

# An H $\alpha$ outburst in the B emission line star HD 76534

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Abstract. We present the discovery of unusually rapid and strong variations in the H $\alpha$  emission line of the emission line star HD 76534. Within two days, a strong emission line changed to photospheric absorption, while the line was in emission only two hours later. The observed timescale is an order of magnitude shorter than has been observed before in Be-type stars.

Two different scenarios that may be able to explain the observed behaviour are explored. The deduced mass loss rates are in agreement with the mass ejection mechanism, that has been invoked to explain the H $\alpha$  outbursts of variable Be stars like  $\lambda$ Eri and  $\mu$  Cen. The fact however that the H $\alpha$  line profile appears to trace a steady-state circumstellar envelope is not in agreement with the expected variable emission from a disk-like structure which is being built up in a few days.

In this paper, a new hypothesis is brought forward to take into account the sudden increase of H $\alpha$  in HD 76534, a change in the ionizing continuum from the star which ionizes a different fraction of a steady state circumstellar envelope.

**Key words:** stars: activity – stars: circumstellar matter – stars: emission-line, Be – stars: individual: HD 76534– stars: mass loss

## 1. Introduction

HD 76534 is a bright B2Ve star with  $V \sim 8$ . By virtue of its H $\alpha$  emission and claimed circumstellar nebulosity, it was thought at first to be a Herbig Be star (van den Bergh & Herbst 1975, Herbst 1975). It is one of the exciting stars of the Vela-R2 association, and lies close to its main sequence (Herbst, 1975). Its status as a Herbig Be star was questioned however by Thé et al. (1985) who argued that since HD 76534 does not have a significant near-infrared excess, it should not be classified as such.

In view of the above, we will regard HD 76534 as a classical Be star in the remainder of this paper, although it will not affect any of our conclusions. Here we report on the discovery of dramatic variations in its H $\alpha$  line on unusually short timescales.

Such variations have been detected in few Be stars, notably  $\mu$  Cen (Peters, 1986; Hanuschik et al. 1993) and  $\lambda$  Eri (Smith, Peters & Grady 1991). These stars have long periods without significant H $\alpha$  emission, but sometimes undergo an H $\alpha$  outburst where the emission rises to an equivalent width (EW) as high as -6 Å within days. The emission then fades on somewhat longer timescales until only a photospheric profile remains. The above authors propose that the H $\alpha$  outburst traces the build-up of a circumstellar disk which neither reaches steady state nor exceeds the local escape velocity, and falls back onto the stellar photosphere. Observations such as these can provide important clues on the manner of the formation of disks around Be stars.

## 2. Spectroscopic observations

Optical spectropolarimetric data were obtained with the 3.9 meter Anglo-Australian telescope on 9 and 11 January 1995. The weather was adequate for spectroscopy on January 9. Useful spectropolarimetric data could be taken on January 11.

The instrumental set-up included a half-wave plate rotator set to various angles to obtain the Stokes parameters and a calcite block to separate the light leaving the retarder into perpendicularly polarized light waves. Two holes in the dekker allow one to simultaneously observe the sky background. Four spectra are recorded, namely the O and E rays of the target object and of the sky respectively. One complete polarization observation consists of a series of four consecutive exposures at different rotator positions.

A  $1024 \times 1024$  pixel TEK-CCD detector was used, which combined with the 250B grating resulted in a wavelength coverage from 3786 - 7510 Å, at a projected pixelsize of 3.6 Å. Medium resolution observations with the 1200V grating yielded a coverage from 6335 - 6882 Å, in steps of 0.54 Å. Wavelength calibration was performed by observing a copper-argon lamp before each exposure. Spectropolarimetric standards were observed throughout the night. The instrumental polarization was found to be negligible.

One series of 4 spectra of HD 76534 was taken in the low resolution setting on 9 January 1995. The exposure time was 50 s for each wave plate position. On 11 January,  $2 \times 4$  sets of data were taken in the low resolution setting, again with exposure times of 50 s. Two hours later, HD 76534 was observed at

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medium resolution. Two series of spectra with integration times of 300 s were taken. A log of the observations is provided in Table 1. In the remainder of this paper, we will denote the polarization spectrum taken on 9 January 'Run 1', those taken on 11 January Runs 2A and 2B for the two series of low resolution spectra, and Runs 3A and 3B for the high resolution spectra.

