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ABSTRACT

2371 photoelectric UBV observations obtained between 1962 and 1979 and twelve radial velocity measurements made in 1971 are reported. The long-periodic variation in time of maximum light discovered by van Genderen has been confirmed and the values of its period (P_1 = 1170 days = 3.20 yr) and semiamplitude (A = 0.00540 day = 467 sec) were improved. A secular change in the pulsation period ($\beta = 10^{-12}$ day·cycle^{-1}) has been found. Small cycle-to-cycle variations are clearly seen but a search for periodic modulation failed. The photometric parameters of the light curves are discussed. The two-colour diagram of SZ Lyn suggests an interstellar reddening of E(B-V) = 0.04 magn. Our spectra do not show any feature of the presence of doubled lines. Our observations are compatible with the hypothesis that SZ Lyn is a single-lined spectroscopic binary with a period of 3.20 yr and a total velocity amplitude 18 km·s^{-1}.

INTRODUCTION

The light variability of SZ Lyncis (=BD+44°1718 = HD 67390 = AGK2 +44°795 =CSV 1220 = S4747) was discovered by *Hoffmeister* (1949a,b). The star was first investigated photographically and visually by *Soloviev* (1955) and *Tsesevich* (1956a, b) who considered it as an eclipsing variable of W UMa type with a period of 0.212 day, and later of 0.274 day. Using photoelectric observations *Schneller* (1961) and *Eggen* (1962) rejected the earlier classification and demonstrated the RRs character of the variable. *Gefferth* and *Szeidl* (1962) and *Notni* (1962) determined the correct period of its light variation: P = 0.12053 day. *Gefferth* and *Szeidl* (1962) noticed small changes in the light variation amplitude from cycle to cycle but failed to find periodic variations in the height of maximum. Later *van Genderen* (1963) and *Broglia* (1963) investigated the light curve of the variable and found no irregularities. *He Tien-jian* and *Xiong Da-run* (1964) found the period to be decreasing. *Joshi* and *Srivastava*'s (1967) observations showed sudden shifts in the time of occurrence of the star's light maximum. According to them the period of the variable and its light and colour curves undergo drastic changes. It was reported by *van Genderen* (1967) that there are small changes in the height of the maximum and in the form of the light curve. He was the first to point out that the O-C's produced by a linear ephemeris appeared to follow a sine-curve relation with a period of 3.1 years. *Binnendijk* (1968), however, found no evidence for variation in the height of the maximum nor in the shape of the light curve. On the other hand, *Wisse* and *Wisse* (1969) found the changes in the height and shape to be roughly correlated, therefore they considered these variations as real. Moreover the epoch of maximum given by *Wisse* and *Wisse* (1969) considerably deviates from *van Genderen*'s nonlinear ephemeris. In an attempt to resolve the discrepancies, high speed UBV photometry was carried out by *Barnes* and *Moffett* (1974, 1975). The existence of irregularities in the height of maximum light having a total amplitude of about 0.04 magn was confirmed. *Barnes* and *Moffett* (1975) improved the parameters of the periodic variation from a linear element and interpreted this long periodic modulation as light travel time effect supposing that SZ Lyn is a member of a binary system. *Duerbeck* (1976) suggested that there was an increase in brightness of SZ Lyn. This effect, however, could not be confirmed by *Karetnikov* and *Medvedev* (1978). They were unable to find any correlation between high and sharp maxima, although they also pointed out the changes in the form of the light curve. *Garrido* et al. (1979) found that the variations in the height of the maximum did not exceed ~ 0.03 magn and they confirmed that the residuals from a constant period fitted a sine-wave well. According to their study no other significant change in the period seemed to be present.

The observations of *Africano* (1978) and *Hopp* and *Witzigmann* (1979) showed, however, that the O-C values of the times of light maximum were definitely larger than the standard deviation in the determination of the non-linear ephemeris of *Barnes* and *Moffett* (1975). This fact suggests that a redetermination of the period should be done with new observations.

According to the studies of *Willis* (1972) and *Alania* (1972, 1974) the metal abundance of SZ Lyn is normal or the star is slightly metal deficient, since $\Delta S \approx 1$ or 2 near minimum light.

The strongest support for the binary hypothesis may come from radial velocity measurements. First, *Woolley* and *Aly* (1966) investigated the radial velocity variation of SZ Lyn, but they did not remark on spectral duplicity. *McNamara* and *Feltz* (1976) secured a number of spectrograms of SZ Lyn with a dispersion of 40 $A \cdot mm^{-1}$; they did not comment upon doubled lines either. Their careful analysis showed that the velocity data were uncertain and too limited in scope for testing the binary hypothesis at that time. At any rate, the data available to them did not support the long-period velocity variation. Recently *Bardin* and *Imbert* (1981) measured the radial velocities of SZ Lyn at high time resolution. The results fully confirmed the binary hypothesis and led to a coherent provisional orbit with a fairly large computed eccentricity.

We present our photometric and spectroscopic observations to enable a more rigorous period analysis and give further support to the hypothesis that SZ Lyn is a component of a binary system.

PHOTOMETRIC OBSERVATIONS

On 28 nights in the period 7 February 1962- 27 February 1979, 2371 three-colour photoelectric observations were obtained at Konkoly Observatory. Most of the observations were carried out with the 24 inch telescope equipped with an unrefrigerated photometer. This photometer employed an 1P21 photomultiplier tube in 1962 and an EMI 9502B tube in the years 1963-1979. The colour filters were nearly on the UBV system: in ultraviolet light 2 mm UG1, in blue light 1 mm BG12 plus 2 mm GG13, in yellow light 2 mm GG11 Schott-filters were used. On two nights (namely on J.D.2441679 and J.D.2443931) the 20 inch telescope at the mountain station of Konkoly Observatory was used. The photometer of this telescope contained an EMI 9058QB multiplier and the following Schott-filters: UG2 in U, BG12+GG13 in B, and GG11 in V.

A summary of photoelectric observations obtained at Konkoly Observatory in different years in UBV light by different observers is presented in Table 1.

All observations were made differentially with respect to the comparison star BD +45°1544 chosen conveniently close to SZ Lyn. Additional observations were obtained during the observational period by checking the constancy of the comparison star. A second comparison star, BD +44°1716, was selected for this purpose and the intercomparisons indicated that the main comparison star was sufficiently constant. The comparison stars were calibrated on the UBV system through reference to standard stars from the list of *Johnson* and *Morgan* (1953) and *Iriarte* et al. (1965). These observations were made on three good and uniform nights in 1964, 1967 and 1968, respectively. The magnitudes and colours of the comparison stars are given in Table 2. This table also lists the values of comparison stars of other observers.

The individual observations of SZ Lyn are presented in Table 9a,b,c.These observations have been converted to the standard UBV system. In the reduction of the observations to ΔU, ΔB and ΔV magnitudes, mean differential colour curves on the instrumental system were formed for each year and then these mean curves were used for the colour corrections in the transformation equa-

Table 1

Journal of observations

Date	J.D.	U	B	V	Observer
1962.02. 7/8	2437703.4007 - .4926	-	36	30	B. Szeidl
9/10	705.5297 - .5698	-	13	12	K. Gefferth
10/11	706.2517 - .3642	-	59	53	- " -
11/12	707.4157 - .6032	-	78	76	B. Szeidl
21/22	717.2963 - .3450	-	17	14	- " -
22/23	718.4326 - .5747	-	53	55	- " -
03. 2/3	726.4874 - .5291	-	22	16	- " -
20/21	744.3201 - .4112	-	28	22	- " -
1963.01.22/23	38052.3373 - .3868	18	16	-	K. Barlai
	.4266 - .5783	44	41	-	B. Szeidl
02.21/22	082.3243 - .5074	132	-	27	- " -
1964.02.13/14	38439.2701 - .5243	53	56	52	- " -
03. 2/3	457.3117 - .4575	40	41	42	- " -
1967.02. 5/6	39527.4781 - .5698	29	29	29	- " -
6/7	528.5788 - .6455	22	21	21	- " -
1968.02.18/19	39905.2832 - .3964	33	38	41	- " -
1969.01.21/22	40243.3204 - .4176	31	32	32	- " -
1971.01.28/29	40980.3980 - .4210	-	12	12	L. Büki
03.24/25	41035.3337 - .4386	-	55	55	- " -
31/04. 1	042.3650 - .4150	-	8	8	- " -
1971.12.26/27	41312.3880 - .4658	-	41	41	L. Vargha
1972.03.13/14	390.3182 - .4279	28	30	30	B. Szeidl
1972.12.27/28	41679.5672 - .7050	36	36	36	- " -
1974.02.27/28	42106.2898 - .4140	-	36	36	- " -
1975.02. 7/8	42451.3844 - .4872	-	40	40	K. Olah
10/11	454.3845 - .5092	-	45	45	B. Szeidl
1978.03.10/11	43578.3050 - .3880	-	31	29	- " -
1979.01. 5/6	43879.5399 - .5874	-	17	17	K. Olah
02.26/27	931.2953 - .4520	-	50	53	- " -
total number of observations		466	981	924	

Table 2

Comparison stars of SZ Lyn

Star	V	B-V	U-B	Reference
BD $+44^{\circ}1716$	8.48	+0.98	+0.79	Present paper (n=8)
$+44^{\circ}1719$	10.93	+0.78	+0.36	Eggen (1962)
$+45^{\circ}1540$	9.80	+0.49		Joshi, Srivastava (1967)
	9.88	+0.48		van Genderen (1967)
	9.974	+0.560		Karetnikov, Medvedev (1978)
$+45^{\circ}1544$	9.45	+0.48		Broglia (1963)
	9.48	+0.47		Joshi, Srivastava (1967)
	9.43	+0.46	+0.03	van Genderen (1967)
	9.556	+0.387		Karetnikov, Medvedev (1978)
	9.44	+0.45	+0.03	Present paper (n=8)

tions. As the comparison star was close to the variable, no correction has been made for differential extinction. The accuracy of the individual observations can be taken as about 0.01 magn.

THE PERIODS

The correct period of light variation of SZ Lyn was determined independently by *Gefferth* and *Szeidl* (1962) and by *Notni* (1962). *Gefferth* and *Szeidl* analysed their own photoelectric observations and combined them with those of *Schneller* (1961). They gave the ephemeris:

$$J.D.max = 2437718.5568 + 0\overset{d}{.}120\ 534\ 87 \cdot E. \qquad \text{Eq.1.}$$

Notni used *Soloviev*'s (1955) photographic, *Tsesevich*'s (1956a) visual and photographic, and *Schneller*'s (1961) photoelectric observations and he obtained:

$$J.D.max = 2437368.403 + 0\overset{d}{.}120\ 534\ 73 \cdot E. \qquad \text{Eq.2.}$$

First, *He Tian-jian* and *Xiong Da-run* (1967) concluded that the period was not constant. They computed an ephemeris with the quadratic term:

$$J.D.max = 2437780.0311 + 0\overset{d}{.}120\ 533\ 37 \cdot E - 5\overset{d}{.}728 \times 10^{-10} \cdot E^2. \qquad \text{Eq.3.}$$

Soon after this, a thorough investigation of the period of SZ Lyn was carried out by *van Genderen* (1967). From the photoelectrically observed times of maximum light available to him at that time, *van Genderen* came to the conclusion that the observations can adequately be represented by a periodic term:

$$J.D.max = T_o + P_o \cdot E - A \cdot \cos 2\pi \left(\frac{T_{max} - T_o}{P_1} - \Phi\right) \qquad \text{Eq.4.}$$

where $T_o = 2438124.39849$, $A = 0.00569$ day,
$P_o = 0.120\ 534\ 93$ day, $\Phi = -0.019$,
$P_1 = 1129$ days.

Later on this ephemeris was improved by *Barnes* and *Moffett* (1975) and by *Garrido* et al. (1979). The parameters of ephemerides derived by different authors are given in Table 3.

Recent observations suggested that a redetermination of the parameters of the ephemeris be carried out thereby enabling the periods to be greatly improved. Such a redetermination can, of course, be based only on photoelectric observations. The available times of light maxima observed photoelectrically are collected in Table 4. The long series of visual and photographic maxima published by *Soloviev* (1955), *Tsesevich* (1956a, b, 1966), *Berdnikov* (1972, 1975, 1977), *Braune* et al. (1972, 1973, 1977, 1981) and *Busch* (1975, 1976) are not used here.

