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DISCOVERY OF PULSATIONS IN A5(8) V COMPONENT OF THE ALGOL-TYPE SYSTEM TW Dra

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According to the strategy of Central Asian Network (CAN) collaboration (Mkrtichian et al., 1998) we are carrying out the survey for search for and study of new pulsating components in eclipsing binary stars. In the previous two publications (Mkrtichian and Gamarova, 2000; Gamarova et al., 2000) we reported about our first discoveries of new pulsating components in eclipsing binary systems R CMa and AS Eri. In this paper we present our third detection of δ Scuti-type pulsation in the primary component of the semi-detached eclipsing binary system TW Dra.

TW Dra is a semi-detached binary system with A5(8) V primary and K0 III secondary components. According to spectral class the primary component of TW Dra is situated inside the instability strip and was included to our list of target stars. Photoelectric observations of TW Dra through Johnson V filter using comparison HD 138852 (V = 5.758, Sp = K0III) and check HD 139549 (V = 9.13, Sp = F8) stars were carried out on April 26/27 and 28/29 2001 (JD 2452026, JD 2452028) with the 0.48-m telescope at Tien-Shan Astronomical Observatory (Kazakhstan). The data were reduced using standard reduction procedures for differential data. The magnitude differences between TW Dra and HD 138852 folded with the orbital period are shown on Fig. 1. The phases of orbital period were calculated according to the GCVS ephemeris HJD(Min I) = 2444136.2956 + 2.806847 $\times$ E (Kholopov et al., 1985).

Our observations covered the descending branch of the primary minima (JD 2452026) and out-of-eclipse part of the orbital light curve (JD 2452028) (see Fig. 1). For search for and analyse short-periodic pulsational variability we removed the orbital trends from the light curve. The pulsational light curves of the two nights are plotted in Fig. 2. The small-amplitude variations appear during both nights including the night which corresponds to the descending branch of primary minima.

The time series analyses were carried out with Kurtz's modification (Kurtz, 1985) of the Discrete Fourier Transform (DFT) algorithm of Deeming (1975). For determination of accuracy of the obtained values of frequency and amplitude of pulsations we used routines "Four", which realizes least-squares multi-frequency method of differential corrections fitting the multi-frequency signal simultaneously with set of given frequencies (Andronov, 1994). The amplitude spectrum of the two nights is shown in the top panel of Fig. 3. The highest peak at 17.99 ± 0.02 c/d ($P = 0\overset{d}{.}0556$) with semi-amplitude of about 2.1 ± 0.3 mmag is well visible and confirms the presence of pulsation. The amplitude spectrum of the residual is shown in the bottom panel of Fig. 3. It does not show any prominent peak above the noise level. The sine-wave fit with the period of $0^{\mathrm{d}}.0556$ for both nights is shown in Fig. 2 by a solid line. The phase curve folded with the same period is shown in Fig. 4.

Adopting the $M = 1.7M_{\odot}$ and radius $R = 2.4_{\odot}$ for TW Dra (Svechnikov and Kuznetsova, 1990) we determined the mean density of the primary $\rho/\rho_{\odot} = 0.123$ that gives the pulsation constant $Q = 0.0190$. This value is close to the 2nd overtone of low ℓ-degree modes (Fitch, 1981).

