

(DTOO «Fesenkov Astrophysical Institute», Almaty, Republic of Kazakhstan)

MWC 342: RESULTS AND ANALYSIS OF PHOTOMETRIC AND SPECTRAL VARIATIONS

Annotation. In the paper the results of spectrophotometric and photometric observations are given, received for Be star MWC 342 during 2006 August – 2011 September at highmounting Assy-Turgen observatory. The analysis of photometric data shows that for MWC 342 are probably inherent the three mode of variability: the irregular brightness changing with amplitude ~ 0.5 mag., quasi-periodical with period 100-200 days and the cyclic changes of brightness with the period $P = 5588$ days and amplitude $\Delta V = 0.26$ mag. The photometric variations demonstrate the complicate behavior at clear absent their relations with spectral changes during our observations. On time intervals ~ 100 days the color index (B-V) not depends upon V value, while the average (B-V) value increases with increasing of star brightness. Apparently, there are some mechanisms, which influence mostly on brightness changes than on (B-V) variations. In spectra the H α , H β , numerous FeII lines, forbidden [OI] lines and MgI, SiII are presented. The H α and H β line contours have the two component profiles and are typical for Be star with rotating and extending envelope. Moreover on all spectra the line HeI $\lambda 6678$ is present, which shows P Cyg structure with flat-peaked emission. It is firstly determined the line [NII] $\lambda 6584\text{\AA}$, which is seen on red wing of H α line. It was found that the heliocentric velocity V_r for red components of H α and H β lines is constant in accuracy limits and equals to $V_r=0\pm 15 \text{ km s}^{-1}$ during all our observational period. Thus the V_r-V_a value may consider as V_a velocity of absorption component. On continuum level the half-width of lines are H α $\sim 1000 \text{ km s}^{-1}$, H β $\sim 500 \text{ km s}^{-1}$. The average shifts of V_a absorption component for HeI $\lambda 6678$ are from 170 km s^{-1} to 180 km s^{-1} . Received by us the absorption value up to MWC 342 is $A_v=4.62$ mag. We find that the observed Balmer decrement, reduced for absorption, is $D_{34}=2.14$, if we adopt the observed value $D_{34}=10.7$.

Keywords: Ae/Be Herbig stars; individual object – MWC 342.

Тірек сөздер: Хербигтің Ae/Be жұлдыздары; MWC 342 – жекешеленген объектілері.

Ключевые слова: Ae/Be звезды Хербига; индивидуальные объекты – MWC 342.

1. Introduction. MWC 342 is an emission-line star. The first observations of MWC 342 were made by Merrill and Burwell (1933) [1]. A complete description of spectrum was published by Swings and Struve (1942) [2]. A more complete list of emission lines is given in papers [3, 4]. The spectrophotometric investigations in wide spectrum region (3300-7560 Å) are made by Arkhipova and Ipatov (1982) [5]. Most of the lines that appear in the spectrum belong to the ion

FeII. Except for lines of the Balmer series, spectrum of MWC 342 includes addition a few SiII, [OI], HeI. In spectrum MWC342 are completely absent the any absorption lines [3, 4].

The presence of the infrared excess was confirmed by Allen (1973) [6]. The polarization was investigated by Zickgraf & Shulter-Ladback [7], who found the intrinsic polarization. Moreover, the relationship of polarization value, including the polarization value in H_a line, shows that the intrinsic polarization is caused by emission scattering on dust grains in circumstellar dust envelope [7]. A more complete the photometric observations of MWC 342 are given in papers [8-10].

In 2001 in Astrophysical institute was began the program of spectral and photometric observations of Be and TTau stars. In given paper we present the results of spectroscopic and photometric measurements of MWC 342. The observations were carried out at the Assy-Turgen observatory 1-m telescope of the Fesenkov Astrophysical Institute of National Academy of sciences of Kazakhstan Republic during 2006 August – 2011 September.

2. Photometric investigations. The photometric BVRI dates were received with CCD camera ST-7 and filters of SBIG. In spite of that R and I filters gives the magnitudes in Johnson-Cousins system, we reduced our observations to the standard Johnson system. All photometric observations were corrected for flat field, received from twilight sky. The stars HD194684, HD195089 and HD196240 were used as standards. The observations of investigated star and reference stars were made at the same zenith distances. The results of photometric observations are given in Table 1.

