SPECTRAL MONITORING OF THE HERBIG AE STAR HD 179218

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Some results of the spectral observations of the Herbig-type Ae star HD 179218, performed on the 2 m telescope of the ShAO of ANAS in 2015-2017, are presented. It was discovered the variation in the spectral parameters of the Hα and Hβ lines and the profiles of these lines in 2015. A wavelike variation in the parameters of the emission component of the Hα line with a characteristic time of $\sim$ 40 days was found. The observed wave is characterized by a significant decrease in the values of the measured line parameters; the branches of decrease and increase are more clearly expressed. At the same time, at the moment of the minimum, the appearance and disappearance of additional blue and red emission-absorption components is observed in the profile of the Hα emission line. The same observed wave was detected in 2016, but according to 2017, only a chaotic change in the spectral parameters of these lines was observed. The variability in the spectrum of the star can be explained by the existence of the polar wind and accretion or the result of the duplicity of the system.

Keywords: stars: variables: Herbig Ae/Be— stars: circumstellar matter — stars: individual – HD179218 .

1. INTRODUCTION

HD 179218 (MWC 614, Sp B9-A2) is an isolated HAeBe type star. Despite the fact that the star is relatively bright comparatively to other HAe stars, it has been studied less. Only when the star was included in the catalog of The et al. [1], it became the subject of active research. The circumstellar surroundings of the star were studied by IR photometry and speckle interferometry by Millan-Gabet et al. [2], Prizkal et al. [3], which did not reveal closely spaced components. Spec-

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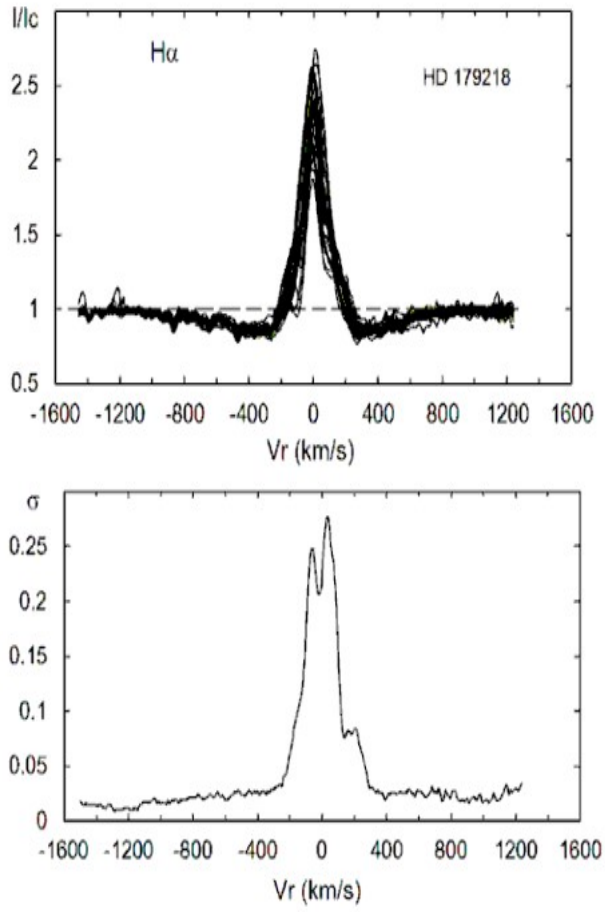

Fig. 1. The overlaying profiles of the line Hα (top panel) and variation in the root-mean- square deviation σ of the intensity versus of the radial velocities (bottom panel). Here I – is the intensity at the given wavelength of the spectrum, and Ic – the intensity of the

tral studies of the star were performed by Miroshnichenko et al. [4] and in more detail by Kozlova [5], Kozlova and Alexeev [6].

