High S/N simultaneous optical and IR spectrophotometric observations of Herbig Ae/Be stars

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ABSTRACT- We present a preliminary report on simultaneous optical and infrared observations on a sample of Herbig Ae/Be stars carried out at the European Southern Observatory in La Silla-Chile in March 1984 and in March-April 1985.
In this paper Z CMa, V380 Ori, R Mon and HD53367 are analyzed A strong variability in both energy distribution and Hα line profile is detected in Z CMa, while for HD53367 only He I and Hα profile's variations are revealed; V380 Ori and R Mon show non significant variability.

1. INTRODUCTION

The Herbig Be star Z CMa is localized in a large expanding nebular region and it is the most interesting object of an association of very young stars called CMa R1.According to Finkenzeller et al(1984) Z CMa is a double star system. The light curve is characterized by irregular fluctuations, but from a comparison between the present behaviour and the old one,it seems that the star is now on a relatively quiescent phase,(Covino et al,1984). The spectral type is peculiar:the absorption spectrum looks like that of a moderately rotating F star superimposed on a late B spectrum (Strom et al,1972,Covino et al,1984).

V380 Ori is the illuminating star of NGC 1999; it is an irregular variable of T Tauri type of early spectral class (B8-A2 e). In the optical range the spectrum is characterized mainly by the very strong emission lines of H,FeII,TiII and CaII; In the near infrared the emission lines of OI,CaII and HeI are the most important features.

R Mon is the nucleus of the nebula NGC 2261 and according to Herbig (1960) it is not a star, but resembles a small coma; probably the star is deeply embedded in a dust nebula and it is not directly observable. The spectral class

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is unknown and the emission spectrum reveals a similarity with the one of V380 Ori.

HD53367 is probably a spectroscopic binary which might explain its emission line spectrum (Finkenzeller et al 1984). The IR colours indicate that the object may be a normal Be star (accidentally) associated with a dark cloud material.

2. OBSERVATIONS

2.1-Optical Medium dispersion spectra (114 Å/mm) in the range 4700-7000 A were obtained with the Boller and Chivens spectrograph mounted at the Cassegrain focus of the ESO 1.52m telescope; the Image Dissector Scanner was used with a double 8" aperture deker. Standard ESO reduction has been made. Rms values of the noise have been computed on many line free region of the spectra and the relative signal to noise ratios at the continuum level have been computed; typical values range from 50 to 150, while for the most relevant emission features the S/N ratios are ranging between 100 and 300. In Figures 1,2 and 3 the spectra of Z CMa, V380 Ori and R Mon are reported.

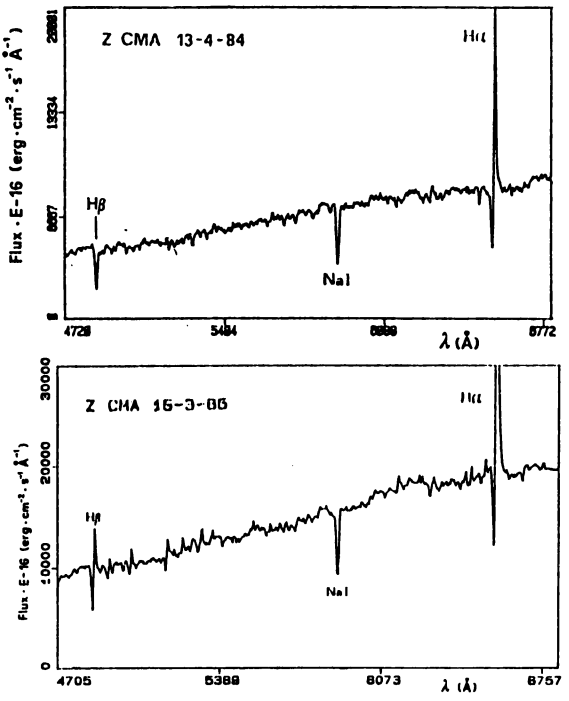

Fig 1. a-up b-low 1.52m ESO + IDS

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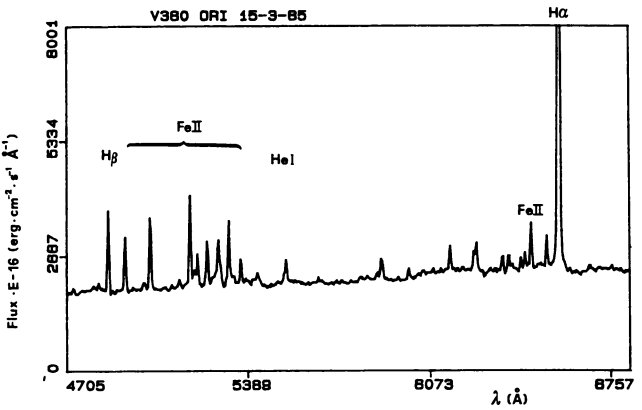