Table 1 – The results of photometric observations of MWC 342

Date	JD +2450000	V	B-V	V-R	V-I
1	2	3	4	5	6
18.08.2006	3966,27	10,51	1,28	1,56	2,54
23.08.2006	3971,33	10,42	1,33	1,56	2,60
22.09.2006	4001,19	10,60	1,29	1,61	2,67
26.09.2006	4005,20	10,66	1,32	1,62	2,65
12.07.2007	4294,28	10,51	1,31	1,54	2,56
17.07.2007	4299,29	10,66	1,28	1,59	2,58
18.07.2007	4300,30	10,65	1,29	1,61	2,58
19.07.2007	4301,32	10,57	1,30	1,60	2,57
09.08.2007	4322,21	10,73	1,26	1,64	2,62

10.08.2007	4323,19	10,70	1,29	1,63	2,57
12.08.2007	4325,23	10,68	1,24	1,59	2,57
13.08.2007	4326,25	10,68	1,27	1,61	2,56
09.09.2007	4353,15	10,62	1,30	1,59	2,61
10.09.2007	4354,15	10,67	1,29	1,64	2,65
11.09.2007	4355,14	10,56	1,30	1,56	2,54
12.09.2007	4356,14	10,64	1,30	1,60	2,58
13.09.2007	4357,14	10,69	1,29	1,61	2,59
14.09.2007	4358,17	10,70	1,31	1,60	2,57
04.09.2010	5444,23	10,62	1,28	1,57	2,58
09.11.2010	5510,04	10,66	1,29	1,58	2,46
05.06.2011	5718,31	10,68	1,27	1,55	2,49
03.07.2011	5746,34	10,49	1,20	1,45	2,39
07.07.2011	5750,21	10,68	1,25	1,54	2,51
30.07.2011	5773,29	10,61	1,35	1,50	2,53
03.08.2011	5777,35	10,69	1,30	1,56	2,48
04.08.2011	5778,27	10,67	1,26	1,52	2,44
02.09.2011	5807,26	10,65	1,30	1,49	2,44
03.09.2011	5808,22	10,69	1,32	1,53	2,47
26.09.2011	5831,11	10,55	1,26	1,47	2,39
In columns of Table 1 are given the following data: 1 - the observation date, 2 - the Julian date, 3 - the V magnitude in Johnson system, 4–6 - the color indexes. The measuring errors are on the average ± 0.006 .					

The most data observations of MWC342 were performance by V.S.Shevchenko's group [8] in 1980-1994, Ju.K.Bergner [9] and A.S.Miroshnichenko [10] in 1995-1998. The results of statistic analysis of these and our observations are given in paper [18]. The additional observations of 2010-2011 confirm these results. The analysis of all photometric data shows that for MWC 342 are probably inherent the three mode of variability: the irregular brightness changing with amplitude ~ 0.5 mag., quasi-periodical with period 100-200 days and the cyclic changes of brightness with the period $P=5588$ days and amplitude $\Delta V= 0.26$ mag.

3. Description of the Line Spectrum. The spectral observations of MWC 342 were made with the spectrograph UAGS and CCD camera with 1530x1020 pixels. Dispersion is 0.5\AA on pixel. Spectral investigations of MWC 342 were carried out in regions of H_α and H_β lines. The

flat field was received from the white screen illuminated halogen photo optic lamp OSRAM. For all spectra S/N for continuum are equal 42 in H _{α} region and 16 in H _{β} region. The error in wave length definition is $\pm 0.5\text{\AA}$. λ Cyg star was used as standard for determining of absolute flux values in MWC342spectrum.

The profiles of H _{α} and H _{β} Balmer lines have the clear two-peaked structure. In our spectra together with known lines Fe [3, 4] in optical region the lines [OI], MgI, SiII are also well seen. Moreover on all spectra the line HeI $\lambda 6678$ is present, which shows P Cyg structure with flat-peaked emission. It is firstly determined the line [NII] $\lambda 6584\text{\AA}$, which is seen on red wing of H _{α} line. The results of spectral observations are given in Tables 2, 3.