According to the classification [7], the spectral energy distribution (SED) of the star belongs to group I, i.e. starting with the infrared band K and further there is an excess of radiation excited in the dust. On the [8] the profile of the line Hα is consisting of a stable single-peak structure. Perhaps the star has a close companion, about 2.5 arcsec distance [9]. Fedele et al. [10] showed that the star has two dust rings at distances of 1 AU and 20 AU, and the space between

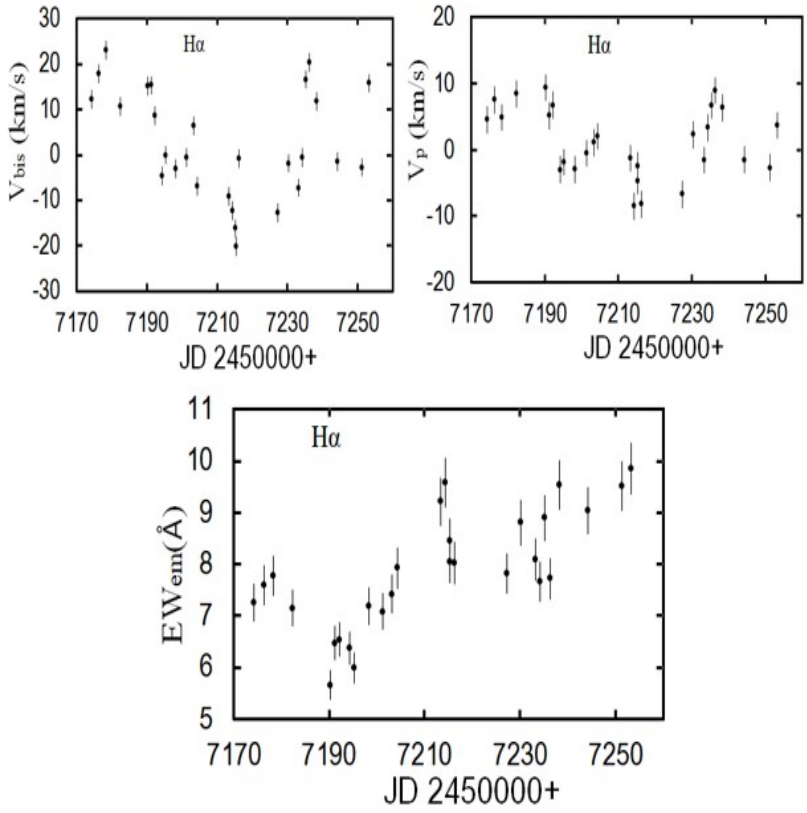

Fig. 2. Variation of radial velocities Vbis (upper left panel), Vp (upper right panel) and equivalent widths (bottom panel) of emission component in the line Hα. The values of the vertical bars are corresponding to the average error of parameters continuum at the same wavelength.

from 1 to 6 AU from the star filled with gas. The magnetic field of the star was measured by Hubrig et al. [11] where on the data 2008 they have got about 51 $\pm$ 30 G.

The purpose of this report is present the results of spectral monitoring of the star in the visual range of spectrum.

2. THE LINE Hα.

This line has a complex structure which consists of an emission component that is superimposed on the core of broad photospheric absorption. The structure of the emission component varies from night to night, sometimes in both the red and blue wings of the line, additional emission components appear and disappear.

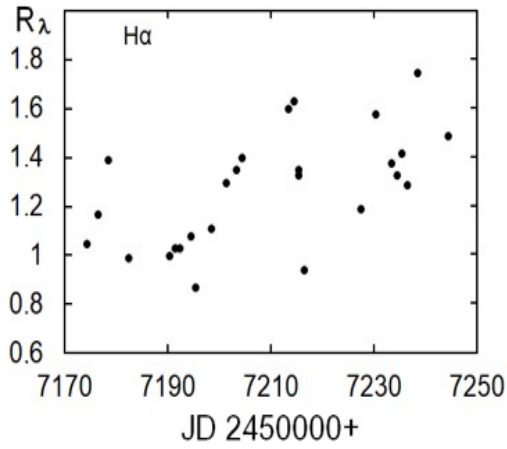

Fig. 3. Variation in time of the parameters FWHM (left panel) and Rλ (right panel) of the emission component of the line Hα.

Fig.1 shows all overlaying profiles of the Hα line, as well as the variation in the root-mean-square deviation σ from the average in intensity for a given value of the radial velocity. Here (and further for other line profiles) the ordinate is given by the ratio relative intensity I/Ic, where I – the intensity at a given wavelength of the spectrum, and Ic – the continuum intensity at the same wavelength. Hence it can be seen that the main variability in the central emission occurs at the peak, and also to a lesser extent on both wings. It is also seen that the intensity varied on the blue wing is noticeably larger than on the red wing. The appearance of the blue component is observed between dates JD2457190-2457196, and its gradual disappearance. Exactly on these dates, there is a deep minimum in the values of the parameters RV, EW, FWHM (Figures 234).