The initial processing of the data was performed in the IRAF package. After bias-subtraction and flatfielding, the individual spectra were extracted by tracing the pixel rows containing the data. The wavelength calibration was performed by fitting a 3<sup>rd</sup> order polynomial through more than 20 identified lines in the arc spectra, and resulted in dispersion fits with a  $\sigma$  of 0.5 and 0.07 Å for the low and medium resolution spectra respectively. The resulting spectral resolution as measured from the arc spectra is 8 Å and 1 Å respectively.

The E and O arrays were then extracted into 2-dimensional frames and imported into the Time Series/Polarimetry Package (TSP) incorporated in the FIGARO software package maintained by STARLINK. The Stokes parameters were determined and subsequently extracted.

## 3. Results

#### 3.1. Polarization

The polarization is almost constant along the entire spectrum with P = 0.5% and a position angle of  $125^{\circ}$  at H $\alpha$  (see Table 2). On the occasions that we observed HD 76534, both the polarization and the position angle remained essentially constant.

The position angle is in close agreement with the results by Jain & Bhatt (1995), who observed HD 76534 polarimetrically in broad band on two occasions. Their results showed a significant change in the polarization (from  $1.26 \pm 0.13\%$  to  $0.26 \pm 0.12\%$  within two months in the *R* band), while the position angle remained constant within the errors  $(130^\circ \pm 3^\circ \text{ and } 123^\circ \pm 14^\circ \text{ respectively})$ .

If the change in polarization reported by Jain & Bhatt is real, it is reasonable to expect that the bulk of the polarization is circumstellar. This poses the question as to where the circumstellar material responsible for the observed polarization is located. As described by Thé et al. (1985) and Hillenbrand et al. (1992), there is no significant excess emission in the near-infrared which could be attributed to a dense dusty envelope or a circumstellar disk. The IRAS flux densities do not support the presence of much circumstellar matter either. The point source crosscorrelation coefficients listed in the IRAS Point Source Catalog (see IRAS Explanatory Supplement, 1985) for this object are less than 100% indicating the presence of an extended infrared source, rather than an unresolved point source. As pointed out by Oudmaijer (1996), such extended IRAS sources are due either to a large extended circumstellar dust shell, or to the star heating up the local interstellar material. Since HD 76534 is located close to a star-forming region, the latter possibility is more likely. In either case, the dust traced by the IRAS detections will not be opaque enough to account for the scattering.

**Table 1.** Log of the observations

Run	Date	Exp. (s)	UT start
1	9/10-1-1995	50	16:48:56
			16:50:13
			16:51:30
			16:52:47
2A	11/12-1-1995	50	14:20:07
			14:21:24
			14:22:41
			14:23:58
2B	11/12-1-1995	50	14:27:01
			14:28:18
			14:29:35
			14:30:52
3A	11/12-1-1995	300	17:16:28
			17:21:59
			17:27:30
			17:33:01
3B	11/12-1-1995	300	17:40:35
			17:46:06
			17:51:37
			17:57:08

N.B. The wavelength coverage and spectral resolution of Run 1 and 2 are 3786 - 7510 Å and 8 Å respectively, Run 3 covers a range of 6335 - 6882 Å with a resolution of 1 Å (corresponding to  $\sim 46$  km s<sup>-1</sup> at H $\alpha$ ).

Thus, if the (change of) polarization is due to circumstellar scattering, the agent is not visible in the photometric data. If the polarization were due to a modestly ionized circumstellar disk, where electron scattering is the main source of polarization, it is hard to explain the constant polarization between spectra with and without H $\alpha$  emission, as found in Run 2 and 3. Clearly, the question of the origin of the polarization in HD 76534 is not settled yet.

