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Observations of emission-line stars with IR excesses. II. Multicolor photometry of B[e] stars

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Abstract. — *UBVRIJHK* and *UBVRI* photometry of 10 peculiar Be stars obtained in 1989-1994 using the 1-meter telescope of the Assy Observatory in Kazakhstan is presented. The observed properties of the objects are briefly described. This paper summarizes a part of an observational program on early-type stars with emission-line spectra and infrared excesses.

Key words: photometry — B[e] stars

1. Introduction

Stars surrounded by circumstellar shells exhibit in general some variability in brightness, spectral features, polarization, etc. Investigation of this a variability helps to understand their nature. Well-known examples are the explanation of Algol-type minima in a group of Herbig Ae/Be stars (Grinin 1992) and of long-term photometric variations in Luminous Blue Variables (Wolf 1989).

In 1984 we started an observational program of *UBVRIJHK* photometry and optical polarimetry of stars with IR excesses. At present we have obtained several-year observations of 11 Herbig Ae/Be stars (Bergner et al. 1993), of 17 VV Cep-type stars (Miroshnichenko & Ivanov 1993), of some miscellaneous objects, and of the 10 B[e] stars presented here. Most of the objects for the latter program were taken from the Allen & Swings' (1976) list and have not been studied intensively in the past. This group is certainly not homogeneous in physical nature and evolutionary status. The stars are mainly massive high-luminous stars (analogous to the B[e] supergiants in the Magellanic Clouds, Zickgraf et al. 1986), intermediate or high mass binary systems (for example, RY Sct, MWC 623, GG Car), and/or young Planetary Nebulae.

In this paper we limited ourselves to brief comments on the characteristics of the stars (Sect. 3) and on the original photometry. We have decided to publish deep investigations of different types of objects separately. In Sect. 4 we present the main results of our program. This paper marks the end of a part of our studies. The next group of objects we are going to investigate is a group of almost unstudied early-type stars with strong IR excesses described by Dong & Hu (1991). In some sense, it will be a continuation of this program because almost all of the objects reported here are listed by these authors.

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2. Observations

The photometric *UBVRIJHK* observations were carried out at the 1-meter (Assy Observatory, 2700 m altitude) and the 60-cm (Almaty, 1400 m altitude, July 1994 only) telescopes of the Fessenkov Astrophysical Institute of the National Academy of Sciences of the Kazakhstan Republic with a two-channel photometer-polarimeter (Bergner et al. 1988) in 1989-1994 (diaphragm 26″, chopping distance 84″). They were obtained simultaneously with a GaAs photomultiplier in *UBVRI* (Johnson system) and with a PbS detector in *JHK*.

The comparison stars have sufficient brightnesses to be observed with a high signal-to-noise ratio. Their photometry was mainly taken from the literature. Our photometry for these comparison stars is presented in Table 1. We have used η Cyg as a comparison star for MWC 623 in the *JHK*-bands. *UBV*-photometry of HD 45629, a comparison star for HD 45677, is from Nicolet (1978). We additionally obtained its $(V-R)$=0$^{m}_{.}$03 and $(R-I)$=−0$^{m}_{.}$04. Observational errors are given in Table 2 as a function of magnitude. For the faintest stars the errors are mainly due to the atmospheric conditions. Since the atmospheric transparency and weather conditions in Almaty are worse than those in Assy the errors for observations obtained at the 60-cm telescope in July 1994 (JD 2449542 – JD 2449560) were larger than the others especially in the U-band. The observations obtained in less good nights are marked by colons (corresponding errors are about $0\overset{\rm m}{.}07$ – $0\overset{\rm m}{.}12$ and about $0\overset{\rm m}{.}15$ – $0\overset{\rm m}{.}20$ for the U-band in July 1994). Tables 3-13 present the results of our photometry.

Table 1. Photometry of the comparison stars

Object	BS	U	B	V	R	I	J	H	K
MWC 84	BS 1313	7.85	6.82	5.71	4.97	4.40	3.94	3.35	3.25
MWC 137	BS 2235	9.82	7.93	6.42	5.15	4.19	3.71	3.00	2.77
MWC 930	BS 6892	8.53	7.47	6.33	5.45	4.95	4.28	3.68	3.58
MWC 623	BS 7640	5.27	5.45	5.52	5.56	5.63	-	-	-
MWC 314	BS 7300	7.50	6.64	5.60	4.91	4.42	3.92	3.37	3.27
MWC 342	BS 7800	9.38	7.57	6.07	4.69	3.84	3.12	2.28	2.05
MWC 349	BS 7867	-	7.54	6.61	5.91	5.28	4.77	4.26	4.15

