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**A PERIOD ANALYSIS OF THE SEMI-REGULAR
VARIABLE SW VIR***

SW Vir (HD 114961) is a semi-regular SRb variable of spectral type M7III with an amplitude of approximately one and one-half magnitudes in V (Kholopov et al. 1985). Its variability was discovered by W. P. Fleming in 1901 from photographic plates of the Henry Draper Memorial (Pickering 1901). In the Second Catalog of Variable Stars, Cannon and Pickering (1907) listed the period as irregular and the magnitude range as 7.4 to 8.8 from a combination of visual and photographic measurements. Lause (1929) derived a period of 157 days and a time of maximum of JD 2425291. From a total of 2679 photographic observations covering the years 1890 to 1938, Payne-Gaposchkin (1952) derived 45 times of maximum and 39 times of minimum and from them a period of 150 ± 22 days. The total magnitude range during that interval was given as 8.17 to 9.40.

SW Vir was placed on the observing menu of the Smithsonian 10-inch Automatic Photoelectric Telescope (APT) in 1986 when it was relocated from Fairborn Observatory in Ohio to the Smithsonian Institution's F. L. Whipple Observatory on Mt. Hopkins in southern Arizona (Genet and Boyd 1987, Baliunas et al. 1987, Genet and Hayes 1989). The APT is equipped with an Optec SSP-3a photometer (Persha and Sanders 1983) and observes in the Johnson V, R, and I bandpasses. Five seasons of APT data from 1986 to 1990 have been obtained on SW Vir. Figure 1 shows the V band light variations plotted against heliocentric Julian Date. Each point is the mean of three differential observations and has been corrected for differential extinction and transformed to the Johnson system. Means with a standard deviation of 0.02 magnitudes or greater have not been plotted and are not used in this analysis. The comparison star was HR 5047 ($V = 5.89$) giving a total magnitude range of 6.65 to 7.95 in V.

A period search was performed on the APT data by looking at residuals from fits of sinusoids over the range of trial periods from 1 to 1500 days. The resulting periodogram for the V data is shown in Figure 2 where the sums of the squares of the residuals to the sine fits are plotted against trial period. The deep minimum yields a period of 162.4 ± 0.5 days for SW Vir where the uncertainty is computed by the method of Hooten and Hall (1990). Two shallower minima occur at 113 and 285 days which correspond to the one year aliases of the true period resulting from the seasonal gaps in the data.

Table I gives the times of maximum of SW Vir estimated from the APT light curves along with their estimated uncertainties. Also included is a well-defined maximum estimated from 1970 photoelectric photometry by Wisse and Wisse (1971). The interval

*Based on data from the Automatic Photoelectric Telescopes of the Smithsonian Astrophysical Observatory

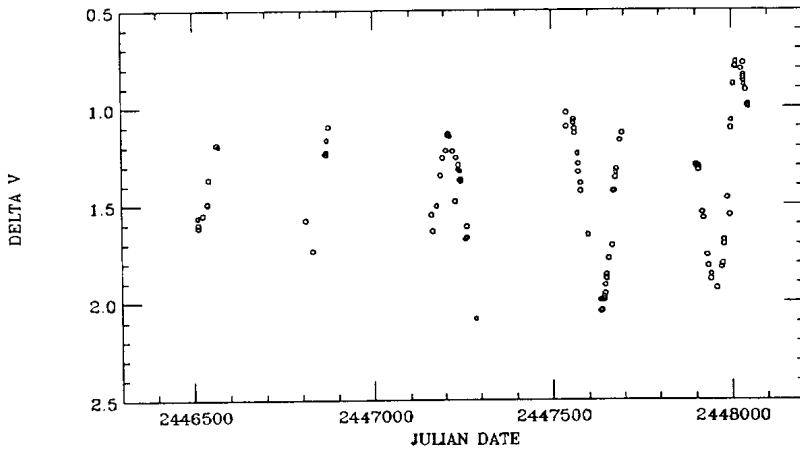


Figure 1: V band APT light curve of SW Vir from 1986 to 1990.