3. LINES Hβ AND HEI 5876

In the line Hβ mainly we have observed a wide photospheric profile, on which at some nights are superimposed weak emission peaks (Fig.5). In most cases, such emission peaks are located symmetrically with respect to the line center, and have displacements about from -150 to -270 km/s in blue and from +150 to +250 km/s in the red wings, respectively. In the Fig.6 have shown the spectral region containing the lines He I λ5876 Åand the sodium doublet D1, D2 NaI. This section presents the results of the analysis for the helium line. As can be seen, this line has blue and red emission components separated by a central absorption.

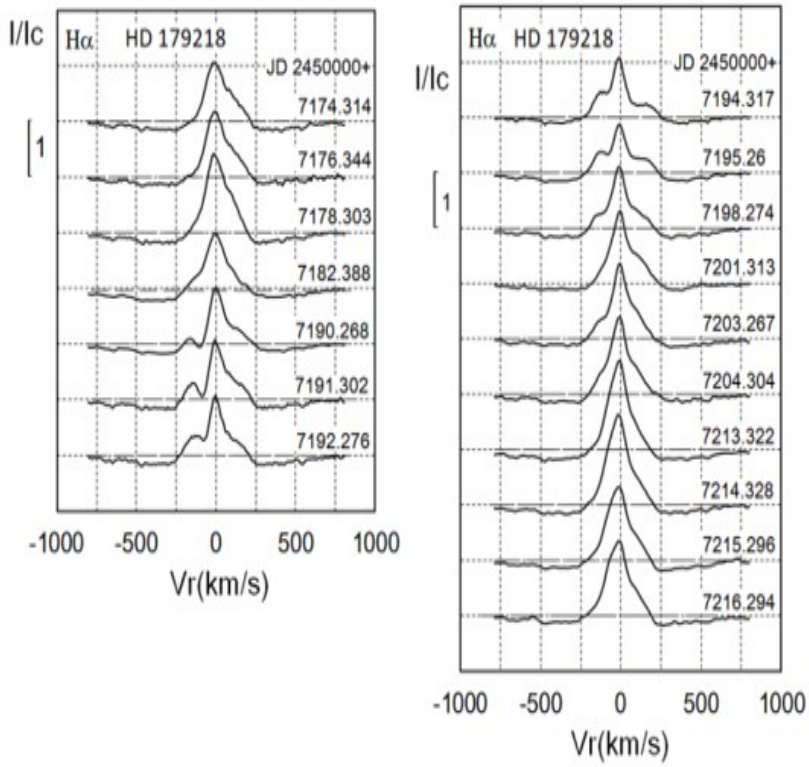

Fig. 4. Variations in the profile of the emission component of the line Hα for the descending and ascending branches over 42 days of observations in the first wave-like variations.

In Fig.7 and 8 the time variation in the spectral parameters of the lines Hβ and He I λ5876 Ålines is presented. As can be seen, in general, these lines show a synchronous variation with the Hα-line. Moreover, we can see a large chaotic scatter and sometimes large dips in the parameters of individual lines. As can be seen from Fig.8 during the deep minimum in the parameters of the Hα line, a flare like increase in the intensity of the He I λ 5876 Åline is observed.

4. LINES D NAI AND SI II LINE

Figure 9 shows that the profiles of the D1, D2 NaI lines represent narrow blue-wing absorption lines in which they will have a weak emission (inverse P Cyg). Such structure is a sign of matter accretion. Interestingly, according to [5], the profiles of these lines have an emission component on the red wings. This