Table 2 – Spectral data for H _{α} and [OI]

DATE	JD245000 0	EWH α (\AA)	Ib	Ia	Ir	Vr-Va (km/s))	Vr-Vb (km/s))	FW0.1 I (km/s)	EW630 0 (\AA)	I6300 (I _{cont} = 1)
			I _{cont} = 1							
1	2	3	4			5	6	7	8	9
18.08.2006	3966,20	240	10,9	7,5	56, 9	91	204	548	1,7	2,3
20.09.2006	3999,20	261	11,3	7,6	60, 4	91	227	502	1,8	2,2
26.09.2006	4005,20	262	11,9	8,0	65, 3	91	204	515	2,4	2,7
10.07.2007	4292,20	251	10,4	9,4	58, 9	136	181	500	1,6	1,7
14.07.2007	4296,20	266	11,0	8,9	66, 6	91	159	503	2,0	2,3
17.07.2007	4299,20	322	12,9	11, 8	70, 6	136	159	567	2,0	2,3
18.07.2007	4300,20	309	12,6	10, 0	80, 3	113	181	499	2,0	2,2
19.07.2007	4301,20	293	11,8	9,6	77, 4	91	159	490	2,1	2,4
09.08.2007	4322,30	340	15,1	11, 8	85, 6	91	158	490	2,4	2,6
10.08.2007	4323,10	329	15,1	11, 5	87, 0	91	158	480	2,7	2,5

12.08.200 7	4325,10	334	15,0	12, 3	85, 0	113	159	484	2,4	2,5
13.08.200 7	4326,10	340	15,4	12, 1	89, 0	113	159	470	2,2	2,4
09.09.200 7	4353,10	279	12,4	9,5	69, 6	91	204	482	1,9	2,4
10.09.200 7	4354,10	291	13,3	10, 1	70, 6	91	182	490	2,1	2,6
11.09.200 7	4355,10	279	12,4	9,5	69, 6	91	181	490	1,9	2,4
12.09.200 7	4356,10	300	13,8	10, 5	73, 0	113	181	490	2,0	2,4
13.09.200 7	4357,10	309	13,8	10, 3	83, 0	91	181	470	2,2	2,5
30.07.201 1	5773,29	261	13,9	9,8	58, 2	90	158	520	2,1	2,6
03.08.201 1	5777,35	278	17,8	12, 1	62, 6	90	136	543	1,4	2,2
04.08.201 1	5778,27	266	17,6	10, 0	69, 4	90	136	498	2,5	2,9
02.09.201 1	5807,26	224	13,0	6,6	59, 2	90	159	520	2,4	3,0
26.09.201 1	5831,11	234	19,2	7,8	56, 7	68	136	498	2,3	2,4

In columns of Table 2 are given the following data: 1 - the observation date, 2 - the Julian date, 3 - the H α line equivalent width in Å, 4-intensities of the blue emission peak, central absorption, and red emission peak in continuum units, 5, 6 - differences radial velocities between these peaks, 7 - full width at a level 0.1intensity read peak, 8 - the [OI] λ 6300 Å line equivalent width in Å, 9 - intesity of the [OI] λ 6300 Å.

The data for line [OI] λ 6363 Å are absent in Table 2, since the ratio $(I(\lambda 6300) - I_{\text{cont}})/(I(\lambda 6363) - I_{\text{cont}})$ is practically constant and equal 2.84 ± 0.09 .

Table 3 – Spectral data for H β

DATE	JD2450000	EWH β (Å)	Ib	Ia	Ir	Vr-Vb (km/s)	Vr-Va (km/s)
			I _{cont} = 1				
1	2	3	4			5	6
23.08.2006	3970,50	20,8	0,40	-1,11	9,13	245,00	123,00
20.09.2006	3999,19	30,8	0,91	0,86	10,87	215,00	100,00
26.09.2006	4005,19	38,3	1,67	0,55	15,11	200,00	100,00
14.07.2007	4296,19	38,7	1,72	-0,38	17,19	245,00	138,00
18.07.2007	4300,19	53,7	1,21	0,54	20,06	276,00	153,00
09.08.2007	4322,29	35,3	1,24	0,36	15,25	215,00	123,00
10.08.2007	4323,09	37,7	2,08	0,48	15,84	215,00	153,00
12.08.2007	4325,09	35,1	1,22	0,55	12,94	215,00	123,00
13.08.2007	4326,09	39,6	1,58	0,34	16,92	184,00	92,00
09.09.2007	4353,09	33,0	1,58	0,28	14,71	184,00	123,00
10.09.2007	4354,09	35,6	1,73	0,44	14,34	184,00	91,00
11.09.2007	4355,09	31,1	1,52	0,30	12,14	215,00	123,00
12.09.2007	4356,09	34,3	1,30	0,28	13,46	184,00	123,00
13.09.2007	4357,09	37,7	1,43	0,41	15,03	123,00	215,00
30.07.2011	5773,29	25,7	1,57	0,58	7,56	183,00	91,00
03.08.2011	5777,35	24,7	3,78	0,48	8,63	153,00	92,00
04.08.2011	5778,27	28,1	2,52	0,52	10,92	153,00	91,00
02.09.2011	5807,26	20,8	2,25	-0,75	7,07	276,00	122,00
26.09.2011	5831,11	29,0	5,63	1,04	13,71	122,00	61,00
The columns 1–6 of Table 3 for H β have the same subscripts as the columns 1–6 of Table 2 for H α .							