Table 2. Typical observational errors

σ	U	B	V	R	I	J	H	K
$< 0.^{\rm m}01$	9.5	11	11	11	9	4.5	4	3
$< 0.^{\rm m}03$	11.5	12	12	12	10.5	5.5	5	4.5
$< 0.^{\rm m}05$	12.5	13.5	13.5	13.5	12	6.5	6	5.5
$< 0.^{\rm m}07$	13	14.5	14.5	14.5	12.5	7	6.5	6
$< 0.^{\rm m}10$	14	16.5	16.5	16.5	14	8	7.5	7

Table 3. *UBVRIJHK* photometry of MWC 84

JD2440000+	U	B	V	R	I	J	H	K
7779.41	11.95	12.38	11.60	10.54	9.70	7.76	6.22	5.04
7781.41	12.01	12.54	11.56	10.55	9.59	7.39	6.19	5.13
7782.40	12.06	12.44	11.58	10.50	9.69	7.82	6.23	4.95
7783.43	12.22	12.51	11.72	10.63	9.59	7.55	6.22	4.86
7785.42	12.17	12.47	11.71	10.61	9.67	7.68	6.17	4.90
7786.43	11.96	12.49	11.57	10.57	9.69	7.44	6.06	5.00
7791.39	11.75	12.31	11.47	10.48	9.50	7.67	6.19	5.07
7814.38	11.89	12.42	11.56	10.61	-	7.58	6.20	4.98
7845.28	12.00	12.39	11.60	10.54	9.64	7.39	6.32	4.94
7846.24	11.93	12.40	11.58	10.52	9.63	7.69	6.21	4.98
7850.33	12.00	12.41	11.59	10.49	9.58	7.59	6.23	4.95
7851.25	11.97	12.37	11.59	10.54	9.65	-	6.21	4.98
7931.09	11.99	12.34	11.44	10.47	9.60	7.60	6.33	5.11
7932.07	11.99	12.40	11.62	10.51	9.62	7.62	6.20	4.94
8142.46	11.91	12.44	11.52	10.58	9.69	-	6.26	4.94
8169.32	11.99	12.51	11.63	10.60	9.79	7.81	6.27	4.91
8170.35	12.03	12.56	11.72	10.65	9.80	7.75:	6.33	5.00
8172.36	12.07	12.49	11.60	10.56	9.74	7.81:	6.39	5.03
8174.34	12.13	12.57	11.64	10.55	9.68	7.50	6.29:	5.03
8176.37	12.10	12.49	11.64	10.63	9.80	7.49:	6.24	4.97
8202.32	12.13	12.57	11.44	10.60	9.83	8.03	6.40	5.07
8203.32	12.03	12.58	11.70	10.68	9.79	7.53	6.25	4.97
8204.30	11.99	12.56	11.76	10.66	9.91	7.76	6.32	5.10
8205.29	12.00	12.62	11.76	10.65	9.81	7.71:	6.14	5.00
8206.31	12.00	12.63	11.74	10.69	9.91	-	6.27	4.86

Table 4. *UBVRIJHK* photometry of MWC 314

JD2440000+	U	B	V	R	I	J	H	K
8110.32	11.62	11.46	9.71	8.47	7.27	6.49	5.75	5.34
8111.28	11.69	11.48	9.91	8.46	7.29	6.31	5.66	5.39
8114.25	11.71	11.45	9.84	8.47	7.22	6.59	5.78	5.45
8143.18	11.74	11.50	9.95	8.55	7.38	6.51	5.93	5.38
8169.14	11.65	11.42	9.81	8.45	7.25	6.51	5.68	5.29
8173.12	11.66	11.47	9.83	8.46	7.25	6.36	5.74	-
8204.09	11.81	11.65	10.05	8.64	7.28	6.53	5.86	5.39

Table 5. *UBVRIJHK* photometry of L_kHα 101

JD2440000+	U	B	V	R	I	J	H	K
7913.19	-	15.66	14.76	12.42	11.04	8.13	5.73	3.14

3. Comments on the objects

The common features of the observed stars are strong Balmer emission lines without P Cyg-absorptions and other emissions by low excited ions (mainly Fe II, [Fe II], [O I]). The best studied object among them is HD 45677 = FS CMa. It has a strong infrared excess, probably circumstellar, and shows silicate dust bands in emission (Olnon et al. 1986). Savage et al. (1978) studying the spectral energy distribution (SED) from 0.155 μm to 20 μm concluded that the optical properties of the dust surrounding HD 45677 differs from that of normal interstellar dust. Modelling of the SED assuming a spherical distribution of circumstellar dust was not able to explain all its features (Sorrell 1989). Swings (1973) suggested a non-spherical structure from an analysis of the spectrum. Recently the object was recognized as a Herbig Be star with a disk-like shell (Grady et al. 1993). It exhibited variability within $0\overset{\rm m}{.}3$ in the photographic region between 1899 and 1969 (Swings & Swings 1972). Later its brightness decreased by nearly $1^{\rm m}$. Several authors have already published the results of its monitoring during different periods (Feinstein et al. 1976; Kilkenny et al. 1985; Halbedel 1989 and 1991). The object shows quasi-periodic variations in visual brightness with a period of nearly $300^{\rm d}$.

