

RADIAL VELOCITY VARIATIONS IN 69 ORIONIS

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69 Ori (B5 V) was discovered as a Be star in 1976 (Doazan et al., 1977). We observed this object at the Merate Observatory during the periods Nov. 77. - Jan. 78 - Jan. 78 and Oct. 78 - Feb. 79 obtaining 20 red spectrograms and 25 blue ones with a dispersion of 35 Å/mm. We performed also B and V photo-electric observations during 12 nights altogether. The results from the red spectra and the photometric measurements have been discussed by Bossi et al. (1981).

The radial velocities obtained from the blue spectra show a significant difference between the two observational seasons, i.e. $\langle V \rangle_{77-78} = 14 \pm 6$ km/sec and $\langle V \rangle_{78-79} = 40 \pm 6$ km/sec. This fact can be due to the presence in the photosphere of rising motions during the phase of the envelope ejection and/or to a long period binarity. The radial velocities of the H_{α} envelope absorption referred to the photospheric one, given as CA in Bossi et al. (1981), also showed significantly different mean values between the two groupes of data.

The only relevant set of radial velocities in literature foregoing our observations is due to Blaauw and Van Albada (1963). They suggest a possible binarity with a period of about 19 days.

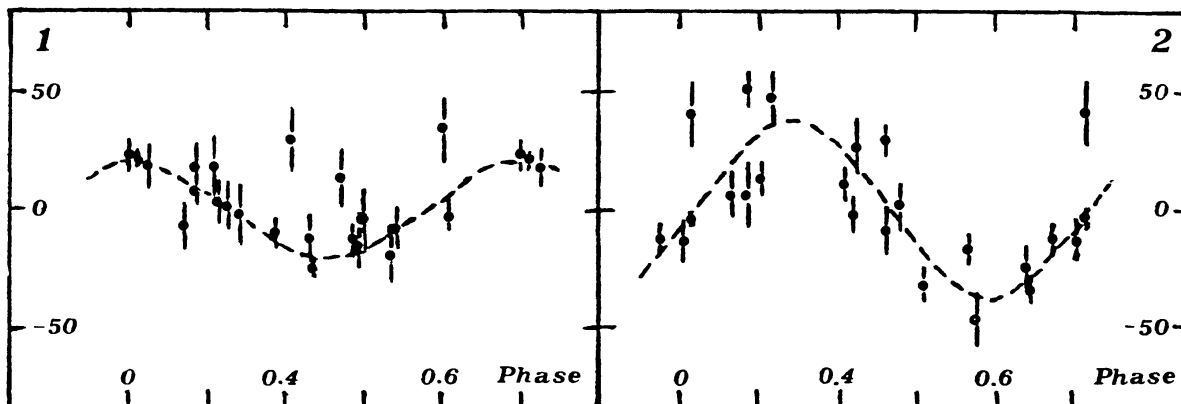
We have analysed independently our blue and red radial velocities by means of a least squares periodogram method which took into account the long-term variation using a third degree polinomial. We can exclude any significant variability with such a period. On the contrary both sets of our data fit with a period of 1.28 days (Fig. 1 and Fig. 2), even if we cannot exclude as alternative periods one of about 5 days or another of about 0.56 days.

With a similar method we computed also the power spectrum resulting from the data of Blaauw and Van Albada (1963) (Fig. 3). The assumed 19 days period results only in aliases corresponding to the peak that in our data gave the 5 days period. Therefore we believe that also this last one is an alias. The periods derived from the 1955 data are

a little shorter (1.13 or 0.53 days) than ours and the connected amplitude of the variations is lower.

If the real period is the longer one, the variability may be attributed or to a contact binarity or to the presence of photospheric spots. The second hypothesis appears the most reliable, since our photometric data seems to exclude the presence of eclipses, which would be very probable in such a close system seen quasi equator-on (Bossi et al, 1981). On the other hand the contemporary increase of period and amplitude, which perhaps happened between 1955 and the present time, does not follow the Kepler's third law. Finally the different lines cannot easily fit a binary model.

