

The record-breaking rotational deceleration of the He strong CP star HD 37776 (V901 Ori)

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Abstract. We study the long-term light and spectral variations in the He-strong, magnetic chemically peculiar star HD 37776 to search for changes of its 1.5387 d period in 1976–2007. We analyze all published photometric observations and spectrophotometry in the He I 4026 Å-line. The data were supplemented with 506 new (*U*)*VB* observations obtained during the last 2 observing seasons, 66 estimates of He I equivalent widths on 23 CFHT spectrograms and 69 on Zeeman spectrograms from the 6-m telescope. All the 1895 particular observations have been processed simultaneously. We confirm the previously suspected increase of the period which is a record among CP stars. The mean rate of the period increase during the last 31 years is 0.541 ± 0.020 s per year. We interpret this ongoing period increase as the slowing down of the star's surface rotation due to momentum loss through events and processes in its magnetosphere.

Key words: stars: chemically peculiar – stars: individual: HD 37776

HD 37776 is a well-known He-strong B2IV star showing rotationally modulated spectroscopic, magnetic and photometric variations with the period 1.538675(5) days (Adelman, 1997). Mikulášek *et al.* (2007a) suspected that the period is increasing.

We determine the rate of increase, by analyzing an extensive set of 1895 photometric and spectral observations obtained in ten time intervals well distributed over the last 31 years. The times of the maxima of the brightness, JD_{\max} , can be well approximated by a cubic formula:

$$JD_{\max} \cong M_0 + \bar{P}E + \frac{\bar{P}\bar{\dot{P}}}{2} (E^2 - \alpha_1 E - \alpha_2) + \frac{\bar{P}^2\ddot{P}}{6} (E^3 - \alpha_3 E^2 - \alpha_4 E - \alpha_5), \quad (1)$$

where M_0 is the time of the basic maximum of the light curves near the weighted center of the measurements, \bar{P} and \ddot{P} are the mean time derivative and the

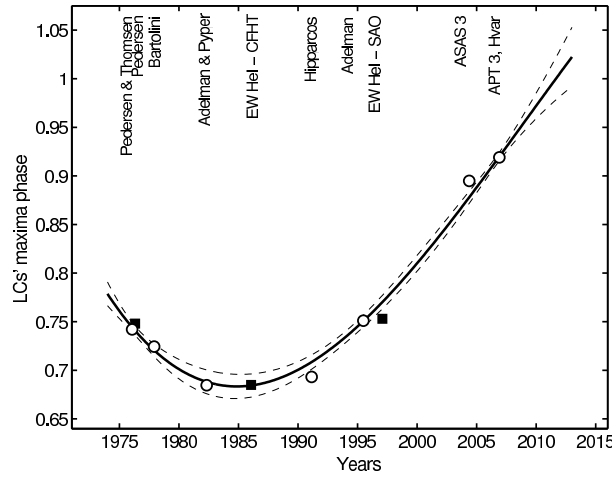


Figure 1. The O–C diagram of the star HD 37776, ■ – spectroscopy, ○ – photometry.

second derivative of the period, respectively, \bar{P} is the mean period. E is the epoch counted from M_0 and $\alpha_{1,\dots,5}$ are constants determined by time distribution of the data, providing the independence of individual terms in the formula. We derived: $M_0 = 2\,449\,112.550(3)$, $\bar{P} = 1.5387128(8)$ d, $\ddot{P} = 1.72(6) \times 10^{-8}$, $\dot{P} = -28(13) \times 10^{-13}$ d $^{-1}$, $\alpha_1 = 847.8$, $\alpha_2 = 1.029 \times 10^8$, $\alpha_3 = -693.9$, $\alpha_4 = 1.297 \times 10^7$, $\alpha_5 = 1.584 \times 10^9$. There is no doubt that since 1976 the period of the star has increased (27σ -certainty). Moreover, a slowing down of the rate of the period increase, (the negative \dot{P}), is not excluded. HD 37776 slows down its rotation or, at least, the rotation of its surface layers. Precession and light-time effect have been excluded. For details see Mikulášek *et al.* (2008).

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