## 3.2. The spectrum

The radial velocity of HD 76534 was determined by fitting Gaussians through several strong absorption lines in the medium resolution spectrum. This yielded a value of  $(19 \pm 3 \text{ km s}^{-1})$ , in agreement with Thackeray, Tritton & Walker (1973) who determined the radial velocity to be 17 km s<sup>-1</sup>.

In the medium resolution spectra, the H $\alpha$  line is double peaked, with a peak-to-peak separation of 125 km s<sup>-1</sup>. This value is, within the error margins, equal to the *v* sin*i* of 110 km s<sup>-1</sup> of the underlying photosphere (Thackeray, Tritton & Walker, 1973). The central reversal of the emission is located at the stellar rest-velocity.

The full width at the 1% level of the emission line is 740 km s<sup>-1</sup> and the full-width-at-half maximum (FWHM) of the line is 350 km s<sup>-1</sup>, which is larger than the observed correlation between the  $v \sin i$  and the FWHM of the H $\alpha$  emission of a Be star would imply (Hanuschik, 1989). It is therefore possible that this surplus broadening may be due to optical depth related effects (e.g. electron scattering). It is also possible that the broadening is in part caused by a radial outflow component.



**Fig. 1.** Continuum rectified total spectra of HD 76534. Upper panel: low resolution spectra taken on 9-10 January (Run 1). Middle panel: low resolution spectra taken on 11-12 January (Run 2A; dotted line 7 minutes later, Run 2B). Lower panel: high resolution spectra taken on 11-12 January 1995 (Run 3A; dotted line 30 minutes later, Run 3B). Note that the vertical scales are different.

The H $\alpha$  emission line profile is similar to the observation of Thé et al. (1985). They found a strong doubly-peaked emission line, where the maximum of the emission reached 2.5 times the continuum level. From their Fig. 1, we measure an EW of  $-7 \pm 0.5$  Å.

#### 3.3. Spectral variations

The spectra of Runs 1, 2A, 2B, 3A and 3B have been continuum normalized and plotted around H $\alpha$  in Fig. 1. The upper panel shows the spectrum on 9 January. The line is strongly in emission and has an equivalent width of -5.5 Å. The middle panel shows the low resolution data taken on 11 January. The H $\alpha$  line appears much weaker, it effectively fills in the absorption line and hardly exceeds the continuum level. The dotted line represents the spectrum taken only 7 minutes later. The emission decreased between these two observations to the point of disappearing. The lower panel shows the high resolution spectra taken 2 hours after the data taken in the middle panel – H $\alpha$  is strongly in emission. The dotted line represents the spectrum half an hour later. Between these two measurements, the EW increased 23%.

The picture that emerges from these data is that between Run 1 on 9 January and Run 2 on January 11, the H $\alpha$  line strength had decreased, yet it was strongly in emission only two hours later, still increasing in equivalent width. Clearly, we do not know what the pattern of variation was between the first observation on January 9 and Run 2, 2 days later. The timescale of these variations is an order of magnitude shorter than similar observed behaviour in Be stars like  $\mu$  Cen.



Fig. 2. Evolution of the E.W. of H $\alpha$  in the individual spectra. Upper panel: low resolution spectra taken in Run 2 at 14:00 hours, lower panel medium resolution spectra in Run 3 taken at 17:00 hours UT. The horizontal axis indicates the time in minutes after 14:00 and 17:00 hours UT respectively. The errors on the individual points are smaller than the plot symbols.

It is appropriate to investigate whether changes in the continuum flux level could be the reason of the difference in the EW of the emission line. We inspected the number counts in the continuum close to H $\alpha$ . Comparisons between Runs 2A and 2B and also between Runs 3A and 3B indicate number count differences in the region of only 3%. This suggests that the continuum level could not have changed enough to account for the H $\alpha$  equivalent width changes observed within each of Run 2 and Run 3. We do not have the necessary data to intercompare Runs 1, 2 and 3.

