

THE CHANGING PERIOD OF SZ TAURI

SUSAN R. TRAMMELL
Maria Mitchell Observatory
Nantucket, MA 02554

Received 17 November 1987

Abstract

Recent observations of the s-Cepheid, SZ Tauri, indicate a fourth change in period. The new elements, valid after JD 2442000, are $JD_{(max)} = 2444496.578 + 3.14907 E$. The new period is compared to previous work that examined the possibility of a return to a previous pulsational period.

* * * * *

SZ Tau is one of a group of Cepheids being observed for the Maria Mitchell Observatory (MMO) by the 10-inch Automatic Photoelectric Telescope (APT) on Mount Hopkins in Arizona. These Cepheids are bright members of the group called s-Cepheids or DCEPS, characterized by small amplitudes and almost sinusoidal light curves. They are believed to be pulsating in the first harmonic mode (Ivanov and Nikolov 1976).

Photoelectric data in the UBV system were obtained during the first quarter of 1987, with 10-second integrations through each filter for SZ Tau and comparison and check stars. The comparison star was HD 29836, for which only the HD magnitude, 7.12 visual, was found in the literature (Cannon and Pickering 1918). The check star was HD 30780, also known as V480 Tau, a suspected Delta Scuti star with $P = 0.042$ day and a very low amplitude, 5.09 - 5.11 V (Hoffleit 1982). The variability of HD 30780 was not evident in the data obtained for this project, so its published mean magnitudes ($V = 5.10$, $B = 5.31$, and $U = 5.43$) could be used with the mean values of check - comparison in the APT data to calibrate the comparison star. The resulting magnitudes for HD 29836 are $V = 7.14$, $B = 7.81$, and $U = 8.10$. The standard deviations, based on the deviations from the mean are ± 0.002 , ± 0.002 , and ± 0.019 , respectively.

Magnitudes of SZ Tau were found by applying the differential values, variable - comparison, to these newly calculated magnitudes. The elements adopted are (Szabados 1977; Kukarkin et al. 1974) are:

$$JD_{(max)} = 2441659.194 + 3.148380E. \tag{1}$$

These elements and magnitudes were used to plot folded light curves in B and V. Figure 1 shows the B curve. The light curves match previously published photoelectric light curves within 0.01 magnitude, confirming the calibration of the magnitudes of the comparison star. Maximum comes at phase 0.38, however, indicating that equation (1) no longer applies.

Szabados (1977) made an extensive study of the period behavior of SZ Tau up to that date. Other observations of SZ Tau after Szabados' paper have been made by Berdnikov (1977) and Moffett (1980). Table I lists the values of O-C that are now available to update Szabados' work.

New elements applicable after JD 2442000 for SZ Tau were computed by least squares:

$$JD_{(max)} = 2444496.578 + 3.14907 E. \tag{2}$$

$\pm 0.019 \quad \pm 0.00003$

Figure 2 shows the O-C diagram published by Szabados (1977) with this line segment and the new data added. The previous work had indicated three changes in period prior to JD 2436300. With the additional data a fourth period change is evident. The entire O-C diagram is well satisfied by the five line segments shown, of which the first four are by Szabados. The corresponding elements are in Table II.

The epochs given for JD 2418500 to 2436300 were not tabulated by Szabados and have been calculated from measures of his graph. They may not be exact, but the periods are as he published them.

Szabados had suggested that the pulsational period at JD 2436300 matched a previous period valid before JD 2418500. It is interesting to note that the newest period almost matches the period valid between JD 2425500 and JD 2436300. This "stepwise" O-C diagram may be important in examining the theory concerning the evolution of this class of Cepheids.

This research was supported by National Science Foundation grants AST 8320491 and AST 8619885. The acquisition of the photoelectric data from Mount Hopkins was made possible through funding from the Theodore Dunham, Jr., Grant for Research in Astronomy. This project was conducted under the guidance of Dr. Emilia P. Belserene, whom I would like to thank for all her advice and support.

REFERENCES

- Berdnikov, L. N. 1977, *Perem. Zvez. Prilozh* 3, 325.
 Cannon, A. J. and Pickering, E. C. 1918, *Ann. Harvard Coll. Obs.* 92, 57.
 Hoffleit, D. 1982, *The Bright Star Catalogue*, Fourth Edition, Yale University Observatory, New Haven, CT.
 Ivanov, G. R. and Nikolov, N. S. 1976, *Astrophys. Letters* 17, 115.
 Kukarkin, B. V. *et al.* 1974, *Second Supplement to the General Catalogue of Variable Stars*, Third Edition, Moscow.
 Moffett, T. J. 1980, *Astrophys. Journ. Suppl.* 44, 427.
 Szabados, L. 1977, *Budapest Mitt.*, No. 70.