MWC 137 (Sh2-266), a star surrounded by a small cometary nebula, is listed in the catalogues of Planetary Nebulae (Perek & Kohoutek 1967), of B[e] stars (Allen & Swings 1976), and of Herbig Ae/Be stars (Finkenzeller & Mundt 1984; Shevchenko 1989). Frogel et al. (1972) from multiaperture *JHKLM* observations found that size does not exceed 5″. Altenhoff et al. (1976) discovered strong radio emission from MWC 137, but Skinner et al. (1993) detected a much weaker radio flux and suspected its non-thermal nature. The source is unresolved in radio. Sabbadin & Hamzaoglu (1981) analysing the spectra of the star and its nebula concluded that MWC 137 is a low exitation nebula around a peculiar star.

Table 6. *UBVRIJHK* photometry of MWC 342

JD2440000+	U	B	V	R	I	J	H	K
7880.04	12.18	12.01	10.83	9.45	8.48	7.41	6.12	4.92
8016.44	11.88	12.18	10.99	9.43	8.53	7.25	6.17	4.94
8109.28	11.84	11.98	10.79	9.37	8.46	7.27	6.11	4.92
8110.40	11.78	11.95	10.77	9.36	8.44	6.97	6.07	4.79
8112.32	11.82	11.98	10.74	9.36	8.46	7.54	6.19	4.94
8113.31	11.87	11.97	10.81	9.38	8.43	7.34	6.17	5.00
8114.30	11.80	11.91	10.78	9.34	8.35	7.34:	6.13	4.96
8115.40	11.70	11.92	10.71	9.30	8.35	7.17:	6.18	4.95
8119.38	11.74	12.00	10.76	9.34	8.40	7.33	6.20	4.97
8120.29	11.73	11.91	10.70	9.33	8.41	7.55:	6.38:	5.03
8122.41	11.65	11.87	10.66	9.32	8.44	7.40	6.32:	5.07
8123.35	11.68	11.90	10.75	9.33	8.43	7.54	6.25	5.03
8169.22	12.01	12.22	10.96	9.48	8.50	7.48	6.18	4.81
8170.22	11.83	12.08	10.86	9.47	8.67	7.24:	6.16	4.86
8172.19	11.73	11.84	10.66	9.30	8.40	7.51	6.27	4.97
8173.21	11.94	11.96	10.73	9.35	8.49	7.41	6.15	4.97
8174.18	11.78	11.79	10.61	9.18	8.28	7.50	6.32:	5.03
8175.11	11.79	11.79	10.58	9.26	8.41	7.42	6.12	5.09
8176.12	11.82	11.90	10.68	9.32	8.46	7.35	6.08	4.86
8404.41	11.93	11.91	10.73	9.27	8.51	-	5.74:	4.88:
8405.40	11.57	12.04	10.97	9.63	8.86	6.52	5.55	4.75
8409.40	12.13	12.09	10.93	9.39	8.63	-	5.72	4.65:
8410.38	12.20	12.14	10.90	9.47	8.59	6.82	6.04	-
8463.35	-	11.96	10.86	9.39	8.50	6.52	5.85	4.94
8464.35	12.01	12.04	10.90	9.46	8.58	7.13	5.71	4.81