A small systematic phase lag between the blue and yellow light maxima have been found by some of the authors. For example, from the observations of *Karetnikov* and *Medvedev* (1977, 1978) a phase difference

$$\Delta T = T(\text{max. in B}) - T(\text{max. in V}) = -0.0006 \pm 0.0004$$

can be deduced. Since most of the authors determined the times of maximum brightness in B bandpass, we used the blue maxima (if available) as the zero phase in our period analysis. Some observers assumed that for every colour the maximum occurred at the same time and they published the average values of the time of blue and yellow light maxima. This discrepancy, however, does not give rise to serious problems in the period analysis. Usually the estimated accuracy of the determination of the time of the best observed maximum light is about 0.0007 day ≈ 1 minute. If we compare this value with

$$T(\text{max. in B}) - \frac{T(\text{max. in B}) + T(\text{max. in V})}{2} \approx -0\overset{d}{.}0003$$

it turns out immediately that the average values of times of maximum light in blue and yellow can also be used without any restriction in the period analysis.

It is clear that the O-C values for SZ Lyn produced by a linear ephemeris follow a sine-curve relation. Since previous investigations of the period changes of dwarf cepheids showed that the period of a star might be increasing or decreasing continuously, we tried to fit the epochs of maximum of SZ Lyn to the following relation:

$$\text{J.D.max} = T_o + P_o \cdot E + \frac{\beta}{2} \cdot E^2 - A \cdot \cos 2\pi \left(\frac{P_o}{P_1} \cdot E - \psi_o\right) \qquad \text{Eq.5.}$$

where T_o is the initial epoch of maximum corresponding to E=0; P_o is the pulsation period of SZ Lyn; P_1 is the period of the sinusoid; β is the secular change of the pulsation period during one cycle; A is the semiamplitude of the sine-curve; and ψ_o is the phase shift. Values for the six parameters were determined by the method of least squares giving the same weight to all observations:

T_o = 2438124.39801 ±.00012 | A = 0.00540 day, ±.00011

P_o = 0.120 534 934 day, ±18 | β = +0.010 x 10^{-10} day·cycle^{-1} ±.007

P_1 = 1170 days, ±3 | ψ = -0.015 ±.005.

For comparison with others' results these values are also given in Table 3. The observations used here cover almost $6P_1$ whereas the baseline of coverage was only $1.6P_1$ in *van Genderen*'s (1967), $3.8P_1$ in *Barnes* and *Moffett*'s (1975), and $5.0P_1$ in *Garrido* et al.'s (1979) discussions.

Four maxima have been excluded from the fit to Eq.5. Three (E=2919, 2977 and 18459) were already reported by *Joshi* and *Srivastava* (1967) and by *Wisse* and *Wisse* (1969) to deviate significantly from the non-linear ephemeris. The epoch (E=21073) published by *Popovici* (1971) deviates from our non-linear ephemeris by at least three times the acceptable timing uncertainties of photoelectric maxima ($\sim 0^d.0015$ = 2 minutes).

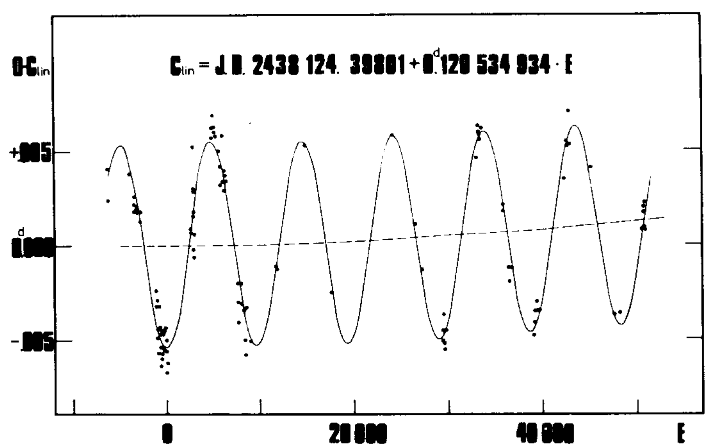


Figure 1: $O-C_{lin}$ versus E. The solid line indicates the goodness of fit for the non-linear ephemeris Eq. 5. The dashed line shows the secular variation in the pulsation period.

In columns 4 and 5 of Table 4 the $O-C_{lin}$ residuals from the linear portion of Eq.5, and the O-C residuals determined from Eq.5 are given. The phases of the sinusoid ψ are also given in Table 4 in column 6. Fig. 1 indicates the goodness of fit for the non-linear ephemeris. It shows the residuals from the linear part in Eq.5 versus epoch number E and the non-linear fit is drawn in.

Table 3

Parameters of ephemerides

T_o	P_o	P_1	A	φ	10^{10}xβ	No. max	Reference
2433 946.493*	0.212 032 5	-	-	-	-	7*	Tsesevich (1956a)
33 946.523*	0.274 084 2	-	-	-	-	18*	Tsesevich (1956b)
37 718.5568	0.120 534 87	-	-	-	-	7	Gefferth, Szeidl (1962)
37 368.403	0.120 534 73	-	-	-	-	13	Notni (1962)
37 367.44321 ±.00087	0.120 533 34 ±.000 000 19	-	-	-	-	11	van Genderen (1963)
37 367.44186 26	0.120 533 486 52	-	-	-	-	11	Broglia (1963)
37 780.0311	0.120 533 37	-	-	-	-11.556	11	He Tian-jian, Xiong Da-run (1964)
38 124.39714 66	0.120 534 87 10	-	-	-	-	60	van Genderen (1967)
38 124.39849 21	0.120 534 93 05	1129 ±18	0.00569 ±.00018	-0.019 ±.011	-	48	van Genderen (1967)
39 121.7003	0.120 531 88	-	-	-	-	24	Binnendijk (1968)
38 124.39770 56	0.120 534 81 04	-	-	-	-	94	Barnes, Moffett (1975)
38 124.39828 17	0.120 534 906 20	1146 10	0.00572 19	-0.010 08	-	66	Barnes, Moffett (1975)
38 124.39824 17	0.120 534 920 13	1150 10	0.00573 20	-0.007 08	-	70	Garrido et al. (1979)
38 124.39801 12	0.120 534 934 18	1170 3	0.00540 11	-0.015 05	+0.010 ±. 07	116	Present study

*Minimum times and No. of minima are given

Table 4

Photoelectrically observed maxima

Epoch of maximum ($JD_{\odot}$)	Rem.	E	($O-C_{lin}$)	(O-C)	ψ	B_{max}
2437367.441	Sc	- 6280	+0.0024	-0.0013	0.368	
368.407	Sc	- 6272	.0041	+0.0004	.369	
642.021	Eg	- 4002	.0038	-0.0005	.603	
706.2645	Pp	- 3469	.0022	-0.0008	.658	9.320
707.4695	Pp	- 3459	.0018	-0.0011	.659	9.334
.5908	Pp	- 3458	.0026	-0.0004	.659	9.312
718.5587	Pp	- 3367	.0018	-0.0009	.668	9.328
726.5141	Pp	- 3301	.0019	-0.0006	.675	9.341
744.3535	Pp	- 3153	.0021	+0.0002	.690	9.345
780.031	HX	- 2857	.0013	+0.0003	.721	
.152	HX	- 2856	+0.0018	+0.0008	.721	
977.343	HX	- 1220	-0.0024	+0.0018	.889	
997.351	HX	- 1054	.0032	+0.0013	.906	
38001.568	vG	- 1019	.0049	-0.0004	.910	
.689	vG	- 1018	.0044	+0.0001	.910	
003.378	HX	- 1004	.0029	+0.0017	.912	
021.576	vG	- 853	.0057	-0.0009	.927	
.699	vG	- 852	.0032	+0.0016	.927	
032.305	HX	- 764	.0043	+0.0007	.936	
052.4333	Pp	- 597	.0054	-0.0002	.953	9.340
.5545	Pp	- 596	.0047	+0.0005	.954	9.340
053.276	HX	- 590	.0064	-0.0012	.954	
055.205	HX	- 574	.0060	-0.0008	.956	
.3268	Br	- 573	.0047	+0.0005	.956	9.338
.4463	Br	- 572	.0057	-0.0005	.956	9.331
.5681	Br	- 571	.0045	+0.0007	.956	9.332
057.3752	Br	- 556	.0054	-0.0002	.958	9.335
.4964	Br	- 555	.0047	+0.0005	.958	9.349
.6172	Br	- 554	.0045	+0.0008	.958	9.329
082.4464	Pp	- 348	.0055	-0.0001	.979	
114.3880	Br	- 83	.0056	-0.0002	.006	9.354
118.367	vG	- 50	.0043	+0.0011	.010	9.340
.485	vG	- 49	.0068	-0.0014	.010	9.345
124.393	vG	0	.0050	+0.0004	.015	
140.423	Br	+ 133	-0.0062	-0.0009	.029	9.346
439.3565	Pp	2613	+0.0007	-0.0004	.284	9.331
.4772	Pp	2614	.0009	-0.0003	.284	9.333
457.3173	Pp	2762	.0018	+0.0002	.300	9.330
.4376	Pp	2763	.0016	-0.0001	.300	9.355
460.210	JS	2786	+0.0017	-0.0001	.302	
463.342	JS	2812	-0.0002	-0.0021	.305	
464.189	JS	2819	+0.0030	+0.0012	.305	
465.276	JS	2828	.0052	+0.0033	.306	
466.238	JS	2836	.0029	+0.0010	.307	
467.200	JS	2844	+0.0006	-0.0013	.308	
471.297	JS	2878	-0.0006	-0.0026	.311	
(476.249	JS	2919	+0.0095	+0.0074	.316)	
(483.241	JS	2977	.0105	+0.0081	.322)	
701.8866	Bi	4791	.0057	+0.0003	.509	
708.6377	vG	4847	.0069	+0.0015	.514	9.354
709.6014	vG	+ 4855	+0.0063	+0.0009	0.515	9.351

Table 4 (cont.)

Epoch of maximum ($JD_{\odot}$)	Rem.	E	($O-C_{lin}$)	(O-C)	ψ	B_{max}
2438712.6148	vG	+ 4880	+0.0063	+0.0009	0.518	9.341
725.5117	vG	4987	.0060	+0.0007	.529	
752.5114	vG	5211	.0058	+0.0007	.552	9.354
788.5505	vG	5510	.0050	+0.0003	.583	9.359
809.4022	vG	5683	.0042	-0.0002	.600	9.339
830.4949	vG	5858	.0032	-0.0007	.618	9.340
834.234	JS	5889	.0058	+0.0018	.622	
844.4771	vG	5974	.0034	-0.0003	.630	9.354
849.5396	vG	6016	.0034	-0.0002	.635	9.344
850.3839	vG	6023	.0040	+0.0004	.635	9.338
.5034	vG	6024	.0029	-0.0006	.636	9.355
871.3567	vG	6197	+0.0037	+0.0006	.653	9.345
39052.5129	vG	7700	-0.0041	-0.0022	.808	9.336
.6355	vG	7701	.0020	-0.0001	.808	9.341
054.5631	vG	7717	.0030	-0.0010	.810	9.335
.6846	vG	7718	.0020	-0.0001	.810	9.340
092.7726	Bi	8034	.0031	-0.0001	.843	
121.7007	Bi	8274	.0034	+0.0003	.867	
130.4981	vG	8347	.0050	-0.0012	.875	9.316
145.4461	vG	8471	.0033	+0.0007	.888	9.334
.5642	vG	8472	.0058	-0.0017	.888	9.345
205.4706	vG	8969	.0052	-0.0003	.939	9.342
527.5441	Pp	11641	.0011	+0.0001	.214	9.337
528.6288	Pp	11650	.0012	-0.0001	.215	9.350
531.401	JS	11673	-0.0013	-0.0003	.218	
905.3070	Pp	14775	+0.0053	0.0000	.537	9.322
40243.3996	Pp	17580	-0.0025	-0.0002	.826	9.329
(349.3521	WW	18459	.0003	+0.0043	.917	9.386)
(664.4239	Po	21073	-0.0068	-0.0049	.186)	
41035.443	Pp	24151	+0.0058	+0.0001	.503	
312.4276	Pp	26449	+0.0011	+0.0004	.740	9.341
390.4113	Pp	27096	-0.0013	+0.0002	.806	9.352
678.8475	BM	29489	.0052	-0.0005	.053	
679.5714	Pp	29495	.0045	+0.0002	.054	9.315
.6913	Pp	29496	.0051	-0.0005	.054	9.320
683.7909	BM	29530	.0037	+0.0009	.057	9.292
.9096	BM	29531	.0055	-0.0009	.057	9.312
684.0312	BM	29532	-0.0045	+0.0001	.057	9.278
42106.3947	Pp	33036	+0.0046	-0.0007	.418	9.340
129.5391	KM	33228	.0063	+0.0008	.438	
136.2887	KM	33284	.0059	+0.0003	.444	
.4091	KM	33285	.0058	+0.0002	.444	
.5294	KM	33286	.0056	0.0000	.444	
162.4450	KM	33501	.0062	+0.0003	.466	
451.4834	Pp	35899	.0018	-0.0001	.713	9.340
454.4971	Pp	35924	+0.0021	+0.0003	.716	9.341
531.7560	Af	36565	-0.0019	-0.0015	.782	
532.7210	Af	36573	.0012	-0.0007	.783	
533.6852	Af	36581	.0012	-0.0008	.784	
837.3091	Du	39100	.0048	-0.0004	.043	9.280
841.2875	Du	39133	.0041	+0.0003	.047	9.270
871.4218	KM	39383	.0035	+0.0006	.072	
872.3861	KM	+39391	-0.0035	+0.0006	0.073	

Table 4 (cont.)

