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Atmospheric Dynamics of Long Period Cepheids

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Abstract. We present a spectroscopic study of two long period Cepheids: X Cyg and SV Vul, together with the prototype of the class.

1. Introduction

Since the longer the period, the larger the luminosity, long period Cepheids are of main importance for Universe scaling. However, these stars, scarcely studied, seem to present irregularities from one pulsation cycle to another (Simon & Kanbur, 1995). For instance, the larger the period, the more unstable the character of the light curve (see e.g. Antonello & Morelli, 1996). Are these irregularities due to the propagation of shock waves induced by pulsation?

The spectra were obtained with the 1.52 m telescope, using the AURELIE spectrograph. The observations were made between August 31 and October 22, 2000 therefore only one pulsation cycle has been obtained for SV Vul. Two spectral domains, each of 120 Å width, were considered, centered on 6040 and 6590 Å. The spectral resolution was 35 000, and the signal-to-noise ratio between 50 and 150.

2. Results

It has already been shown that stars with large amplitude atmospheric motions induce shock waves, and also non reproducable variation curves from one cycle to another (see e.g. Taylor et al., 1997). Here, neither δ Cep nor X Cyg present such irregularities.

The line doubling observed by Kraft (1957), which could be an indicator of the shock wave passage, is not confirmed either.

[1] also ESO/Paranal

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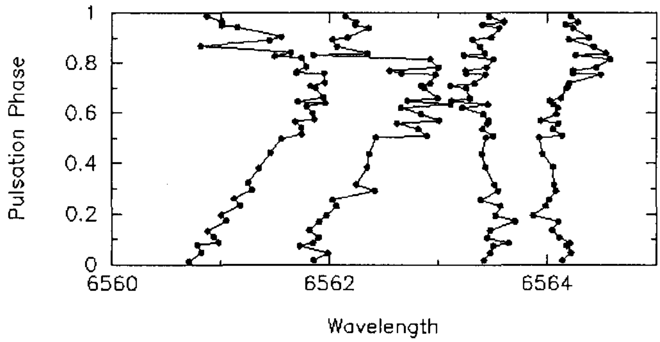

Figure 1. Wavelength associated with the Hα blue, central and red components. Also reported (first variation on the left) is the evolution of the Fe I at 6003 Å line, shifted by 558 Å.

The radial velocity curves present an acceleration around phase 0.9, which amounts to 10 cm s^{-2} for SV Vul and 27 cm s^{-2} for X Cyg, the total velocity amplitude being 43 and 53 km s^{-1} respectively. As already noted by Wallerstein (1983) a bump appears near phase 0.85 on the radial velocity curve associated to X Cyg. This bump, induced by a resonance, may be associated to an additionnal shock wave (see e.g. Bersier & Burki, 1995). This bump is not present in the case of SV Vul; nevertheless the upper part of the velocity curve is nearly flat.

Three absorption components can be observed on the Hα profile, the blue and red ones being at respectively 1 Å and 1.5 Å apart from the central component (Fig. 1). The blue component is present during phases (0.90–1.14), while the red one is present during phases (0.65–1.15) and (0.65–0.8) for X Cyg and SV Vul respectively. While the central and red components do not present significant variations, that associated to the blue component closely follows that of the metallic line. In addition, a red emission component is also present during phases (0.2–0.5), the intensity of which being larger for X Cyg than for SV Vul.

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