Astron. Astrophys. 180, L17–L19 (1987)

ASTRONOMY AND ASTROPHYSICS

Letter to the Editor

HD 151932 variability revisited*

J. M. Vreux[1], P. Magain[2], J. Manfroid[1], and R. Scuflaire[1]

[1] Institut d'Astrophysique, 5, avenue de Cointe, B-4200 Cointe-Ougrée, Belgium
[2] European Southern Observatory, La Silla, Chile

Received March 13, accepted April 1, 1987

SUMMARY

Variations have been observed in the blue absorption component of He I lines (as previously reported) as well as in the SiIV λ 4089 emission. A longer time basis is necessary to ascertain the nature of that variability.

Key words: Stars: Wolf-Rayet - Variability.

1. INTRODUCTION

The main interest of HD151932, a WN7 A, lies in the discovery by Seggewiss (1974) of two components in the violet displaced absorption edges of the HeI lines, one of which exhibiting a variable radial velocity. These variations have a peculiar shape that he describes as ascending branches separated by about 3.5 days (Seggewiss, 1977). So far this is the only WR star for which such a behaviour has been reported. These observations (photographic coudé spectroscopy) had been performed in 1971 (8 nights). In 1975 and 1977, HD151932 has been investigated again by Seggewiss and Moffat (1979) using various techniques. The result was, in some way, less exciting. The 13 scans of the HeI λ 5876 line they have secured are all nearly identical whereas the absorption component of that line was varying in the form of ascending branches in 1971. Only the coudé data obtained during 16 consecutive nights in February-March 1977 exhibit some variations reminiscent of the ones observed in 1971 in the sense that they appear in the absorption edges of the HeI lines at λ 3889 and λ 4472. Nevertheless these variations are slow compared to the 1971 period (3.5 days) and of much smaller amplitude; no periodicity can be derived from the observations. There is only one point on which the 1971 and 1977 observations agree: at both epochs the HeII and NIII - IV - V absorption and emission components have constant velocities, the variations are only observed in the absorption edges of the HeI lines (Seggewiss and Moffat, 1979).

* Based on observations collected at the European Southern Observatory, La Silla, Chile.

2. OBSERVATIONS

Low dispersion spectroscopic observations (29 A mm^{-1}) were performed with the Boller and Chivens spectrograph attached to the 2.2 m telescope (detector: coated GEC CCD described in ESO Messenger, 41, September 1985). Spectra were obtained on May 24 (2 spectra, 3 h. 08 m. apart), 25 (one spectrum) and 27 (two spectra, 1 h. 31 m. apart). Since a rough examination of the data indicated the presence of strong spectroscopic variations, a follow up was decided by one of us (P.M.) who was conducting another program with the 1.4 m Coudé Auxiliary Telescope (CAT) feeding the Coudé Echelle Spectrometer (CES) (see ESO Manual, Danks, 1983 for details). With its very high dispersion (2.23 A mm^{-1}) this instrument is marginally suited to the study of WR star. These high quality CES data proved nevertheless valuable both for the extension of the observing run they provide and for the discussion of the 2.2 m data. Two spectra per night were secured on June 2, 3, 4, 7 and 8, and one on June 6.

Some photometric observations collected roughly at the same epoch are described elsewhere (Magain et al., 1987).

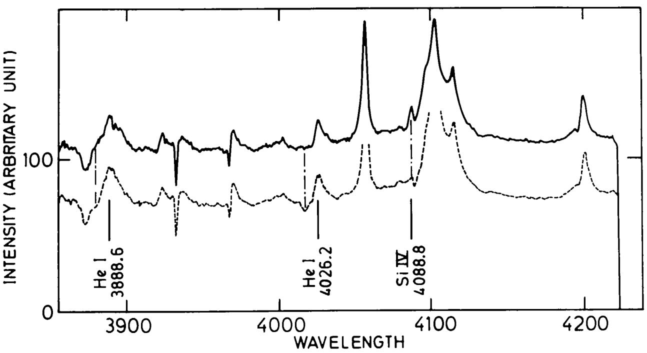

Figure 1. Spectrum of HD 151932 (29 A mm^{-1}) obtained May 24 (full line) and May 27 (dashed line). The parts of the spectrum of May 27 exhibiting variations relative to the one of May 24 have been indicated

In order to illustrate the variations observed with the low dispersion spectroscopy, the spectrum obtained May 24 is displayed on figure 1 (full line) as well as the spectrum of May 27 (dashed line). From left to right the most striking differences are:
- a modification in the shape of the red wing of the absorption component of He I λ 3889 which results from an increase of the red part of the absorption component.
- the appearance of a well defined absorption component on the blue side of the He I λ 4026 emission.
- the nearly disappearance of the emission of SiIV λ 4089.