Epoch of maximum ($JD_{\odot}$)	Rem	E	($O-C_{lin}$)	(O-C)	ψ	B_{max}
2442874.3152	KM	+39407	-0.0030	+0.0011	0.075	
.4352	KM	39408	-0.0035	+0.0005	.075	
43232.4309	HW	42378	+0.0035	-0.0014	.381	
257.3835	GE	42585	.0053	0.0000	.402	
258.4685	GE	42594	.0055	+0.0002	.403	
287.3985	GE	42834	.0071	+0.0014	.428	
288.3600	GE	42842	.0043	-0.0014	.429	
578.3668	Pp	45248	+0.0041	+0.0007	.677	9.339
879.5758	Pp	47747	-0.0037	+0.0001	.934	9.341
931.4059	Pp	48177	-0.0036	+0.0006	.978	9.340
44222.3817	Ga	50591	+0.0008	+0.0003	.227	9.330
257.4574	Ga	50882	.0009	-0.0007	.257	9.316
261.3156	Ga	50914	.0020	+0.0003	.260	9.325
.4359	Ga	50915	.0017	+0.0001	.260	9.312
262.2787	Ga	50922	.0008	-0.0009	.261	9.315
269.2711	Ga	+50980	+0.0022	+0.0003	0.267	9.323

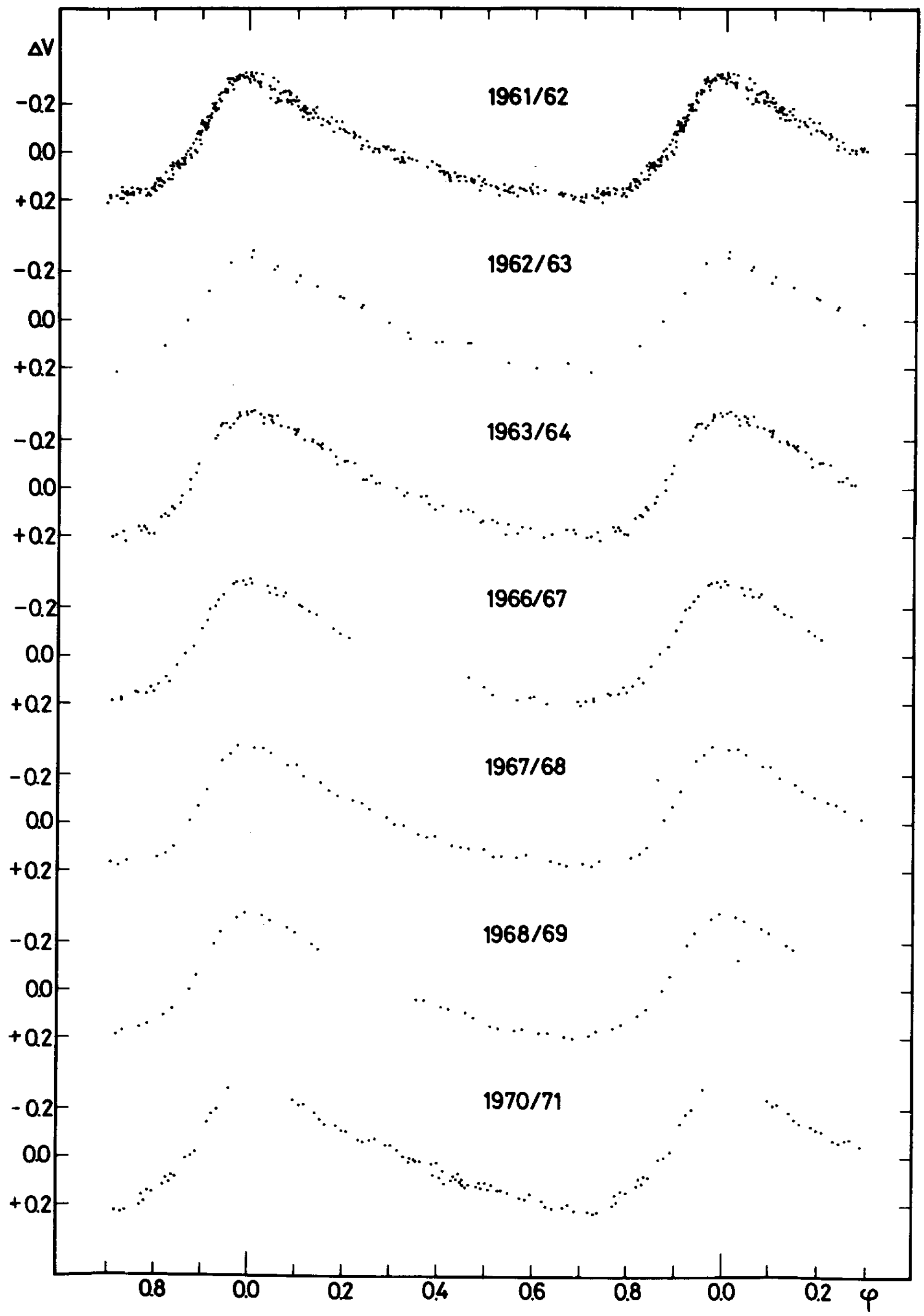
Remarks to Table 4: Sc = Schneller (1961); Eg = Eggen (1962); HX = He Tian-jian and Xiong Da-run (1964); vG = van Genderen (1963, 1967); Br = Broglia (1963); JS = Joshi and Srivastava (1967); Bi = Binnendijk (1968); WW = Wisse and Wisse (1969); Po = Popovici (1971); BM = Barnes and Moffett (1975); KM = Karetnikov and Medvedev (1977, 1978); Af = Africano (1978); Du = Duerbeck (1976); HW = Hopp and Witzigmann (1979); GE = Garrido et al. (1979); Ga = Garbusov (1980); Pp = Present paper

LIGHT AND COLOUR CURVES

Composite light curves in V are shown in Fig. 2 for different years. As can be seen in the figure the light curves are regular and typical of the class of variables to which SZ Lyn belongs. The small deviations in the light curves are caused by small cycle-to-cycle variations which do not exceed 0.04 in magnitude at maximum light in any bandpass. A part of the scatter on the light curves may be attributed to instrumental and extinction effects or observational errors.

Since some of the dwarf cepheids (e.g. RV Ari, VZ Cnc) show the beat phenomenon it is an obvious assumption that the cycle-to-cycle change can be explained by this phenomenon. A search for this effect in SZ Lyn was made but without success.

Changes in the height of maximum light with period P_1 have been claimed by some observers and denied by others. *Barnes* and *Moffett* (1975) found no significant variation in maximum with period P_1. On the other hand, *Garbusov* (1980) reported periodic brightness changes in maximum light. To see if this variation is real or not we also gave the blue (B) magnitude of our maxima in


ΔV
-0.2
0.0
+0.2
1961/62
1962/63
1963/64
1966/67
1967/68
1968/69
1970/71
0.8
0.0
0.2
0.4
0.6
0.8
0.0
0.2
φ

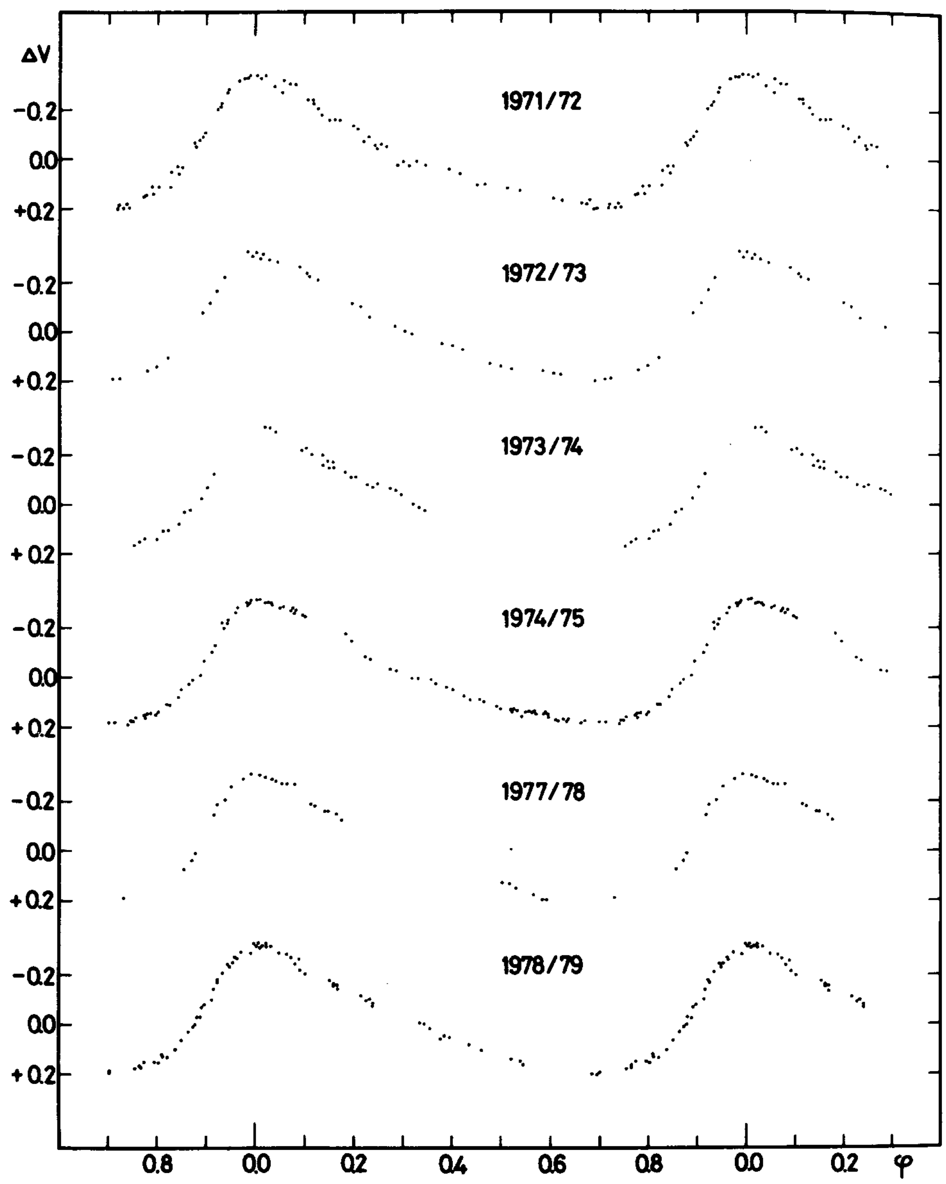


Figure 2: Composite light curves in V for different observational seasons

Table 4 and presented the B magnitude at maximum light versus phase in the P_1 = 1170-day cycle (Fig. 3). We found no evidence for periodic variation of brightness maximum. It is interesting to note that the B maxima of *Barnes* and *Moffett* and of *Duerbeck* lie above the average value.

The O-C values are also plotted against phase ψ in Fig. 3. No clear trend

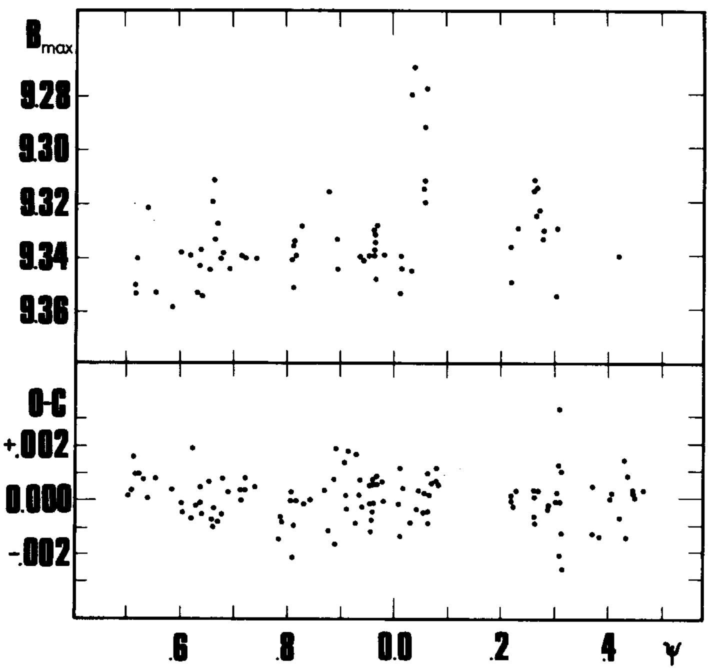


Figure 3: Maximum brightness in B light and variation in time of maximum versus phase of the 1170-day period.

seems to be present that would indicate a departure from the sinusoidal variation.

