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RAPID VARIATION IN H_α EMISSION OF γ CASSIOPEIAE

The well known Be star γ Cassiopeiae has been an object of intense study through over a century. Apart from the major phases namely, Be, Be shell, and normal B star with time scales of decades, the star also shows rapid changes in the visible spectrum. The time scales of these variations may be of the order of months, days and even a few minutes. Slettebak and Snow (1978) found simultaneous emission events in the H_α line and ultraviolet Si IV and Mg II lines lasting for a duration of about 100 minutes. Rapid profile variations on a time scale of a few minutes have been detected for H_β by Hutchings (1976) and Doazan (1976). These changes are believed to be erratic. Reynolds and Slettebak (1980) have found definite evidence of the change in emission intensity on the time scale of months for four Be stars, though night to night changes, and changes on an individual night are less certain.

In this communication, we report the scanner observations taken at the Uttar Pradesh State Observatory, on four nights in October-November 1986. Appreciable changes in H_α line are seen.

The observations were secured at the Cassegrain focus of the 104-cm reflector through a spectrum scanner and standard d.c. recording technique. The dispersion at the focal plane of the spectrophotometer is 70 Å/mm. An entrance aperture of 2mm (equivalent to 30 arc sec) and an exit slit of 0.4 mm have been used.

The tracings were read out near the H_α line at 2 mm intervals on the chart paper, which corresponds to nearly 13 Å in wavelength scale. A free hand continuum was drawn on both sides of the H_α line, and the emission intensity in terms of continuum I_λ/I_c was read out at points covering the entire line.

Figure 1 shows the I_λ/I_c versus λ plot. In this plot the position of the peak on the red side of the line is designated as origin of wavelength scale. Figure 1 clearly shows the sequence of changes in the shape of the H_α line during the period of these observations.

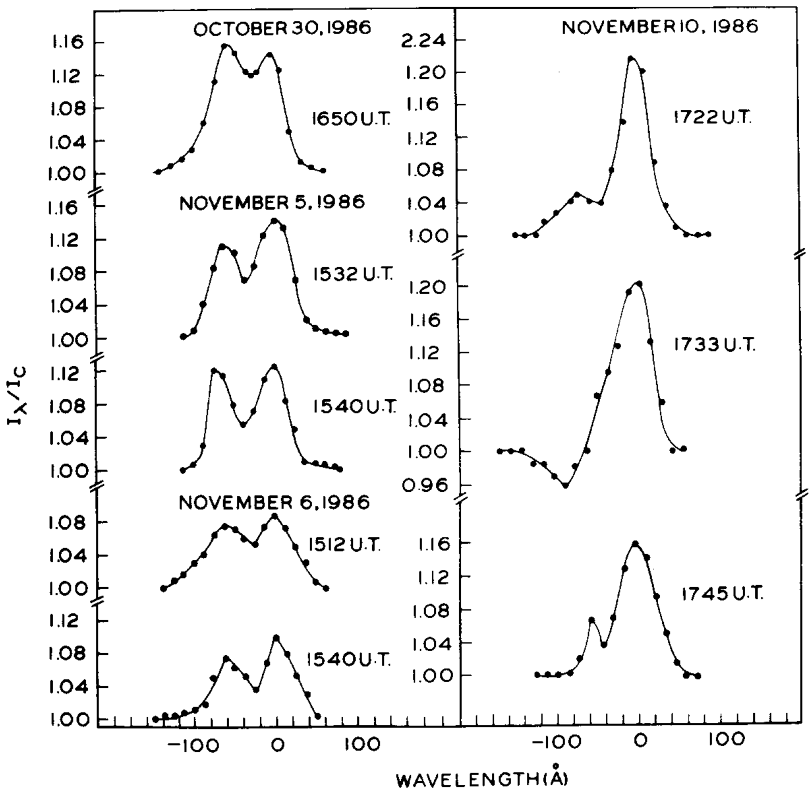

Figure 1. Spectral scans of H_α line on four nights

On October 30, the violet component of the line is the stronger one. On November 5 and 6, the red component has become slightly stronger compared to the violet. On November 10, however, the violet component has become very faint with respect to the red one. In fact in one scan on November 10, at 17:33 UT, the violet component is entirely absent. There seems to be an extended underlying absorption instead. The reality of this absorption feature may, however, be uncertain.

In order to estimate the changes in the total emission intensity of the H_α line, we have planimetered the area under the emission curves of each scan. Table I shows these values along with the equivalent widths of each scan. It is apparent from Table I that the H_α emission intensity was maximum at 14.2 Å on 30 October 1986. The same seems to have increased to an average of about 11.4 Å on 10 November 1986.

Table I. Measured intensities of the H_α line

Date	UT	Area under the curve (cm^2)	Equivalent width (Å)
1986 October 30	0.742	35.6	14.2
November 5	0.647	30.1	12.0
November 5	0.653	26.8	10.7
November 6	0.633	23.2	9.3
November 6	0.653	20.0	8.0
November 10	0.724	31.5	12.6
November 10	0.731	28.6	11.4
November 10	0.740	25.2	10.1

The hydrogen emission mechanism in Be stars is the ionization of hydrogen atom both from the ground, and excited states, followed by recombination to the excited states and then cascading to lower excited states. The amount of recombination radiation in a particular line depends on the hydrogen particle density (N_i,N_e) and the emitting volume. Fresh ejection of material is required to increase the emitting volume having the appropriate particle density for the rapid changes observed in the shape of the H_α line and its total strength. This ejection of stellar matter could occur from random points along the equatorial regions of the rotating stellar disc, causing changes in the particle density as well as the emitting volume density.

Due to this matter taking part in the rotation also, the region of the increased particle density would present differently to the line of sight, causing the changes in the shape of the line. The particle density in the emitting regions of the Be stars are believed to be 10^{10}-10^{12} cm^{-3} (Hirata and Kogure, 1984). An increase in the density to twice the mean value would mean addition of some $10^{11} cm^{-3}$ particles, or an addition of some 10^{-13} gram of hydrogen.

Changes of this magnitude have not been reported earlier for γ Cas. This situation may therefore represent a particular phase of activity of the star.

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