Astronomical and Astrophysical Transactions, 1998, Vol. 15, pp. 81–84
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A SEARCH FOR EVOLUTIONARY PERIOD CHANGES IN SMALL-AMPLITUDE CEPHEIDS

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(Received April 18, 1996)

Moments of maximum brightness were determined using Hertzsprung's method for 39 stars attributed in the GCVS-IV (Kholopov *et al.*, 1985–1987) to small-amplitude DCEPS Cepheids. An analysis of O–C diagrams enabled us to conclude that the periods of SZ Cas, V Oph, EU Tau and α UMi (and possibly of SU Cas, V1726 Cyg, V473 Lyr and UV Mon) show evolutionary changes.

KEY WORDS Cepheids, stability of pulsations

1 INTRODUCTION

According to theory, the evolutionary tracks of Cepheids crossing the instability strip do not run parallel to the lines of constant periods. In the case of the first crossing, when the track is almost a straight line, this must lead to a progressive increase of the pulsation period and the data points in the O–C diagram must fall nearly on a parabola with branches directed upwards.

There is a hypothesis (Efremov, 1968) that low-amplitude pulsations of classical Cepheids (DCEPS tupe, according to the classification of GCVS-IV) occur during the first crossing of the instability strip. Forty-five DCEPS stars are listed in GCVS-IV, but two of them - V382 Car and V1359 Aql – do not show any period variability (Berdnikov and Turner, 1995a,b) and another four – FN Aql, V1162 Aql, V378 Cen and X Lac (Berdnikov and Pastukhova, 1994a,b) turned out to be normal, classical (DCEP-type) Cepheids. This study deals with the search for evolutionary period changes among the remaining 39 small-amplitude Cepheids.

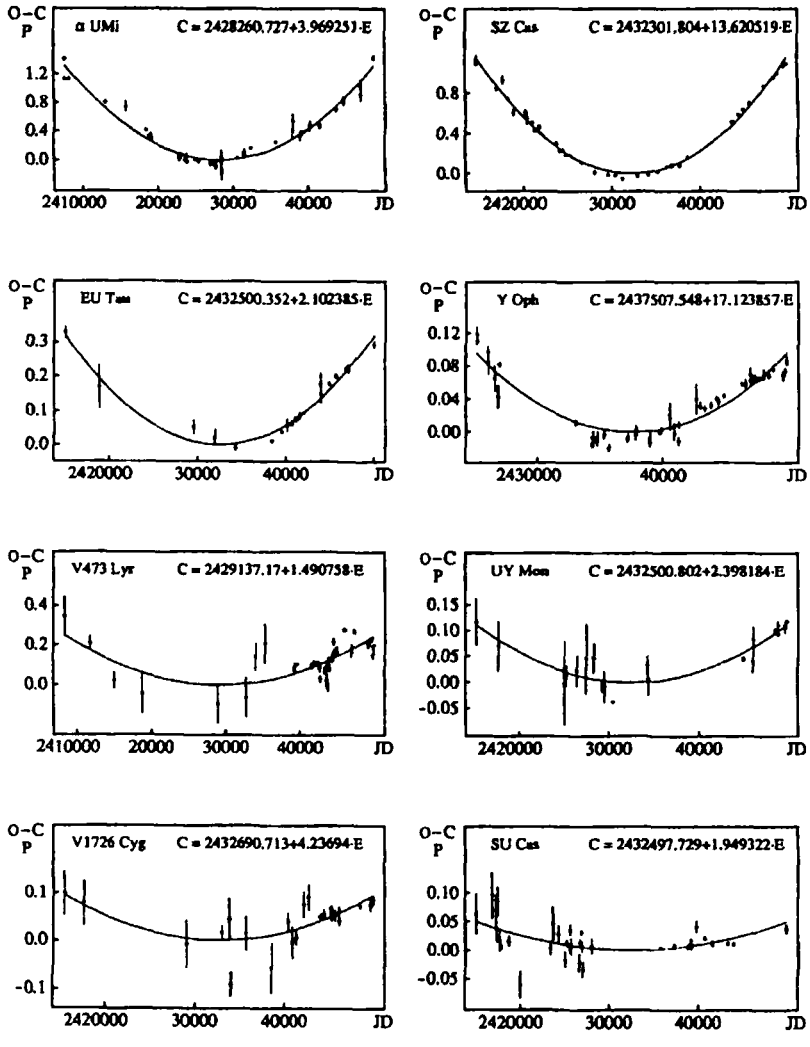

Figure 1 The O-C diagrams for DCEPS Cepheids α UMi, SZ Cas, EU Tau, Y Oph, V473 Lyr, UY Mon, V1726 Cyg and SU Cas. The lines are parabolas fitted to the O-C residuals.

