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FCAPT *uvby* Photometry of the mCP Stars BN Cam, EP Vir, FF Vir, and HD 184905

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ABSTRACT. We studied differential single-channel Strömgren *uvby* observations of four magnetic CP (mCP) stars, obtained with the Four College Automated Photoelectric Telescope (FCAPT), which now have two epochs of observations. To bring the recent photometry of BN Cam into agreement with earlier FCAPT photometry, we adjusted its period to 2.73501 days. As we found several older photometric studies whose data are consistent with this value, its period appears to have been constant for the past 35 years. We refined the period of EP Vir to 16.3071 days and reduced the errors in its ephemeris. When we compare the light curves from the observing seasons in which complete light curves were obtained, we find the small differences among them to be suggestive of variability. For FF Vir and HD 184905, the periods are 129.99 and 1.84535 days, respectively, as found by previous FCAPT data studies. Their light curves are similar to those of previous *uvby* and *V* measurements for the past 35 years.

Online material: color figures, extended table

1. INTRODUCTION

Most magnetic chemically peculiar (mCP) stars are photometric, spectrum, and/or magnetic variables whose emergent energy distributions, abundances, and magnetic field strengths are dependent on photospheric location. Often a distant observer records a variety of variability as they rotate, since the magnetic and rotational axes are sufficiently unaligned. Theory (Michaud & Proffitt 1993 and references therein) indicates that hydrodynamical processes, in particular radiative diffusion and gravitational settling in radiative envelopes with strong magnetic fields, produce their anomalous photospheric abundances. They are functions of the local magnetic field strength and the evolution of the field and elemental abundances from the time at least when the stars were on the zero-age main sequence, and possibly earlier.

Studies with the Four College Automated Photoelectric Telescope (FCAPT) at Fairborn Observatory, Washington Camp, Arizona, have determined the periods and the shapes of light curves of many mCP stars. When there are two or more epochs of comparable data, one can detect variable light curves (see, e.g., Adelman 2002) and use them to improve periods. For spectrum variables with moderate rotation, surface abundance maps derived from spectroscopy serve as tests of mCP star theories. Light curves representing different filters may provide an idea of the surficial abundance complexity and/or the magnetic field geometry.

The first author's initial mCP star studies used more observations (50 to 75) than had been the usual practice to determine or to improve the periods and to provide the details of the light curves. The study of 56 Ari (Adelman et al. 2001) established a second period of about 5 years and interpreted it as being due to the precession of the rotational axis around the magnetic axis. It utilized some 10 years of data, with sufficient data each year, to determine the shapes of the light curves. As studies of a second epoch of FCAPT photometry of some mCP stars were completed, a few showed light-curve discrepancies with the first epoch of FCAPT photometry. This suggested that such behavior was more common than had been thought. Pyper & Adelman (2005) found that perhaps 20% of the mCP stars might have variable light curves, with most of these objects exhibiting precessing axes. Recently, a number of mCP stars with at least two epochs of photometry were examined and found to have constant periods for a considerable period of time (see, e.g., Adelman 2006).

Now at least 3 years of photometry have been obtained for other mCP stars with previous FCAPT photometry. In comparing these sets, there are some problems; for example, the neutral-density filters were replaced with the photometer a few years ago. Now we use neutral-density filters with multiples of 1.25 mag, while earlier observations used multiples of 2.5 mag. On occasion between seasons, the neutral-density filters were changed to obtain better statistics for one or more stars in each group of variable, comparison, and check stars. With the aid of *Hipparcos* photometry (ESA 1997), the comparison and check stars were selected from the least variable stars close on the sky to variables that had somewhat similar V magnitudes and $B - V$ colors. For a few groups, the comparison and/or the check star were changed if they proved not to be as stable as desired. Such changes require zero-point adjustments when comparing data from different observing sea-

TABLE 1
PHOTOMETRIC GROUPS

HD	Star Name	Type	V	Spectral Type	Filter
32650	BN Cam	v	5.43	B9pSi	2
33541	HR 1683	c	5.74	A0 V	2
30085	HR 1510	ch	6.37	A0 IV	2
111133	EP Vir	v	6.34	A0p	1
109860	HR 4805	c	6.33	A1 V	1
110951	32 Vir	ch	5.22	F0 IIIm	2
126515	FF Vir	v	7.12	A2p	1
127167	HR 5418	c	5.94	A5 IV	2
125489	HR 5368	ch	6.19	A7 V	1
184905	V1264 Cyg	v	6.48	A0pSi	1
184875	HR 7444	c	5.35	A2 V	3
186307	HR 7499	ch	6.23	A6 V	1

sons. *Hipparcos* photometry has been a good but not perfect guide to selecting such stars.