There could be a trivial cause for the variation of the H $\alpha$  emission; HD 76534 is a visual binary where the components are separated by 2.1", with the secondary 1.3 magnitude fainter in the Gunn z band than HD 76534 (Reipurth & Zinnecker, 1993). In the unlikely event that the AAT tracking would fail on a timescale of minutes, the secondary can dilute (enhance) the spectrum of HD 76534 giving rise to a lower (higher) EW of H $\alpha$ . The arguments against this having happened are (i) we have no evidence that the continuum level changed significantly during the observations, (ii) the polarization remained essentially constant, (iii) the position angle of the binary (303°) does not allow both objects to fall within the 1" wide N-S slit, as used during the high resolution observations, at the same time.

As the observed variability is most likely not caused by instrumental or atmospheric effects, we can use the data as timeseries spectra. Each polarization spectrum consists of 4 individual spectra with short integration times. Assuming that the polarization across H $\alpha$  is not deviant from the continuum, the low resolution spectra of Runs 2A and 2B constitute a time series of 8 spectra (the sum of the E and O rays) taken within

Table 2. Derived results

Run	E.W. $H\alpha$	E.W. He6678
	(Å)	(Å)
1	-5.5	0.54 (0.03)
2A	1.4	0.59 (0.03)
2B	2.4	0.59 (0.05)
3A	-7.3	0.52 (0.02)
3B	-9.0	0.52 (0.02)
	Pol. (%)	$\Theta$ (°)
2A	0.45 (0.06)	126 (4)
2B	0.44 (0.06)	123 (4)
3A	0.50 (0.02)	125.3 (1.0)
3B	0.52 (0.02)	122.9 (1.0)

Note: the polarizations are measured over 6600 - 6700 Å, numbers between brackets denote the errors.

10 minutes, the medium resolution spectra consist of 8 spectra taken within 41 minutes.

The variation of the EW of H $\alpha$  is plotted in Fig. 2, where it decreases from 0.5 to almost 3 Å in 10 minutes in Run 2, while two hours later the emission increases linearly with time; the EW increases from -6.6 to -9.5 Å in 40 minutes, corresponding to 4.35 Å per hour. If the underlying absorption has an equivalent width of 2.8 Å, the maximum observed absorption, we can estimate that the transition from absorption to emission, if steady, would have taken 2.8 hours. Throughout Run 3, the H $\alpha$  line has the same peak-to-peak separation and FWHM.

Apart from the H $\alpha$  emission, few spectral changes are visible between the spectra of 9 and 11 January. The absorption lines have the same strength within the errors, as illustrated in Table 2, where the EW of the strong He  $\lambda$ 6678 line is presented. Like the EW, the radial velocity of this line was constant within the errors throughout Run 3. It appears that the spectral type did not change perceptibly between these two spectra.

In the following, we discuss two possible causes for the observed changes, a sudden mass outburst, where the newly ejected ionized material gives rise to emission, or a change in the ionizing continuum from the star which ionizes a different fraction of a steady state circumstellar envelope.

## 4. A mass outburst

If the onset of the emission is due to a sudden ejection of mass, the observed timescale provides an opportunity to make a simple estimate of the mass loss rate. In order to do this, we need some basic parameters such as the distance, mass and radius of HD 76534. Membership of the Vela-R2 association has been used to assign a distance d = 870 pc (Herbst, 1975). Using this, Hillenbrand et al. (1992) derived  $R_* = 7.5 R_{\odot}$  and  $M_* = 11 M_{\odot}$  for  $A_V = 1$ . Although there is room for improvement on these values, they are sufficiently accurate for the present purpose.

The volume emission measure is calculated as follows. From  $R_C = 7.83 \text{ mag}$  (Thé et al. 1985), and EW(H $\alpha$ ) = -9 Å, we find F(H $\alpha$ ) = 1.5 × 10<sup>-11</sup> erg cm<sup>-2</sup> s<sup>-1</sup>. Taking the H $\alpha$  recombination coefficient for a (T = 10<sup>4</sup> K, n<sub>e</sub> = 10<sup>9</sup> cm<sup>-3</sup>) gas (Hummer & Storey, 1987), we obtain the emission measure EM (=  $\int n_e^2 dV$ )

=  $1.7 \times 10^{57}$  cm<sup>-3</sup>. Taking the extinction at the *R* band into account, the value becomes twice as large.

