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Abnormal reversal of V/R ratio of Hα line in the shell star HD 142983

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In this communication we report the spectroscopic observations of Hα line profiles of HD 142983. The star showed very interesting behavior at Hα line. The Hα line was found to be strongly in emission displaying two emission peaks. The V emission component of the line was found to be much stronger than the R emission component.We have also collected other available data on Hα line from the literature to explore the variation of this line. Our data combined with others exhibited very interesting behavior. During the year 2001 the V component was smaller than the R component (i.e. V/R<1); during 2003 the V and R components became almost equal (i.e. V/R~1) and during 2004 the V component became larger than the R component (i.e. V/R>1). Our present investigation shows that during the period 2001-2007, this star underwent an abnormal reversal of V/R ratio. From the line profiles we have measured the important parameters like: equivalent width (W), Ip/Ic ratio and V/R ratio.

Key Words: Shell star, Hα line, V/R variation, Atmosphere

INTRODUCTION

The stars whose atmospheres are abnormally extended have intrigued astronomers ever since 1866. These are hot, early-type stars with extended atmospheres. They are fascinating not only because of the bright lines added to the regular spectrum, but also for an unusual set of dark lines produced by the absorption in the abnormally high strata of gaseous atoms. A small group of these objects are called "Shell stars".The term "Shell" introduced by Struve[1], now provides a convenient designation for B-and A-type stars whose unusually dark spectral lines bear evidence of having been produced in an atmospheric level high above the normal reversing layer. The shell star HD 142983 is the one among the most extensively observed star. Its spectral type is B3-4III with projected relational velocity[3] of 400 kms^{-1}. The shell of 48 Lib was nearly constant[5] form 1904-1931.

Merrill[2], found that the disturbance initiated by the eruption occurred in 1935-1936. 48 Lib is a well known shell star which showed long-term cyclic velocity and V/R variations[5,6]. Its cyclic duration of 9 years has been reported by

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Hanuschik et al[7]. This star is very popular, not only for the long-lasting presence of numerous deep shell absorption lines, but also for large variations of Balmer emission lines.

Large changes have been observed[8-11] in the shape and intensity of the shell lines in 48 Lib. The spectrum variability of this classical shell star has been extremely studied by Mennickent and Vogt[12,13]. They observed that during the last two and half decades, there was a rather pronounced long-term variation of the V/R ratio of the Balmer emission lines with variable period ranging between 7 to 12 years. Hanuschik *et al.*[7] have reported the Hα observations of 48 Lib between 1985-1993 and found that Hα profile show strong asymmetry, changing only slowly during this period. By combining his observations with the previous one (from 1950-1993) they found that 48 Lib have a cycle time of 9 years.

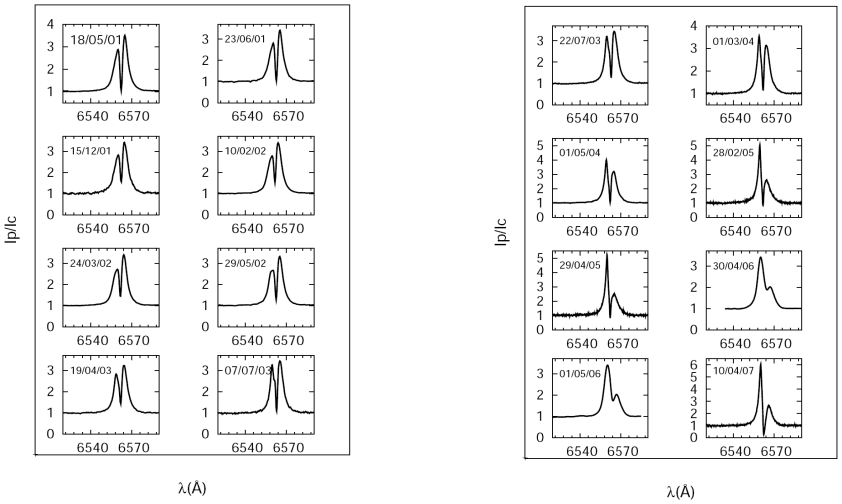
OBSERVATIONS AND DATA REDUCTION

The observations were carried out during April 30 and May 01,2006 by using IUCAA's 2m telescope mounted with Faint Object Grism Spectrograph (IFOSC7) having resolution of 4.4Å and blazed to 5000Å. IFOSC employs an EEV 2k×2k thinned black illuminated CCD with 13.5μ pixels having a field of view of about 10.5arcmintes.Long-slit of 100μ width was used in front of the spectrograph. The reduction of the data has been standard. The steps were bias subtraction, division by the normalized flat field, wavelength calibration and normalization to the stellar continuum. The wavelength calibration was carried out by using the helium neon comparison spectrum.

RESULTS AND DISCUSSION

Our observations of Hα line alongwith others' collected from the literature[15] are displayed in Figures 1 a,b. The broad wings and very strong Hα emission line divided into V and R components are obvious from these figures. The epoch covered in the present investigation is from 2001 to 2007. In Table 1 we have listed the measured line parameters of the Hα line like: Equivalent width, Ip/Ic ratio and V/R ratio.

It is clear from these Figures that during the year 2001, the V component of emission line was weaker than R component. More or less the strength of V component went on increasing till the year 2003. Thereafter, from about 2004 onwards the V component started gaining strength and became stronger than the R component. This change continued till the year 2007, when the V component attained much more strength than R component.



(a) (b)

Fig. 1. a,b Hα line profiles of HD 142983

Table 1 Measured parameters of HD 142983

Date	Ip/Ic	V peak	R peak	V/R	Eq. W. (Å)
18/05/2001	3.50	2.88	3.50	0.82	-24.42
23/06/2001	5.42	2.81	5.42	0.82	-22.10
15/12/2001	3.42	2.83	3.42	0.82	-24.09
10/02/2002	3.40	2.78	3.40	0.82	-23.89
24/03/2002	3.40	2.72	3.40	0.80	-23.51
29/05/2002	3.33	2.67	3.33	0.80	-23.48
19/04/2003	3.24	2.83	3.24	0.87	-21.78
07/07/2003	3.46	3.27	3.46	0.94	-22.88
22/07/2003	3.45	3.21	3.45	0.93	-23.59
01/03/2004	3.56	3.56	3.14	1.13	-22.35
01/05/2004	4.01	4.01	3.21	1.24	-24.06
28/02/2005	5.06	5.06	2.59	1.95	-23.02
29/04/2005	5.25	5.25	2.53	2.07	-23.48
30/04/2006	3.42	3.42	2.02	1.69	-22.04
01/05/2006	3.41	3.41	2.03	1.67	-21.33
10/04/2007	6.05	6.05	2.67	2.26	-24.27

Conclusions

From the present analysis it can be easily concluded that 48 Lib underwent an abnormal change of V/R ratio of Hα line during 2003 to 2004. The observed V/R variation cycle-time in 48 Lib in not strictly constant, but it changes from cycle-to-cycle[15]. This may reflect slight changes in the disk structure i.e. in the disc thickness due to heating or cooling. The V/R cycle periods are related to precession caused by the rotational flattening of the star. In the systems where we see the disc almost edge-on, one can expect the phase with V/R<1, to be followed by an (partial) eclipse of the region, with the enhanced emission. Before this region reappears at the other side of the disc V/R becomes larger than unity i.e. V/R>1.

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