A criterion to predict the most likely precessing mCP stars would be most useful. Theory (Shore & Adelman 1976) indicates that the rate of precession is due to the change of the moment of inertia from its initial value, due to a magnetic field operating in the stellar envelope. For precession to be easily observed photometrically, once "spots" appear, the change of the moment of inertia along the magnetic field axis must attain some small critical fraction of the moment of inertia. Precession continues until the poloidal field strength decays to some critical strength. With at least on order of 20% of the mCP stars showing changes in the shapes of their light curves, it is likely that precessional behavior occurs among a considerable fraction of the mCP stars for a good portion of their main-sequence lifetimes. Only for the most rapidly rotating mCP stars ($v \sin i \geq 140$ km s^{-1}) does the polar flattening due to rotation contribute to the changes in the shapes of the light curves.

Strong magnetic fields in mCP stars produce regions ("spots") with abundances that are quite different than solar. The amplitudes of a star's light curves represent the largest flux differences between observed regions of the photosphere over certain wavelength ranges. Those stars with the largest amplitudes maximize such differences. As it is easier to see the details of changes in the shapes of light curves with large amplitudes, the stars that have them should be observed to study such possible effects. If the inclination angles between the line of sight and the rotational axis and the amplitudes were known for a significant number of mCP stars, then a variety of correlations could be examined.

Here we study FCAPT single-channel differential instrumental Strömgren *uvby* photometry of four mCP stars: BN Cam, EP Vir, FF Vir, and HD 184905. The FCAPT 0.75 m automated telescope measures the dark count and then sky-ch-c-v-c-v-c-v-c-ch-sky in the four Strömgren filters for each group of variable (v), check (ch), and comparison (c) stars, where sky is a reading of the sky. No corrections are made for neutral-density filter differences among the stars of a group. Table 1 provides information on each group (Hoffleit 1982; Hoffleit et al. 1983; SIMBAD). The stellar periods were found with the Scargle periodogram (Scargle 1982; Horne & Baliunas 1986). Table 2 contains the photometric values, their averages, and the standard deviations of v-c and ch-c for each filter. As those for ch-c are of an order of 0.005 mag, the errors for v-c are probably similar. The first observing season for the FCAPT was from fall 1990 through spring 1991. This paper includes data taken during observing season 17 (2006 September to 2007 July).

Our amplitudes were determined from the differences between the maximum and minimum values, with an allowance for the photometric accuracy. Their errors depend on the photometric coverage near the extrema. For 50 values, the errors are of an order of 0.007 mag. To see if the differences are significant, it is best to overplot or compare the data near the extrema.

To determine whether offsets between the results of different observing seasons are needed for a filter system, we select one set as the standard, often the one with the largest number of values, and then overplot other sets. If there are systematic

TABLE 2
uvby PHOTOMETRY FOR BN Cam, EP Vir, FF Vir, AND HD 184905

HJD	u(v − c)	u(ch − c)	v(v − c)	v(ch − c)	b(v − c)	b(ch − c)	y(v − c)	y(ch − c)
BN Cam								
Year 15:								
2453311.9730	−0.762	0.659	−0.495	0.617	−0.429	0.615	−0.386	0.627
2453312.9647	−0.696	0.658	−0.463	0.618	−0.407	0.632	−0.364	0.636
2453318.9553	−0.730	0.658	−0.474	0.621	−0.420	0.629	−0.372	0.642
2453320.9473	−0.699	0.656	−0.462	0.614	−0.408	0.627	−0.364	0.645
2453322.9407	−0.765	0.657	−0.488	0.614	−0.441	0.629	−0.384	0.641
2453329.9649	−0.741	0.658	−0.478	0.619	−0.421	0.628	−0.376	0.640
2453336.9569	−0.728	0.657	−0.475	0.617	−0.420	0.625	−0.372	0.637
2453340.9293	−0.741	0.650	−0.479	0.610	−0.424	0.623	−0.374	0.631
2453342.9205	−0.704	0.657	−0.463	0.623	−0.405	0.632	−0.354	0.640

NOTE.—Table 2 is published in its entirety in the electronic edition of the *PASP*. A portion is shown here for guidance regarding its form and content.

differences, then we apply a magnitude correction to bring the other set into best agreement with the first. We make such corrections only for entire seasons of observing. This procedure is most successful with well-defined light curves.

