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MARKED AND SHORT TIME-SCALE CHANGES IN THE CH Cyg EMISSION LINE PROFILES OBSERVED IN NOVEMBER 1993

CH Cyg has been known for a long time as a bright (m_{vis} ~7 mag) M-type semi-regular variable. It has been only after 1963 that it started to show an increasing level of activity which manifested through five distinct *bright* or *outburst* phases (Deutsch 1964; Mikolajewski *et al.* 1990; Skopal *et al.* 1993). CH Cyg is a binary system composed of an M6-7 giant and a probably magnetic WD, the latter being eclipsed every 16 yr (Mikolajewski *et al.* 1987). CH Cyg is usually associated with the symbiotic stars.

The 5^{th} and still ongoing bright phase has begun in the summer of 1989 (Tomov *et al.* 1989; Mikolajewski *et al.* 1990; Tomov and Mikolajewski 1992; Kuczawska *et al.* 1992). CH Cyg is presently still rising in brightness (Mikolajewski *et al.* 1992; Skopal *et al.* 1993; Leedjärv 1993). Large amplitude flickering has been observed in U as well as in B and V bands, and marked variations in the emission line spectrum have been announced. Particularly interesting are the reports of large line profile changes over a few days time interval and the presence of emission and/or absorption components of Balmer lines with radial velocity of several hundred km/s (Aufdenberg *et al.* 1993; Leedjärv 1993).

CH Cyg has been regularly monitored at the Asiago Astrophys. Obs. with CCD spectrograph since 1986. We have a large collection of low resolution, absolutely calibrated spectra over the region 3350-11000 Å as well as high resolution Echelle spectra. The results of this long term monitoring will be presented elsewhere. However, prompted by the mentioned reports of large and short time-scale emission line profile variations, in this note we briefly describe the results of our search for such events over a 48 hour time interval in late November 1993. The observations of Hα and Hβ profiles presented in Figure 1 were secured on Nov. 25 and 27 1993, with the Echelle+CCD spectrograph attached to the Asiago 1.82 m telescope. The spectral resolution (from the width of thorium comparison lines) is ~0.3 Å FWHM for the Hα region and 0.2 Å FWHM for the Hβ region. The S/N ratio of the continuum in the original spectra varies from 135 to 60. The wavelength scale of the Asiago Echelle+CCD spectrograph is particularly well suited for accurate radial velocity works as demonstrated in the model study of Munari & Lattanzi (1992).

The profiles presented in Figure 1 show two basic facts: (*a*) there are features whose intensities and radial velocities remain pretty well fixed (like the main emission peak and the absorption component with the less negative velocity) and (*b*) there are other features – those at most extreme |RV| values – which present dramatic changes over time scales of hours or very few days. The latter fact is particularly evident in the region of Hβ profiles where the broad emission seen centered at λ_o 4853 Å on 25.11.93 is missing two days later and the deep absorption centered at λ_o 4857 Å on 27.11.93 was not visible two days earlier. The lack of corresponding features in the Hα profiles (recorded simultaneously with Hβ) is quite puzzling and questions the direct link of these features with high speed hydrogen clouds.