The recordings of spectrogram in region H α and H β are represented on Figures 1, 2, respectively. The profiles of H α and H β Balmer lines are given on Figures 3, 4. The X axis corresponds to heliocentric velocity in km s⁻¹.

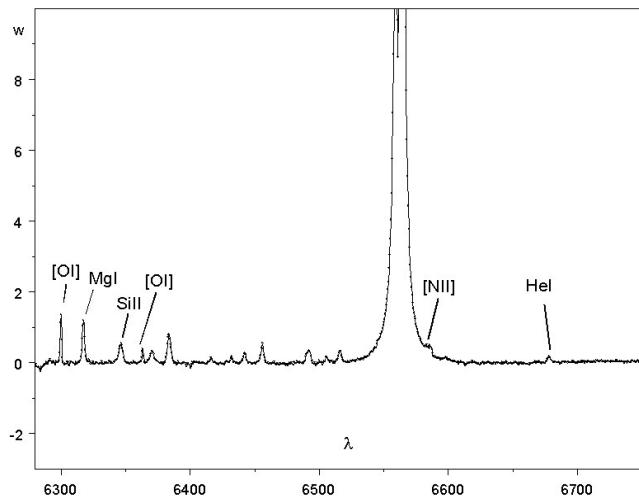


Figure 1 – The spectrogram in H α region
region

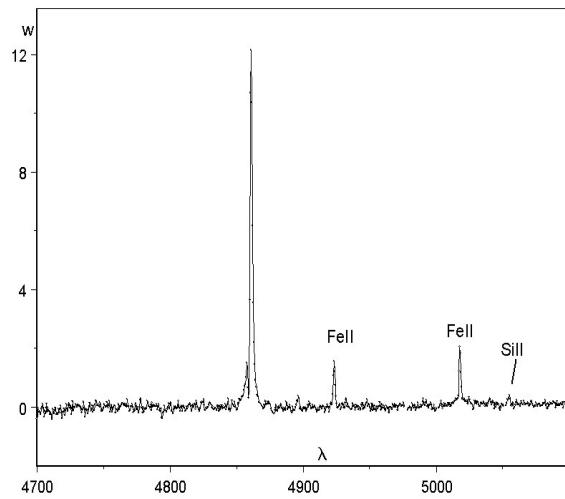


Figure 2 – The spectrogram in H β

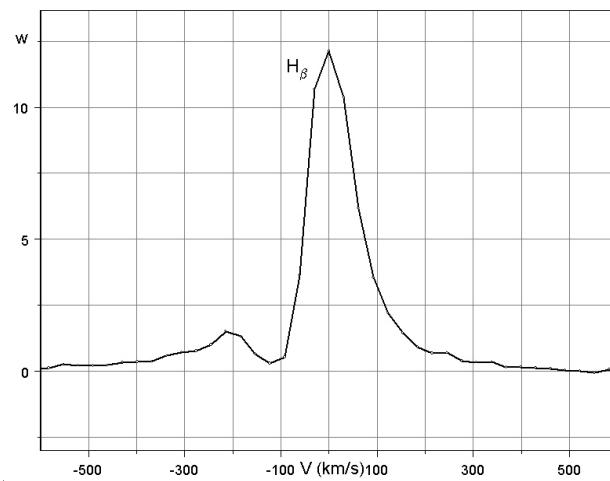
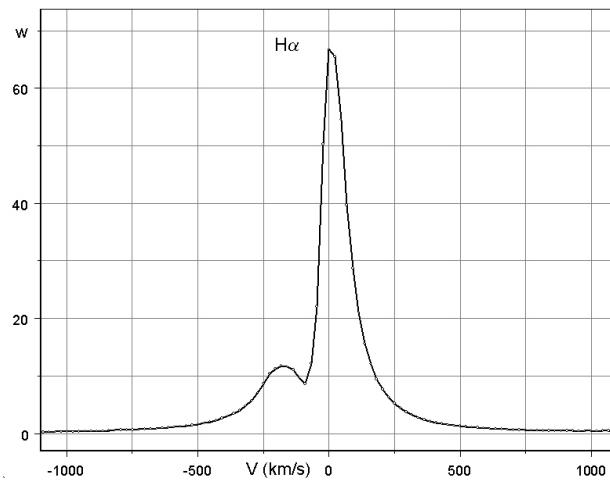


Figure 3 – The H_{α} profile

Figure 4 – The H_{β} profile

For some dates we determined the flux absolute values in H_{α} and H_{β} lines. The relative results are given in Table 4. The flux absolute values are determined with $\approx 10\%$ accuracy. For Balmer decrement determination (D_{34}) we used the line fluxes.