Table 7. *UBVRIJHK* photometry of MWC 623

JD2440000+	U	B	V	R	I	J	H	K
7778.23	11.91	12.08	10.93	9.54	8.38	7.51	6.22	5.51
7779.23	11.79	12.04	10.87	9.55	8.39	7.43	6.40	5.48
7780.19	11.78	12.04	10.84	9.49	8.41	7.37	6.39	5.48
7781.25	11.71	12.14	10.96	9.54	8.43	7.24	6.24	5.55
7782.27	11.85	12.09	10.87	9.49	8.27	7.06	6.47	5.52
7783.23	11.92	12.13	10.82	9.47	8.31	7.14	6.32	5.57
7785.27	11.81	12.13	10.99	9.50	8.37	7.14	6.19	5.47
7786.21	11.92	12.11	10.88	9.51	8.34	7.33	6.07	5.46
7789.23	11.86	12.01	10.82	9.47	8.37	7.24	6.30	5.55
7844.04	11.78	12.02	10.85	9.48	8.36	7.49	6.29	5.58
7846.03	11.81	12.05	10.86	9.51	8.36	7.42	6.34	5.52
7850.02	11.68	11.96	10.79	9.43	8.24	7.29	6.33	5.53
8111.33	12.02	12.16	10.87	9.48	8.30	7.07	6.30	5.58:
8112.29	11.82	12.12	10.91	9.52	8.36	7.11	6.39	5.78
8113.28	11.88	12.06	10.84	9.53	8.27	7.49	6.32	5.57
8115.36	11.86	11.99	10.85	9.47	8.21	7.38	6.31	5.61
8119.33	-	-	-	-	-	7.35	6.29:	5.50:
8122.28	12.16	12.16	10.94	9.60	8.38	7.46	6.37	5.58
8123.27	11.46	12.26	11.00	9.58	8.41	6.77	5.74	5.15
8143.22	11.79	12.12	10.90	9.51	8.36	7.22	6.42	5.52
8145.18	11.88	12.12	10.88	9.51	8.41	7.35	6.15	5.56
8169.18	11.78	12.13	10.93	9.53	8.36	7.77	6.44	5.66
8172.16	11.95	12.12	10.77	9.48	8.31	7.21	6.32	5.66
8175.08	11.97	12.10	10.90	9.48	8.31	7.22	6.19	5.54
8176.09	11.98	12.11	10.88	9.52	8.38	7.19	6.20	5.65
8203.10	12.02	12.24	10.98	9.63	8.44	7.48	6.35	5.51

Table 8. *UBVRIJHK* photometry of MWC 349

JD2440000+	B	V	R	I	J	H	K
6897.47	15.66:	12.93	10.28	8.59	6.40	4.90	3.30
6899.48	16.02	12.89	10.14	8.26	6.35	4.94	3.24
6924.43	15.69	12.94	10.25	8.58	6.49:	5.00	3.30
7016.32	15.38	12.95	10.31	8.60	6.41:	4.92	3.27
7018.35	15.74	13.05	10.24	8.62	6.70:	4.97	3.31
7044.17	15.53	12.89	10.21	8.36	6.32:	4.74	3.04
7045.17	15.23	12.80	10.24	8.46	6.38:	4.81	3.13
7052.17	15.82	12.83	10.21	8.43	6.20	4.70	3.09
7367.21	15.88	12.82	10.14	8.30	6.19:	4.74	3.04
7459.17	-	-	10.25	8.46	6.20:	4.72	3.06
7813.17	15.99	12.97	10.30	8.57	6.49	4.96	3.25
7814.17	15.80	12.98	10.34	8.63	6.46	5.03	3.30
7846.12	15.89	13.03	10.36	8.68	6.46	5.01	3.38
7883.05	15.93	13.09	10.45	8.71	6.64	5.23	3.48
8142.21	-	12.87	10.51	8.92	-	5.19	3.25
8147.18	15.67	13.20	10.51	8.76	6.70	5.32	3.56
8147.36	-	13.06	10.43	8.83	-	5.22	3.47
8148.22	15.57:	13.16	10.53	8.81	6.71:	5.20	3.51
8175.16	-	13.19	10.53	8.72	6.69	5.16	3.45
8176.16	16.03	13.17	10.53	8.74	6.66	5.16	3.47
8204.15	16.04	13.19	10.55	8.84	6.75	5.10	3.51
8855.35	16.00	13.05	10.31	8.53	-	-	-

Table 9. *UBVRIJHK* photometry of MWC 930

JD2440000+	B	V	R	I	J	H	K
7778.15	15.21	12.56	9.94	8.21	6.69	5.50	5.17
7781.15	-	-	-	-	6.63	5.94	5.21:
7782.15	14.93	12.48	9.98	8.22	6.74	5.82	5.20
7785.14	15.25	12.42	10.11	8.24	6.62	5.91	5.20
7791.17	15.46	12.45	9.66	8.49	6.63	5.90	5.27
8109.24	15.05	12.41	9.98	8.25	6.84	5.99	5.48:
8110.21	15.95:	12.56	9.99	8.24	6.51:	5.88	5.28
8112.23	15.85:	12.52	9.97	8.21	6.70:	6.08	5.30
8115.21	14.99	12.45	9.93	8.21	6.75	5.97	5.36
8143.15	15.34	12.55	10.00	8.29	6.82	6.10	5.34
8145.14	15.20:	12.61	10.12	8.50	6.67	5.94	5.38
8148.18	14.98	12.47	10.11	8.39	6.97	6.03	5.53
8465.21	14.28	12.61	10.09	8.44	-	-	-
8770.44	15.60	12.79	9.99	8.30	-	-	-
8782.37	15.25:	12.56:	10.08	8.31	-	-	-

Shevchenko (1989) reported about 6 *UBVRi* observations in 1984-1986 showing a variability of $\Delta V = 0^{m}15$. He supposed that it could be a very massive O–type star emerging from a molecular cloud. Thus there were many suggestions on the nature of MWC 137 but none was proved. In our paper on Herbig Ae/Be stars we have already published its *UBVRIJHK* photometry obtained in 1987-1990 (Bergner et al. 1993). Here we present new results.