If, on the contrary, the period of about 0.5 days is the real one, the variability may be due either to a pulsation or to a rotation of an object with tri-axial deformation, that would cause a double wave curve for each stellar rotation. The first hypothesis seems to fails since such a period is too long for radial pulsations, and the observed amplitudes appear too large for non-radial ones. The second hypothesis derives from some well known results of classical mechanics, which predict the tri-axial ellipsoidal configuration for bodies not far from the rotational instability (Jacobi, 1834 ; Chandrasekar, 1969). In this way many features of the observed data could be explained. The different amplitudes in velocity variations for different lines could be connected with different temperatures in different photospheric regions (where the coldest zones are the farthest from the barycentre). Moreover, if the increase in period from 1955 to the present time is real, we would have a good agreement with the consequent increase in the velocity amplitude : both phenomena are connected to a growth of the deformation and hence of the moment of inertia between an inactive period and one of greater instability.



Blue radial velocities (1) and CA velocities (2) in km/sec phased with a period of 1.28 days.

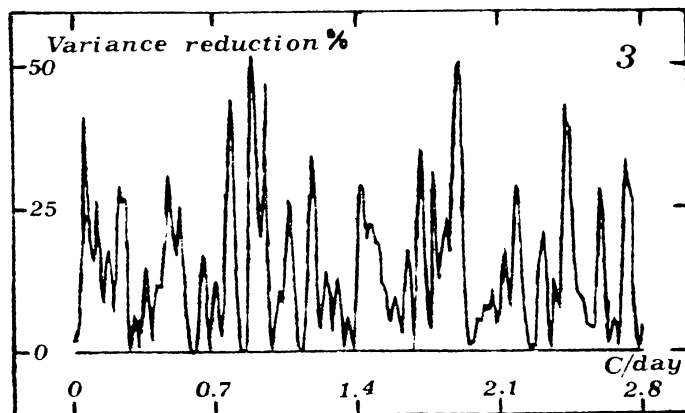


Fig. 3 . Frequency analysis of the 1955 radial velocities.

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DISCUSSION

Fehrenbach: Pourquoi avez vous rapporté vos VR à celles du shell? Quel est la raison de votre ajustement polynomial?

Mantegazza: 1. In the red spectra the photospheric H_{α} absorption is partially masked by the emission, so it is impossible to measure its position with an optical comparator. The adopted procedure, based on the use of a P D S microphotometer, gives more reliable results for wavelength differences than for absolute wavelengths. The envelope absorption line was the only unambiguous available reference.
2. Due to the presence of variations in our radial velocities with time scales larger than our time-base, it was necessary to take them into account in the analysis for short-term variations. This was accomplished by computing for each trial frequency a simultaneous least-square solution for the amplitude and the phase of a sinusoid and the coefficients of a 3th degree polynomial. This procedure avoids the introduction of deformations in the power spectrum (see Vanicek, 1971, *Astrophys. Space Sci.*, 12, 10).

Sareyan: Do you think the high dispersion in your radial velocity curves could be due to the "phasing" scatter, i.e. to the fact that you put together different cycles that could be not similar in shape and amplitude?

Mantegazza: May be, especially for the red data, the r.m.s. residual of the blue data after the sinusoidal fit is comparable with the average error bar of the individual measurements.

Harmanec: Be sure that I would like to see periodicity in RV data for Be stars but I must object you that if you admit to have points covering almost the whole range of variations in one narrow phase interval then you can find many such "periods".

Mantegazza: I agree that the fit of the data of Blaauw and van Albada is quite poor: the error bar of these data is presumably a little smaller than their amplitude of variation. But if they have a periodic behaviour the periods suggested by us are the only reliable. Curiously their values are nearly coincident with the ones determined from our spectra.

Bolton: Have you calculated the statistical significance of your fit to the velocity curve? If so, what is it?

Mantegazza: No, we haven't. The correspondence among three periods, of which two are practically coincident, seems to use sufficiently significant. They were obtained independently from three different sets of data.