Table 4

DATE	$F_{\alpha} \times 10^{10} \text{ эрг/см}^2$	$F_{\beta} \times 10^{10} \text{ эрг/см}^2$	D_{34}
1	2	3	4
19.07.2007	3.307	---	---
12.08.2007	3.140	---	---
30.07.2011	1.210	0.120	10.06

02.09.2011	0.690	0.060	11.35
In columns of Table 4 are given the following data: 1 - the observation date, 2 - the flux in H_α line, 3 - the flux in H_β line, 4 - the Balmer decrement, received on fluxes in F_α , F_β lines.			

4. Analysis of spectral observation results. It was found that the heliocentric velocity V_r for red components of H_α and H_β lines is constant in accuracy limits and equals to $V_r=0\pm15 \text{ km s}^{-1}$ during all our observational period. Thus the $V_r - V_a$ value may consider as V_a velocity of absorption component. On continuum level the half-width of lines are $H_\alpha \sim 1000 \text{ km s}^{-1}$, $H_\beta \sim 500 \text{ km s}^{-1}$. The average shifts of V_a absorption components for HeI $\lambda 6678$ are from 170 km s^{-1} to 180 km s^{-1} . Analogous data are received in work [4]: for $H_\beta - 120 \pm 7 \text{ km s}^{-1}$ and $H_\alpha - 97 \pm 3 \text{ km s}^{-1}$.

In spite of EW significant variations, the changing's of EW equivalent widths of $H\alpha$, $H\beta$, [OI] $\lambda 6300\text{\AA}$ are correlated with star brightness variations. The relation between V star brightness and EW ($H\alpha$) is shown on Figure 5. Probably, the variation of EW values of emission lines defines the level of star con-tinuum. In same time as seen from Table 4 the real flux variations are observed, which, probably, connects with additional matter outflows from star.

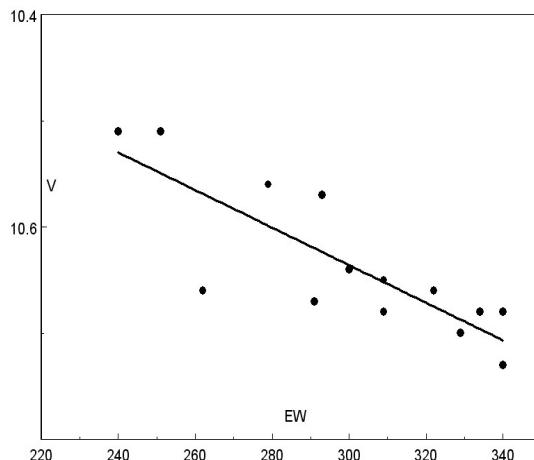


Figure 5 – V versus EW(H_α)

The H_α and H_β line contours have the two component profiles are typical for Be star with rotating and extending envelope.

In cases of extended envelopes with gradient of extend velocity the excited degree rapidly diminishes in envelope with distance from star [11]. The star atmosphere (the envelope) may be roughly represented in terms of opacity and transparent parts of atmosphere. Herewith as it was shown in same paper [11], the main energy lot in line is radiated by opacity part for each

concrete line of atmosphere. From this it follows that the main energy lot in H_{β} line is radiated by more deep levels, than in H_{α} line. But as the absorption and emission arise in same extended level, then we may consider that determined by us V_a values show also the extend velocity of envelope on different distances from star. In same time the distance between emission components characterizes the relation between extend velocity and rotation of atmosphere. There are needed the theoretical constructions of lines contours with using of received observational data in order to derive the concrete data about velocity of outflow matter, the rotation velocity, the excitation degree for different altitudes in MWC 342 envelope.

5. Interstellar extinction. The different authors evaluate the absorption up to MWC 342 from 1.4 mag [3], 1.5 mag. [5] up to 3.7 mag. [10] at various physical parameters of star, circumstellar envelope and interstellar matter.

