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Is TU UMi a W UMa-type system?

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Abstract

TU UMi was discovered as a variable star by Hipparcos satellite (ESA 1997) and catalogued as a δ Sct star by Kazarovets et al. (1999). Analysis of new photometric observations carried through the years 2001 and 2002 is presented. The frequency obtained is in good agreement with that given by the Hipparcos Catalogue. Using the derived $uvby\beta$ indices we propose that this star could be a W UMa-type eclipsing binary system.

Introduction

TU UMi (SAO 8123, $m_v = 8\overset{\mathrm{m}}{.}76$) was found to be a variable star by the HIPPARCOS satellite. The Variability Annex of the Hipparcos Catalogue (ESA 1997) reports TU UMi to have a period of $0\overset{\mathrm{d}}{.}188546$ with Hp magnitudes ranging between $8\overset{\mathrm{m}}{.}837$ to $8\overset{\mathrm{m}}{.}893$ and the spectral type is listed as F2. Later Duerbeck (1997) suggested that this star can be a contact binary star (EW) or a pulsating star. In Kazarovets et al. (1999) it is considered as a DSCTC and Rodríguez et al. (2000), on the basis of the preceding information, considered it as a δ Scuti-type variable. With these additional observations in the Strömgren photometric system, it should be possible to define the nature of this star.

Observations

The observations were carried out on three nights in April 2001 and five nights in March 2002, using the 90 cm telescope at Sierra Nevada Observatory, Spain. This telescope is equipped with a six channel $uvby\beta$ photometer for simultaneous measurements in $uvby$ or in the Hβ channels respectively (Nielsen 1983). The data consist of 684 measurements in Strömgren $uvby$ colours collected

over 8 nights of observation and a time span of 332 days. Additionally, in one night Hβ data were also obtained. The comparison stars were C1 = SAO 8087 and C2 = SAO 8171.

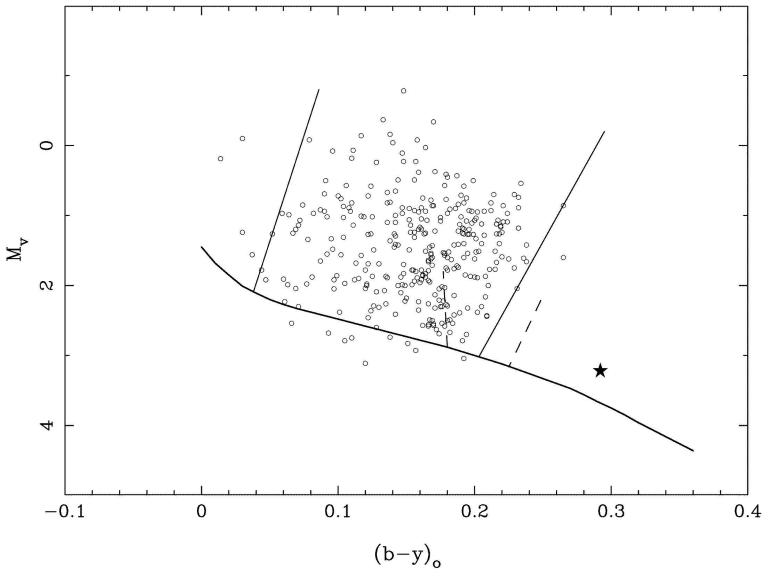

Figure 1: δ Sct-type pulsators in the H-R diagram. The borders of the instability strip are shown (continuous for δ Sct stars and dashed for γ Dor). The position of the TU UMi star is shown with the symbol $\star$.

Results

Looking at the light curves of the data in (b-y) and c_1 no variations were found. That suggests no pulsational nature of the variations of this star.

Table 1: *uvbyβ* indices obtained for TU UMi and C1 comparison star. Indices for C2 are taken from Hauck & Mermillod (1998).

Object	V	b-y	m_1	c_1	β
TU UMi	8.76	0.292	0.145	0.449	2.643
C1 = SAO 8087	7.38	0.127	0.192	0.867	2.821
C2 = SAO 8171	8.29	0.084	0.189	0.965	2.867

In the catalogues there is only Strömgren photometry for the C2 comparison star, the indices were taken from Hauck & Mermillod (1998). The Johnson V

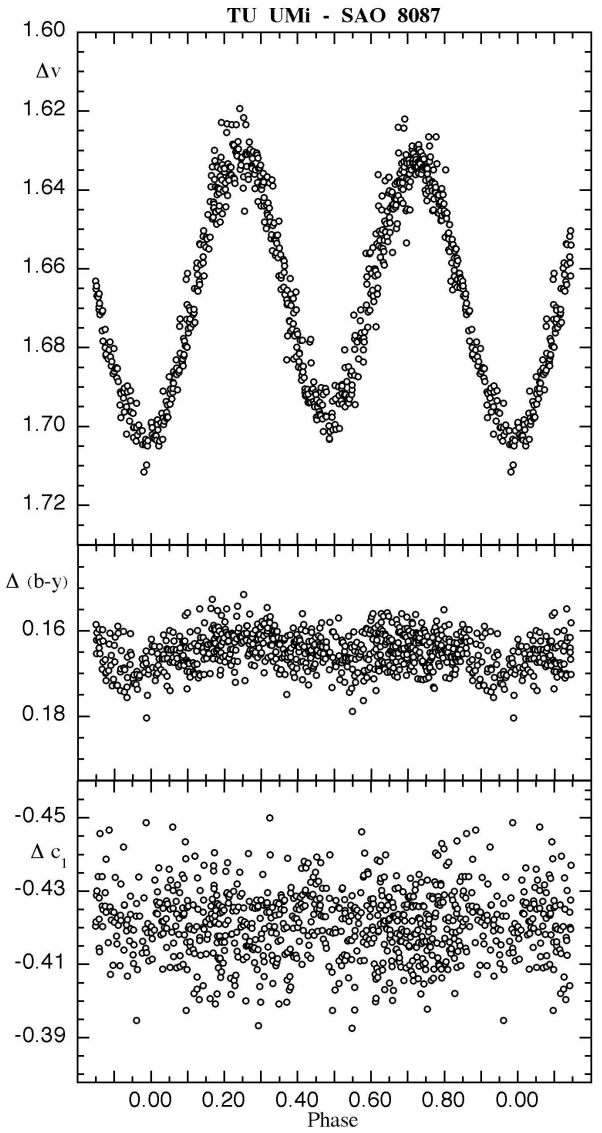

Figure 2: Light-curve and colour-index of TU UMi over the cycle variation.

magnitude for the C2 was derived from the Tycho catalogue. From the magnitude and index differences of the stars obtained by us, we derived the values

for the other stars. The results are given in Table 1. Using the above colour indices, we dereddened them making use of Crawford's (1979) calibration. We derived a null colour excess, (b-y)$_0$ = 0.292 and M$_v$ = 3.22. Figure 1 shows the position of TU UMi in the colour-magnitude diagram. The position of the star in the H-R diagram is clearly outside the δ Sct and γ Dor instability strip borders.

The analysis of this star was carried out by means of the Fourier Transform method and we obtained a period of P = $0\overset{\mathrm{d}}{.}188544$, in good agreement with that given in the Hipparcos catalogue. Figure 2 shows the light curve of the observed data in the v filter and colour index (b-y) and c_1 along the period of $0\overset{\mathrm{d}}{.}377088$, the magnitude differences being made with respect to the C1 star.

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