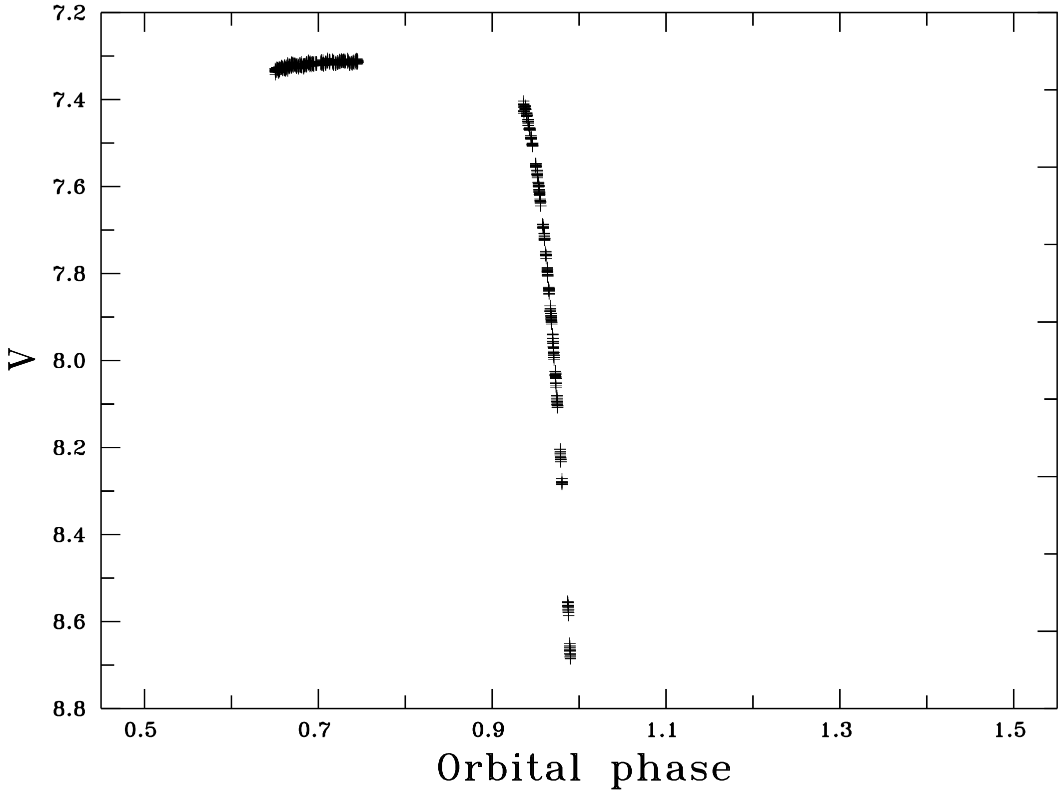

Figure 1. The orbital light curve

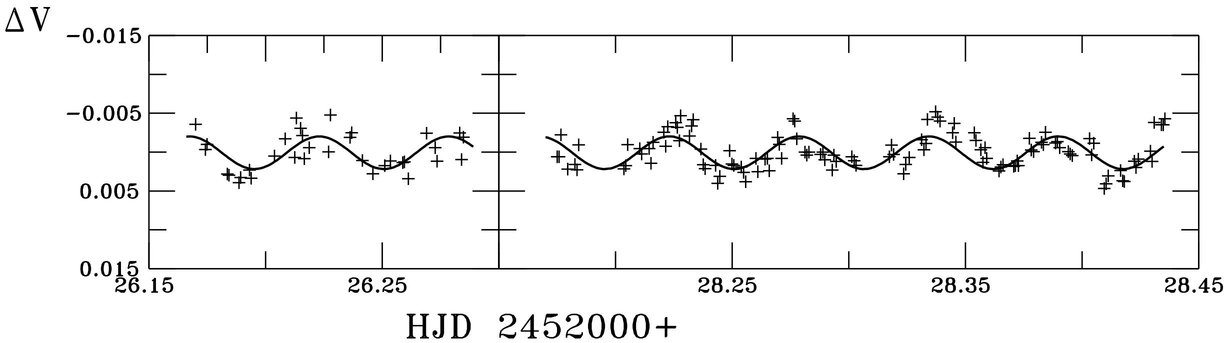

Figure 2. The pulsation light curves. Orbital trends are removed

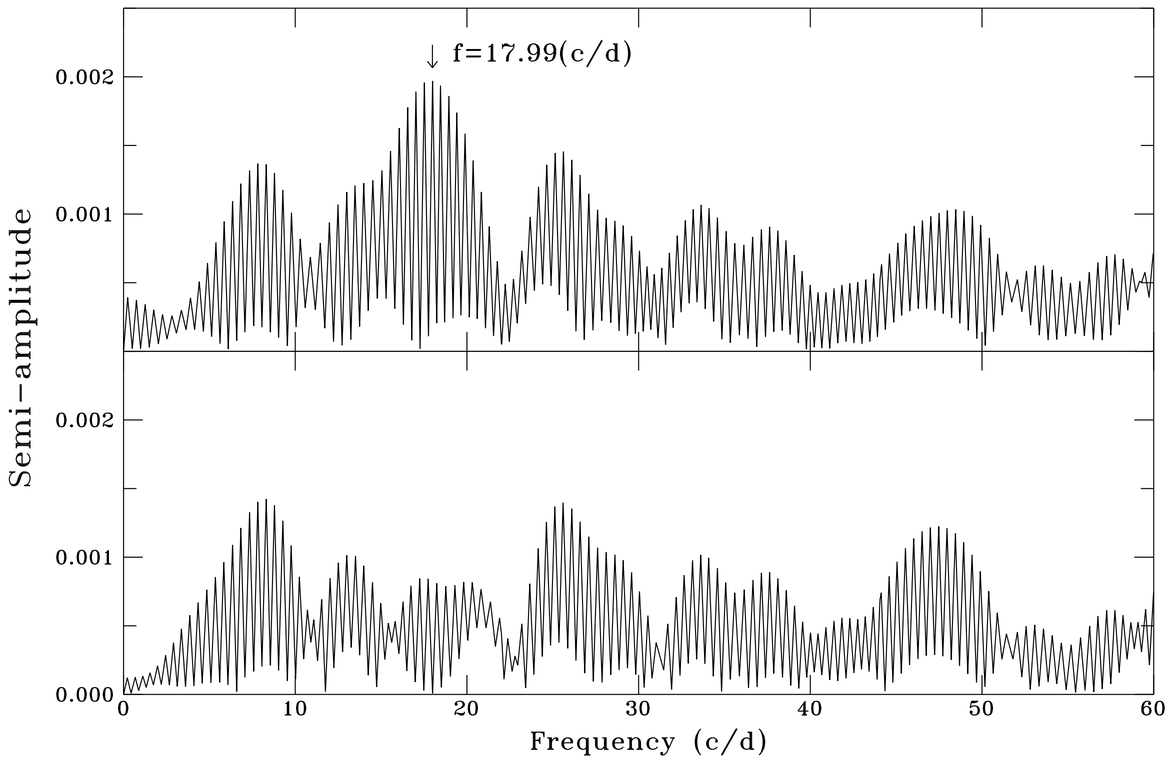

