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THE DROP IN BRIGHTNESS OF MWC 560≡V694 Mon

M. MIKOŁAJEWSKI[1], T. TOMOV[2], L. GEORGIEV[3], A. JONES[4]

[1] Centre for Astronomy, Nicolaus Copernicus University, Toruń, Poland
[2] NAO Rozhen, Smolyan, Bulgaria
[3] Instituto de Astronomia, UNAM, Mexico
[4] Carter Observatory, Wellington, New Zealand

MWC 560 is a symbiotic-like variable demonstrating a large variety of changes in its brightness and spectrum. The system consists of an M4.5 giant and a white dwarf – probably magnetic. The time scale of the observed variations in the star brightness ranges from minutes to years. In the optical, the spectrum of the star is dominated by a hot continuum corresponding to a late B star. A forest of emission lines, mainly of HI and singly ionized metals, with constant radial velocity and relatively small variations in the intensity is always present. The most amazing spectral features are the intense and variable absorption components, mainly of the Balmer lines, appearing with blue-shifts reaching several thousands km s^{-1} (see for details Tomov et al. 1996; Tomov & Kolev 1997, and references therein).

After the highest (V$\sim$9^{m}) maximum ever observed in 1990, the MWC 560 brightness decreased by about 1^{m} until 1993 (Fig. 1). Then for several years the star brightness showed variations reaching an amplitude of about $0\overset{m}{.}5$ around a mean value V$\sim$$10\overset{m}{.}2$. A not so prominent maximum, best visible in the visual light curve in Fig. 1, appeared in 1995. The time interval between the 1990 and 1995 maxima well agrees with the proposed orbital period $\sim$1930^{d} (Doroshenko et al. 1993).

During the first months of 1997 a systematic decrease in the visual brightness of MWC 560 began (Fig. 1). A noteworthy drop in magnitude of MWC 560 occurred in April 1997. The magnitudes obtained on April 23 and 26 in comparison to March 23 indicate the amplitudes of drops about $1\overset{m}{.}5$, $0\overset{m}{.}9$, $0\overset{m}{.}7$, $0\overset{m}{.}3$ in U, B, V, R, respectively, and possibly about $0\overset{m}{.}1$–$0\overset{m}{.}15$ in I. The visual estimates in April show the lowest values since 1990 as well. Unfortunately, in May the star became invisible in our observatories. First visual estimations obtained in July–August confirm the existence of the drop.

As it can be seen in Fig. 1, during all the period 1990–1997 the brightness of the star varies in a very similar way in the UBVR bands with an amplitude strongly decreasing from U to R. The character of the changes is different in I band only. This indicates that the hot continuum remarkably contributes to the brightness of MWC 560 up to the wavelengths covered by the R filter and that in the I band the flux from the M giant dominates. Therefore, the observed drop in the brightness, most probably is caused by a phenomenal decrease in the flux of the hot continuum source.

The spectroscopic monitoring of MWC 560 showed slightly increasing activity at the beginning of the last observing season in September 1996 (Georgiev et al. 1996). Examples of the changes in the absorption lines of HI, HeI, HeII and FeII between September 16 and 19 are shown in Fig. 2. The spectra were obtained by the echelle spectrograph of the 2.1 m telescope, OAN San Pedro Martir (Mexico) – spectral range 3700–7000 Å, resolution about 0.4 Å and S/N ratio changing between 50 and 100 over the spectral range.