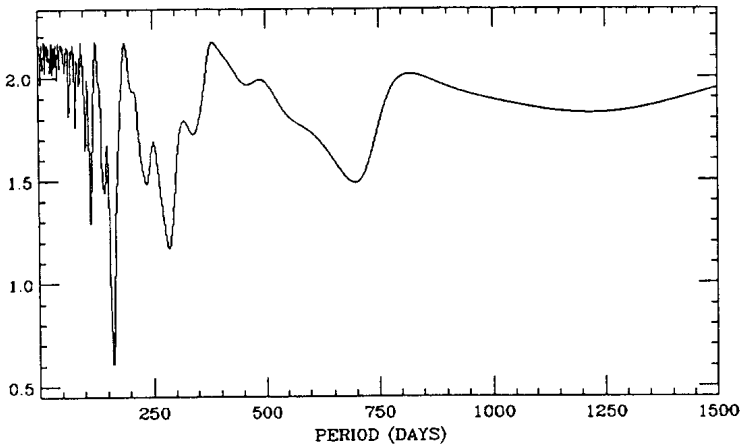


Figure 2: Periodogram of the SW Vir data from Figure 1.

between JD 2440711, the maximum of Wisse and Wisse, and JD 2447210, the well-defined maximum in the third year of the APT data, is 6499 days or 40.02 cycles of the 162.4 day period derived above. This implies that the cycle count has not been lost in the intervening two decades between these sets of data. Considering the uncertainty of three days in the times of these two maxima, a slightly improved period of 162.5 ± 0.2 days can be derived and the following ephemeris given:

$$\text{JD (max.)} = 2447210 + 162.5 E$$

$$\begin{array}{ccc} \pm 3 & & \pm 2 \end{array}$$

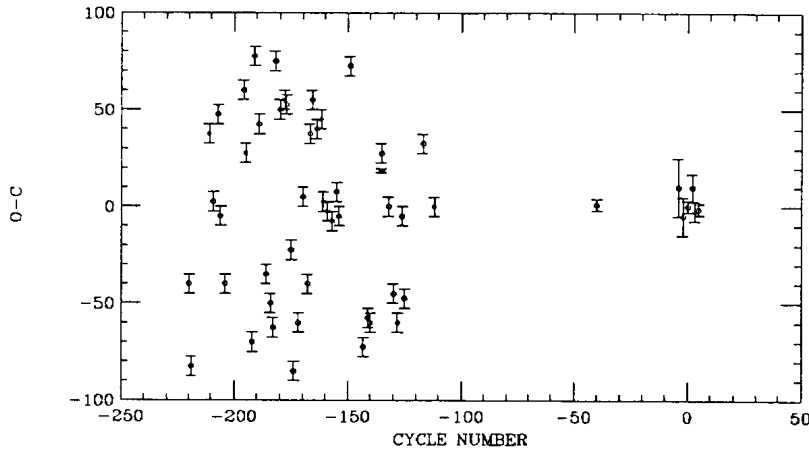


Figure 3: O-C diagram of SW Vir including the recent APT data as well as earlier photoelectric, photographic, and visual data.

Table 1. O-C's for the photoelectrically determined times of maximum

Cycle	Maximum (JD)	O-C (days)	Source
-40	2440711 \pm 3	+1	Wisse and Wisse
-4	2446570 \pm 15	+10	this paper
-2	2446880 \pm 10	-5	this paper
0	2447210 \pm 3	0	this paper
+2	2447545 \pm 7	+10	this paper
+3	2447695 \pm 5	-2.5	this paper
+5	2448021 \pm 3	-1.5	this paper

The differences between the observed and computed times of maximum (O-C) calculated from this ephemeris are listed in Table 1 and plotted in Figure 3 where the O-C's derived from the Payne-Gaposchkin and Lause maxima are also included. While the photoelectric data (1970 -1990) are consistent with a constant period of 162.5 days, the earlier photographic and visual data (1890 - 1938) are not. In fact, the earlier O-C's scatter over the entire range of the period. The SRb classification of SW Vir seems to be consistent with the early data, but the stable period of the later data suggests a classification of SRa. SW Vir may be similar to certain semi-regular variables discussed by Cadmus et al. (1990) that exhibit sudden amplitude and period variations suggested to be due to pulsation mode switching. SW Vir will continue to be monitored by the Smithsonian 10-inch APT.

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