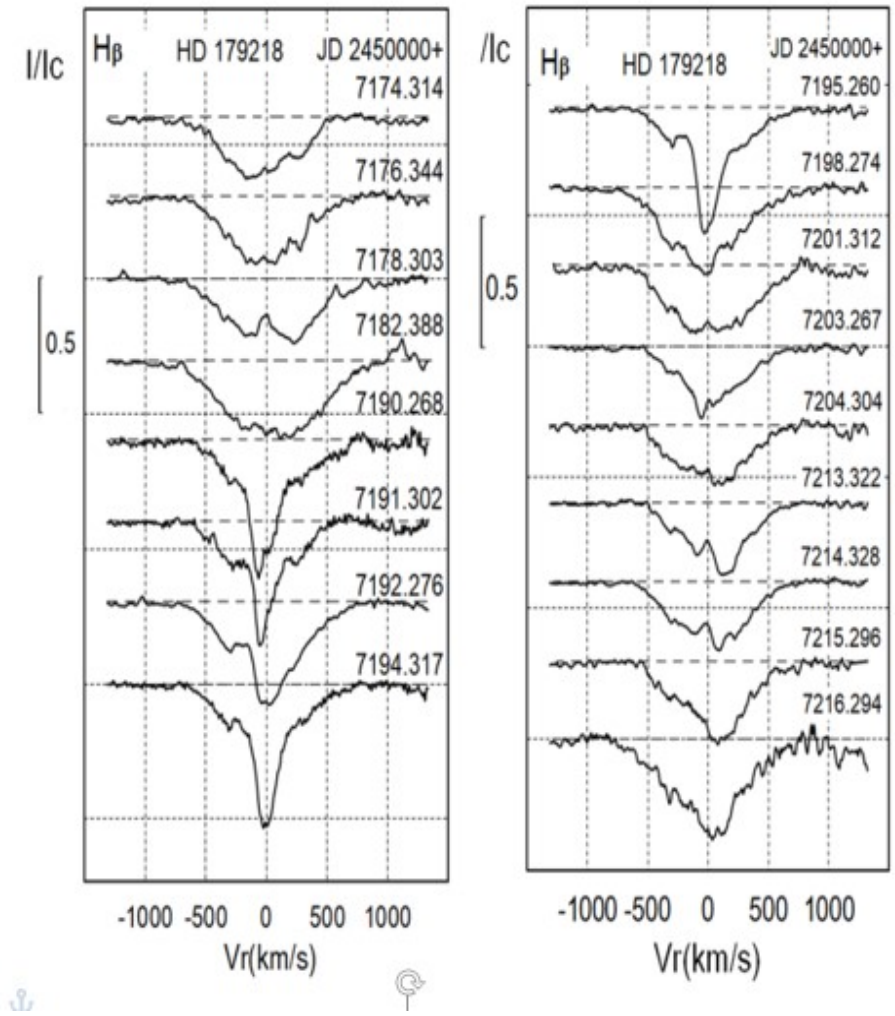

Fig. 5. The profiles of the line Hβ obtained at the first wave of variations in the spectral parameters lines of the line. The left panel corresponds to the time of fall, the second panel, the increase in the parameters of the line.

indicates that in these lines in different seasons both the matter outflow and its accretion can be observed. Perhaps this depends on the orientation of the direction of motion of the circumstellar gas to the observer.

The Fig. 9 shows diagrams of time variations for the parameters of D1, D2 NaI lines. As can be seen, in general, the radial velocities of the peak of lines Vp show a radial velocity of -15 km/s with a mean scatter $\pm$ 10 km/s. The shift of the radial velocity of the peak Vp to the blue part of the spectrum is observed

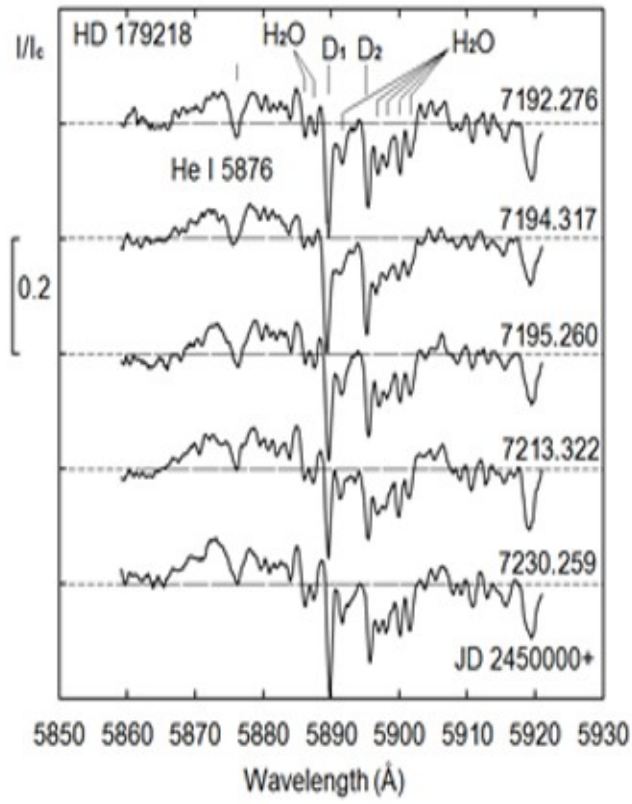

Fig. 6. A spectral range of spectra is containing of Hel 5876 Åand doublet D1, D2 NaI. (Individual sky atmospheric lines are indicated).

with a decrease in the intensity of the hydrogen lines.