MWC 349 (V 1478 Cyg) and L_kHα101 (NSV 01618) are both strong radio and infrared sources and have very strong emission-line spectra (EW Hα $\sim$ 1000 Å). In spite of many similarities in their properties, L_kHα101 is considered to be a young stellar object (Hamann & Persson 1989), while MWC 349 is apparently an evolved star (Herzog et al. 1980). Leinert (1986) discovered a circumstellar disk around MWC 349 by direct interferometric observations. A disk-like structure of matter surrounding L_kHα101 was suggested by many authors from analysis of different observational features (Hamann & Persson 1989; Barsony et al. 1990). The properties of both objects are quite complicated and have been the subject of any papers generally based upon infrared and radio observations (Hoare et al. 1994; Planesas et al. 1992). A photographic light curve of MWC 349 was published by Gottlieb & Liller (1978). Its only *UBVRI* photoelectric observation was obtained by Lee (1970). The CCD *BVri* photometry of L_kHα101 was presented by Barsony et al. (1990).

MWC 314 = BD +14°3887 – is a poorly-investigated object. Merrill (1927) discovered emissions in its spectrum. Swensson (1942) detected the H and K Ca II interstellar lines and the 4430 Å band, Balmer emissions from H_α to H_8, Na I 5890 and 5896 Å emissions and estimated its spectral type as gG2-3 or dG4-5 from the SED in continuum, and as B2 from the excitation degree. Photospheric lines and spectral features of late-type stars were not observed. Allen (1973) noted that the object's SED corresponds to that of a late-type star but that it might be a symbiotic system or a reddened normal star. IRAS fluxes were obtained only at 12 and 25 μm. Only three optical photometric observations in the Johnson system with very similar results have been published for the star (Hiltner 1956; Lee 1970; Haupt & Schroll 1974).

A quantitative study of the spectrum of MWC 84 has been made by Chkhikvadze (1970). He has estimated the its spectral class (O6-B0), interstellar extinction ($1\overset{m}{.}5$) and distance (1 kpc). From these results he derived the absolute visual magnitude of $0\overset{m}{.}5$ which is inconsistent with the modern values for such spectral types because even for a B0 ZAMS star $M_v = -3\overset{m}{.}1$ (Straizhys & Kurilene 1981). Downes (1984) obtained a 4000−7000 Å spectrum and compared it with those of XX Oph and MWC 314, noting differences in the strength of He I emissions (MWC 84 has the strongest lines). Downes considered this difference as due to a stellar temperature difference in these objects. Earlier Allen (1973) suggested that one sees a late-type star continuum in the near infrared of XX Oph and MWC 314, while MWC 84 shows circumstellar dust radiation. Hence, while secondaries in MWC 314 and MWC 84 have not been detected their evolutionary status remained unknown.

Photometry of MWC 930 was obtained only in the infrared region (Allen & Glass 1975). From objective-prism specta it has been classified as B8e (Sanduleak & Stephenson 1973) or OB (Maehara 1982). Allen (1975) analysing information about the star pointed out that MWC 930 might be a composite system or a reddened Be star. The IRAS data show a strong excess at 60 and 100 μm. MWC 930 was not listed in the Allen & Swings' (1976) catalogue, but its spectral characteristics are very close to those of the other objects discussed here.

MWC 342 and MWC 623 have very similar emission spectra and SEDs in visual region. From spectrophotometry between 3100 and 7800 Å Arkhipova & Ipatov (1982) suggested that they both might be binary systems composed of a B8–dwarf and an early–M giant. In each case the M–star must be brighter in the V-band than the B–star by more than $1^{\rm m}$. Since TiO absorption bands were not detected, these authors suspected that they might be masked by the emission lines and considered their interpretation as requiring confirmation. An alternative model for MWC 342 was proposed by Brosch et al. (1978). They have concluded that the observed line intensities and the SED can be produced by a B3 III star with a circumstellar shell of gas and dust. High-resolution spectroscopy of MWC 623 made by Zickgraf & Stahl (1989) shows the presence of photospheric absorption lines of an early–B and an early–K star. They compared its red spectrum with that of the Sun and of Arcturus and concluded that it was very close to that of a K2–giant. The ratio of the He I absorptions and C II λ4267 gives a spectral type near B2 for the other component. No optical photometry was published for MWC 623, and only a few observations for MWC 342 (Hiltner 1956; Lee 1970).