Figure 3. The amplitude DFT spectra

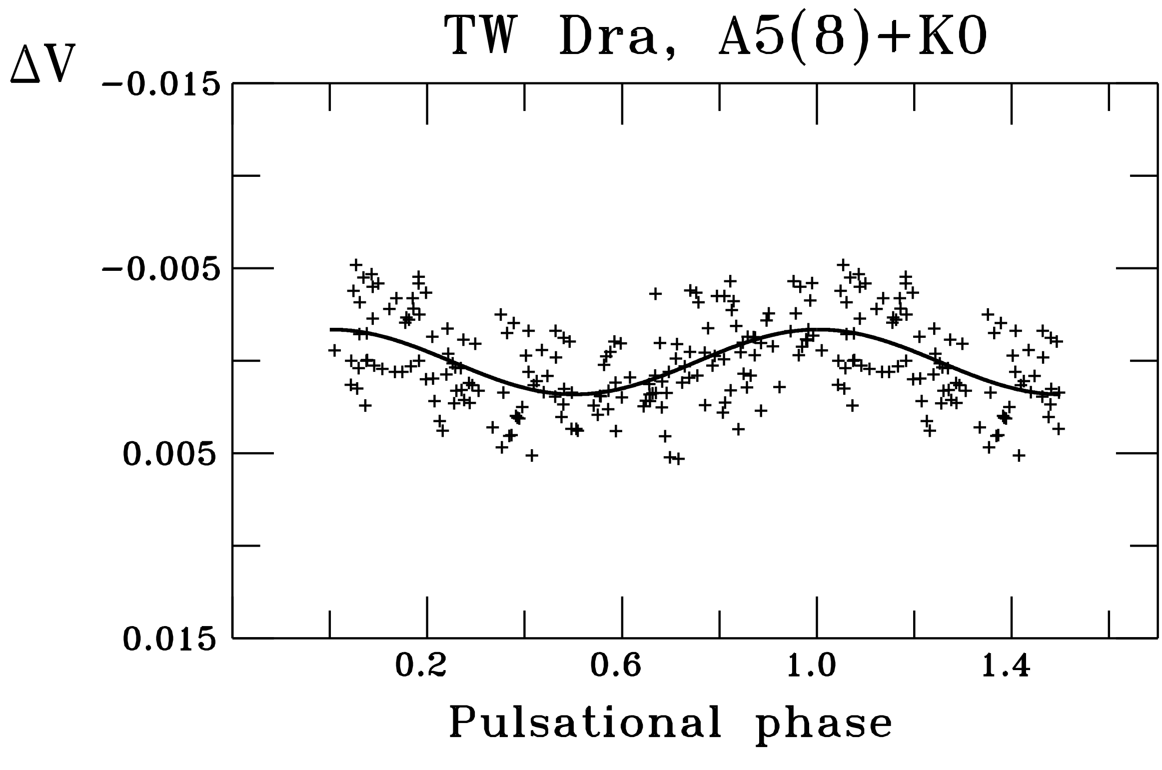

Figure 4. The phase curve folded with the period of $0^{\rm d}_{\cdot}0556$

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