2 METHODS AND MATERIALS USED

To study period changes of Cepheids, we applied the commonly used technique of analysis of O-C diagrams. We used all published photoelectric, photographic, and visual observations as well as almost 5000 of our own unpublished photographic observations and reduced all of them using our modification (Berdnikov, 1992) of Hertzsprung's method.

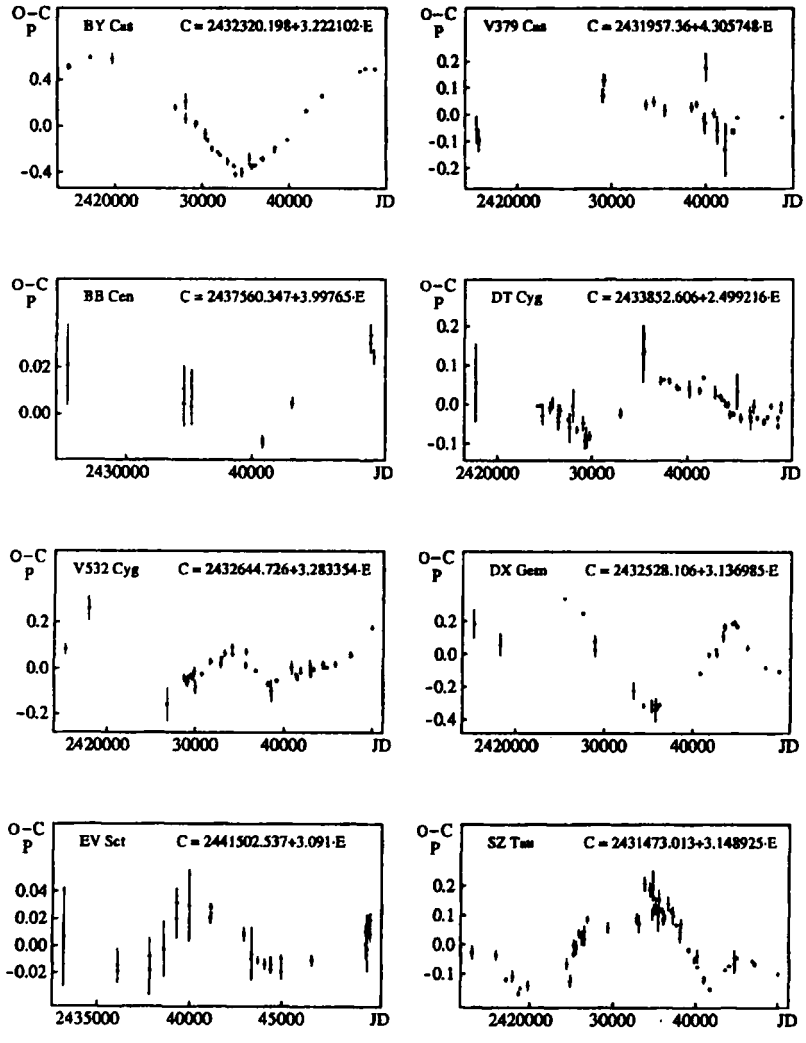

Figure 2 The O–C diagrams for DCEPS Cepheids BY Cas, V379 Cas, BB Cen, DT Cyg, V532 Cyg, DX Gem, EV Sct and SZ Tau.

3 RESULTS

The data obtained by Hertzsprung's reductions of observations are indicated in the O–C diagrams by circles with vertical bars showing error limits of the O–C residuals. For the sake of convenience, the O–C values in the graphs are expressed in fractions of the corresponding periods.

Figure 1 shows that parabolas fit well the O–C residuals for α UMi, SZ Cas, EU Tau and Y Oph, while the presence of evolutionary period changes in graphs for SU Cas, V1726 Cyg, V473 Lyr and UY Mon is open to question.

The O–C residuals for the first four stars in Figure 1 show distinct cyclic variations of an unknown nature superimposed on the parabolas. In cases when the amplitudes of these variations are small compared with evolutionary period changes, the parabolas are clearly seen, otherwise evolutionary period changes are either uncertain or are not seen at all (Figure 2).

Unfortunately, for most DCEPS Cepheids the available data are insufficient to allow a study of their period changes.

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