RAPID VARIATION OF SHELL LINE PARAMETERS IN ζ TAU

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ζ Tau is a Be star which probably showed already in 1973 rapid variations in Hα emission strength with time scales of a few minutes (Bahng, 1976). It represents, moreover, the primary of a well-known binary system with a period of 132.91 days (e.g., Hynek and Struve, 1942), and its shell displays long term instabilities with time scales of some years (Delplace and Chambon, 1976). The basis of the present work is a compact set of 82 grating photographic spectrograms obtained at Merate by means of the 137 cm reflector with an inverse dispersion of about 35 Å/mm between Jan 17 and Jan 24, 1983. Forty four of these spectra cover the range between ∿ 4000 and ∿ 5000 Å, the other ones being centered on Hα.

All the visible spectral lines appear asymmetrical or, when different components are recognizable (photospheric absorption, shell emission and/or absorption), their centers lie at different wavelengths. These configurations, averaged on all the spectra and analysed with some simple assumptions (axial symmetry for the shell, quiet photosphere, $i=90^{\circ}$), lead to the following mean departure velocities for the matter crossing the zones in which the various lines are formed (in order of distance from the star):

He I 4472 :	-10 ± 5 km/sec
Mg II 4481:	5 ± 7 km/sec
Hδ:	14 ± 7 km/sec
Hγ:	69 ± 5 km/sec
Hβ:	51 ± 8 km/sec
Hα:	66 ± 8 km/sec.

Apparently, a mechanism supplying energy prevails over the gravity within a certain radius: maybe a magnetic transfer of angular momentum.

A possible magnetic field cannot explain, however, the rapid, meaningful variations which we find in all these parameters, and also in some line intensities, especially the Hβ emission (an example is shown in the figure). The time scales, consistent with our exposure times (on the average 10 minutes for the blue spectra), may agree with the ones proposed by Bahng. On the other hand, the general behaviour of the whole Hβ emission should exclude simple models as heterogeneous rotating shells. A simple shell pulsation is also excluded: not only spectral analyses of the variations of all the parameters, performed

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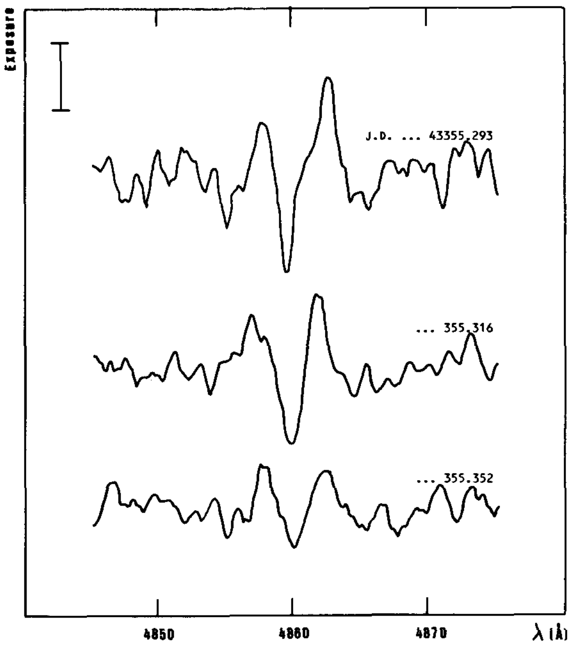

The bar in the upper left corner represents an exposure corresponding to 25% of the continuum.

according to Vanicek (1971), yield no unequivocal result, but the ratio of the shell radius to the speed of sound would lead to time scales of several days. As mentioned above not even a magnetic field is sufficient to change this situation: assuming the Alfven speed as a scale for the magnetogasdynamic wave propagation, a mean density of 10 particles/cm for the shell plasma, and even assuming a simple bipolar field, a mean value for B of about 10 Gauss on the stellar surface would be required. Only very high order shell pulsations could be hypothesized: perhaps combinations (even non-linear) of different overtones.

In order to test this hypothesis, and also in order to get more certain evidence of the phenomenon in this and in other Be stars, we intend in the future to take advantage of the better time resolution and signal-to-noise ratio permitted by the Reticon spectrophotometer now available at our observatory.

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