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# Observational study of the anomalous Cepheid XZ Ceti

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**Abstract.** Photometric and radial velocity observations show that the brightest known anomalous Cepheid, XZ Ceti pulsates in the first overtone. This Cepheid, peculiar in the Galactic field shows strong period changes appearing on a short time scale.

**Key words.** Stars: variables: Cepheids – Stars: individual: XZ Ceti

## 1. Introduction

The distinctive features of anomalous Cepheids are the short pulsational period and up to 2 magnitudes higher luminosity than that of the RR Lyrae type stars of the corresponding period. According to the recent paradigm the anomalous Cepheids are extreme metal-deficient siblings of classical Cepheids (Caputo et al. 2004).

Anomalous Cepheids also occur in our own Galaxy, in metal-poor environment. Zinn & Dahn (1976) identified the first such variable: the star V19 in the globular cluster NGC 5466 (= BL Bootis). Various pieces of evidence suggest that a much brighter star in the galactic field, XZ Ceti also belongs to anomalous Cepheids (Teays & Simon 1985).

In order to have a deeper insight into the behaviour of XZ Ceti, new photometry was performed and radial velocity measurements were obtained at the Siding Spring Observatory, Australia, in Dec. 2004-Jan. 2005. For a more detailed description of the equipment and the reduction of the observational data, the reader is referred to Szabados, Kiss, & Derekas (2005).

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## 2. Pulsation amplitudes

The V light curve folded on the best fitting period, 0.819 d, is seen in the left panel of Figure 1. The solid line is the Fourier fit to the data points.

The ratio of the radial velocity amplitude, $A_{RAD.VEL.}$ (=34.2 km/s), and the photometric amplitude, $A_V$ (=0.449 mag), is $A_{RAD.VEL.}/A_V = 76.2$. This amplitude ratio serves as a useful diagnostic tool in classifying XZ Ceti. For RR Lyrae type stars this amplitude ratio is 36.4 on average (Liu 1991). In the case of BL Her type variables, the photometric

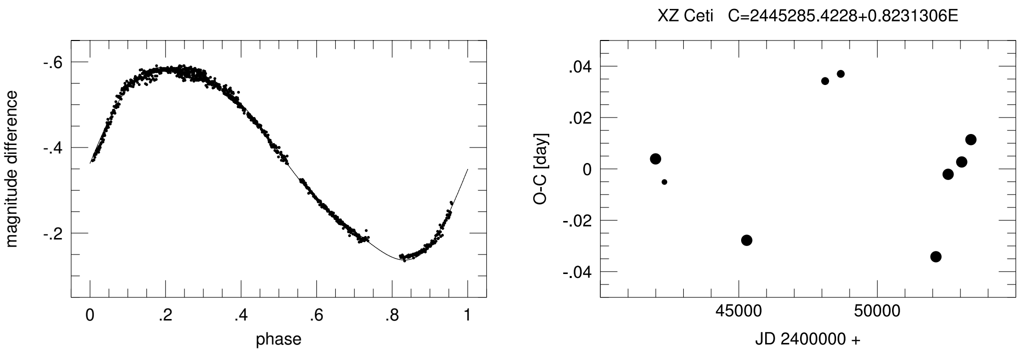


**Fig. 1.** Left panel: Differential $V$ magnitudes of XZ Ceti folded on the best fitting period, 0.819 day. Right panel: The plot of the $O-C$ residuals indicates an unstable pulsation period of XZ Ceti.

and radial velocity data taken from the literature give an average ratio of 47.2. For classical Cepheids, this ratio is 43.6 for fundamental mode and 59.7 for first overtone pulsators (Szabados 2000). The value of 76.2 for XZ Cet is extremely large to be an RR Lyr or BL Her type variable. Based on its phenomenological similarity with BL Boo and the above amplitude ratio, XZ Cet may be pulsating in the first overtone.

## 3. Period changes

The available photometric observations of XZ Ceti (Dean et al. 1977 Teays & Simon (1977), the Hipparcos (ESA 1997) and ASAS (Pojmanski 1997) data) cover about thirty years. This time base is sufficient for studying changes in the pulsation period with the $O-C$ method. Without giving the individual $O-C$ residuals in a tabular form, the plot of the residuals is only shown here. In the right panel of Figure 1 the size of the circles refers to the weight assigned to the given residual in the fitting procedure (circles of increasing diameters correspond to weights 1, 2, and 3). The weighted least squares fit resulted in the ephemeris:

$$C = \mathrm{JD}\,2445285.4228 + 0.8231306 \times E$$
$$\pm .0066 \quad \pm 0.0000010$$

The starting epoch corresponds to the moment of the median brightness on the rising branch of the light curve.

The $O-C$ diagram (right panel of Figure 1) shows that the period of XZ Ceti behaves in a peculiar way: definite short term changes appear in the period of pulsation.

The difference between the actual (0.819 d) and the average (0.823 d) pulsation periods amounting to 0.5 % is especially noteworthy.

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