On both May 24 and May 27 the second spectra obtained a few hours apart (respectively 3 h. 08 m. and 1 h. 31 m. apart) exhibit no obvious variations.

The kind of variations recorded with the CES are illustrated in the next figure. On the upper part of figure 2 is plotted the profile observed June 3 at 8 h. 55 U.T. (full line) along with the one recorded on June 4 at 8 h. 40 U.T. (dashed line, an absence of which meaning that the two profiles coincide). On the lower part of figure 2 is displayed in the same way the most rapid variation observed: the full line corresponds to the profile observed June 7 at 00 h. 20 U.T., the dashed line to June 7 at 8 h. 25

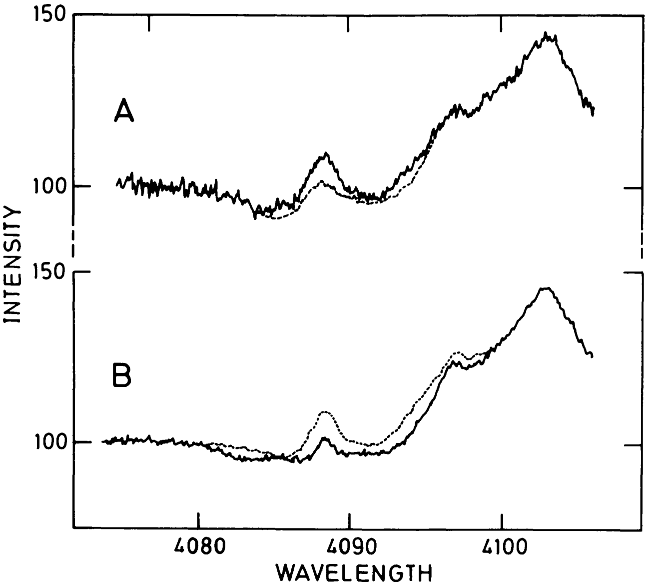

Figure 2. High dispersion spectrum (2.3 Å mm^{-1}) of HD 151932. Upper part. Full line: June 3, at 8h. 55 U.T. Dashed line: June 4, at 8h 40 U.T. Lower part. Full line: June 7, at 00h. 20 U.T.. Dashed line: June 7, at 8h. 25 U.T.

From the low dispersion data we know that the left part of these figures do not correspond to the "true" continuum as there is a rather faint and broad emission around λ 4078, quoted as unidentified by Smith and Kuhi (1981).

Nevertheless the same low dispersion data indicate that the intensity of that feature is not varying (at least at the epoch of the 2.2 m observations). As a consequence we have decided to use that part of the tracings to define the level of a pseudo continuum to which we could refer to describe the variations.

The SiIV λ 4089 line corresponds to the transition J = 1/2 - J = 3/2 in the 4 s ^{2}S - 4 p ^{2}P^o multiplet. The second line of the same multiplet, corresponding to the transition J = 1/2 - J = 1/2, lies at λ 4116 and is clearly visible on the tracings. This last line exhibits no variation at all (this is also true for the other emission lines like the NIII blend, the NIV line and the HeII lines).

This, combined with the deepening the absorption component of the He I line mentionned above lead us to consider a deepening of an underlying (blue shifted) absorption as a reasonnable explanation for the SiIV 4089 variation. Nevertheless this hypothesis faces some difficulties. The broad emission on the red side of SiIV λ 4089 is due to NIII λ 4097, λ 4103 with contributions of HeII (λ 4100) and HI (λ4102). If the varying absorption has to be attributed to a blue shifted absorption component of NIII λ 4097 one would also expect a varying absorption component of NIII λ 4103 which belongs to the same multiplet, the deepening of which would most probably produce a variation of the position of the inflexion appearing in the blue wing of the blend, variation which is not observed on the low dispersion spectra and on most of the CES spectra. We face the same problem with HeII λ 4100 and HI λ 4102. In addition, for these two lines we would expect to observe some simultaneous variations on the lines of the same series available on the low dispersion spectra, even if they are blended. Such variations are not observed.

On the high dispersion spectra we clearly see the SiIV λ 4089 emission as well as the nearly resolved NIII λ 4097. If some of the data available indicate that part of the apparent variation of SiIV λ 4089 on the low dispersion data can be attributed to a varying underlying absorption, data like the ones displayed on the lower part of figure 2 indicate that part of the variation is also due to the emission itself. In that context it is indeed unfortunate that the SiIV λ 4116 is not accessible on the high dispersion spectra.