The outer radius of the gas is dependent on the travel time which we take as 10,000 s ( $\sim 2.8$  hours, the timescale of the variability) and the velocity law,  $v(r) = v_0 + (v_{\infty} - v_0)(1 - v_0)(1$  $\mathbf{R}_*/\mathbf{r})^{\beta}$ , where  $\mathbf{v}_0$  is the initial velocity,  $\mathbf{v}_{\infty}$  the velocity at infinity, and R\* the radius of the star. Adopting a value of the terminal velocity of 1000 km s<sup>-1</sup>,  $v_0 = 10$  km s<sup>-1</sup> and  $\beta = 0.7$  (Friend & Abbott 1986), the distance travelled is 0.33 R<sub>\*</sub>. At this radius, the velocity happens to be 380 km s<sup>-1</sup>, a similar figure to the observed line broadening of 370 km s<sup>-1</sup>. So, if the line width were entirely due to kinematic broadening, the adopted velocity law parameters combine to give a consistent picture. Assuming spherical symmetry and the above parameters, we find a mass loss rate of  $10^{-8}$  M<sub> $\odot$ </sub> yr<sup>-1</sup> is able to match the observed emission measure. Other combinations of the above parameters have been explored and we find that the choice is not critical in terms of the order of magnitude deduced for the mass loss rate.

However, the H $\alpha$  line profile is symmetric and double peaked. This suggests that the ionized region does not originate in a spherically symmetric wind, because then some profile asymmetry should be apparent. Applying instead a more conventional geometry for the Be star case, where the matter is compressed into a disk, the estimate for the mass loss rate becomes less trivial. Since the de-projected velocities in the circumstellar disk would be larger than observed (the  $v \sin i$ of HD 76534 is quite low, suggesting a near pole-on orientation), we have no value for the outflow velocity. Furthermore, we can not uniquely disentangle the contribution of the different kinematical and non-kinematical factors governing the line-broadening. In view of such problems, we can do no more than adapt the result from the spherically symmetric case, to provide an order of magnitude estimate for a disk mass loss rate.

In a flattened geometry, smaller mass loss rates are capable of matching the observed emission measure. The reasoning is as follows. For example, the volume occupied by a disk with an opening half angle of 5° is about ten times less than that occupied by a sphere. In order to conserve mass, the electron density must be ten times larger. Since the resulting emission measure is proportional to the square of the density times the volume, one obtains an emission measure that is of order ten times larger for the same mass loss rate in the spherically symmetric case. Conversely, in order to obtain the same emission measure, a mass loss rate which is the square root of ten smaller than in the spherically symmetric case will reproduce the same EM.

We thus obtain a few times  $10^{-9} \text{ M}_{\odot} \text{ yr}^{-1}$ , which is comparable to the  $3.8 \times 10^{-9} \text{ M}_{\odot} \text{ yr}^{-1}$  Hanuschik et al. (1993) determine for  $\mu$  Cen.

#### 5. A change in the ionizing continuum

If the hydrogen was already present around the star in a partly neutral steady-state envelope, a change in ionizing flux from the star could, in principle, be the cause of the observed emission. As the Lyman continuum constitutes a tiny fraction of the total energy output of a B star, it might undergo dramatic changes without requiring much adjustment of the ultraviolet or optical flux. Only two B stars have been observed in the Lyman continuum,  $\beta$  and  $\epsilon$  CMa (Cassinelli et al. 1996 and Cassinelli et al. 1995, respectively). The first object shows  $\beta$  Cepheid pulsations. Cassinelli et al. (1996) detected changes with a total amplitude of more than 30% in the extreme ultraviolet (between 504 and 700 Å) of  $\beta$  CMa, while the object is variable in the V band with an amplitude of only 0.02 magnitude. Interestingly, the period of these variations in this star – classified as a giant – is 6 hours.