MWC 17 was considered as a possible Planetary Nebula (Leibowitz 1977) or a symbiotic system (Martel & Gravina 1985b). Visual photometry obtained by Lee (1970) in 1969 and by Martel & Gravina (1985a) in 1982 differ from each other by $1\overset{m}{.}5$ ($13\overset{m}{.}22$ and $11\overset{m}{.}66$ respectively). Strafella et al. (1987) detected variability of the order of $1^{\rm m}$ in the near infrared.

Thus one can see that there is a lack of photoelectric observations for almost all of these objects at visual and near infrared wavelengths especially of simultaneous observations. Our program led to some interesting results which we briefly discuss below.

4. Discussion

As shown by previous investigations of our program objects, all of them demonstrate a large variety of observational features. This led us to obtain observations by different methods including a cooperative program. Another feature of our program is that the majority of our objects are situated in the northern hemisphere while other recent programmes on similar objects were devoted to southern stars (McGregor et al. 1988; Shore et al. 1990; Lopes et al. 1992). Let us discuss some results of our observations.

An analysis of our photometry of MWC 314 by Deeming's (1975) method showed the presence of regular variability with a period of $4\overset{d}{.}16$. It will be interesting to obtain more frequent photometry to check this result. Its SED between 0.36 and 25 μm is very similar to that of the peculiar high-luminous Be–type stars without circumstellar dust like P Cyg or HD 316285 (Miroshnichenko & Gubotchkin 1992). We used the method of Lamers & Waters (1984) to fit the SED and found that it can be explained by a B1–supergiant with a mass loss rate of nearly 10^{-6} $M_\odot$/yr (Miroshnichenko 1994b).

Regular brightness changes were detected also for MWC 84 and MWC 930. We suggest that these stars can be binary systems consisting of a hot dwarf and a cool giant similar to MWC 623. A detailed study of these objects can be founds in Miroshnichenko (1994a).

We observed MWC 342 for the longest period in comparison to other objects of this program. The first part of our results was published by Bergner et al. (1990). We reported there the discovery of its regular photometric and polarimetric variability, modelled its SED, and concluded that MWC 342 was a young (possibly Herbig Ae/Be) star. After this the star was included to the General Catalogue of Variable Stars as V 1972 Cyg (Kazarovets et al. 1993). Later we found that there is an X-ray source near the star position (Amnuel et al. 1979) and suggested that MWC 342 could be a Be/X–ray binary system (Miroshnichenko 1991). These two hypotheses are not consistent with each other because Be/X-ray systems are not young objects. We believe that new observations especially in the X-ray region are needed to clarify the object's nature. Preparing this paper we found systematic errors in the $(U-B)$ of MWC 342 due to the very red comparison star BS 7800 (late K-giant). The values of $(U-B)$ published in our previous paper (Bergner et al. 1990) should be changed as: $(U-B)_{\rm true} = (U-B) + 0\overset{\rm m}{.}26$.

Spectroscopic estimates of the components' spectral types in MWC 623 together with the SED constructed on the base of infrared photometry and spectrophotometric data of Swings (1981) led Zickgraf & Stahl (1989) to derive $E_{B-V} = 0\overset{\rm m}{.}8$ and a black-body temperature of the infrared excess of $T_{\rm bb} \sim 930$ K. Using our photometry we analysed the object's SED in the range of 0.36 – 10.4 μm and found from the best fit that the late component should be cooler (K7 III). This implies different values of E_{B-V} and $T_{\rm bb}$ ($0\overset{\rm m}{.}5$ and 850 K respectively). A brief summary of this work was recently published by Miroshnichenko (1992).

From an analysis of our data together with other information published for MWC 137 we deduced that its observational characteristics are in a good agreement with an early-B star near the ZAMS (Miroshnichenko 1994c). Our JHK–photometry (Bergner et al. 1993) as well as previously published near infrared observations show variability about $0\overset{\rm m}{.}6$. This is more typical for binary objects among B[e]–type stars (for example, MWC 17). It is not clear whether it is a Herbig Be star or more massive object that just left the Main–Sequence. In this sense MWC 137 is similar to WRA 1484 = Hen 1191 (de Winter et al. 1994).

We could not obtain so definitive conclusions for the rest of our sample (HD 45677, MWC 17, MWC 349, and L_kHα101). We indicate here only some details following from our results.