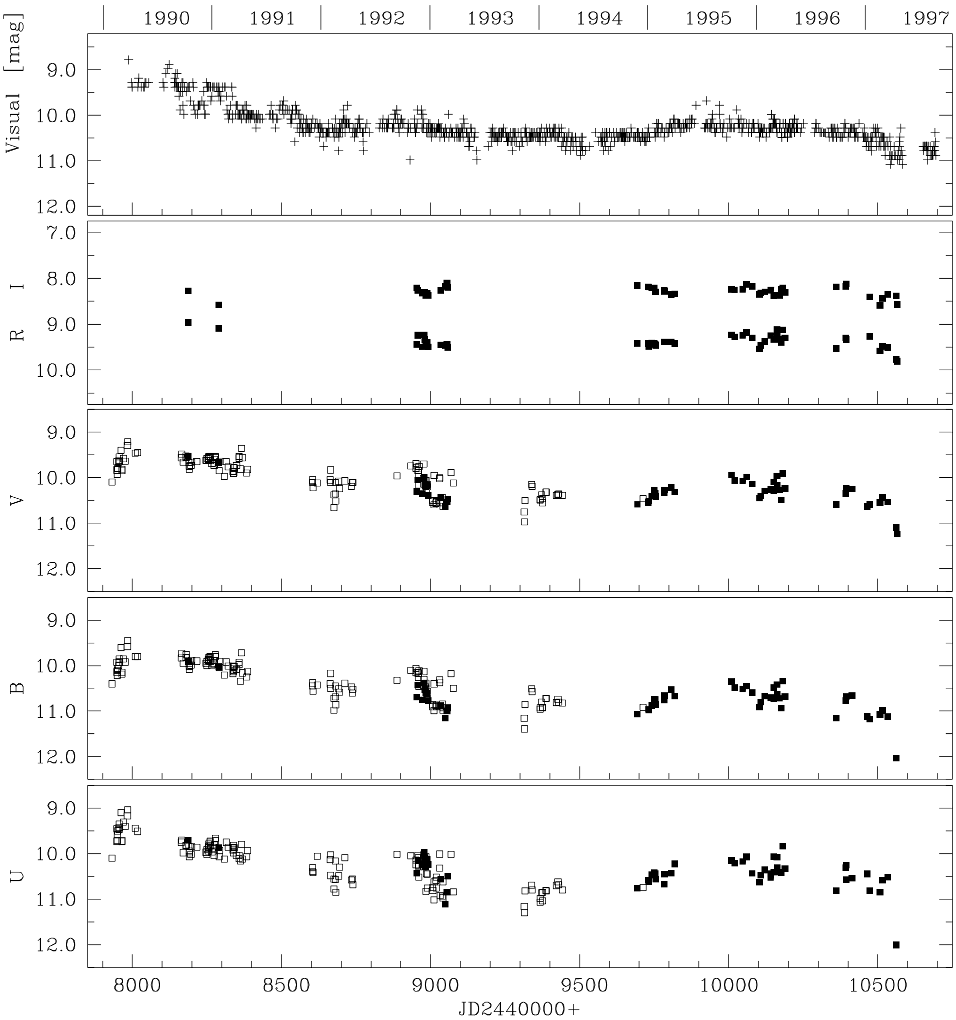

Figure 1. UBVRI and visual light curves of MWC 560. The data from Tomov et al. (1996) (*squares*) are combined with new UBVRI observations from Torun (Poland), new UBV observations from Rozhen (Bulgaria) (*filled squares*) and new visual estimates by A.J. (New Zealand). Description of the equipment and the accuracy of the observations can be find in Tomov et al. (1996). The visual magnitudes are corrected with $-0\overset{m}{.}22$ as in Tomov et al. (1996).

The Balmer absorptions appeared with a strongly variable multicomponent structure. The blue wings of these absorptions (Hγ in Fig. 2) are extended to about $-2000\,\mathrm{km\,s^{-1}}$ on September 16 and to more than $-3000\,\mathrm{km\,s^{-1}}$ on September 19. The intensity of the slowest absorption component, with a velocity of the order of -600 to $-700\,\mathrm{km\,s^{-1}}$, remarkably decreases in four days. A relatively strong absorption of FeII 5169 Å is present on September 16 at $\sim -1400\,\mathrm{km\,s^{-1}}$. The intensity of this feature gradually decreases, simultaneously with strong variations in its shape, and in the spectrum on September 19 a much fainter, clearly double component ($\sim -1500\,\mathrm{km\,s^{-1}}$ and $\sim -2000\,\mathrm{km\,s^{-1}}$) can be seen. The HeI 4471 Å line behaves differently. On September 16 this absorption is weak and because of the blending with the emissions it is difficult to say something about its shape. On the September 17, 18 and 19 spectra a relatively intense absorption component of this line can be seen, changing in shape and with slightly increasing blue-shift (reaching about $-2200\,\mathrm{km\,s^{-1}}$ on September 19). On the spectra of the last two dates an additional, much weaker and slower ($\sim -500\,\mathrm{km\,s^{-1}}$ — $-600\,\mathrm{km\,s^{-1}}$) absorption component of HeI 4471 Å appeared in the spectrum of MWC 560.