In order to investigate the light and colour curves, normal points were computed. First the individual observations were collected in phase using the ephemeris given by Eq. 5 and then they were averaged together into phase bins $0.02P_0$ wide. These values were then inter/extrapolated to the phases: φ = 0.01, 0.03,....,0.99. The normal points are given in Table 5. The most important characteristics of the light and colour curves were derived by using the normal points, and they are summarized in Table 6. The two-colour diagram for SZ Lyn during the mean cycle is shown in Fig. 4. The unusual feature in the colour loop during the phase interval 0.32-0.44 found by *Barnes* and *Moffett*

Table 5

Normal points of V, B-V and U-B observations

φ	V	B-V	U-B	φ	V	B-V	U-B
.01	9.129	+0.211	+0.147	.51	9.575	+0.361	+0.124
.03	9.146	.210	.150	.53	9.586	.355	.130
.05	9.166	.214	.147	.55	9.596	.355	.127
.07	9.183	.226	.141	.57	9.602	.365	.122
.09	9.206	.234	.144	.59	9.605	.374	.124
.11	9.235	.240	.146	.61	9.612	.374	.128
.13	9.259	.251	.136	.63	9.618	.372	.133
.15	9.281	.261	.133	.65	9.622	.375	.130
.17	9.302	.270	.138	.67	9.627	.376	.119
.19	9.322	.282	.136	.69	9.632	.371	.110
.21	9.345	.288	.130	.71	9.632	.368	.112
.23	9.368	.290	.124	.73	9.626	.369	.116
.25	9.388	.297	.124	.75	9.615	.372	.114
.27	9.407	.304	.130	.77	9.603	.370	.112
.29	9.426	.313	.128	.79	9.590	.362	.104
.31	9.445	.321	.120	.81	9.566	.353	.093
.33	9.458	.329	.117	.83	9.534	.340	.092
.35	9.468	.341	.114	.85	9.495	.323	.101
.37	9.482	.344	.115	.87	9.447	.306	.107
.39	9.499	.341	.123	.89	9.388	.285	.107
.41	9.516	.343	.123	.91	9.318	.267	.112
.43	9.531	.347	.119	.93	9.247	.253	.123
.45	9.541	.355	.116	.95	9.190	.236	.132
.47	9.550	.362	.113	.97	9.153	.221	.137
.49	9.563	+.363	+.116	.99	9.127	+.212	+.141

Table 6

Most important characteristics of the light and colour curves

$\langle V\rangle = 9.424$	$\langle B\rangle - \langle V\rangle = +0.303$	$\langle B-V\rangle = +0.312$
$\langle B\rangle = 9.727$	$\langle U\rangle - \langle B\rangle = +0.125$	$\langle U-B\rangle = +0.124$
$\langle U\rangle = 9.852$		
$V_{max} = 9.125$	$V_{min} = 9.633$ (φ = .703)	$A_V = 0.508$
$B_{max} = 9.336$	$B_{min} = 10.004$ (φ = .684)	$A_B = 0.668$
$U_{max} = 9.480$	$U_{min} = 10.127$ (φ = .650)	$A_U = 0.647$

(1975) is not seen in our diagram. The probable explanation for this is that our normal points are formed from the observations of different years and of different accuracy, and the fine details are smoothed out.

Although there is a slight difference between the forms of our two-colour diagram and that of *Barnes* and *Moffett* (1975), their results can be confirmed. An interstellar reddening of E(B-V) = 0.04 magn seems to be reasonable from our diagram.

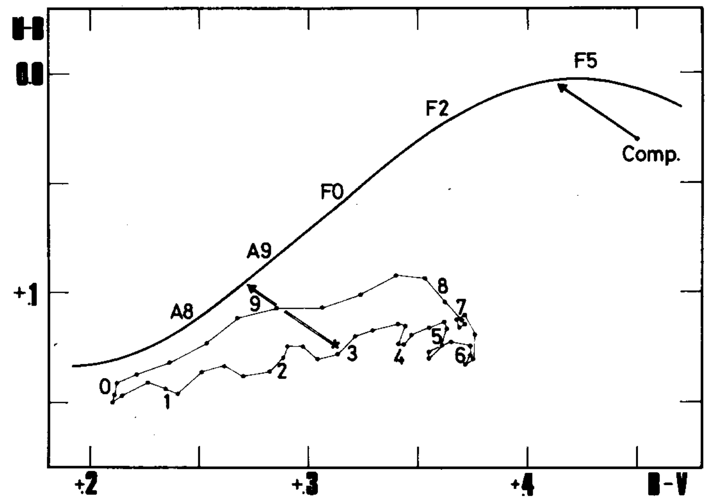


Figure 4: (U-B)-(B-V) diagram for SZ Lyn during the mean cycle. Phases are shown as numbers on the loop, with zero phase being that of maximum light. The mean position of SZ Lyn is also marked by an asterisk within the loop. The arrows point to the dereddened positions of SZ Lyn and its main comparison star in the two-colour diagram relative to the Hyades main sequence.

RADIAL VELOCITY MEASUREMENTS

Woolley and *Aly* (1966) were the first to measure the radial velocity of SZ Lyn. From 17 spectra they obtained a mean velocity of +31.9 ± 2.3 $km \cdot s^{-1}$ and calculated a radial velocity amplitude of 23.7 ± 8.8 $km \cdot s^{-1}$.

Later on *McNamara* and *Feltz* (1976) obtained spectrograms of SZ Lyn with the 100 inch telescope at Mount Wilson Observatory with a dispersion of 40 Amm^{-1}. From these measurements a mean velocity of +22 $km \cdot s^{-1}$ and a radial velocity amplitude of 44 $km \cdot s^{-1}$ were derived. The difference in the mean radial velocity values could be explained by the binary nature of SZ Lyn. *McNamara* and *Feltz* secured, however, a single-trail spectrogram of SZ Lyn as well, and obtained an average velocity 24.4 ± 2 $km \cdot s^{-1}$. The binary phase of these observations was about the same as that of *Woolley* and *Aly*'s observations. Thus *McNamara* and *Feltz*'s results seem to be in contradiction with the binary hypothesis.

Bardin and *Imbert* (1981) observed SZ Lyn with the CORAVEL photoelectric spectrometer on two nights in 1979 and in 1980. They obtained very accurate and high time resolution radial velocity curves. Their results confirmed the binary nature of SZ Lyn. They obtained for the average velocities 41.11 ± 0.14 $km \cdot s^{-1}$ on J.D. 2444206 and 43.36 ± 0.12 $km \cdot s^{-1}$ on J.D. 2444324. No significant amplitude variation was detected from cycle to cycle. The total variation of the radial velocity was 39.9 $km \cdot s^{-1}$. Using the available mean radial velocities an orbital eccentricity of e = 0.26 was computed which is fairly large. Here we should recall the fact that the O-C diagram of light maxima suggests nearly zero eccentricity.

As a contribution to settling this problem it seems to be worth publishing our radial velocity measurements. In 1971 twelve spectrograms (at a reciprocal dispersion of 60 Amm^{-1}) were secured with the Cassegrain spectrograph of the 72 inch telescope of the Dominion Astrophysical Observatory on baked IIa-O plates on three nights. The plates were measured on the DAO Arcturus measuring machine. Spectrograms of a number of standard velocity stars were also secured on the three nights and measured to check on possible systematic errors, but none were found. In Table 7 we list the plate number, the date and Julian Day of each spectrogram, the number of lines measured the radial velocity and the phase computed with Eq.5.

In Fig. 5 our individual radial velocity measurements are plotted against the phase of the pulsation period, and a free-hand velocity curve has been drawn through the observations. A mean velocity of about 32.8 $km \cdot s^{-1}$ was found from our velocity data (with an estimated error of 2.5 $km \cdot s^{-1}$). Relying only on our own data the maximum and minimum velocities of the SZ Lyn velocity curve have been fixed at about 53 $km \cdot s^{-1}$ and 14 $km \cdot s^{-1}$, respectively, which yield a velocity amplitude of 39 $km \cdot s^{-1}$.

Table 7

Radial velocities of SZ Lyn

Plate No.	Date	Heliocentric J.D. 24..	No. of lines	R.V. kms^{-1}	Phase
70887	1971.02.17	40999.8405	14	46.4 ± 4.2	0.6308
888		.8731	13	24.4 ± 4.9	.9012
889		.9037	4	19.1 ± 4.7	.1551
71017	1971.03.31	41041.7409	17	26.9 ± 2.0	.2505
018		.7638	15	36.9 ± 2.9	.4405
019		.7877	14	47.0 ± 4.1	.6388
020		.8162	13	32.3 ± 4.3	.8753
021		.8398	16	16.9 ± 3.2	.0710
063	1971.04.14	41055.7351	13	30.8 ± 3.0	.3516
064		.7695	4	50.9 ± 3.9	.6370
065		.8032	16	24.0 ± 3.5	.9166
066		.8348	15	20.4 ± 3.4	.1787

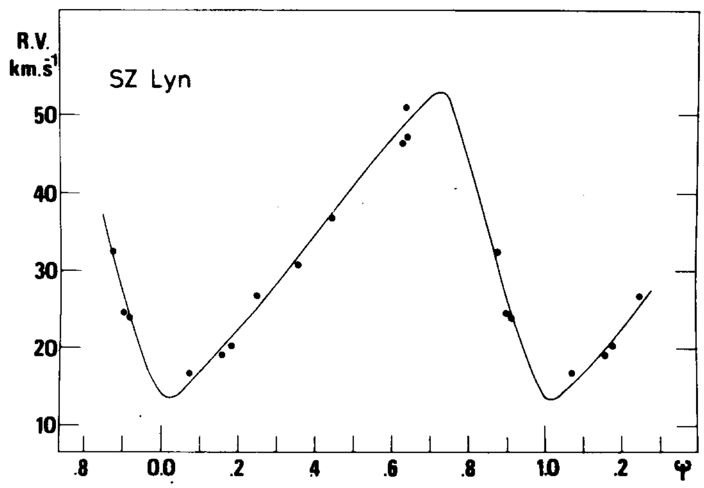


Figure 5: Radial velocity curve of SZ Lyn. A free-hand curve has been drawn through the observations.

BINARY MODEL

The 3.20-year periodicity in the time of maximum light found by *van Genderen* (1967) has been interpreted by *Barnes* and *Moffett* (1975) as a modulation of the phase of maximum light by binary motion. Since the O-C values can be fitted well with Eq.5 we have good reason to assume that the orbit of SZ Lyn in the binary system is nearly circular ($e \simeq 0$).

For a circular orbit of radius $\underline{a}$ and inclination $\underline{i}$ the variation in time of maximum light of a variable star attributed to the light travel time across the orbit in a binary system is given by

$$\Delta T_{max} = \frac{a \cdot \sin i}{c} \cos 2\pi \left(\frac{P_o}{P_1} \cdot E - \psi_o\right) \qquad \text{Eq.6.}$$

where P_o is the pulsation period, P_1 is the orbital period, c is the light velocity and ψ_o is the orbital phase at $E = 0$. Equation 6 is the last term in Eq.5:

$$a_{SZ} \sin i = cA = 0.93 \text{ AU},$$

$$K_{SZ} = cA \frac{2\pi}{P_1} = 8.69 \text{ km} \cdot \text{s}^{-1}$$

and the radial velocity variation is given by

$$\text{mean R.V.} = \gamma + K\cdot sin\, 2\pi(\frac{P_o}{P_1}\cdot E - \psi_o) \qquad \text{Eq.7.}$$

where γ is the system velocity, relative to the Sun.

Equation 7 can be compared with the observations. In Table 8 the mean velocities of SZ Lyn taken from *Woolley* and *Aly* (1966), *McNamara* and *Feltz* and *Bardin* and *Imbert* (1981) are collected. Our measurement is also given. In Fig. 6 these data are plotted against orbital phase $\psi = (P_o/P_1)E - \psi_o$. If Eq.7 is fitted to the very accurate measurements of *Bardin* and *Imbert*, we obtain:

$\gamma = 34.00\ \text{km}\cdot\text{s}^{-1}$.