One should bear in mind that the Lyman continuum of B stars is not well known, having only been observed directly in the two cases just mentioned. Cassinelli et al. (1995) found that the observed continuum radiation from  $\epsilon$  CMa (B2II) is an order of magnitude stronger than model atmospheres predict. This discrepancy is smaller or perhaps absent for  $\beta$  CMa (B1 II-III, Cassinelli et al. 1996), yet illustrates the uncertainty of the current knowledge of the ionizing continuum of B stars.

It is thus possible that slight atmospheric changes due to some pulsation mechanism are capable of increasing the ionizing continuum significantly, whilst having a small effect on the optical spectrum. Although the period of the activity in HD 76534 is not known, it is likely that it is of order hours. Such timescales have been observed both in  $\beta$  Cepheid variables and, photometrically, in several Be stars, where the periods range from several hours to days, and are often attributed to non-radial pulsations (Peters, 1991). Unfortunately, the number of photometric measurements of HD 76534 is low, and it is unclear whether the V band is variable at all.

A useful exercise is to use existing model atmosphere predictions to estimate the number of ionizing Lyman continuum photons emitted by an early B dwarf. If the ionization of the envelope is entirely attributable to Lyman continuum photons, then we would hope to find this number to be at least comparable to the number of recombinations associated with the H $\alpha$  emission measure we have derived (~ 10<sup>45</sup> s<sup>-1</sup>). Taking a stellar effective temperature of 22000 K for a B2 star from the main sequence scale of Schmidt-Kaler (1982), a surface gravity log(g) = 4.0, and stellar radius 7.5 R<sub> $\odot$ </sub>, the predicted Lyman continuum photon luminosity is  $1.6 \times 10^{45}$  s<sup>-1</sup> according to the Kurucz (1992) grid. Hence, the numbers are in the right neighbourhood. Furthermore, in this spectral type range, the Lyman continuum flux is a very sensitive function of stellar parameters (e.g. roughly doubling with a 1000 K increase in effective temperature). Given this sensitivity we can only conclude that the early B spectral range is that in which atmospheric variability is most likely to be betrayed by changes in circumstellar ionization.

There is a caveat. If the H $\alpha$  emission arises in a circumstellar disk presenting sufficient optical depth to require ionization of hydrogen via the Balmer rather than the Lyman continuum, it becomes highly improbable that the H $\alpha$  variability is attributable to an ionization change. This is because the factor of several change in H $\alpha$  EW would demand almost as big a change in the Balmer continuum and Lyman line fluxes. Assuming radiative excitation to n=2, a crude argument would be that the Balmer continuum is used twice (see Drew, 1989). Since this is where the Planck maximum for this star falls, it is obviously implausible.

# 6. Discussion

We have discovered dramatic changes in the H $\alpha$  emission line object HD 76534. While the line was strongly in emission on the first day of our observing run, it faded to the point of disappearance two days later, but went strongly into emission within the following two hours, making it the fastest transition of the H $\alpha$  line from absorption into emission observed in any Be-type star to date.

Under the assumption that there are no changes in polarization across the H $\alpha$  line, we have used the polarization spectra as timeseries spectra, enabling us to follow the evolution of the line at short time intervals. In the last series of spectra (Run 3), we find that the line strength increased linearly with time. During these 40 minutes, the line profile, the radial velocity and the FWHM remained constant within the errors.

In the above we presented two mechanisms that could be responsible for the sudden onset of H $\alpha$  emission in HD 76534.

The mass outburst mechanism was suggested by Hanuschik et al. (1993) who studied the Be star  $\mu$  Cen (B2IV-Ve). This object belongs to a small group of Be stars which have been described as showing sudden changes in the H $\alpha$  line.  $\mu$  Cen has undergone several outbursts over the last years (Peters, 1986; Hanuschik et al. 1993), with rise and fade times of the emission that are an order of magnitude longer than observed in HD 76534. Hanuschik et al. (1993) proposed that the H $\alpha$  emission originates in a circumstellar disk that is built up within a couple of days, and then falls back onto the star as the radiation pressure is insufficient to make the gas reach velocities larger than the local escape velocity. The main point in favour of this hypothesis for  $\mu$  Cen is that during the rise of the emission strong V/R variations are present, only after several rotation periods is the disk circularized, yielding a stable V/R ratio. In addition, they show that the peak-to-peak separation of the H $\alpha$  line decreases during the rise and increases during the fading, implying that a rotating disk is respectively growing and shrinking.

