis to estimate atmospheric parameters and chemical compositions, Astron. Astrophys., 349, (1999), 553-572.

3. C.Leitherer. H-alpha as a tracer of mass loss from OB stars, Astrophysical Journal, 326, (1988), 356-367.

4. А.Г.Галазутдинов. Система обработки звездных эшелле-спектров. 1. Обработка изображений. 2. Обработка спектров, Нижний Архыз, (1992), 52, (Препринт / Спец. астрофиз. обсерватория РАН; №92).