Figure 6 suggests that the orbit may be non-circular. Further precise radial velocity data are required to construct a reliable radial velocity curve

Table 8

Mean radial velocities of SZ Lyn

J.D. 24...	Mean velocity	Orbital phase (ψ)	Observers
38717	31.9	0.52	Woolley and Aly (1966)
41025	24.4 ± 2	2.49	McNamara and Feltz (1976)
41041	32.8 ± 2.5	2.51	Present paper
42474	22 ± 2	3.73	McNamara and Feltz (1976)
44206	41.11 ± 0.14	5.21	Bardin and Imbert (1981)
44324	43.36 ± 0.12	5.31	Bardin and Imbert (1981)

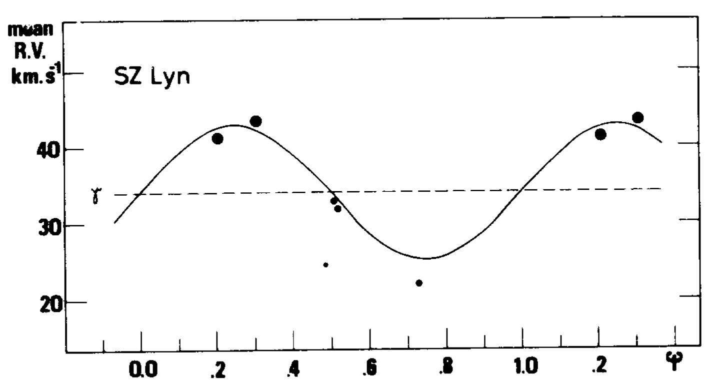


Figure 6: Mean radial velocities versus binary phase ψ. The solid line has been calculated from the variation in time of maximum light assuming a circular orbit (e=0). The curve was fitted to the observations of Bardin and Imbert (1981).

and to achieve the precision required for determining the eccentricity e of the binary orbit.

Since we failed to see any doubled lines in the spectra of SZ Lyn we have to assume that the variable is a single-lined spectroscopic binary. The mass function can easily be determined from the above derived data:

$$f(M_2) = \frac{M_2^3 \sin^3 i}{(M_{SZ}+M_2)^2} = 1.038 \times 10^{-7}(1-e^2)^{1.5} K^3 \cdot P_1$$

If we adopt e = 0

$$f(M_2) = 0.080 \ M_\odot$$

where M_{SZ} is the mass of the pulsating component (dwarf cepheid SZ Lyn) of the system, and M_2 is the mass of the unseen companion.

The magnitude difference between SZ Lyn and the unseen companion should be, at least, 1.5 magn. Assuming that the unseen companion is a main sequence star, then the mass ratio of the components is

$$\frac{M_{SZ}}{M_2} \geq 1.43,$$

if the mass-luminosity function of *McCluskey* and *Kondo* (1972) is valid for both components. This result compared with the mass function of the binary system yields:

$$1 \geq \sin^3 i \geq \frac{0.47 \ M_\odot}{M_2} .$$

Thus we obtain

$$0.70 \ M_{SZ} \geq M_2 \geq 0.47 \ M_\odot .$$

The unreddened mean colour index of SZ Lyn is $(B-V)_o = 0.27$. Hence, if it is on or near the main sequence, $M_V \simeq +2^m\!.6$, and $M_{SZ} \simeq 1.7 \ M_\odot$, then $i \geq 50^o$.

It may also be natural to assume that the unseen companion is a white dwarf. Whatever the assumption the binary model describes and explains well the observed features: the variation in time of light maxima and mean radial velocities.

SUMMARY

Three-colour photoelectric observations obtained at Konkoly Observatory on 28 nights from 7 February 1962 through 27 February 1979 were used to define the photometric behaviour of SZ Lyn. Its light curves are typical of the class of variable to which SZ Lyn belongs, nevertheless small cycle-to-cycle variations are present in each bandpass. These variations, however, do not exceed 0.04 in magnitude at maximum light, and they are even smaller at minimum light. The search for both short and long periodic modulation in amplitude or in maximum brightness failed.

An interstellar reddening of E(B-V) = 0.04 magn has been deduced from our two-colour diagram. This value is slightly smaller than that given by *Barnes* and *Moffett* (1975).

All available light maxima observed photoelectrically were used to investigate the variation in the pulsation period. The long periodic variation in time of maximum light has been confirmed. The variation approximated by a sine-curve has a period of 1170 ± 3 days and a semiamplitude of 467 ± 10 sec. A secular change of $\beta = 10^{-12}$ day·cycle^{-1} in the pulsation period has been also found.

New radial velocity data of SZ Lyn obtained at Dominion Astrophysical Observatory with the Cassegrain spectrograph of the 72 inch telescope in 1971 have been given which provide a mean radial velocity of 32.8 km·s^{-1} at J.D. 2441041. All available radial velocity observations are discussed. It has been shown that both the photometric observations and the radial velocity measurements are compatible with the hypothesis proposed by *Barnes* and *Moffett* (1975) that SZ Lyn is a component of a binary system.

Acknowledgements

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Budapest-Szabadsághegy, July 18, 1983

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Table 9a

Photoelectric yellow observations of SZ Lyn

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2437703		2437706		2437707		2437707	
.4014	−0.047	.2572	−0.244	.4206	+0.171	.5308	+0.143
.4034	.015	.2583	.258	.4220	.169	.5356	.166
.4055	−0.020	.2593	.291	.4282	.170	.5377	.183
.4097	+0.043	.2604	.295	.4331	.184	.5686	.129
.4118	.026	.2630	.312	.4345	.178	.5707	.108
.4166	.059	.2651	.321	.4359	.178	.5743	+0.008
.4208	.095	.2670	.268	.4373	.163	.5755	−0.017
.4222	.118	.2695	.273	.4386	.166	.5768	.056
.4243	.119	.2707	.260	.4400	.164	.5782	.130
.4284	.116	.2717	.225	.4414	.151	.5796	.147
.4298	.163	.2741	.214	.4456	.128	.5810	.178
.4312	.135	.2753	.198	.4470	.108	.5824	.182
.4347	.180	.2764	.207	.4484	.083	.5852	.290
.4361	.136	.2791	.186	.4498	.056	.5866	.302
.4375	.148	.2815	.186	.4512	.046	.5880	.319
.4410	.153	.2843	.126	.4525	+0.024	.5893	.332
.4423	.151	.2857	.082	.4539	−0.007	.5907	.332
.4562	.208	.2871	.095	.4553	.046	.5921	.332
.4597	.193	.2885	.093	.4567	.083	.5935	.326
.4611	.209	.2913	.067	.4581	.119	.5963	.311
.4625	.175	.2927	.013	.4595	.132	.5991	.248
.4659	.153	.2944	.018	.4609	.191	.6005	.236
.4673	.148	.2989	−0.012	.4623	.238	.6018	.215
.4687	.110	.3003	+0.011	.4637	.254	.6032	−0.175
.4743	.051	.3031	.035	.4650	.310		
.4757	.033	.3121	.055	.4664	.301	2437717	
.4771	+0.012	.3135	.078	.4678	.319	.3047	+0.132
.4798	−0.076	.3149	.100	.4692	.311	.3061	.146
.4812	.106	.3163	.084	.4706	.310	.3082	.159
.4826	−0.160	.3177	.099	.4720	.253	.3116	.175
		.3211	.107	.4755	.258	.3130	.173
2437705		.3225	.097	.4775	.245	.3151	.195
.5297	−0.114	.3239	.112	.4789	.253	.3304	.111
.5311	.150	.3274	.151	.4803	.242	.3359	.070
.5517	.212	.3302	.161	.4817	.232	.3373	.028
.5524	.214	.3329	.146	.4831	.145	.3387	+0.024
.5534	.192	.3343	.162	.4866	.163	.3411	−0.048
.5543	.172	.3357	.160	.4907	.146	.3422	.123
.5564	.163	.3434	.171	.4921	.128	.3436	.139
.5573	.142	.3468	.188	.4935	.126	.3450	−0.181
.5615	.116	.3482	.204	.4949	.077		
.5656	.084	.3496	.178	.4963	.080	2437718	
.5677	.059	.3538	.175	.4977	.060	.4330	−0.305
.5698	−0.027	.3552	.165	.5027	.011	.4342	.300
		.3572	.156	.5048	.022	.4356	.303
2437706		.3607	.139	.5068	−0.007	.4384	.288
.2524	−0.091	.3628	.119	.5089	+0.002	.4412	.293
.2531	.091	.3642	+0.108	.5224	.100	.4456	.289
.2540	.119			.5245	.119	.4484	.254
.2549	.202	2437707		.5265	.118	.4525	.190
.2558	−0.201	.4157	+0.141	.5287	+0.119	.4546	−0.174

Table 9a (cont.)

Photoelectric yellow observations of SZ Lyn

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2437718		2437726		2438082		2438439	
.4567	−0.112	.4950	+0.092	.4129	+0.216	.4639	−0.066
.4699	+0.002	.4964	.051	.4254	+0.104	.4701	.260
.4713	−0.003	.4978	+0.051	.4310	−0.002	.4722	.252
.4755	+0.032	.5006	−0.004	.4366	.120	.4764	.322
.4776	.043	.5020	.027	.4421	.243	.4785	.320
.4797	.030	.5034	.096	.4477	.261	.4826	.303
.4846	.043	.5055	.194	.4534	.213	.4847	.302
.4866	.057	.5068	.219	.4588	.159	.4889	.238
.4887	.084	.5082	.248	.4643	.143	.4958	.178
.4929	.100	.5103	.260	.4699	.094	.4979	.155
.4950	.117	.5221	.212	.4754	.053	.5021	.108
.4971	.137	.5277	.176	.4810	−0.012	.5042	.099
.5012	.145	.5291	−0.160	.4873	+0.049	.5083	.050
.5033	.159			.4941	.092	.5104	.019
.5054	.167	2437744		.5025	+0.094	.5146	−0.002
.5179	.181	.3208	+0.144			.5167	+0.035
.5200	.176	.3222	.168	2438439		.5208	.034
.5211	.205	.3236	.146	.2833	+0.091	.5229	+0.069
.5266	.189	.3278	.171	.2854	.073		
.5287	.167	.3291	.153	.2896	.094	2438457	
.5308	.170	.3305	.118	.2917	.091	.3131	−0.265
.5338	.182	.3340	.041	.2958	.134	.3145	.291
.5352	.162	.3354	.040	.2979	.132	.3180	.314
.5365	.144	.3368	.024	.3021	.151	.3200	.306
.5393	.073	.3403	+0.006	.3042	.192	.3235	.264
.5407	.063	.3416	−0.115	.3188	.187	.3256	.262
.5421	+0.050	.3659	.210	.3292	.180	.3291	.217
.5449	−0.037	.3673	.173	.3312	.191	.3312	.197
.5463	.084	.3708	.139	.3354	.110	.3346	.180
.5477	.104	.3722	.134	.3375	.090	.3395	.129
.5504	.175	.3736	−0.118	.3417	+0.006	.3464	.036
.5518	.210	.3909	+0.033	.3438	−0.100	.3506	−0.022
.5532	.257	.3923	.024	.3479	.205	.3575	+0.018
.5546	.279	.3937	.024	.3500	.265	.3624	.034
.5560	.306	.3958	.036	.3542	.313	.3742	.097
.5574	.308	.4018	.081	.3562	.303	.3763	.138
.5588	.304	.4039	+0.112	.3604	.266	.3805	.146
.5602	.294			.3625	.278	.3825	.194
.5615	.283	2438082		.3667	.251	.3867	.161
.5643	.223	.3275	−0.290	.3688	.237	.3888	.166
.5657	.205	.3333	.224	.3729	.192	.3923	.206
.5671	.212	.3391	.184	.3750	.175	.3944	.193
.5685	.210	.3504	.093	.3792	.096	.3978	.170
.5713	.189	.3553	−0.041	.3812	.113	.3999	.173
.5727	.186	.3616	+0.013	.3868	−0.036	.4041	.198
.5740	−0.134	.3671	.075	.4424	+0.205	.4062	.221
		.3754	.092	.4451	.182	.4096	.163
2437726		.3824	.095	.4507	.160	.4117	.175
.4881	+0.183	.3921	.177	.4528	.190	.4152	.118
.4902	.154	.3991	.201	.4576	.074	.4173	.114
.4916	+0.143	.4074	+0.178	.4597	+0.058	.4207	+0.027

Table 9a (cont.)