The intensities Rλ of the D1, D2 NaI lines show a wavy-like variation with a small amplitude. A similar character of the variations is shown also by the FWHM of lines (Fig.9). The characteristic time of variations in individual waves is about 10-20 days. The last line of the panels below shows the variation in the intensity ratios and the equivalent widths of the lines D2 to D1. The lines Si II λ6347, 6371 Åare observed in the absorption without signs of the presence of the emission components. The mean value of FWHM of the lines Si II λ6347, 6371 Åwas obtained 2.37 ± 0.05 Åwith the mean-square deviation from the mean value $\pm$ 0.37 Åand $\pm$ 0.50 Å, respectively.

In the Fig.10 was shown fragments of the star's spectrum section containing Si II lines of λ6347, 6371 Å, as well as the [OI] λ 6363 Åline. As can be seen, the general structure of Si II line profiles varies considerably from night to night.

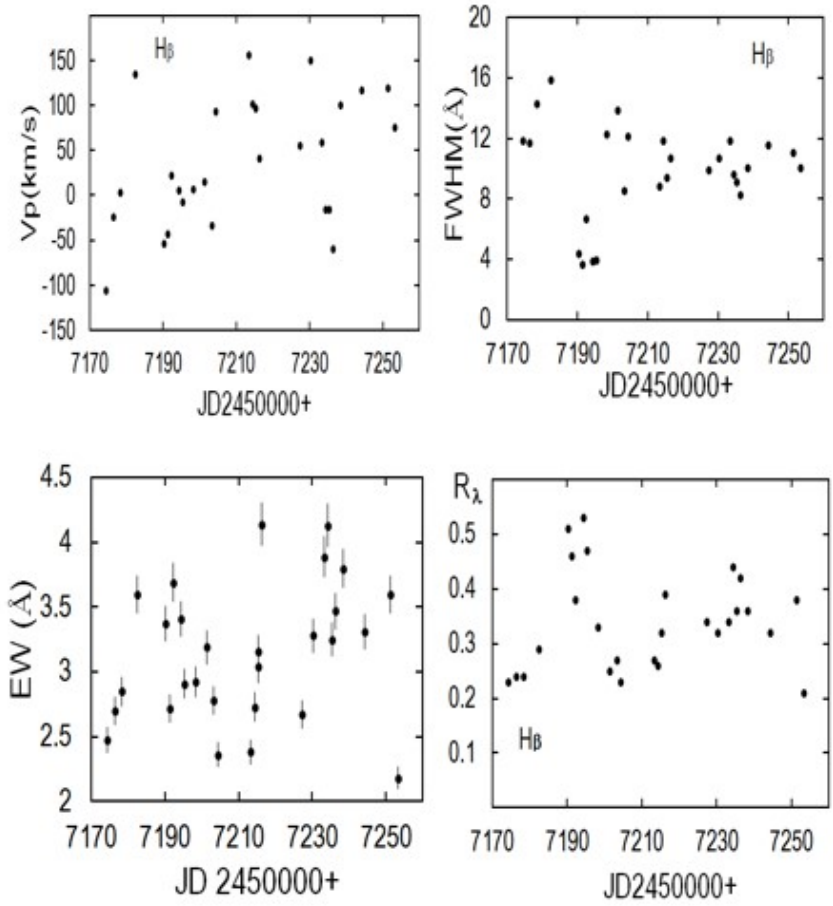

Fig. 7. The time variation of the radial velocity of the peak Vp (upper left panel), half width FWHM (upper right panel), equivalent width EW (lower left panel) and intensity Rλ (lower right panel) of the line Hβ.