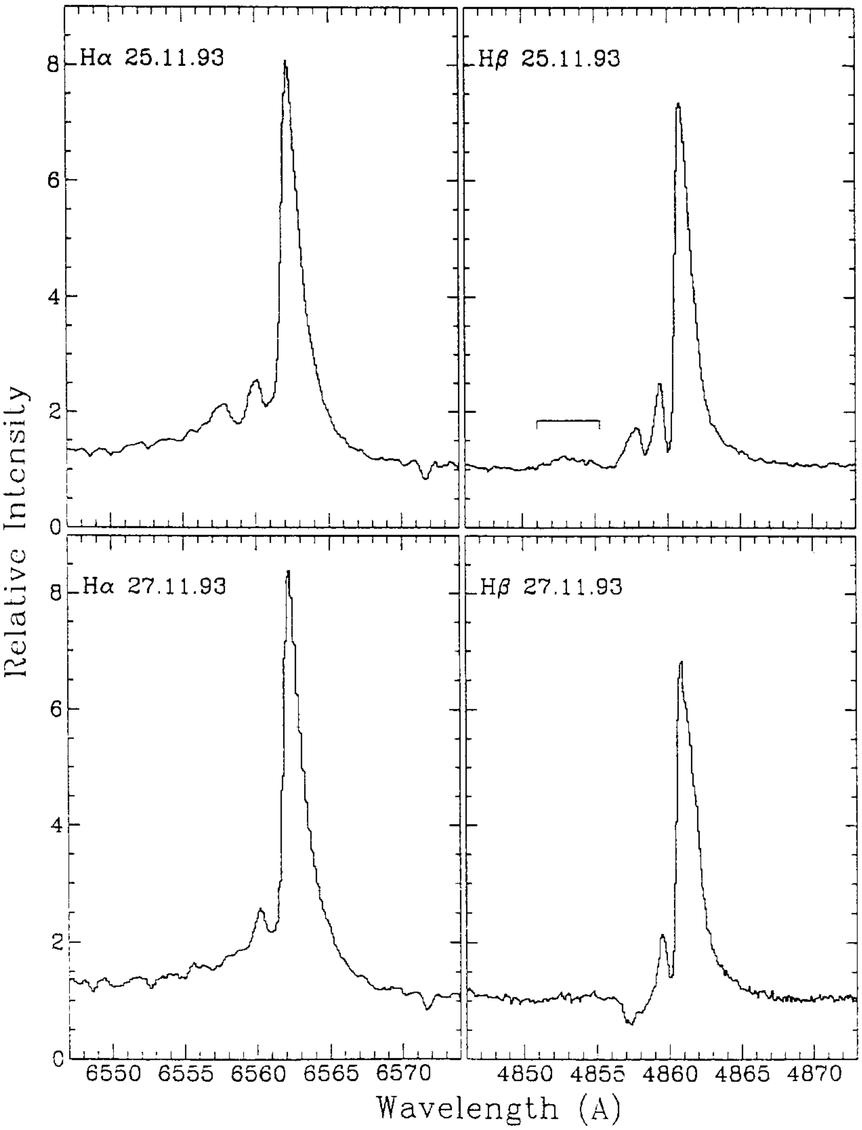


Figure 1. Comparison between the Hα and Hβ profiles of CH Cyg observed at Asiago on 25.11.1993 and 27.11.1993. The wavelength scale is heliocentric and the fluxes are scaled to the local continuum normalized to 1.0. The wavelength range is the same for all panels.

Table 1
$RV_\odot$ (km/s) of the peak of each individual feature observable in the $H\alpha$ and $H\beta$ profiles of Figure 1.

line	date	UT	Individual profile peaks				
$H\alpha$	25.11.93	18.35	-234 (em)	-193 (abs)	-138 (em)	-106 (abs)	-42 (em)
	27.11.93	18.00			-129 (em)	-94 (abs)	-39 (em)
$H\beta$	25.11.93	18.35	-224 (em)	-187 (abs)	-125 (em)	-91 (abs)	-42 (em)
	27.11.93	18.00			-122 (em)	-85 (abs)	-39 (em)

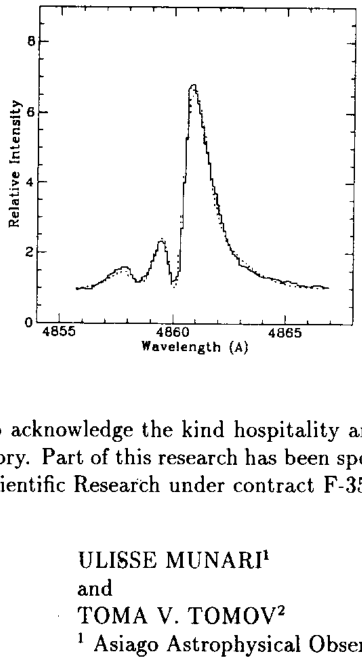
The interpretation of the profiles is *in toto* dependent on the physical assumptions of the adopted model (*e.g.* absorption instead of emission components) and any de-convolution into individual components may be performed in many different ways. A sample fitting to the 25.11.93 $H\beta$ profile, using two emission and two absorption components, is presented in Figure 2. Similarly good fits can be however achieved with different combinations of gaussian components. For sake of quick-look comparison with other published profiles, in Table 1 we list the $RV_\odot$ of the peak of each individual feature observed in the profiles presented in Figure 1.

Kuczawska et al. (1992) and Leedjärv (1993) have presented observations that may suggest the presence of emission components in CH Cyg with $|RV|$ up to 1000 km/s. They have proposed that such high-velocity components are produced by material expelled from the system via precessing jets. In an eclipsing system like CH Cyg (*e.g.* seen edge-on), however it is difficult to accept the idea that the the precession angle is so large to bring – during the precession cycle – the direction of the ejection close to the line-of-sight in order to produce the observed high-velocity components (if one discards the idea of ejection velocities approaching the speed of the light). Even larger difficulties would be encountered by any model which would invoke precessing jets to explain high velocity absorption components, for the obvious reason that the jets in this case must be closely aligned with the line-of-sight (whatever large their ejection velocity could be).

A possible way-out to explain *both* the high-velocity emission and absorption components in the CH Cyg system (seen edge-on), is to admit that a *propeller effect* is at work (Lipunov 1992). The accreted material infalling toward the WD is partially ionized by the hard radiation field of the latter. When this infalling and ionized material reach a distance to the WD of the order of the Alfven radius, it is trapped into the magnetic field which co-rotates with the WD and it is accelerated up to the escape velocity from the system. Ejection in the form of discrete blob can then take place with velocity vectors uniformly oriented with respect to the line-of-sight.

Finally, it may be worth noting that so far the most energetic active phase ever observed in CH Cyg began in 1977, *i.e.* 16 years $\equiv$ 1.0 orbital period ago. If the strength of active phase is regulated in some way by the orbital phase, in the coming years we could witness the formation of an optically thick envelope surrounding the CH Cyg hot component as it was observed during the 4th activity period which started in 1977 and peaked in the years 1981-1984.

Figure 2. Example of multicomponent gaussian fitting to the CH Cyg Hβ profile of 25.11.93 shown in Fig.1. Solid line = observed profile; dotted line = gaussian fit. To fit the profile, two emission and two absorption components were used. Their heights (in unit of the underlying continuum), widths (in Å) and heliocentric wavelengths (in Å) are respectively:
(1st em) 4.14/1.45/4860.79
(2nd em) 1.78/4.29/4860.74
(1st abs) -3.96/0.69/4860.14
(2nd abs) -0.75/0.91/4858.70



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