Photoelectric yellow observations of SZ Lyn

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2438457		2439528		2439905		2440980	
.4228	−0.037	.6079	+0.092	.3839	+0.157	.4182	+0.110
.4298	.218	.6107	+0.040	.3860	.169	.4196	.109
.4319	.270	.6128	−0.009	.3881	.182	.4210	+0.114
.4353	.302	.6149	.039	.3922	.170		
.4374	.298	.6184	.146	.3943	.181	2441035	
.4416	.287	.6205	.206	.3964	+0.157	.3344	−0.238
.4437	.296	.6226	.253			.3358	.216
.4478	.248	.6260	.306	2440243		.3372	.217
.4499	.236	.6281	.293	.3218	+0.042	.3400	.185
.4541	.194	.6302	.298	.3239	.044	.3414	.155
.4563	−0.157	.6344	.258	.3281	.072	.3428	.146
		.6365	.251	.3301	.082	.3455	.132
2439527		.6386	.259	.3343	.095	.3469	.113
.4795	+0.087	.6427	−0.201	.3364	.120	.3483	.106
.4836	.133			.3406	.152	.3511	.067
.4857	.165	2439905		.3426	.163	.3525	.062
.4920	.185	.2839	+0.145	.3468	.168	.3539	.071
.4961	.170	.2860	.130	.3489	.165	.3553	.075
.5072	.191	.2881	+0.101	.3531	.183	.3580	.048
.5093	.187	.2922	−0.008	.3551	.180	.3594	.047
.5114	.177	.2943	.067	.3593	.196	.3608	−0.024
.5156	.160	.2964	.134	.3614	.200	.3643	+0.010
.5177	.160	.3005	.261	.3656	.187	.3657	.023
.5198	.149	.3026	.285	.3676	.171	.3671	.023
.5239	.112	.3047	.319	.3718	.157	.3699	.032
.5260	+0.038	.3089	.313	.3739	.145	.3713	.026
.5281	−0.008	.3110	.309	.3781	.107	.3727	.060
.5323	.111	.3131	.287	.3801	.081	.3754	.082
.5344	.196	.3172	.243	.3843	+0.003	.3768	.106
.5365	.233	.3193	.239	.3864	−0.062	.3782	.126
.5406	.300	.3214	.191	.3906	.189	.3810	.126
.5427	.312	.3255	.165	.3926	.242	.3824	.129
.5448	.314	.3276	.134	.3968	.302	.3838	.142
.5489	.293	.3297	.111	.3989	.321	.3865	.139
.5510	.283	.3339	.089	.4031	.308	.3879	.141
.5531	.245	.3360	.082	.4051	.291	.3893	.152
.5573	.212	.3381	.054	.4093	.262	.3921	.172
.5594	.179	.3422	−0.021	.4114	.243	.3935	.175
.5615	.170	.3443	+0.012	.4156	.190	.3949	.154
.5656	.111	.3464	.013	.4176	−0.165	.3976	.180
.5677	.087	.3505	.051			.3990	.208
.5698	−0.073	.3526	.057	2440980		.4004	.216
		.3547	.054	.3987	+0.001	.4032	.208
2439528		.3589	.094	.4001	.026	.4046	.198
.5802	+0.175	.3610	.103	.4015	.016	.4060	.225
.5844	.199	.3631	.108	.4064	.075	.4094	.228
.5927	.210	.3672	.112	.4078	.093	.4108	.235
.5962	.185	.3693	.140	.4092	.116	.4122	.229
.6004	.155	.3714	.141	.4126	.072	.4157	.205
.6038	.133	.3755	.145	.4140	.121	.4171	.188
.6059	+0.119	.3776	+0.135	.4154	+0.118	.4219	+0.122

Table 9a (cont.)

Photoelectric yellow observations of SZ Lyn

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2441035		2441312		2441679		2442106	
.4233	+0.110	.4477	-0.158	.5950	-0.116	.3717	+0.107
.4247	.085	.4491	.158	.5971	.097	.3731	.104
.4275	.010	.4519	.134	.5990	.054	.3759	.080
.4289	+0.001	.4533	.123	.6055	-0.019	.3772	.028
.4303	-0.022	.4547	.071	.6078	+0.001	.3786	+0.023
.4330	.137	.4575	.056	.6096	.012	.3814	-0.026
.4344	.180	.4589	.060	.6168	.050	.3828	.069
.4358	.197	.4603	-0.053	.6195	.061	.3842	.125
.4386	-0.284	.4630	+0.024	.6220	.076	.3966	.313
		.4644	.007	.6287	.130	.3980	.307
2441042		.4658	+0.025	.6314	.139	.3994	.291
.3657	+0.101			.6340	.151	.4056	.221
.3671	.095	2441390		.6415	.162	.4070	.226
.3685	.095	.3189	-0.090	.6438	.172	.4084	.201
.4074	.162	.3210	-0.041	.6462	.175	.4112	.156
.4088	.146	.3307	+0.013	.6541	.202	.4126	.144
.4102	.148	.3328	.025	.6565	.196	.4140	-0.144
.4136	.092	.3383	.043	.6584	.191		
.4150	+0.082	.3411	.061	.6652	.156	2442451	
		.3453	.105	.6674	.138	.3851	-0.175
2441312		.3474	.103	.6702	+0.104	.3865	.144
.3887	+0.186	.3529	.117	.6787	-0.075	.3900	.083
.3901	.204	.3557	.131	.6805	.116	.3914	.071
.3915	.202	.3640	.157	.6823	.167	.3962	.030
.3943	.200	.3661	.168	.6841	.219	.3976	-0.025
.3957	.197	.3710	.179	.6911	.299	.4015	+0.006
.3971	.197	.3731	.165	.6931	.294	.4029	.004
.4012	.144	.3779	.186	.6953	.293	.4059	.013
.4026	.110	.3800	.179	.6974	.277	.4073	.027
.4040	.111	.3842	.147	.7050	-0.222	.4101	.041
.4074	.048	.3863	.146			.4115	.050
.4088	.028	.3904	.111	2442106		.4142	.074
.4102	+0.028	.3925	+0.058	.2905	-0.201	.4156	.096
.4130	-0.066	.3967	-0.050	.2917	.176	.4181	.090
.4144	.081	.3988	.092	.2931	.171	.4191	.097
.4158	.111	.4029	.214	.2959	.130	.4219	.118
.4185	.201	.4050	.285	.2973	.108	.4233	.127
.4199	.228	.4099	.329	.2987	.107	.4260	.139
.4213	.273	.4120	.337	.3015	.081	.4271	.136
.4241	.317	.4161	.295	.3029	.071	.4302	.137
.4255	.332	.4182	.265	.3042	.083	.4313	.140
.4269	.340	.4258	.223	.3070	.065	.4337	.151
.4296	.331	.4279	-0.179	.3084	.054	.4351	.164
.4310	.340			.3098	.037	.4385	.168
.4352	.319	2441679		.3126	-0.003	.4399	.170
.4366	.306	.5693	-0.323	.3140	+0.016	.4427	.187
.4380	.300	.5713	.323	.3154	.024	.4441	.175
.4408	.242	.5731	.313	.3647	.164	.4476	.180
.4422	.237	.5818	.259	.3661	.153	.4490	.179
.4436	.205	.5838	.235	.3675	.142	.4521	.189
.4463	-0.159	.5864	-0.207	.3703	+0.140	.4531	+0.176

Table 9a (cont.)

Photoelectric yellow observations of SZ Lyn

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2442451		2442454		2443578		2443931	
.4566	+0.166	.4898	-0.214	.3807	-0.191	.3482	+0.138
.4576	+0.144	.4919	.258	.3818	.179	.3504	.148
.4754	-0.223	.4926	.283	.3842	.161	.3514	.166
.4768	.235	.4947	.301	.3849	.160	.3682	.201
.4813	.291	.4954	.301	.3870	.144	.3696	.204
.4823	.310	.4974	.316	.3880	-0.125	.3706	.189
.4858	.300	.4981	.315			.3779	.169
.4872	-0.297	.5002	.300	2443879		.3789	.148
		.5009	.292	.5406	+0.194	.3823	.155
2442454		.5030	.283	.5464	.178	.3833	.124
.3852	-0.272	.5037	.285	.5477	.175	.3845	.134
.3862	-0.269	.5058	.275	.5515	.147	.3896	.030
.4393	+0.132	.5065	.258	.5531	.133	.3908	+0.009
.4400	.128	.5085	.247	.5566	.102	.3918	-0.028
.4418	.157	.5092	-0.241	.5579	.063	.3928	.067
.4425	.140			.5613	+0.003	.3938	.079
.4446	.139	2443578		.5624	-0.028	.3960	.139
.4453	.149	.3071	+0.129	.5655	.102	.3970	.179
.4474	.144	.3092	.136	.5668	.170	.3982	.212
.4481	.150	.3106	.153	.5698	.227	.3996	.246
.4501	.175	.3149	.180	.5712	.271	.4008	.251
.4508	.180	.3169	.197	.5763	.316	.4018	.264
.4529	.182	.3182	.202	.5773	.311	.4029	.293
.4668	.176	.3349	.191	.5788	.312	.4050	.286
.4675	.161	.3495	.076	.5866	-0.260	.4060	.324
.4696	.153	.3516	.041			.4070	.327
.4703	.144	.3523	+0.007	2443931		.4080	.315
.4724	.151	.3571	-0.145	.2953	-0.239	.4090	.325
.4731	.142	.3578	.185	.2965	.215	.4100	.314
.4751	.109	.3599	.205	.2979	.198	.4120	.286
.4758	.112	.3613	.262	.3041	.175	.4140	.283
.4779	.079	.3641	.289	.3048	.159	.4150	.265
.4786	.049	.3662	.308	.3058	.154	.4254	.154
.4807	.024	.3682	.306	.3117	.110	.4265	.136
.4814	+0.007	.3696	.294	.3127	.088	.4342	.097
.4836	-0.007	.3714	.287	.3142	-0.067	.4352	.082
.4843	.066	.3721	.281	.3321	+0.048	.4465	-0.006
.4863	.099	.3738	.272	.3333	.056	.4476	+0.003
.4870	.132	.3748	.271	.3380	.085	.4490	.019
.4891	-0.195	.3766	-0.268	.3412	+0.103	.4514	+0.062

Table 9b

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2437703		2437703		2437703		2437703	
.4007	-0.210	.4090	-0.116	.4194	-0.020	.4278	+0.004
.4021	.185	.4111	.080	.4215	.016	.4291	.029
.4048	-0.135	.4132	-0.076	.4236	-0.015	.4305	+0.039

Table 9b (cont.)

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2437703		2437706		2437707		2437707	
.4340	+0.061	.2637	-0.563	.4164	+0.078	.5235	+0.034
.4354	.052	.2644	.582	.4213	.068	.5256	.036
.4368	.045	.2656	.551	.4234	.063	.5277	.011
.4403	.074	.2689	.567	.4248	.069	.5298	.046
.4416	.077	.2702	.562	.4262	.067	.5346	.038
.4430	.092	.2711	.529	.4275	.083	.5367	.047
.4465	.095	.2734	.477	.4289	.114	.5388	+0.069
.4479	.119	.2746	.453	.4338	.089	.5697	-0.009
.4493	.109	.2759	.431	.4352	.093	.5734	.050
.4528	.120	.2784	.428	.4366	.103	.5748	.091
.4541	.133	.2796	.383	.4380	.084	.5762	.177
.4555	.122	.2808	.372	.4393	.072	.5775	.263
.4590	.141	.2822	.336	.4407	.098	.5787	.311
.4604	.140	.2850	.293	.4421	.099	.5803	.336
.4618	.122	.2864	.296	.4463	.047	.5817	.366
.4652	.122	.2878	.301	.4477	+0.014	.5845	.475
.4666	.094	.2906	.246	.4491	-0.012	.5859	.548
.4680	+0.110	.2920	.231	.4505	.061	.5873	.559
.4736	-0.037	.2934	.213	.4518	.077	.5886	.578
.4750	.071	.2968	.174	.4532	.100	.5900	.571
.4764	.080	.2982	.179	.4546	.188	.5914	.588
.4791	.187	.2996	.135	.4560	.219	.5928	.583
.4805	.230	.3024	.126	.4574	.264	.5942	.579
.4819	-0.353	.3114	.055	.4588	.300	.5956	.550
		.3128	.025	.4602	.370	.5998	.439
2437705		.3142	.021	.4616	.409	.6012	.466
.5304	-0.265	.3156	.008	.4630	.452	.6025	-0.438
.5318	.306	.3170	-0.006	.4644	.485		
.5521	.442	.3204	+0.013	.4657	.532	2437717	
.5528	.412	.3218	.030	.4671	.542	.2963	+0.040
.5538	.395	.3232	.039	.4685	.556	.2984	.044
.5548	.372	.3267	.038	.4699	.555	.3005	.051
.5557	.351	.3281	.059	.4713	.547	.3040	.106
.5568	.364	.3295	.037	.4727	.532	.3054	.091
.5594	.305	.3322	.072	.4762	.505	.3075	.101
.5608	.346	.3336	.072	.4782	.500	.3109	.104
.5622	.326	.3350	.062	.4796	.489	.3123	.124
.5663	.255	.3378	.089	.4810	.450	.3137	.106
.5691	-0.211	.3392	.101	.4824	.398	.3311	.039
		.3427	.098	.4838	.402	.3324	+0.022
2437706		.3461	.107	.4873	.370	.3366	-0.096
.2517	-0.224	.3475	.127	.4914	.268	.3380	.111
.2527	.317	.3489	.113	.4928	.291	.3394	.180
.2535	.382	.3531	.116	.4942	.250	.3417	.255
.2545	.360	.3545	.114	.4956	.258	.3429	.295
.2554	.394	.3558	.093	.4970	.232	.3443	-0.345
.2565	.438	.3600	.065	.4984	.220		
.2576	.468	.3614	.044	.5037	.176	2437718	
.2588	.481	.3635	+0.010	.5058	.169	.4326	-0.468
.2598	.511			.5079	.152	.4335	.482
.2626	-0.565	2437707		.5100	-0.128	.4349	-0.521

Table 9b (cont.)