At absorption estimation up to MWC342 we will proceed from following assumptions. The occurrence of HeI $\lambda 6678$ line in emission shows that the exciting star has the spectral class not later then B0-B0.5V, $M_V = -4.0$ mag., $(B-V)_0 = -0.30$ mag. [12]. We adopt the distance up to star $D \approx 1$ kpc [13], suggesting that it is situated in NGC 6910 and NGC 6913. We discuss the different versions of properties of interstellar matter and MWC 342 dust envelope when $R_v = 3.1$, $R_v = 3.6$. Moreover, it was considered the case when the absorption up to star is produces both the interstellar matter with $R_v = 3.1$ and the dust envelope with $R_v = 3.6$ [3].

The observed by us values are $(B-V) = 1.29$ mag., $V = 10.66$ mag. (the average during our observations), what gives $E(B-V) = 1.59$ mag. and $A_v = 4.93$ mag. From here we have the distance modulus $V - M_v = 9.73$ mag., $D = 883$ pc.

At A_v estimation we not taken into account the conceivable contribution of additional free-free radiation of environment gas. The investigation of B and Be stars in clusters shows that Be stars after correction for interstellar absorption have the excess reddening $E(B-V)$ with large value scattering for different objects. However, there is the tendency of increasing of reddening with growth of $EW(\text{\AA})$ and star luminosity. If to interpret the excess reddening as a additional radiation, arising at free-free and free-boundary transitions, then $E(B-V)^{ff}$ may achieve the value 0.1 mag, and an additional emission in V band may be 0.25 mag [15]. Thus, the observed value $E(B-V) = 1.58$ mag for MWC 342 after correction will be $E(B-V) = 1.49$ mag. Then $A_v = 4.62$ mag, a distance modulus $V - M_v = 10.04$ mag, what is correspond to $D = 1$ kpc. Taking into account the uncertainty of adopted values for R_v and $E(B-V)^{ff}$ it is may consider that the received distance is well agree with assumption that object MWC 342 locates on the distance $D \approx 1$ kpc and the absorption to it is $A_v = 4.62$ mag.

At absorption calculation in H_{α} and H_{β} lines and $A_v = 4.62$, we were used by empiric curve for inter-stellar absorption [16]. In result we have $A_{\beta} - A_{\alpha} = 1.75$. If we adopt for $D_{34} = 10.7$ (2.58 mag) from Table 4, then we find that the observed Balmer decrement, reduced for absorption, is $D_{34} = 2.14$.

6. Discussion. The analysis of photometric data shows that for MWC 342 are probably inherent the three mode of variability: the irregular brightness changing with amplitude ~ 0.5 mag., quasi-periodical with period 100-200 days and the cyclic changes of brightness with the period $P = 5588$ days and amplitude $\Delta V = 0.26$ mag. The photometric variations demonstrate the complicate behavior at clear absent their re-lations with spectral changes during our

observations. On time intervals ~ 100 days the color index (B-V) not depends upon V value, while the average (B-V) value increases with increasing of star brightness V. Apparently, there are some mechanisms, which influence mostly on brightness changes than on (B-V) variations. Because of motion of individual large productions the dust envelope inhomogeneous structure may cause the brightness variations, but in same time not changing the star color. As far as it goes the smooth variations of average values V and (B-V) on large time intervals, then they may be caused both the star pulsation and MWC 342 binarity, as it is noticed in paper [10]. However, there are not available some sort of weighty observational evidence to the made speculations.

We made some no very valid assumptions at extinction calculations up to MWC 342, namely R_v is equal to 3.1 and the reddening, stipulated by radiation of gas envelope $E(B-V)^{ff}=0.1\text{mag}$. Nevertheless, the determined up to MWC 342 distance and reduced for absorption the Balmer decrement, which is in indicative limits for stars with emission [11], can claim that we find the plausible estimation for $A_v=4.62$.

7. Conclusion. Our data analysis shows that it is difficult to draw a conclusion about reality of cycle brightness variations on periods 100-200 days. But in same time it is well observed the brightness variations on large time scale, perhaps, even periodical with observed period $P=15$ years. Received by us the absorption value up to MWC 342 is $A_v=4.62\text{mag}$. The Balmer emission line contours are characteristic for Be stars with rotating and extending envelope. The shift of absorption components V_α shows, that the velocity of envelope extending falls with altitude. It was founded that HeI $\lambda 6678$ line shows P Cyg structure with flat-peaked emission. Sometimes the analogous profile is observed for WR stars [17]. There are needed the theoretical constructions of lines contours with using of received observational data in order to derive the concrete data about velocity of outflow matter, the rotation velocity, the excitation degree for different altitudes in MWC 342 envelope. For bringing out geometry of radiated and radiation scattering fields there are required the polarimetric observations in different spectra regions and in individual lines (H_α).

