COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4150

Konkoly Observatory
Budapest
26 January 1995
*HU ISSN 0374 – 0676*

# IS TX DELPHINI A POPULATION I (CLASSICAL) CEPHEID?

The pulsating variable TX Del (SAO 16272, BD +3°4437) is a well-known, relatively bright ( $\langle V \rangle = 9.2$ mag) Cepheid classified as Type II according to the catalogue of Harris (1985). The classification is based on its large distance from the galactic plane: [z] = 450 pc if we assume d = 1.1 kpc distance from the Sun derived from the period–luminosity relation of Type II Cepheids (Harris, 1985). The assumption that TX Del is a classical Cepheid would result in [z] = 1.2 kpc (Harris & Welch, 1989). This latter [z] distance is much larger than the scale height of classical Cepheids (70 pc, Fernie, 1968; Harris, 1985), therefore Harris & Welch (1989) concluded that TX Del is very probably a Type II Cepheid.

There are some other criteria of the classification of Cepheid variables, e.g. metallicity, galactic kinematics, light curve shape, etc. (see Harris, 1985 and the references therein). The classification, however, has large difficulties known for a long time. Up to now the separation based on the [z] distances seems to be the most useful and reliable. It is interesting that none of these criteria support the Type II status of TX Del, because it is a metal-rich star among Type II Cepheids ( $[Fe/H] > 0.5$ according to Meakes et al., 1991) and its light curve is very similar to those of classical Cepheids (e.g. Szabados, 1980). Recently TX Del has been discovered to be a member in a spectroscopic binary. Harris & Welch (1989) separated the pulsational and orbital radial velocities and determined the orbital parameters of the system.

A project of computing physical parameters of metal-rich Type II Cepheids via various Baade–Wesselink techniques has been started by the authors. Unfortunately, the number of stars is quite low due to the lack of precise radial velocity measurements but TX Del is one of the best observed objects in this sample. There are many light curves available and the precise pulsational velocity curve determined by Harris & Welch (1989) enabled us to compute the mean radius with acceptable accuracy. The used data are plotted against phase in Figure 1.

We applied two kinds of techniques deriving the radius: the "classical" Baade–Wesselink method based on equal levels of the colour index (B−V) (method #1) and the surface-brightness method based on the Barnes–Evans relation and the $(V-R)_0$ index (method #2). Both methods have lead to very similar results. Figure 2 shows the result of velocity curve integration and the computed radii at certain phases (using method #1). The physical parameters obtained are tabulated in Table I. $E(B-V) = 0.1$ was adopted from Meakes et al. (1991).

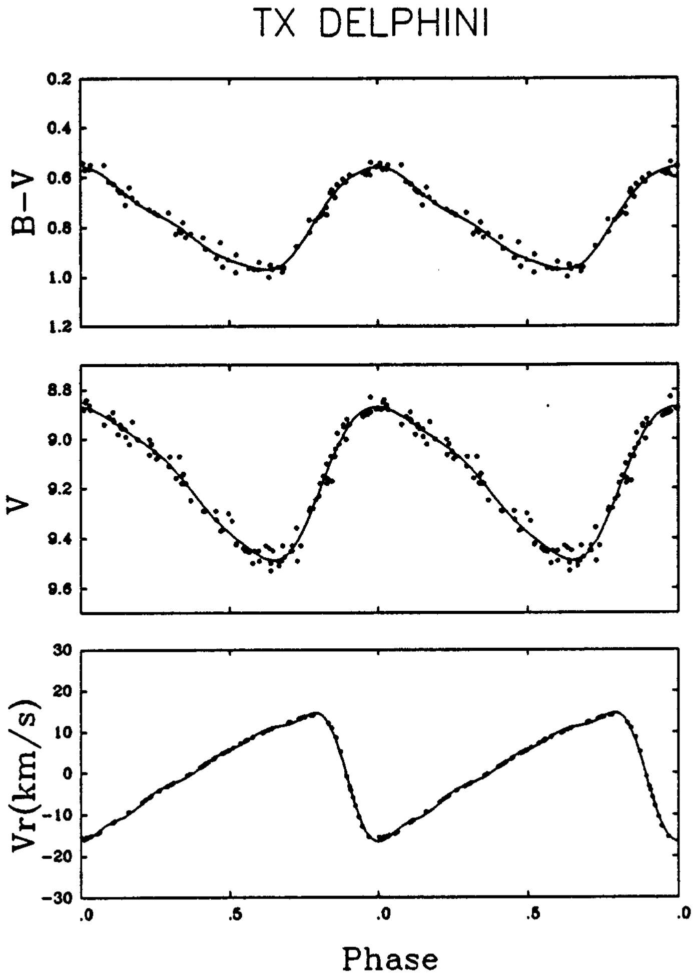


Figure 1 : Light-, color- and radial velocity curve of TX Del

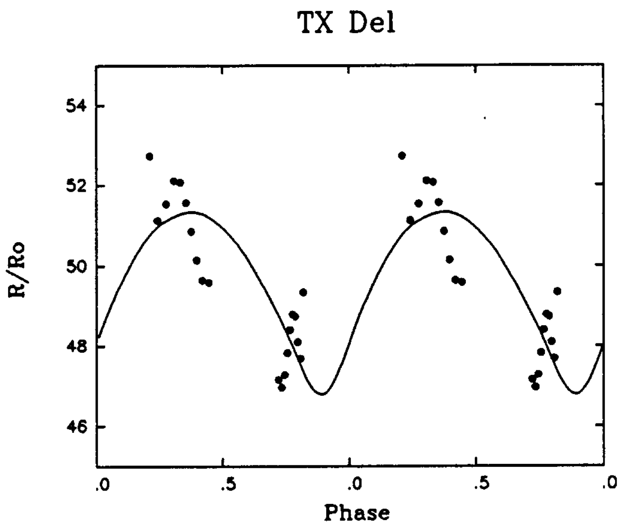


Figure 2 : Radius variation of TX Del during a pulsational cycle. The solid curve is the result of velocity curve integration, the filled circles are the radii obtained from the Baade-Wesselink solution.

Table I
Baade–Wesselink parameters and inferred parameters of TX Del

| $R/R_\odot$ | $(B-V)_0$ | $T_{eff}$(K) | $L/L_\odot$ | $M/M_\odot$ | d(pc) | z(pc) |
|---|---|---|---|---|---|---|
| 48±2 | 0.67 | 5500±200 | 1940±300 | 6±0.3 | 3000 | 1200 |

The obtained radius of TX Del ($R/R_\odot = 48$) shows that this star is too large to be a Type II Cepheid. The "normal" radius of an object of this type should be about 16 $R_\odot$ which is considerably smaller. Moreover, the inferred radius is in very good agreement with the period–radius relation for classical Cepheids (Gieren, Barnes & Moffett, 1989). Thus it is probable that TX Del is a Population I (classical) Cepheid. Using this assumption we can estimate the luminosity and the mass of TX Del as well as its distance from the Sun and the galactic plane respectively. These derived parameters are also summarized in Table I.

Since TX Del is a member of a binary system (the orbital period is quite short, $P_{orb}$ = 133 days) it is important to compare its radius with respect to the radius of the Roche-lobe. The mass function of the system is 0.04 $M_\odot$ therefore the minimum mass of the companion is 1.1 $M_\odot$. The Roche-lobe radius thus becomes about 110 $R_\odot$, so the ratio of radii $R_{star}/R_{Roche} \approx 0.44$. This value increases up to 0.5 if the companion is assumed to be as massive as TX Del.

This work was supported by the Hungarian OTKA Grant #F007318.

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