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2437718		2437726		2437744		2438052	
.4363	-0.523	.4874	+0.063	.4112	+0.068	.5554	-0.527
.4377	.518	.4895	.031			.5623	.508
.4391	.518	.4909	+0.028	2438052		.5651	.456
.4477	.440	.4943	-0.044	.3405	-0.259	.5665	.423
.4518	.408	.4957	.070	.3424	.198	.5679	.406
.4532	.396	.4971	.100	.3438	.164	.5706	.368
.4553	.323	.4999	.131	.3481	.137	.5720	.328
.4706	.206	.5013	.181	.3500	.102	.5734	.311
.4720	.170	.5048	.338	.3516	.077	.5762	-0.270
.4766	.111	.5062	.405	.3561	.070		
.4787	.128	.5075	.449	.3579	.064	2438439	
.4856	.064	.5096	.504	.3595	.050	.2708	-0.137
.4877	-0.031	.5110	.510	.3651	.018	.2729	.131
.4898	+0.003	.5124	.541	.3674	-0.008	.2826	.031
.4940	.042	.5145	.555	.3725	+0.044	.2847	.031
.4960	.039	.5159	.543	.3748	.074	.2889	-0.016
.4981	.051	.5173	.510	.3813	.093	.2910	+0.006
.5044	.087	.5214	.463	.3831	.110	.2951	.037
.5064	.092	.5228	.426	.3859	+0.108	.2972	.043
.5148	.113	.5256	.422	.4266	-0.460	.3014	.061
.5190	.089	.5270	.386	.4280	.487	.3035	.091
.5210	.116	.5284	-0.409	.4294	.515	.3125	.087
.5231	.127			.4403	.487	.3174	.120
.5276	.069	2437744		.4417	.475	.3285	.075
.5297	.076	.3201	+0.093	.4431	.468	.3306	.058
.5318	.102	.3215	.124	.4463	.413	.3347	+0.012
.5345	.072	.3229	.105	.4477	.410	.3368	-0.021
.5358	.062	.3271	.095	.4491	.388	.3410	.147
.5372	+0.005	.3284	.108	.4533	.333	.3431	.232
.5400	-0.047	.3298	+0.075	.4547	.326	.3472	.392
.5414	.096	.3333	-0.023	.4561	.296	.3493	.457
.5428	.142	.3347	.094	.4602	.261	.3535	.547
.5456	.260	.3361	.091	.4616	.228	.3556	.553
.5470	.275	.3396	.148	.4630	-0.213	.3597	.548
.5484	.375	.3410	.239	.5248	+0.080	.3618	.517
.5511	.425	.3423	.260	.5262	.087	.3660	.458
.5525	.471	.3458	.400	.5276	.085	.3682	.446
.5539	.530	.3562	.522	.5304	.040	.3722	.390
.5553	.577	.3604	.462	.5317	+0.018	.3743	.362
.5581	.574	.3652	.432	.5331	-0.003	.3785	.298
.5595	.567	.3666	.413	.5359	.060	.3806	.269
.5608	.564	.3701	.366	.5373	.088	.3847	-0.219
.5622	.556	.3715	.349	.5387	.146	.4431	+0.109
.5650	.519	.3729	.320	.5415	.231	.4458	.105
.5664	.484	.3902	.090	.5429	.278	.4514	.055
.5678	.467	.3916	.080	.5442	.316	.4535	+0.042
.5692	.447	.3951	.056	.5470	.435	.4583	-0.052
.5720	.421	.4008	.031	.5484	.470	.4604	.093
.5734	.376	.4029	-0.014	.5498	.485	.4646	.257
.5747	-0.367	.4050	+0.006	.5526	.552	.4667	.317
		.4091	+0.042	.5540	-0.553	.4708	-0.481

Table 9b (cont.)

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2438439		2438457		2439528		2440243	
.4729	-0.509	.4325	-0.512	.6121	-0.134	.3211	-0.094
.4771	.558	.4360	.523	.6142	.175	.3232	.070
.4792	.541	.4381	.519	.6177	.298	.3274	-0.031
.4833	.497	.4423	.511	.6198	.373	.3294	+0.007
.4854	.480	.4444	.504	.6219	.438	.3336	.014
.4896	.418	.4485	.437	.6253	.507	.3357	.017
.4965	.313	.4506	.429	.6274	.518	.3399	.044
.4986	.292	.4548	-0.370	.6337	.509	.3419	.044
.5028	.242			.6358	.479	.3461	.065
.5049	.228	2439527		.6379	.466	.3482	.079
.5090	.180	.4788	+0.013	.6420	-0.416	.3524	.090
.5111	.164	.4816	.034			.3544	.089
.5153	.124	.4850	.058	2439905		.3586	.105
.5174	.090	.4934	.100	.2832	+0.035	.3607	.106
.5215	.081	.4968	.090	.2853	+0.024	.3649	.106
.5236	-0.046	.5065	.112	.2874	-0.013	.3670	.095
		.5086	.128	.2915	.102	.3711	.090
2438457		.5107	.114	.2936	.226	.3732	+0.077
.3124	-0.493	.5149	.103	.2957	.303	.3774	-0.001
.3142	.538	.5170	.103	.2998	.464	.3794	.044
.3173	.568	.5191	+0.072	.3019	.533	.3836	.159
.3194	.540	.5232	-0.010	.3040	.565	.3857	.220
.3228	.522	.5253	.068	.3082	.556	.3899	.373
.3249	.509	.5274	.131	.3103	.559	.3920	.444
.3284	.422	.5316	.286	.3124	.539	.3961	.548
.3305	.409	.5337	.350	.3165	.475	.3982	.559
.3339	.362	.5358	.417	.3186	.439	.4024	.547
.3457	.211	.5399	.500	.3207	.390	.4044	.528
.3513	.157	.5420	.542	.3248	.352	.4086	.494
.3568	.112	.5441	.552	.3269	.318	.4107	.472
.3631	.068	.5482	.547	.3290	.273	.4149	.394
.3694	-0.028	.5503	.492	.3332	.246	.4170	-0.369
.3749	+0.012	.5524	.491	.3415	.159		
.3770	.013	.5566	.414	.3436	.122	2440980	
.3812	.069	.5587	.396	.3498	.072	.3980	-0.128
.3832	.070	.5608	.377	.3519	.067	.3994	.125
.3874	.097	.5649	.285	.3540	.052	.4008	.124
.3895	.091	.5670	.277	.3582	-0.041	.4057	.073
.3930	.103	.5691	-0.257	.3603	+0.002	.4071	.069
.3950	.132			.3624	-0.004	.4085	-0.033
.3985	.111	2439528		.3665	+0.030	.4119	+0.005
.4006	.105	.5795	+0.096	.3686	.050	.4133	.002
.4048	.103	.5837	.098	.3707	.066	.4147	.010
.4069	.120	.5878	.122	.3748	.082	.4175	.052
.4103	.093	.5920	.133	.3769	.097	.4189	.062
.4124	+0.071	.5955	.107	.3790	.082	.4203	+0.074
.4159	0.000	.5997	.107	.3832	.104		
.4180	-0.013	.6031	.064	.3853	.103	2441035	
.4214	.126	.6052	.056	.3874	.103	.3337	-0.448
.4235	.200	.6072	+0.004	.3915	.110	.3351	.447
.4305	-0.456	.6100	-0.075	.3936	+0.123	.3365	-0.413

Table 9b (cont.)

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2441035		2441035		2441312		2441679	
.3393	-0.379	.4379	-0.484	.4623	-0.152	.6212	-0.036
.3407	.369			.4637	.131	.6280	+0.033
.3421	.353	2441042		.4651	-0.122	.6305	.023
.3448	.303	.3650	+0.004			.6332	.043
.3462	.283	.3664	.008	2441390		.6408	.090
.3476	.279	.3678	.008	.3182	-0.240	.6429	.085
.3504	.243	.4067	.086	.3203	.211	.6454	.103
.3518	.231	.4081	.067	.3300	.117	.6531	.108
.3532	.215	.4095	.052	.3321	.081	.6559	.096
.3546	.181	.4129	+0.019	.3376	.046	.6577	.105
.3573	.160	.4143	-0.032	.3404	-0.049	.6646	.069
.3587	.158			.3446	+0.003	.6668	.066
.3601	.141	2441312		.3467	.018	.6692	+0.007
.3629	.113	.3880	+0.107	.3522	.052	.6780	-0.233
.3650	.082	.3894	.108	.3550	.072	.6799	.320
.3664	.083	.3908	.103	.3633	.109	.6817	.374
.3692	.086	.3936	.097	.3654	.119	.6835	.452
.3706	.085	.3950	.104	.3703	.127	.6906	.556
.3720	.061	.3964	.087	.3724	.119	.6924	.562
.3747	.030	.4005	.025	.3772	.113	.6944	.556
.3761	-0.016	.4019	.034	.3793	.096	.6968	.520
.3775	+0.016	.4033	.018	.3835	.074	.7042	-0.441
.3803	0.000	.4067	+0.010	.3856	+0.065		
.3817	+0.008	.4081	-0.025	.3897	-0.005	2442106	
.3831	.021	.4095	.085	.3918	.044	.2898	-0.361
.3858	.039	.4123	.139	.3960	.171	.2911	.355
.3872	.032	.4137	.153	.3981	.240	.2924	.346
.3886	.041	.4151	.230	.4022	.398	.2952	.313
.3914	.083	.4178	.359	.4043	.435	.2966	.300
.3928	.080	.4192	.376	.4092	.526	.2980	.294
.3942	.085	.4206	.412	.4113	.523	.3008	.243
.3969	.138	.4234	.510	.4154	.520	.3022	.239
.3983	.138	.4248	.531	.4175	.505	.3036	.239
.3997	.124	.4262	.546	.4251	.408	.3063	.207
.4025	.122	.4289	.541	.4272	-0.370	.3077	.185
.4039	.122	.4303	.534			.3091	.178
.4053	.119	.4345	.491	2441679		.3119	.132
.4087	.106	.4359	.453	.5682	-0.546	.3133	.134
.4101	.107	.4373	.465	.5707	.572	.3147	-0.113
.4115	.105	.4401	.453	.5726	.573	.3640	+0.089
.4150	.089	.4415	.412	.5804	.499	.3654	.075
.4164	.066	.4429	.395	.5832	.472	.3668	.057
.4212	+0.014	.4456	.332	.5855	.441	.3696	.063
.4226	-0.014	.4470	.314	.5944	.317	.3710	.052
.4240	.056	.4484	.312	.5964	.299	.3724	+0.022
.4268	.120	.4512	.251	.5983	.246	.3752	-0.019
.4282	.138	.4526	.251	.6046	.169	.3765	.069
.4296	.177	.4540	.220	.6071	.143	.3779	.101
.4323	.307	.4568	.195	.6091	.120	.3807	.163
.4337	.362	.4582	.201	.6161	.050	.3821	.203
.4351	-0.410	.4596	-0.197	.6185	-0.053	.3835	-0.253

Table 9b (cont.)