Работа выполнена в рамках республиканской программы 002 «Прикладные исследования в области космической деятельности».

REFERENCES

- 1 Merrill, P.W., Humason, H.L., Burwell, C.G. *Astrophys. J.*, **1933**. 76, 156.
- 2 Swings, P. and Struve, O. *Astrophys. J.*, **1943**. 97, 194.
- 3 Broseh, N., Leibowitz, E.H., Spektor, N. *Astron. Astrophys.*, **1978**. 65, 259.
- 4 Andrillat, J. and Jaschek, L. *Astron. Astrophys. Suppl. Ser.*, **1999**. 136, 59.
- 5 Arkhipova, V.P. and Ipatov, A.P. *SvAZh. Lett.*, **1982**. 8, 288.
- 6 Allen, D.A. *Mon. Not. R. Astron. Soc.*, **1973**. 161, 145.
- 7 Zickgraf, F.J. and Shulter- Ladbeck, R.E. *Astron. Astrophys.*, **1989**. 214, 274.

- 8 Herbst, W., Herbst, D.K., Grossman, E.I. *Astrophys. J.*, **1994**. 108, 109.
- 9 Bergner, Y.K., Miroshnichenko, A.S., Yudin, R.V., Kuratov, K.S., Mukhanov, D.B., Sheikina, T.A. *Astron. Astrophys. Suppl. Ser.*, **1995**. 112, 221.
- 10 Miroshnichenko, A.S. and Corporon, P. *Astron. Astrophys.*, **1999**. 349, 126.
- 11 Sobolev, V.V. *Moving envelopes of stars*, Harvard University Press, Cambridge., **1960**, 33.
- 12 Straizys, V. and Kuriliene, G. *Astrophys. and Space Science*, **1981**, 80, 353.
- 13 Gawford, D.L. and Barnes, J.V. *Astron. J.*, **1977**, 82, 606.
- 14 Bergner, Y.K., Miroshnichenko, A.S. et al. *Astrofizika*, **1990**, 2, 203.
- 15 Waters, L.B.F.M., Cote, J., Lamers, H.J.G.L.M. *Astron. Astrophys.*, **1987**, 185, 206.
- 16 Cardelli, J.A., Geffrard, C. et al. *Astrophys. J.*, **1989**, 345, 245.
- 17 Mihalas, D. *Stellar Atmospheres, second edition*, by Freeman, W.H. and Co, **1978**, 273(in Russian edition).
- 18 Andreev A.V., Kurchakov A.V., Rspaev F.K., Omarov Ch.T. *Izvestija NAN RK*, **1910**. N.4, 41(in Russ.).

Резюме

A. B. Андреев, А. В. Курчаков, Ф. К. Рыспаев

(«Фесенков атындағы Астрофизика институты» ЕЖШС, Алматы, Қазақстан
Республикасы)

MWC 342: СПЕКТРЛІК ЖӘНЕ ФОТОМЕТРЛІК ӨЗГЕРУЛЕРДІҢ

ТАЛДАУЫ ЖӘНЕ НӘТИЖЕСІ

Мақалада Ассы-Түрген обсерваториясында 2006 жылдың тамызынан 2011 жылдың қыркүйегіне дейінгі аралықта Be жұлдыздары MWC 342 үшін алынған бақылаулардың спектрофотометрлік және фотометрлік нәтижелері берілген. MWC 342 үшін фотометрлік талдаулардың мәліметтері үш түрлі айнымалылық тән деп, көрсетеді: жарқырауының амплитудасы ~0.5 mag болатын иррегулярлы өзгерулер, периоды 100-200 күн квази-периодты және жарқырауының циклдік өзгеруі периоды P=5588 күн және амплитудасы