5. CONCLUSION

The results of spectral observations of the Herbig Ae/Be type star HD 179218 are presented. Two wave-like cycles of variability in the parameters of hydrogen lines Hα and Hβ with a characteristic time of $\sim$ 40 days are revealed. The first wave of variations is deeper; the branches of decreasing and increasing the spectral parameters of the lines are more clearly expressed. At the time of the first minimum, in the profile of the emission line Hα the appearance and disappearance of additional blue and red emission components are observed. At the same time,

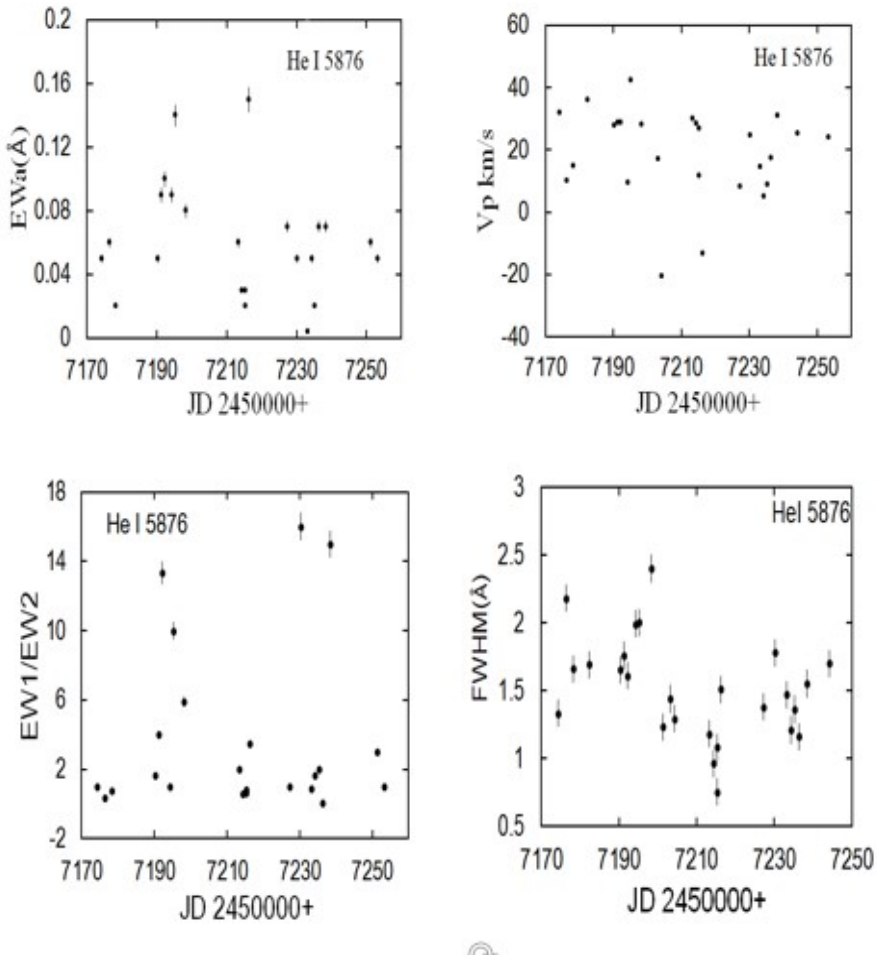

Fig. 8. The time variation of the spectral parameters of the He I line is λ5876 Å.

narrow absorption components were discovered in the Hβ line. Synchronously with this, a significant variation in the lines of He I, Si II, D NaI, [OI] was observed. In addition, the parameters of many spectral lines show variations with smaller amplitude and with a characteristic time of 10-20 days. The same properties were detected in 2016, but according to 2017, only a chaotic change in the spectral parameters of these lines was observed. The variability in the spectrum of the star can be explained by the existence of the polar wind and accretion or the result of the duplicity of the system.