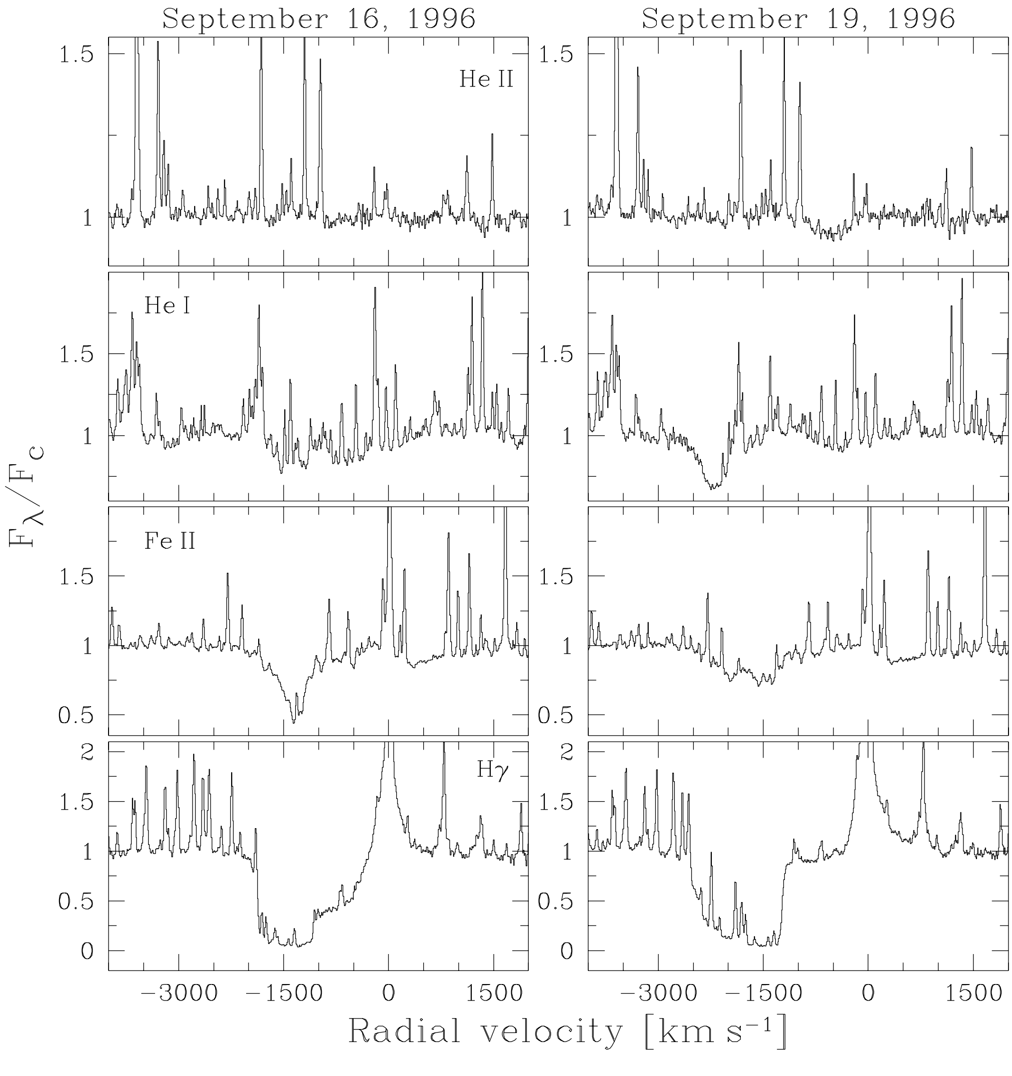

Figure 2. The absorption components of the HeII 4686 Å, HeI 4471 Å, FeII 5169 Å and Hγ lines in the spectrum of MWC 560 observed on September 16 and 19, 1996. The spectra are normalized to the local continuum level. The strongest emission peaks are truncated for plot clarity.

The most intriguing feature is the appearance of a very weak HeII 4686 Å absorption line in the spectrum of MWC 560. It is absent on September 16 and is best visible on September 19. The blue-shift of this line is $\sim -500\,\mathrm{km\,s^{-1}}$ — $-600\,\mathrm{km\,s^{-1}}$, i.e. very close to the velocities of the slowest Hγ and HeI 4471 Å absorption components. The presence of the high excitation lines (as HeII) in the MWC 560 spectrum has not been mentioned before in the literature. An inspection of our old CCD and photographic spectra show that this line was not visible even during the highest activity in 1990 and only a faint absorption line probably appeared in the spectrum in November 1994.

Mikołajewski et al. (1996, 1997) have argued that MWC 560 and CH Cygni may be the prototypes of new subclass of symbiotic binaries deriving energy of the hot component from the stellar wind accretion and the fast rotation of a magnetic white dwarf. The most prominent episode in CH Cyg was a drop in hot continuum observed in July 1984, accompanied by the radio outburst and jets' ejection (Taylor et al. 1985), X-ray emission (Leahy & Taylor 1987), the appearance of wide (up to $\pm 1500\,\mathrm{km\,s^{-1}}$) wings in the Balmer emission lines (Mikołajewski &Tomov 1986) and the broad He II 4686 emission line (Leedjärv et al. 1994). In the oblique rotator model of CH Cyg (Mikołajewski et al. 1990a,b) the drop in July 1984 was interpreted as a transition between *accretor* and *propeller* state of the magnetosphere.

From the historical light curve of MWC 560 (Luthardt 1991) it can be seen that most often the star varies between 12^{m} and 11^{m} in the m_{pg}/B brightness. Only during 1943–1953, and possibly in 1960 and in 1970–1972 has it reached reasonably flat minima with $m_{pg} \approx 12\overset{\mathrm{m}}{.}5$. In 1990 MWC 560 has reached maximum, $B \approx 9\overset{\mathrm{m}}{.}4$ followed by a gradual decrease until March 1997 and $B \approx 11^{\mathrm{m}}$. On the basis of the resemblance between MWC 560 and CH Cyg we can suppose that the drop in the brightness of MWC 560 observed recently may indicate a similar *accretor* $\Rightarrow$ *propeller* transition. In case this is true, any optical and especially X-ray and radio observations would be very valuable.

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