

# SPECTROSCOPY AND PHOTOMETRY OF BE STAR MWC340

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**ABSTRACT.** The spectroscopic and photometric observations of Be star MWC 340 made at Fesenkov Astrophysical institute during 2001-2006 are presented.

**Key words:** HAEBE stars: spectroscopy, photometry.

## 1. Introduction

Investigated by us MWC 340 (BD+40°4124 = V1685 Cyg) star is embedded into diffuse gas nebula of inhomogeneous structure. At distance of 2 arc minutes from star in south-east direction is extended the thin rim (length near 7 arc minutes), passed in south-west direction into diffuse envelope, separated from star by dark most likely absorbed envelope. The molecular coma-like cloud (Hillebrand, Meyer, Strom et al. 1995), extended from south to north, is overlapped on all that. Firstly about small aggregate of stars with emission lines, connected with MWC 340, was reported by Herbig G.H. (1960). The MWC 340 region consist of few tens very young stars attributed to HAEBE stars. The data about 33 stars of isolated association of stars up to main consequence, related with two HAEBE stars MWC 340 and V1686 Cyg, are given in (Hillenbrand et al., 1995). Only eleven of them are seen in visual. Our observations includes the spectral and photometric data for MWC 340 and photometric ones in V band for N2, N3 and N6 (V1686 Cyg = LkHa 224) stars from Table 1 of Hillenbrand, Meyer, Strom et al (1995). The spectroscopic and photometric observations were carried out at the Assy-Turgen highmountain observatory 1-m telescope of the Fesenkov Astrophysical Institute of National Academy of sciences of Kazakhstan Republic during 2001 September - 2006 September.

## 2. Observations

The spectral observations were made with the spectrograph UAGS and CCD camera ST-8 with 1530 1020 pixels. The inverse dispersion was 0.5 Å on pixel. The spectral investigations of MWC 340 were mainly carried out in the regions of H $\alpha$  and H $\beta$  lines. The flat

field for spectrophotometry was received from dome, illuminated by usual tungsten lamp. The reductions for instrumental contour were not made. The equivalent width of H $\alpha$  line was defined without taking into account the blending them by absorption lines. All spectra have the resolution R=6000. The S/N ratio reaches about 25 and 12 in region of H $\alpha$  and H $\beta$  lines, respectively. The photometric BVRI data were received with CCD camera ST-7 and filters of SBIG firm. In spite of that the R and I filters most likely gives the magnitudes in Johnson-Cousiens system, we reduced the our observations to the standard Johnson system. All photometric observations were corrected for flat field, received from twilight sky. The variety of H $\alpha$  lines intensity relatively to continuum (from 13 to 21) is observed. For this time the H $\alpha$  line equivalent width EW is changed in the limits 110 - 160 Å, the brightness in range V= 10.<sup>m</sup>70 - 10.<sup>m</sup>85; (B-V)= 0.<sup>m</sup>84 - 0.<sup>m</sup>94; (V-R)= 0.<sup>m</sup>95 - 1.<sup>m</sup>02. Herewith it should be noted that the measuring error of equivalent width determining at different taking into account of continuum is near 2%. The photometric measuring error of magnitude determining is less than 0.<sup>m</sup>01.

## 3. Results and discussion

The optical spectrum of MWC 340 shows the strong emission of H $\alpha$  and H $\beta$  lines, the forbidden oxygen [OI]  $\lambda\lambda$  6300; 6363 and numerous FeII emission lines. H $\alpha$  and H $\beta$  lines have the clear cut double-peaked profiles with practically non-shifted central absorption, and the ratio of red and blue intensities is changed with time. H $\alpha$  profiles received in different observational dates are shown as example on Fig.1. H $\alpha$  profile with minimum value for blue component (received 2005 October 1) is given off by thick solid line. The nonsymmetrical profile of H $\alpha$  line may be explained by three models:  
-a model, in which the shape of gas envelope is deviate from spherical one;  
-a model of rotating and extending envelope;  
-a model with relatively small inclination of circumstellar discs to the observer, so that a disc material is closed the line of sight.

However, the third model will always provide for  $I_{blue} > I_{red}$ , what is inconsistent with our observations.

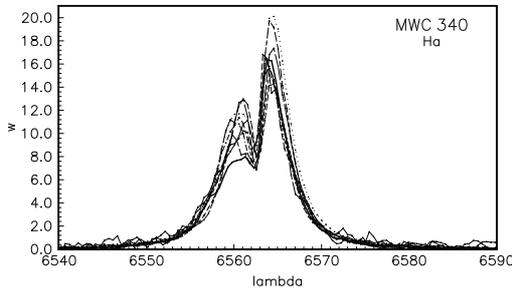


Figure 1: The observed profiles of H $\alpha$  lines.

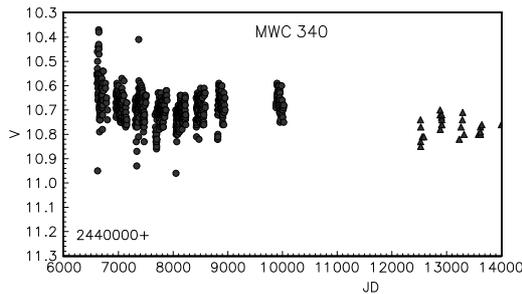


Figure 2: The light curve of MWC340

The first and second models best satisfy to our observations. But in case of third model we must have the some displacement of emission line in spectrum violent region. And if the displacement is little, this is difficult to observe on our spectrograms, taking into account the low resolution ( $R=6000$ ). The problem may be only solved after theoretical calculations with provision for value  $I_{blue} / I_{red}$ . On our observations the MWC 340 star has the practically symmetric and non-shifted [OI]  $\lambda$  6300.31 emission relatively the laboratory wavelength. Herewith there are observed the variations both the equivalent width (from 0.8 to 1.7  $\text{\AA}$  - on our observations; 1.10 - the work (Corcoran and Ray 1997); 1.5 - the work (Finkenzeller 1985)) and the maximum intensity of line relatively to the continuum. In generally, as it assumes, the stars having such profile structure of forbidden lines may be regarded as more evolved than stars, in which the emission are

shifted in blue region of spectrum (Finkenzeller, 1985). Any distinct correlation's of H $\alpha$  line equal width EW with brightness V and color indexes of star were not observed on our observations. Herewith it should be marked that in observed period the amplitude of changing both the brightness V and color indexes of MWC 340 was lower (Fig.2, where filled circles - the Maidanak's data in V band (Herbst and Shevchenko 1999), filled triangles - our measurements), than on data of Maidanak observatory ( $V=10^m.37-10^m.96$ ,  $(B-V)=0^m.68-0^m.93$ ,  $(V-R)=0^m.91-1^m.27$ ). Our photometric measurements in V band for N2, N3 and N6 stars from Table 1 of Hillenbrand, Meyer, Strom et al (1995) showed the variability of N2 ( $V=13^m.64-14^m.01$ ) and N6 ( $V=14^m.21-15^m.31$ ) stars and practically brightness constancy of N3 ( $12^m.08$ ) star, what most likely give evidence about no belonging of this star to the association, but about its projection on given region. The stars in MWC 340 region are significantly younger than those in the surrounded OB associations with the low- and the high-mass stars having formed nearly simultaneously, what lead some authors to the assumption that star formation in this association might have been induced by the propagation of external shock wave into the cloud core.

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