PHOTOMETRIC AND SPECTROSCOPIC OBSERVATIONS OF THE 53 PER STAR : ζ CAS

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ζ Cas (HR 153, m_v=3.66, $v\sin i$=18 kms^{-1}) was classified as a 53 Per variable by Smith (1980). He detected variations in the profile of the 4552 Å Si III line with a period of 0.9 day. The radial velocity and the luminosity were observed to be constant by Abt & Levy (1978) and by Jerzykiewicz (1993) respectively.

1. Observations and analysis

We performed :
Photometric observations at San Pedro Martir Observatory (Mexico) (October 22 to 29, 1990) using uvbyβ Strömgren filters and two comparisons C_1=HR 123 (m_v=4.73, B8Vn), C_2=HR 144 (m_v=5.08, B7III). The star was constant in all filters.

Spectroscopic observations with the Aurélie spectrograph (S/N= 300, resolution 50000) at the O.H.P (France) in October 1990 (one night) and in October 1991 (6 nights).

In the radial velocity (RV) data, we detect two types of variations: first night to night and year to year variations over 2 kms^{-1} and secondly fluctuations over 1 kms^{-1} during each night. After detrending for the night to night variation, we analysed the 1991 data for period determination. Only two peaks can be retained: P_1= 0.173, P_2= 0.215 day with K_1= 0.149, K_2=0.155 kms^{-1} respectively. We are not able to determine which of these two periods (corresponding to frequencies separated by 1 cycle/day) is the good one.

The full width at half maximum (FWHM) of the 4552 Å Si III line varies from one night to an other within 0.08 Å, but no correlation is observed with the night to night RV variations. Short time scale variations within 0.04 Å are also observed. After detrending for the night to night variation, a peak appears in the power spectrum at 0.27 day.

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2. Discussion

Two time scales of variability are present in our RV and FWHM data: night to night changes and short period variations. The lack of correlation between long term variability in the RV and in FWHM suggests that two different phenomena are responsible for these variations.

The long term RV variations could be due to a binary motion. As our observations cover only 6 nights, we reanalysed the Abt & Levy (1978) data. In the periodogram the largest peak is present at 11.53 days with K= 1.80 kms^{-1}. More observations are needed to confirm the orbital period, the amplitude and to determine the orbital elements.

Night to night changes in FWHM could be due to a high degree non radial gravity mode or to surface variations modulated by the stellar rotation. These variations are similar to those observed in 53 Per (Le Contel et al, 1989) and in ι Her (Le Contel et al, in preparation).

The 0.27 d period takes into account the FWHM observations. This period does not appear clearly in the Fourier analysis of the RV measurements, probably due to the fact that the RV amplitudes are of the order of the dispersion on the points. Smith's (1980) period equal to 0.9 d is not detected but such a value would be difficult to find in our observations.

Using Shobbrook calibration (1985), the pulsational constant corresponding to a 0.27 d period is Q=0.049 d. Due to its length this period corresponds to a non radial mode. That is confirmed by the importance of line profile deformations compared to the RV variations.

Considering the B2 IV classification of ζ Cas we should expect this star to be a β Cephei star. However the photometric indices (β=2.625 and C_o=0.152) put it slightly outside the cool border of the instability strip (Sterken & Jerzykiewicz, 1993). The length of the period and the nature of the observed variations also exclude this hypothesis.

As the only clearly variable parameter in our observations is the shape of the profiles, ζ Cas is a typical 53 Per star according to the definition of this group by Smith.

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