$\Delta V = 0.26$ mag. Біз бақылаған уақытта фотометрлік өзгерулер күрделі табиғатты нақты спектрлік өзгерулермен байланыста болмағанда бейнелейді. Уақытша ~100 күндік интервалда тұс көрсеткіш (B-V), V шамасына тәуелді болмайды, сол уақытта жұлдыздың жарқырауы жоғарылағанда, (B-V) орташа мәні көбейеді. Соған қара-ғанда, (B-V) өзгеруіне қарағанда, жарқыраудың өзгерулеріне әсер ететін, қандайда бір механизм бар тәрізді. Спектр сызықтарында H_α , H_β , көптеген FeII сызықтары, тыйым салынған [OI] және MgI, SiII сызықтары кездеседі. Айналатын және кеңеятін қабықшалы Be жұлдыздар үшін әдеттегідей, H_α және H_β сызықтарының пішіндері екі компонентті пішінде болады. Сонымен бірге спектрлерде HeI $\lambda 6678$ сызықтар бар, ол жазық-шыңды эмиссиялы P Cyg құрылымын көрсетеді. H_α сызығының қызыл қанатында көрінетін [NII] $\lambda 6584\text{\AA}$ сызығы алғаш рет көрсетілген. Біз бақылаған барлық уақыт аралығында H_α және H_β сызықтарының қызыл компоненттері үшін гелиоцентрлік жылдамдық V_r табылды және ол әрқашан тұрақты $V_r=0\pm15 \text{ km s}^{-1}$ тең. Сондықтан, $V_r - Va$ мәнін абсорбциялы компонент Va жылдамдығы ретінде қарастыруға болады. Континуум деңгейіндегі сызықтардың жартылай ені $H_\alpha \sim 1000 \text{ km s}^{-1}$, $H_\beta \sim 500 \text{ km s}^{-1}$ құрайды. Абсорбциялы компоненттің орташа жылжуы Va , HeI $\lambda 6678$ үшін 170 km s^{-1} ден 180 km s^{-1} дейін бекітілген. MWC 342 үшін біз алған жұтылу мәні $A_v = 4.62 \text{ mag}$ құрайды. Біз тапқан бақыланатын бальмер декремент, егер бақыланатын мәнді $D_{34} = 10.7$ қабылдасақ, жұтылуы түзетілген, $D_{34} = 2.14$ тең.

Тірек сөздер: Хербигтің Ae/Be жұлдыздары; жекешеленген объекті – MWC 342.

Резюме

A. B. Андреев, A. B. Курчаков, Ф. К. Рспаев

(ДТОО «Астрофизический институт им. Фесенкова», Алматы, Республика Казахстан)

MWC 342: РЕЗУЛЬТАТ И АНАЛИЗ ФОТОМЕТРИЧЕСКИХ И СПЕКТРАЛЬНЫХ ИЗМЕНЕНИЙ

В статье приводятся результаты спектрофотометрических и фотометрических наблюдений, полученных для Be звезды MWC 342 за период август 2006 – сентябрь 2011 на высокогорной обсерватории Ассы – Тургень. Анализ фотометрических данных показывает, что для MWC 342, по-видимому, присущи три вида переменности: иррегулярные изменения яркости с амплитудой ~ 0.5 mag., квази-периодические с периодом 100-200 дней и циклические изменения яркости с периодом $P=5588$ дней и амплитудой $\Delta V = 0.26$ mag. Фотометрические вариации демонстрируют сложную природу при четком отсутствии их связей со спектральными изменениями за период наших наблюдений. На временных интервалах ~ 100 дней показатель цвета (B-V) не зависит от

величины V, в то время как среднее значение (B-V) увеличивается с увеличением яркости звезды. По-видимому, существуют некоторые механизмы, которые влияют главным образом на изменения яркости, чем на вариации (B-V).

В спектрах присутствуют линии H α , H β , многочисленные линии FeII, запрещенные линии [OI] и MgI, SiII. Контуры линий H α и H β имеют двухкомпонентные профили и являются типичными для Be звезд с вращающейся и расширяющейся оболочкой. Более того, на всех спектрах присутствует линия HeI λ 6678, которая показывает P Cyg структуру с плоско-пиковой эмиссией. Впервые отмечена линия [NII] λ 6584Å, которая видна на красном крыле линии H α . Было найдено, что гелиоцентрическая скорость V_r для красных компонент линий H α и H β постоянна в пределах точности и равна V_r=0±15 km s⁻¹ по всему периоду наших наблюдений. Таким образом, значение V_r–V_a можно рассматривать как скорость абсорбционной компоненты V_a. На уровне континуума полуширины линий составляют H α ~1000 km s⁻¹, H β ~500 km s⁻¹. Средние сдвиги абсорбционной компоненты V_a для HeI λ 6678 заключены в пределах от 170 km s⁻¹ до 180 km s⁻¹. Полученное нами значение поглощения до MWC 342 составляет A_v=4.62mag. Мы нашли, что наблюдаемый бальмеровский декремент, исправленный за поглощение, равен D₃₄=2.14, если принимаем наблюдаемое значение D₃₄=10.7.

Ключевые слова: Ae/Be звезды Хербига; индивидуальные объекты – MWC 342.

Поступила 2.09.2013г.