Our optical magnitudes for L_kHα101 are very different from those of Barsony et al. (1990). This is probably due to different contributions of the nebula through the diaphragms used (6″ in CCD–observations and 26″ in our photometer). We additionally obtained one $UBVR$– photometric observation of L_kHα101 with the photometer of the 6–meter telescope of the Russian Academy of Sciences using a 12″ circular aperture and a chopping distance of 22″ on January, 15, 1990. The results (V=$15\overset{\rm m}{.}05 \pm 0\overset{\rm m}{.}02$, $U-B$=$0\overset{\rm m}{.}12 \pm 0\overset{\rm m}{.}07$, $B-V$=$1\overset{\rm m}{.}24 \pm 0\overset{\rm m}{.}04$, $V-R$= $2\overset{\rm m}{.}16 \pm 0\overset{\rm m}{.}03$) confirmed the role of the nebula. Our infrared photometry is very close to other published data indicating a small variability in this range. Unfortunately, L_kHα101 is too faint, and we could not observe it frequently.

Our observations of HD 45677 being reduced together with the photometry of other authors confirm its quasi–periodic variability. We are going to continue its monitoring in order to make possible an analysis for the R and I magnitudes.

MWC 349 demonstrates quite large variability in the near infrared ($\Delta K \sim 0\overset{\rm m}{.}5$) which was not detected previously. Its study using of our results will be published by Yudin (1995).

Our results for MWC 17 are very close to those of Lee (1970). Further observations needed to determine the full range of its variability. MWC 17 can be considered as an object with a very strong infrared excess ($V-[25] > 8^{\rm m}$) among others in the catalogue of Dong & Hu (1991) where it was not included although its color-index $V-[25] = 11\overset{\rm m}{.}9$ even in its brightest state (Martel & Gravina 1985a).

5. Conclusions

Our observations obtained for 10 B[e] stars allow to make more definite conclusions about the nature of several objects. We found that MWC 314 belongs to a group of peculiar high–luminous Be–stars. MWC 84, MWC 930, and MWC 342 are probably binary systems. We hope that our observations of mainly northern objects together with results for southern ones will help to study photometric properties of B[e] stars in more details.

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Table 10. *UBVRI* photometry of MWC 84

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8551.37	11.98	12.44	11.57	10.59	9.74	8996.19	12.22	12.38	11.52	10.45	9.52
8552.30	12.02	12.38	11.58	10.62	9.81	8997.11	12.00	12.50	11.65	10.53	9.64
8553.32	12.43	12.41	11.61	10.62	9.76	8998.14	12.03	12.60	11.68	10.57	9.68
8554.36	12.23	12.55	11.64	-	-	9000.12	11.96	12.50	11.75	10.60	9.59
8555.34	12.38	12.66	11.67	10.59	9.89	9001.17	12.14	12.62	11.68	10.61	9.61
8556.35	12.06	12.64	11.66	10.56	9.79	9002.14	12.13	12.68	11.69	10.57	9.61
8652.11	11.87	12.57	11.67	10.57	9.70	9003.18	12.08	12.58	11.74	10.63	9.77
8932.38	12.05	12.45	11.61	10.56	9.72	9005.18	12.05	12.50	11.66	10.54	9.63
8933.31	12.19	12.63	11.74	10.63	9.78	9243.49	12.01	12.47	11.66	10.49	9.61
8935.31	12.05	13.08	11.75	10.57	9.73	9604.42	12.00	12.51	11.50	10.43	9.58
8995.17	11.79	12.42	11.72	10.49	9.47	9611.41	11.96	12.45	11.41	10.37	9.58

Table 11. *UBVRI* photometry of MWC 137

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8934.37	13.15	13.56	12.20	10.57	9.54	9001.20	12.70:	13.39	12.16	10.56	9.51
8935.49	12.98	13.54	12.10	10.59	9.66	9002.21	12.90	13.47	12.20	10.56	9.50
8961.45	12.77	13.43	12.16	10.63	9.72	9003.23	12.95	13.53	12.27	10.63	9.60
8964.40	13.18:	13.52:	12.24	10.57	9.57	9005.21	12.88	13.45	12.20	10.60	9.55
8998.19	13.12	13.50	12.20	10.59	9.70	9029.14	13.13:	13.29	12.13	10.59	9.65
9000.18	12.68	13.27	12.01	10.49	9.53						