Fig 2. 1.52 m ESO telescope + IDS

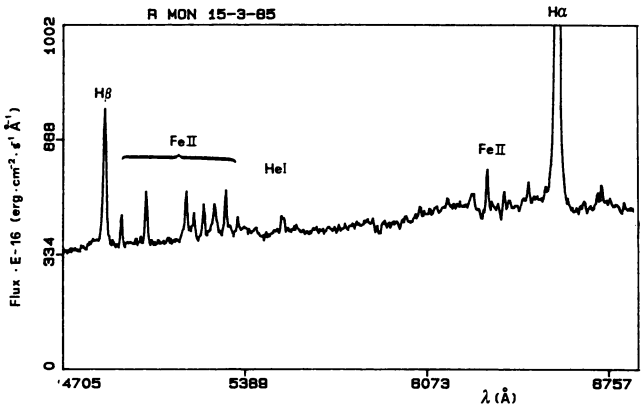

Fig 3. 1.52 m ESO telescope + IDS

High dispersion line profiles have been taken with the Coudé Echelle Spectrograph fed by the 1.4 CAT. the resolving power was 80000. In figure 4 the Hα profile of Z CMa is shown, while in figure 5 the Hα and HeI 5876 line profiles are plotted.

We emphasize the importance of the accuracy during the reduction procedure; as an example the S/N ratio of the Z Cma spectrum of fig.4b at the continuum level was measured for the raw data and after the complete reduction (background subtraction and flat field division). The S/N value improuved from the original 41.5 to the final 170.

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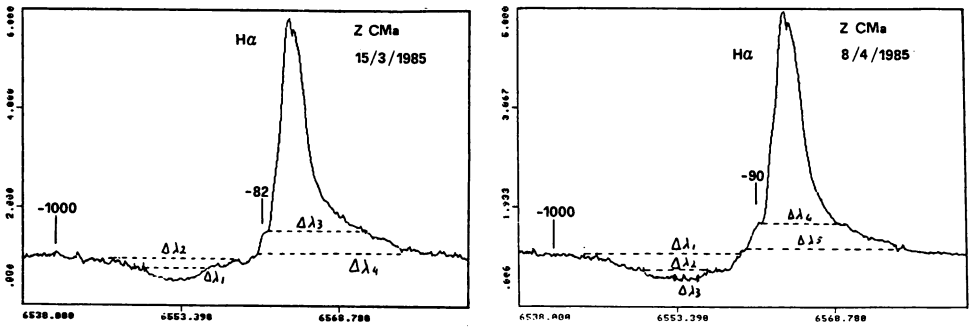

Fig 4. a-left b-right ESO 1.4m CAT + CES

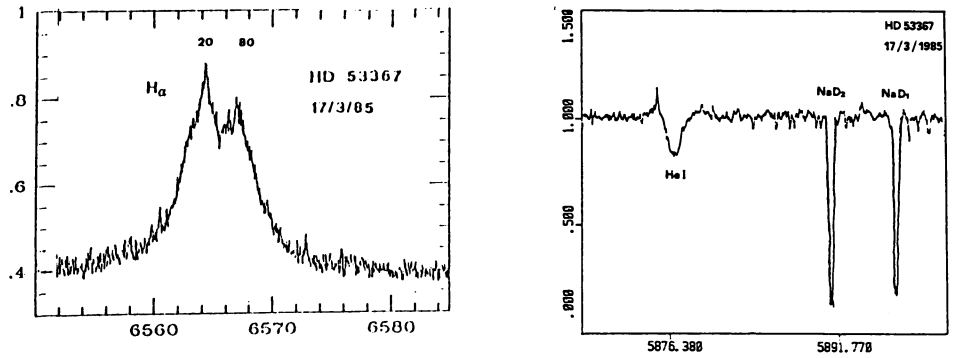

Fig 5. ESO 1.4m CAT + CES

2.2-Infrared Low dispersion spectrophotometry with $\lambda/\Delta\lambda=100$ has been carried out at the ESO 1m telescope. Three different Circular Variable Filters were used to cover the range 1.4-5.3μ with an InSb detector. In figures from 6 to 9 the energy distributions are shown for Z Cma,V380 Ori, R Mon and HD53367 respectively.

Table 1

velocity fields referring to the Z CMa CAT observations (given in Km/sec)

15/3/1985	Δv1	Δv2	Δv3	Δv4	
	283	598	461	813	
8/4/1985	Δv1	ΔV2	ΔV3	Δv4	Δv5
	663	274	151	342	681