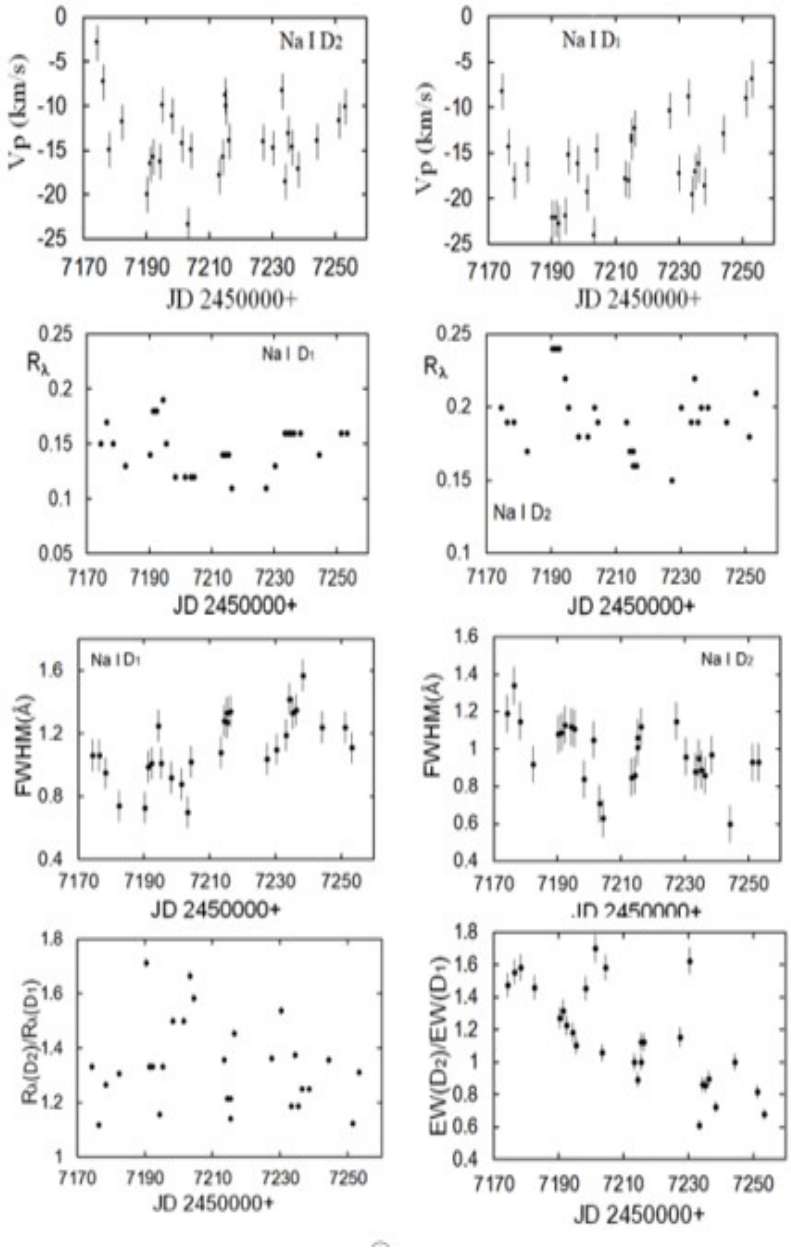

Fig. 9. Time variation of spectral line parameters D NaI lines in 2015.

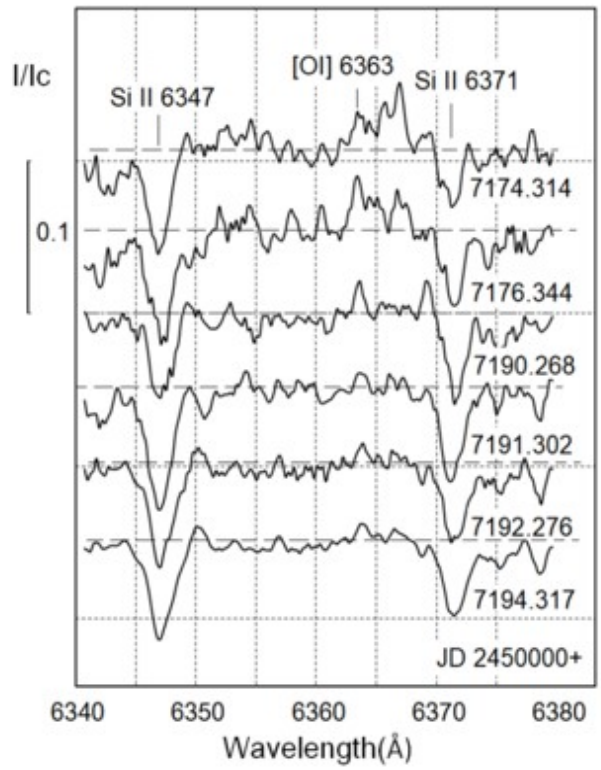

Fig. 10. The segment containing lines SiII and [OI] λ6363 Å.

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