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Mwc 342: results and analysis of photometric variations of brightness

Abstract

The results and analysis of photometric measurements for MWC 342 are given. 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 cyclic changes of brightness with the period P=5588 of days are found. It is shown that on separate intervals of time the periodic changes with the period 115 days are possible but it is difficult to draw a conclusion about reality of cycle brightness variations on periods 100-200 days.

Key words: Photometric BVRI, photometric observation, zenith distance, intrinsic polarization, criterion χ^2_n, brightness variations, periodogram, phase-process diagram.

Introduction

MWC 342 is an emission-line star. The first observations of MWC 342 were made by Merrill and Burwell (1933) [1]. A more 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 &Sulter- Ladback [7], who found the intrinsic polarization. Moreover, the relationship of polarization value, including the polarization value in H_α line, shows that the intrinsic polarization is caused by emission scattering on dust grains in rounded star dust envelope [7]. A more complete the photometric observations of MWC 342 are given in papers [8-10].

Observations

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.

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.

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.

3.1. Photometric variations of MWC 342 brightness

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.

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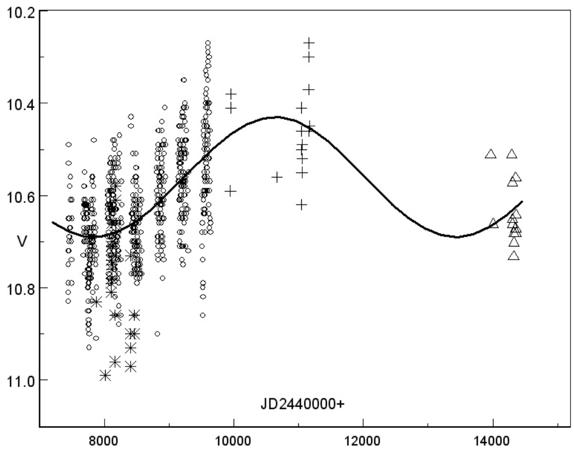
Table 1 – The results of photometric observations of MWC 342

Date	JD +2450000	V	B-V	V-R	V-I
1	2	3	4	5	6
18.08.2006	3966.27	10.513	1.281	1.565	2.539
26.09.2006	4005.20	10.660	1.316	1.618	2.649
12.07.2007	4294.28	10.510	1.306	1.543	2.559
17.07.2007	4299.29	10.658	1.276	1.586	2.585
18.07.2007	4300.30	10.650	1.293	1.607	2.577
19.07.2007	4301.32	10.569	1.305	1.596	2.567
09.08.2007	4322.21	10.732	1.258	1.641	2.618
10.08.2007	4323.19	10.697	1.286	1.628	2.566
12.08.2007	4325.23	10.679	1.237	1.593	2.573
13.08.2007	4326.25	10.675	1.273	1.614	2.555
10.09.2007	4354.15	10.672	1.294	1.635	2.649
11.09.2007	4355.14	10.555	1.297	1.563	2.542
12.09.2007	4356.14	10.640	1.296	1.603	2.578
13.09.2007	4357.14	10.687	1.290	1.612	2.593
14.09.2007	4358.17	10.702	1.311	1.600	2.574
09.11.2010	5510.04	10.662	1.292	1.584	2.465
05.06.2011	5718.31	10.677	1.267	1.551	2.487
03.07.2011	5746.34	10.490	1.204	1.448	2.394
07.07.2011	5750.21	10.681	1.253	1.542	2.508
30.07.2011	5773.29	10.609	1.352	1.501	2.532
03.08.2011	5777.35	10.690	1.305	1.559	2.482
04.08.2011	5778.27	10.666	1.262	1.524	2.440
02.09.2011	5807.26	10.650	1.296	1.492	2.440
03.09.2011	5808.22	10.690	1.323	1.533	2.470
26.09.2011	5831.11	10.552	1.262	1.468	2.392

The results of these and our observations are represented on Fig.1.



O – taken from [8];
*- from[9];
+ - from [10];
▲- from Table 1

Figure 1 – The V values for MWC 342. Observational data

As seen from Fig.1, probably, the brightness changing has the cycle behavior.

The approximation of observations by cosinusoid

$$V = a + b \cdot \cos(\frac{2\pi T}{P} + f) \quad (1)$$

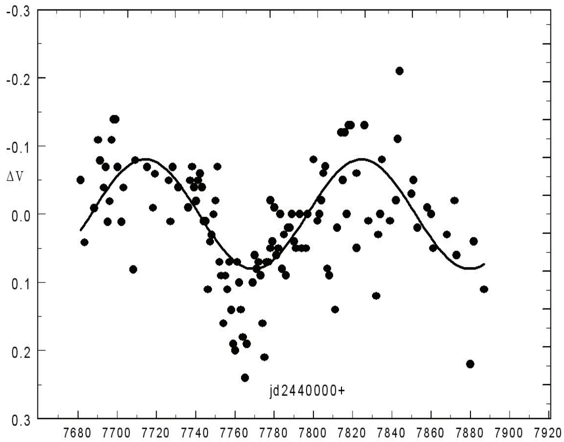


Figure 2.

gives for searching parameters: a=10.56 ± 0.01; b=0.13 ± 0.01; P=5589.5 ± 200; f=3.78±0.37;

The data for V, calculated on equation (1), are given on Fig.1 in mode of solid line. Then from observations V_{obs} we subtracted the data received on equation (1) V_{cal}, and the residue $\Delta V=V_{obs}- V_{cal}$ investigated on probable periodicity with more short period. The creations of periodogram and phase-process diagrams within the limits P=50-300 days for all observational data are shown, that there are absent the periodical variations of brightness within the limits P=50-100 days with the same phase. Using the data for ΔV, we created the ΔV distribution histogram.