Table 12. *UBVRI* photometry of MWC 314

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8402.39	11.96	11.52	9.87	8.48	7.26	8782.40	11.94	11.52	10.07	8.60	7.62
8404.35	11.85	11.56	9.88	8.46	7.24	8793.40	11.84	11.44	10.03	8.48	7.30
8405.37	11.99	11.53	9.85	8.43	7.21	8798.32	12.26	11.76	10.23	8.54	7.43
8406.33	12.00	11.54	9.87	8.46	7.23	8933.05	11.84	11.42	10.02	8.44	7.14
8407.33	11.78	11.53	9.82	8.42	7.19	8937.04	11.82	11.33	9.89	8.38	7.13
8409.35	11.81	11.52	9.84	8.45	7.24	9165.36	11.70	11.50	10.09	8.45	7.17
8410.29	11.46	11.55	9.83	8.34	7.27	9232.31	12.03	11.58	10.11	8.43	7.08
8463.30	11.98	11.58	9.92	8.48	7.25	9542.33	-	11.43	9.84	8.41	7.26
8464.28	11.52	11.53	9.85	-	-	9546.34	11.70:	11.46	9.84	8.35	7.21
8552.05	11.90	11.60	9.93	8.42	7.20	9548.30	12.05	11.94	9.95	8.40	7.24
8553.04	11.98	11.64	9.91	8.43	7.25	9549.31	11.74	11.56	9.94	8.44	7.26
8554.10	12.14	11.69	9.97	8.53	7.26	9550.28	11.80	11.60	9.91	8.40	7.23
8555.08	11.80	11.58	9.91	8.45	7.27	9554.28	11.88:	11.51	9.92	8.41	7.22
8556.05	11.95	11.61	9.93	8.53	7.41	9555.30	11.37:	11.42	9.84	8.39	7.19
8557.06	11.85	11.67	9.96	8.56	7.45	9557.27	11.44:	11.40	9.86	8.39	7.21
8558.04	11.73	11.62	9.93	8.52	7.39	9558.31	11.50:	11.46	9.85	8.37	7.19
8559.04	12.11	11.57	9.92	8.47	7.39	9559.28	11.91:	11.53	9.88	8.40	7.20
8561.04	11.87	11.62	9.91	8.50	7.31	9560.29	-	11.69	9.96	8.43	7.22
9612.09	11.80	11.52	9.94	8.46	7.23						

Table 13. *UBVRI* photometry of MWC 342

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8406.39	11.94	12.03	10.82	9.35	8.45	8562.08	11.98	12.10	10.94	9.35	8.51
8407.36	11.89	11.95	10.83	9.33	8.44	8782.44	11.88	11.93	10.83	9.38	8.45
8553.15	11.80	12.00	10.73	9.33	8.52	8792.40	11.89	12.01	10.86	9.48	8.58
8555.11	11.78	11.91	10.75	9.36	8.54	8793.43	11.84	11.96	10.84	9.42	8.49
8556.10	11.78	11.94	10.74	9.34	8.43	8870.25	11.79	12.03	10.88	9.43	8.51
8557.11	11.66	12.03	10.82	9.44	8.62	8933.07	12.10	11.95	10.87	9.46	8.56
8558.11	11.89	11.99	10.77	9.35	8.49	8935.05	12.02	12.18	11.02	9.54	8.67
8559.14	11.90	11.93	10.75	9.48	8.62	8937.06	11.93	11.98	10.83	9.40	8.50

Table 14. *UBVRI* photometry of MWC 623

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8404.39	12.02	12.08	10.88	9.48	8.52	8554.13	12.40	12.10	10.83	9.42	8.45
8406.36	11.80	12.05	10.85	9.48	8.51	8561.10	11.90	12.09	10.90	9.50	8.51
8410.34	12.07	12.06	10.90	9.48	8.57						

Table 15. *UBVRI* photometry of HD 45677

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8932.42	7.50	8.27	8.23	7.84	7.52	9000.21	7.59	8.28	8.19	7.84	7.68
8933.43	7.44	8.22	8.16	7.83	7.56	9001.21	7.44	8.30	8.23	7.87	7.72
8934.43	7.51	8.27	8.19	7.79	7.52	9002.26	7.43	8.19	8.12	7.74	7.55
8935.45	7.50	8.27	8.16	7.80	7.58	9005.23	7.42	8.23	8.16	7.84	7.68
8996.23	7.54	8.30	8.28	7.92	7.78	9408.16	7.48	8.22	8.15	7.72	7.51
8997.22	7.58	8.29	8.20	7.88	7.80	9427.13	7.42	8.22	8.15	7.79	7.61

Table 16. *UBVRI* photometry of MWC 17

JD2440000+	U	B	V	R	I	JD2440000+	U	B	V	R	I
8551.30	-	14.47:	13.26	11.76	11.41:	8553.24	-	14.45:	13.25	11.69	11.38:
9604.32	-	14.35	13.14	11.75	11.82:						