Neither effect is seen in the case of HD 76534. The medium resolution observations in Run 3 do not show V/R variability, nor kinematical variations in the line. The peak-to-peak velocities remain constant within the observational errors. Of further note is the very symmetric line with  $V \sim R$ . These results imply that the disk was already stable and circularized at the moment the emission was observed. This is not what one would expect based on simple considerations of time scales involved. The estimated rotation period of HD 76534 ( $(2 \pi R_*)/v \sin i \sim 3.5 d/\sin i)$  is long when compared to the observed changes. The material, even if it were co-rotating with the star, can never have achieved a circularization of its orbit within a mere two hours.

This apparent contradiction is lifted by the new hypothesis that we bring forward, namely that of a variable photosphere, where the Lyman continuum changes on short timescales. If the circumstellar material was already present before the increased number of ionizing photons became detectable by the sudden onset of H $\alpha$  emission, there is no need to invoke a build-up of the disk, along with its expected line profile variability. Although the variable photosphere hypothesis seems, at first sight, unlikely, it should be noted that not much is known about the Lyman continua of B stars. As the case of  $\beta$  CMa shows, relatively strong changes in the EUV continuum would go almost undetected in the optical. Given the right circumstances, the ionization of circumstellar material can then be a sensitive tracer of such variability. A likely implication of this hypothesis is that the variability would occur with a short (semi-)regular period. Our observations do not cover a large enough time span to establish any periodicity however.

The only previous spectra of HD 76534 were published by Thé et al. (1985) and Praderie et al. (1991). Their spectra were taken one year apart, and showed 'indistinguishable' (cf. Praderie et al. 1991) line profiles. It is difficult to derive much from this fact. One may conclude that the line was stable in emission for a period of more than one year, implying that the observed changes in this paper are a rare event. Alternatively, it is useful to notice that the exposure times used by the above authors were 2 and 2.5 hours respectively, so that any shorter term variations in either the line profile or EW would have been washed out. An indirect argument against the idea that HD 76534 had a stable emission line profile for a long time, is the fact that we observed variability at all. The spectra presented in this paper are the first to have been taken with integration times which are shorter than the timescale of the variability detected, and, unless we were so fortunate to observe a rare moment in the long term spectral behaviour of HD 76534, it is rather more likely that these variations occur very frequently.

## 7. Final remarks

The case of the rapid variability in the H $\alpha$  line of HD 76534 provides us with new data to understand the H $\alpha$  emission of Be stars, and their rapid variability in particular. However, it seems that HD 76534 is deviant from other examples of Be stars which show sudden outbursts in the H $\alpha$  line. The timescales are shorter, yet the line profile itself appears to trace a dynamically stable circumstellar environment. This contradicts the hypothesis that has been put forward to explain the observed variability in other Be stars, namely a mass ejection which results in a circularized disk after several rotation periods of the central star. In order to explain the observed behaviour of the object, we suggest another mechanism that could explain the sudden outburst, without the necessity of building up the disk on a short timescale. The variability of the Lyman continuum of this object may be responsible for an increase of the ionized volume within the circumstellar envelope, either spherical, or disk-like, that was already present around the star.

The discrimination between the two scenarios could be made when HD 76534 is observed using simultaneous rapid photometry, preferably in the U band, and rapid high resolu-

tion spectroscopy. If stellar pulsations give rise to a changing ionized volume within the circumstellar envelope, one would expect the H $\alpha$  emission to be correlated both with changes in the photometry and radial velocity, while the H $\alpha$  line profile would trace a dynamically stable region. On the other hand, the build-up of a newly ejected envelope should be visible in a less regular evolution of the H $\alpha$  line profile, and is more likely to be an irregular and infrequent occurrence.

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