As seen from Fig.3, the distribution of deviation from average is well fitted by suitable manner picked normal law:

$$P = 4.29 \cdot \exp(-57.8 \cdot \Delta V^2) \quad (2)$$

We used the criterion χ^2_n for more precise testing of hypothesis about normal distribution of V deviations from average value:

$$\chi_n^2 = \sum_{i=1}^{n} \frac{(k_i - P_i N)}{P_i N} \quad (3)$$

where k_i – the number of events contained in interval i, n-the number of intervals, N – the total number of points.

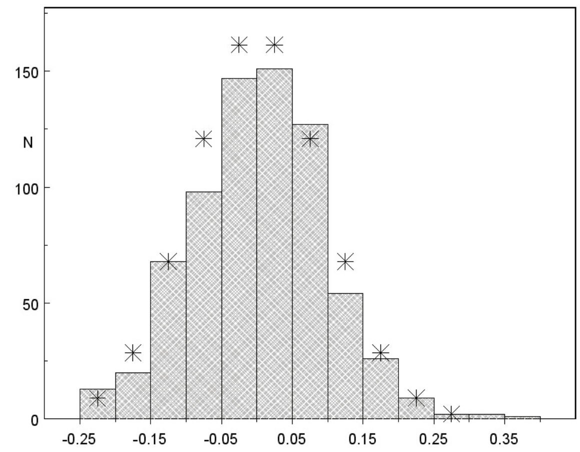


Figure 3 – Histogram ΔV
*- the points, calculated in accordance with normal law

The calculations on equation (2) show, that χ^2=16.4.

The number of degrees of freedom will be equal (n-2), taking into account that the average value and dispersion were found from results of observations. In our case (n-2) = 9. Thus the 5% critical region for agreement criterion is the upper 5% distribution region with 9 degrees of freedom and it gives the critical value χ^2 = 16.92. Received by us value χ^2 = 16.4 is smaller than critical value. This value is not significant. Hence we conclude that adopted by us the normal distribution is adequate for data ΔV.

In same time as A.S.Miroshnichenko pointed out [10], using the data of paper [8], in some cases there are the cyclic brightness variations in U values approximately with period P=132 days.

The values ΔV are given on Fig. 2 for the set of observations the densest on time. Presented on Fig.4, periodogram gives the maximum with period 125 days. But approximation by cosinusoid (P=115 days), which is illustrated on Fig.2 by solid line, gives the better approach to observed data in region of period 110-119 days.

Indeed, if we look upon phase-process diagrams on Fig.5 for period P=115 days and on Fig.6 for period P=125 days, then we have tendency to consider that period P=115 days is better fitted to the observed variations of brightness.

Such investigation was made for other compact sets of work [8]. We not found any convincing evidences for existence of periodicity in brightness variations.

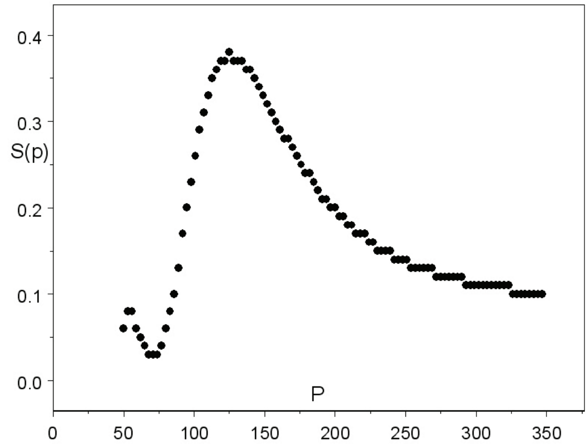


Figure 4 – Periodogram

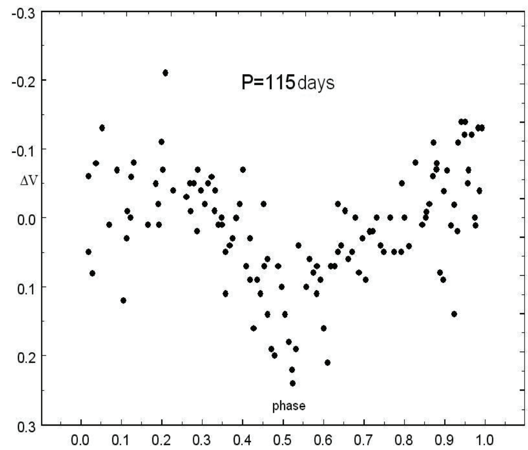


Figure - 5

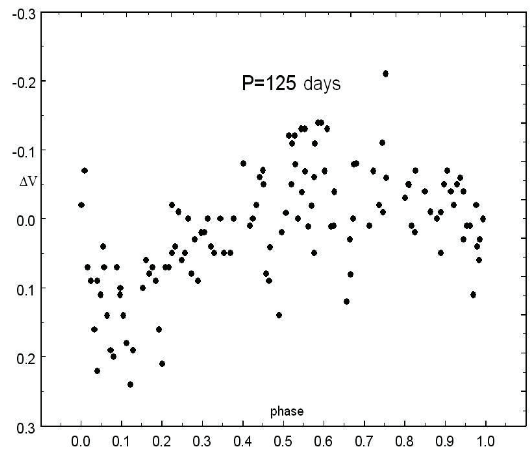


Figure - 6

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 period P=15 years.

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 period P=15 years.

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