TABLE I

O-C Values for SZ Tauri Since 1977

<u>Observed Maximum</u> (JD)	<u>O-C</u> (days)	<u>Source</u>
2442424.475	+0.224	Berdnikov (1977)
2444222.636	+0.661	Moffett (1980)
2446845.772	+1.196	APT

TABLE II

Elements for O-C Diagram of SZ Tauri in Figure 2

<u>JD Interval</u>	<u>Epoch</u>	<u>Period</u> (days)
Before 2418500	2413669.044	3.14839
2418500 - 2425500	2419755.247	3.149235
2425500 - 2436300	2425527.709	3.149057
2436300 - 2442000	2441659.194	3.148380
After 2442000	2444496.578	3.14907

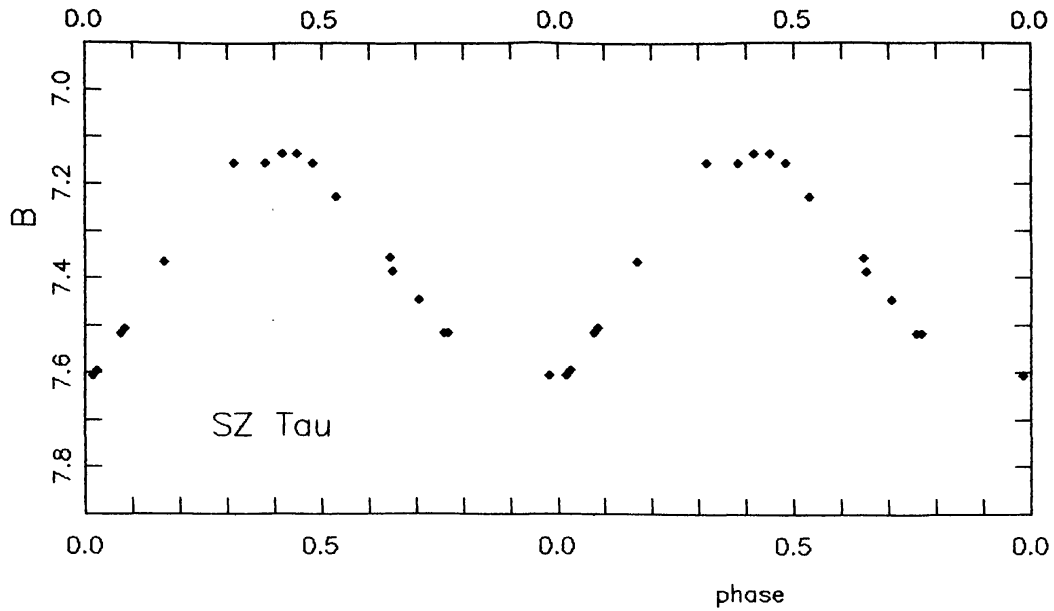


Figure 1. The light curve of SZ Tauri from JD 2446808 through 2446883.

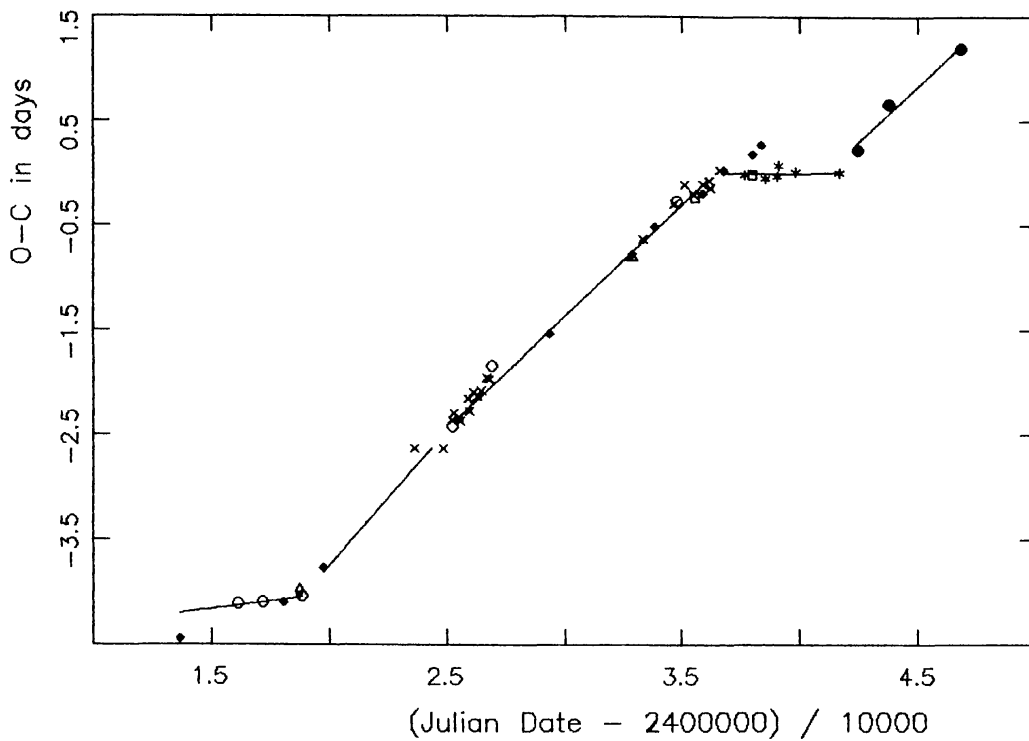


Figure 2. O-C in days plotted against Julian Date for SZ Tau. $C = 2441659.194 + 3.148380 E$. Large dot = new data. The other symbols indicate method of observation and weight as assigned by Szabados: small dot = photographic, 0.5; open circle = photographic, 1; x = visual, 0.5; diamond = visual, 1; square = photoelectric, 2; * = photoelectric, 3. The line segments represent the elements in Table II.