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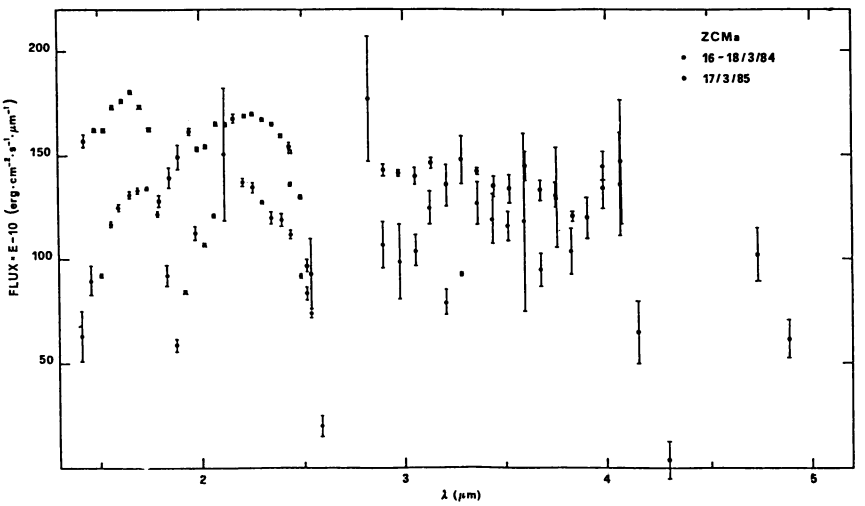

Fig 6. ESO 1m telescope + In b detector

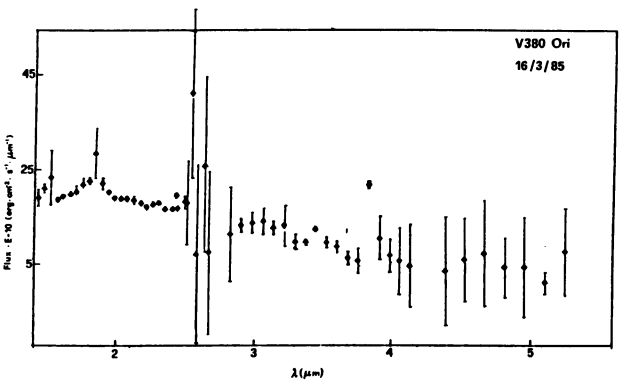

Fig 7.

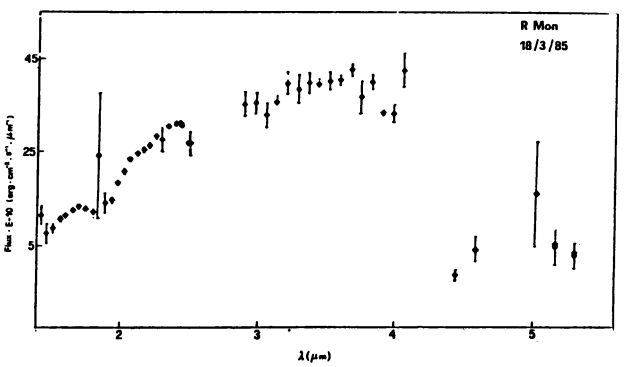

Fig 8.

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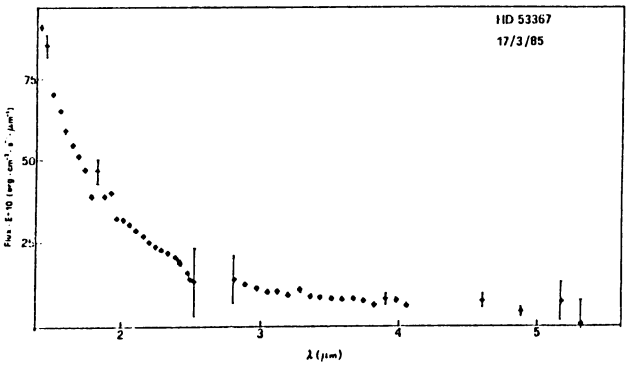

Fig 9.

3. RESULTS

Referring to Z CMa a strong variability is detected in the whole spectral range. In the 1984 IDS spectrum (fig 1a) the Hβ and FeII lines are seen only in absorption and the spectrum is very similar to the one observed in 1983 when the star had the same V magnitude (V=9.3). In 1985 (V=8.8) the object presents very strong P Cygni profiles in the Balmer and FeII(42),FeII(49) lines (see fig 1b). The absorption components are fairly broad and blue shifted of 300Km/sec. Other FeII lines are present only in emission. The high dispersion observations revealed changes in the Hα line profile, as can be seen from fig 4. In particular while the emission component does not shows any significant change in the time scale of 1 month, the shallow and dish like absorption is variyng both in central wavelength and velocity fields of the multiple ejected shell system (see table 1). Infrared spectrophotometry indicate a brightening on long time scale as shown in fig 6, while only minor variations are detected in the two 1985 observations.

A strong variability has been detected in the high resolution spectrun of HD53367. Comparing our data with those by Finkenzeller et al,1984 , we note tha in 1985 the object shows a double peaked Hα and a weaker blue shifted emission peak with a stronger unshifetd absorption component as can be seen in fig 5. In contrast with the other stars analyzed HD53367 has a very weak infrared excess (see fig 9) which suggests that this star is likely to be a normal star with strong emission line activity.

A complete analysis of the data will be given in a forthcoming paper

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