Photoelectric blue observations of SZ Lyn

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2442106		2442454		2443578		2443931	
.3959	−0.545	.3845	−0.467	.3099	+0.043	.2970	−0.473
.3973	.539	.3859	−0.448	.3142	.048	.2984	.455
.3987	.524	.4390	+0.041	.3162	.073	.3045	.373
.4049	.453	.4397	.034	.3176	.077	.3053	.358
.4063	.434	.4414	.043	.3328	.120	.3065	.350
.4077	.426	.4421	.054	.3342	+0.117	.3122	.271
.4105	.386	.4442	.075	.3481	−0.031	.3137	.244
.4119	.337	.4449	.075	.3491	.085	.3147	.235
.4133	−0.329	.4470	.081	.3509	.120	.3328	.052
		.4477	.078	.3519	.139	.3338	.052
2442451		.4498	.100	.3564	.303	.3407	−0.009
.3844	−0.313	.4505	.098	.3575	.345	.3422	+0.012
.3854	.301	.4526	.107	.3592	.434	.3499	.040
.3893	.222	.4665	.102	.3606	.465	.3509	.038
.3907	.215	.4672	.096	.3634	.526	.3520	.044
.3955	.165	.4693	.098	.3655	.544	.3689	.098
.3969	.150	.4700	.078	.3675	.551	.3701	.096
.4008	.092	.4721	.059	.3689	.541	.3723	.087
.4022	.087	.4728	.043	.3710	.532	.3784	.071
.4049	.075	.4748	.023	.3717	.520	.3828	+0.037
.4066	.061	.4755	+0.019	.3731	.520	.3839	−0.012
.4094	.059	.4776	−0.026	.3745	.491	.3850	.054
.4108	.045	.4783	.052	.3762	.467	.3903	.157
.4135	.023	.4804	.110	.3800	.427	.3913	.180
.4149	−0.024	.4811	.137	.3835	.384	.3923	.223
.4177	+0.011	.4832	.176	.3846	.378	.3933	.250
.4184	.020	.4839	.228	.3863	.357	.3955	.314
.4212	.035	.4859	.288	.3877	−0.331	.3965	.360
.4226	.048	.4866	.309			.3977	.383
.4253	.056	.4887	.370	2443879		.3991	.427
.4267	.057	.4894	.418	.5399	+0.117	.4003	.474
.4295	.081	.4915	.458	.5457	.097	.4013	.495
.4309	.085	.4922	.473	.5470	.091	.4034	.531
.4330	.099	.4943	.515	.5507	.067	.4045	.548
.4344	.101	.4950	.534	.5522	.050	.4055	.554
.4378	.118	.4970	.544	.5559	+0.004	.4065	.534
.4392	.113	.4977	.546	.5573	−0.039	.4095	.537
.4420	.122	.4998	.544	.5606	.149	.4115	.519
.4434	.115	.5005	.541	.5617	.193	.4125	.521
.4469	.124	.5026	.518	.5647	.273	.4135	.502
.4483	.116	.5033	.513	.5661	.324	.4145	.492
.4514	.108	.5054	.496	.5691	.425	.4260	.327
.4524	.110	.5061	.485	.5704	.470	.4270	.307
.4559	.108	.5081	.450	.5757	.544	.4356	.217
.4573	+0.086	.5088	−0.440	.5767	.544	.4372	.195
.4747	−0.376			.5779	.542	.4470	.061
.4761	.416	2443578		.5874	−0.439	.4481	.053
.4806	.496	.3050	+0.011			.4497	.043
.4820	.535	.3064	.015	2443931		.4520	−0.035
.4851	.550	.3085	+0.026	.2959	−0.501		
.4865	−0.525						

Table 9c

Photoelectric ultraviolet observations of SZ Lyn

J.D.	ΔU	J.D.	ΔU	J.D.	ΔU	J.D.	ΔU
2438052		2438052		2438082		2438082	
.3373	−0.138	.5602	−0.451	.3936	+0.108	.4553	−0.334
.3415	.137	.5616	.440	.3941	.134	.4560	.340
.3431	.119	.5630	.398	.3948	.165	.4567	.332
.3442	.121	.5658	.365	.3956	.167	.4595	.274
.3491	.044	.5672	.329	.3998	.214	.4602	.263
.3507	.035	.5686	.304	.4004	.213	.4609	.263
.3526	.026	.5713	.277	.4011	.196	.4616	.259
.3570	−0.024	.5727	.250	.4018	.202	.4623	.257
.3588	+0.035	.5741	.241	.4025	.206	.4650	.248
.3602	.041	.5769	.175	.4080	.143	.4657	.236
.3641	.037	.5783	−0.187	.4087	.146	.4664	.236
.3660	.100			.4094	.152	.4671	.223
.3681	.084	2438082		.4102	.151	.4678	.221
.3718	.072	.3243	−0.446	.4109	.146	.4706	.202
.3762	.132	.3265	.403	.4136	.161	.4713	.199
.3780	.117	.3291	.417	.4143	.151	.4720	.195
.3822	.139	.3345	.360	.4150	.187	.4727	.189
.3868	+0.135	.3354	.368	.4157	.180	.4734	.181
.4273	−0.374	.3412	.289	.4164	.178	.4761	.127
.4287	.404	.3419	.282	.4199	.164	.4768	.132
.4301	.421	.3426	.254	.4206	.134	.4775	.087
.4410	.368	.3511	.132	.4213	.132	.4782	.082
.4424	.368	.3518	.146	.4220	.106	.4789	.094
.4438	.364	.3525	.135	.4227	.117	.4824	.092
.4470	.305	.3532	.157	.4261	.064	.4831	.081
.4484	.297	.3560	.130	.4268	.044	.4838	.069
.4498	.287	.3567	.100	.4275	.033	.4845	.057
.4540	.223	.3574	.125	.4282	.013	.4852	.054
.4554	.198	.3581	.105	.4289	+0.010	.4879	.003
.4567	.193	.3588	.095	.4317	−0.066	.4886	−0.004
.4609	.167	.3622	.082	.4324	.096	.4893	+0.017
.4623	.149	.3629	.087	.4331	.116	.4900	.011
.4637	−0.119	.3636	.053	.4338	.137	.4907	.008
.5255	+0.131	.3643	.055	.4345	.161	.4948	.087
.5269	.150	.3650	.058	.4373	.270	.4963	.112
.5283	.134	.3678	−0.018	.4379	.271	.4970	.112
.5311	.094	.3684	+0.001	.4386	.289	.4984	.120
.5324	.076	.3691	+0.010	.4393	.297	.4991	.105
.5338	+0.040	.3698	−0.006	.4400	.331	.5032	.144
.5366	−0.007	.3705	+0.010	.4428	.395	.5046	.142
.5380	.023	.3761	.047	.4435	.412	.5053	.151
.5394	.080	.3768	.056	.4442	.426	.5067	.168
.5422	.208	.3782	.067	.4449	.436	.5074	+0.162
.5436	.232	.3789	.047	.4456	.428		
.5449	.282	.3796	.066	.4484	.391	2438439	
.5477	.362	.3831	.070	.4491	.389	.2701	+0.003
.5491	.418	.3838	.085	.4498	.391	.2722	.002
.5505	.403	.3845	.075	.4504	.378	.2819	.047
.5533	.480	.3852	.093	.4511	.377	.2840	.068
.5547	.485	.3866	.100	.4539	.335	.2882	.049
.5561	−0.456	.3928	+0.107	.4546	−0.331	.2903	+0.096

Table 9c (cont.)

Photoelectric ultraviolet observations of SZ Lyn

J.D.	ΔU	J.D.	ΔU	J.D.	ΔU	J.D.	ΔU
2438439		2438457		2439527		2439905	
.2944	+0.117	.3166	-0.454	.5225	+0.050	.3075	-0.463
.3007	.176	.3187	.438	.5246	+0.010	.3096	.457
.3028	.179	.3221	.390	.5267	-0.010	.3117	.456
.3069	.201	.3242	.333	.5309	.138	.3158	.431
.3167	.230	.3277	.318	.5330	.182	.3179	.359
.3278	.198	.3298	.299	.5351	.324	.3200	.318
.3299	.199	.3332	.264	.5392	.418	.3241	.254
.3340	.117	.3450	.116	.5413	.451	.3262	.202
.3361	+0.043	.3520	-0.032	.5434	.474	.3325	.129
.3403	-0.035	.3562	+0.024	.5475	.451	.3367	.052
.3424	.125	.3638	.025	.5496	.470	.3408	-0.011
.3465	.275	.3687	.043	.5517	.408	.3450	+0.031
.3486	.275	.3756	.113	.5559	.344	.3596	.104
.3528	.402	.3777	.142	.5580	.301	.3617	.115
.3549	.442	.3819	.184	.5601	.311	.3658	.118
.3590	.419	.3839	.184	.5642	.195	.3679	.152
.3611	.408	.3881	.203	.5663	.161	.3700	.170
.3653	.329	.3902	.192	.5684	-0.142	.3741	.165
.3674	.306	.3937	.213			.3762	.195
.3778	.180	.3957	.222	2439528		.3783	.219
.3799	.162	.3992	.214	.5788	+0.150	.3825	.228
.3840	-0.137	.4013	.201	.5830	.153	.3846	.190
.4444	+0.226	.4055	.236	.5871	.191	.3867	.213
.4472	.185	.4075	.203	.5913	.161	.3908	.237
.4521	.139	.4113	.183	.5948	.167	.3929	.232
.4542	.132	.4131	+0.169	.5990	.170	.3950	+0.226
.4590	+0.006	.4221	-0.039	.6024	.149		
.4611	-0.032	.4242	.101	.6045	.123	2440243	
.4653	.185	.4313	.327	.6065	+0.091	.3204	-0.008
.4674	.223	.4332	.381	.6114	-0.027	.3225	+0.008
.4715	.389	.4367	.400	.6135	.031	.3267	.019
.4736	.432	.4388	.404	.6170	.181	.3288	.051
.4778	.421	.4430	.388	.6191	.265	.3329	.063
.4799	.416	.4450	.364	.6212	.321	.3350	.083
.4840	.361	.4492	.316	.6246	.447	.3392	.092
.4861	.337	.4513	.285	.6267	.428	.3412	.136
.4903	.274	.4555	.201	.6288	.417	.3454	.172
.4972	.195	.4575	-0.190	.6330	.411	.3475	.191
.4993	.162			.6351	.411	.3517	.211
.5035	.117	2439527		.6372	.381	.3538	.204
.5056	.094	.4781	+0.133	.6413	.349	.3579	.215
.5097	.080	.4809	.116	.6455	-0.300	.3600	.211
.5118	.044	.4843	.200			.3642	.215
.5160	.004	.4954	.156	2439905		.3663	.183
.5181	-0.009	.4975	.199	.2846	+0.010	.3704	.138
.5222	+0.042	.5058	.215	.2867	+0.002	.3767	.076
.5243	+0.047	.5079	.231	.2908	-0.084	.3788	+0.036
		.5100	.170	.2929	.192	.3829	-0.045
2438457		.5142	.195	.2950	.198	.3850	.105
.3117	-0.359	.5163	.179	.2991	.298	.3892	.297
.3138	-0.404	.5184	+0.153	.3033	-0.439	.3913	-0.368

Table 9c (cont.)

Photoelectric ultraviolet observations of SZ Lyn

J.D.	ΔU	J.D.	ΔU	J.D.	ΔU	J.D.	ΔU
2440243		2441390		2441679		2441679	
.3954	−0.450	.3647	+0.200	.5672	−0.405	.6401	+0.180
.3975	.459	.3696	.218	.5700	.440	.6423	.177
.4017	.440	.3717	.237	.5720	.448	.6446	.180
.4038	.435	.3765	.209	.5797	.375	.6524	.203
.4079	.390	.3786	.189	.5825	.347	.6552	.186
.4100	.377	.3828	.175	.5846	.311	.6571	.184
.4142	.312	.3849	.153	.5937	.178	.6639	.162
.4163	−0.290	.3890	.088	.5957	.177	.6662	.146
		.3911	+0.040	.5977	.144	.6683	+0.109
2441390		.3953	−0.067	.6039	.053	.6775	−0.115
.3293	−0.040	.3974	.101	.6064	.044	.6793	.178
.3314	0.000	.4015	.256	.6085	−0.019	.6811	.261
.3362	+0.023	.4036	.304	.6152	+0.045	.6829	.314
.3397	.051	.4085	.405	.6178	.040	.6900	.427
.3439	.065	.4106	.411	.6203	.050	.6918	.429
.3460	.128	.4147	.408	.6270	.119	.6938	.432
.3515	.120	.4168	.398	.6294	.118	.6961	.404
.3543	.154	.4244	.314	.6323	+0.129	.7034	−0.313
.3626	+0.207	.4265	−0.267				