In summary, no explanation looks straightforward and more detailed observations seem necessary to clarify the true nature of the observed changes in the Si IV λ 4089 emission.

Another question concerns the possibility of a periodicity in these variations. Spectra like the one obtained on June 4, U.T. 8 h. 40 (fig. 2, upper part dashed line) and June 7, U.T. 00 h. 20 (fig. 2, lower part, full line) can be assimilated to the nearly disappearance of SiIV λ 4089 in the low dispersion spectra of May 27. On the opposite, the ones obtained on June 3, U.T. 8 h. 55 (fig. 4, full line) and June 7, U.T. 8 h. 25 (fig. 2, lower part, dashed line) can be assimilated to the low dispersion spectra obtained on May 24 and 25.

In order to try to quantify such a description we have measured the equivalent width of the SiIV λ 4089 emission relative to the pseudo continuum defined above. Due to the large difference in the dispersion (more than a factor 10) we do not expect strictly comparable equivalent widths but orders of magnitude. On figure 3 these equivalent widths are plotted as a function of time. This figure could be indicative that there is some periodicity in the "appearance" of SiIV λ 4089, with some erratic variations of lower amplitude superimposed. In that hypothesis the period would be longer than the pseudo period of 3.5 days observed by Seggewiss in 1971.

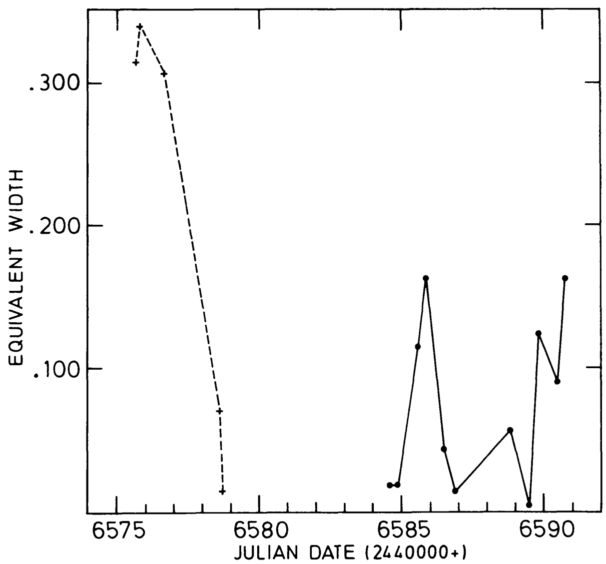

Figure 3. Equivalent width of Si IV λ4089 emission relative to a pseudo continuum (see text) as a function of time. Crosses and dashed line: low dispersion data (29 A mm^{-1}) Dots and full line: high dispersion data (2.3 A mm^{-1}).

3. CONCLUSION

Active in 1971 (Seggewiss, 1977), nearly quiet in 1975 and 1977 (Seggewiss and Moffat, 1979), HD 151932 is again active in 1986. Until now variability had only been observed spectroscopically in the absorption component of the P Cygni profile of HeI lines. Our data show that the activity is not limited to these lines: strong variations are indeed observed in the appearance of the SiIV λ 4089 line. The reason of these variations seem to be complex as a combination of the low and high dispersion data indicates that it can be due to a varying underlying absorption as well as to a variation of the emission itself. If this phenomenon exhibits some periodicity, the period is longer than the one suggested by Seggewiss in 1971.

Nevertheless the main problem with this kind of variability is the length of the time basis: are we dealing with an ephemeral pseudo periodic phenomenon or something which is stable enough to be called periodic. We hope this paper will stimulate more observers to tackle this problem: only the accumulation of numerous data will allow us to unravel the origin of the variations i.e. to make some progress on the processes playing part in the mass loss in addition to radiation pressure.

REFERENCES

MAGAIN, P., MANFROID J. and VREUX J.M., 1987, IBVS in press.

SEGGEWISS, W., 1974, Publ. Astron. Soc. Pac., 86, 670.

SEGGEWISS, W., 1975, in The Interaction of Variable Stars with their Environment, IAU Symp. 67, eds.: V. Sherwood and L. Plaut, p. 285.

SEGGEWISS, W., and MOFFAT, A., 1979, Astron. Astrophys., 72, 332.

SMITH, L., and KUHI, L., 1981, An Atlas of Wolf-Rayet Line Profiles, J.I.L.A. Report n° 117.