2. BN Can

Adelman (1997) performed the most recent photometric study of BN Cam (HR 1643, HD 32650), which was based on 70 sets of values obtained using the FCAPT during observing seasons 2 to 5. The light curves vary approximately in phase, with the amplitudes decreasing with wavelength. That for *u* is relatively large, at 0.11 mag. The ephemeris was determined using the FCAPT data and *V* photometry from Winzer (1974) and Ziznovsky et al. (1992). A period of 2.73745 days was found, while *Hipparcos* data (ESA 1998) gave a period of 0.73250 days. During one period, there is one maximum and one minimum, along with suggestions of structure in these light curves. The derived ephemeris was

$$\mathrm{HJD(maximum\ light)} = 2{,}448{,}232.5843 + (2.73475 \pm 0.00002)E.$$

In the last three observing seasons (15–17), additional FCAPT *uvby* photometry has been obtained that substantially increases the number of values. This provides an opportunity to see if the period is constant and correct, and also to check for variability in the light curves. During observing season 17 (2006–2007), observations were taken continuously for two nights when the star was within 3 hr of the meridian. These observations and the others of this observing season do not produce an acceptable light curve for the shorter proposed period.

Comparison of the published and recent FCAPT observations using the period given above shows that the more recent light curves are displaced in phase. To fix this problem, the period was adjusted to 2.73501 days, and the error to 0.000025 days. The amplitudes are 0.11 mag in *u*, 0.05 mag in *v*, and 0.045 mag in both *b* and *y*. These values are close to those of Adelman (1997), who quotes 0.11 mag for *u*, 0.055 mag for *v*, and 0.050 mag for both *b* and *y*.

From Adelman (1997), we used FCAPT values from seasons 2, 4, and 5. In addition, we included similar data from seasons 15 (34 values), 16 (57 values), and 17 (54 values) in our analysis (see Table 2). Additional values were obtained in seasons 1, 3, 6, and 14 but were not used, as there were too few to define the light curves well by themselves (seasons 1, 3, and 6), and as the light curves did not look like those of other seasons (season 14), for reasons we do not completely understand. A few additional seasons with 50 or more values covering the period well are needed to confirm the stability of the light curves. We examined the *V* data of Winzer (1974) and Ziznovsky et al. (1992), and the values from the *Hipparcos* satellite (ESA 1997). Although these three data sets were not Strömgren values, they were consistent with our new ephemeris.

The FCAPT *uvby* Strömgren values are shown in Figure 1 as a function of our adopted ephemeris. The values are from seasons 2 (*open squares*), 4 (*downward-facing filled triangles*), 5 (*filled circles*), 15 (*upward-facing filled triangles*), 16 (*plus signs*), and 17 (*crosses*). The four Strömgren light curves are approximately in phase and similar to one another in shape. To bring the light curves from the various seasons into best agreement, some offsets were applied in Figure 1, but not in the Table 2 data. For *u* and *y*, seasons 15 and 16 were offset by 0.003 mag, while for *b*, seasons 2 and 17 were offset 0.005 mag.

3. EP Vir

Wolff & Wolff (1972), using *uvby* observations, first correctly found the period of the well-known mCP star EP Vir (HR 4854, HD 111133, BD +06 2660; spectral type A0pSrEuCr). The last major photometric study (North & Adelman 1995) used both Geneva and *uvby* FCAPT Strömgren photometry and found a period of 16.30720 ± 0.00032 days. The four Strömgren light curves are roughly in phase, with the largest amplitude found for the *b* photometry. *Hipparcos* photometry (ESA 1998) indicates a 16.30400 day period, but its time span of observations is 3 years, rather than the over 30 years for this study. The FCAPT data in North & Adelman (1995) are from observing seasons 1 (1990–1991), 2 (1991–1992), 4 (1993–1994), and 5 (1994–1995). Table 2 contains new data from seasons 14 (2003–2004) and 15 (2004–2005), with 73 and 44 values, respectively.

Our primary analysis used the *b* data. Complete light curves were obtained only by Wolff & Wolff (1972) and during FCAPT observing seasons 1, 14, and 15. We did not observe any phase shifts for light minimum between these data sets. The less complete data from observing seasons 2, 4, and 5 can be made to fit the light curve of season 1 via magnitude shifts up to around 0.005 mag. Adelman (1997) found 0.04, 0.05, 0.05, and 0.04 mag as the peak-to-peak amplitudes for *u*, *v*, *b*, and *y*, respectively, while we found 0.04, 0.05, 0.055, and 0.03 mag.

To improve the period of North & Adelman (1995), we used the Scargle periodogram with all the FCAPT values and the Wolff & Wolff (1972) *b* data. Our new period is 0.0001 days (8.64 s) smaller. We adopted Wolff & Wolff's zero phase, which corresponds to maximum light, and reduced its error by a factor of 8 (compared with Wolff & Wolff 1972), due to the consistency of the timing of light minimum among the four complete light curves. The adopted error in the period is about half that of North & Adelman (1995), and considering the signal-to-noise ratio (S/N) values in the Scargle periodogram, we find the ephemeris to be

$$\mathrm{HJD(light\ maximum)} = (2{,}440{,}640.10 \pm 0.10) + (16.3071 \pm 0.0002)E.$$

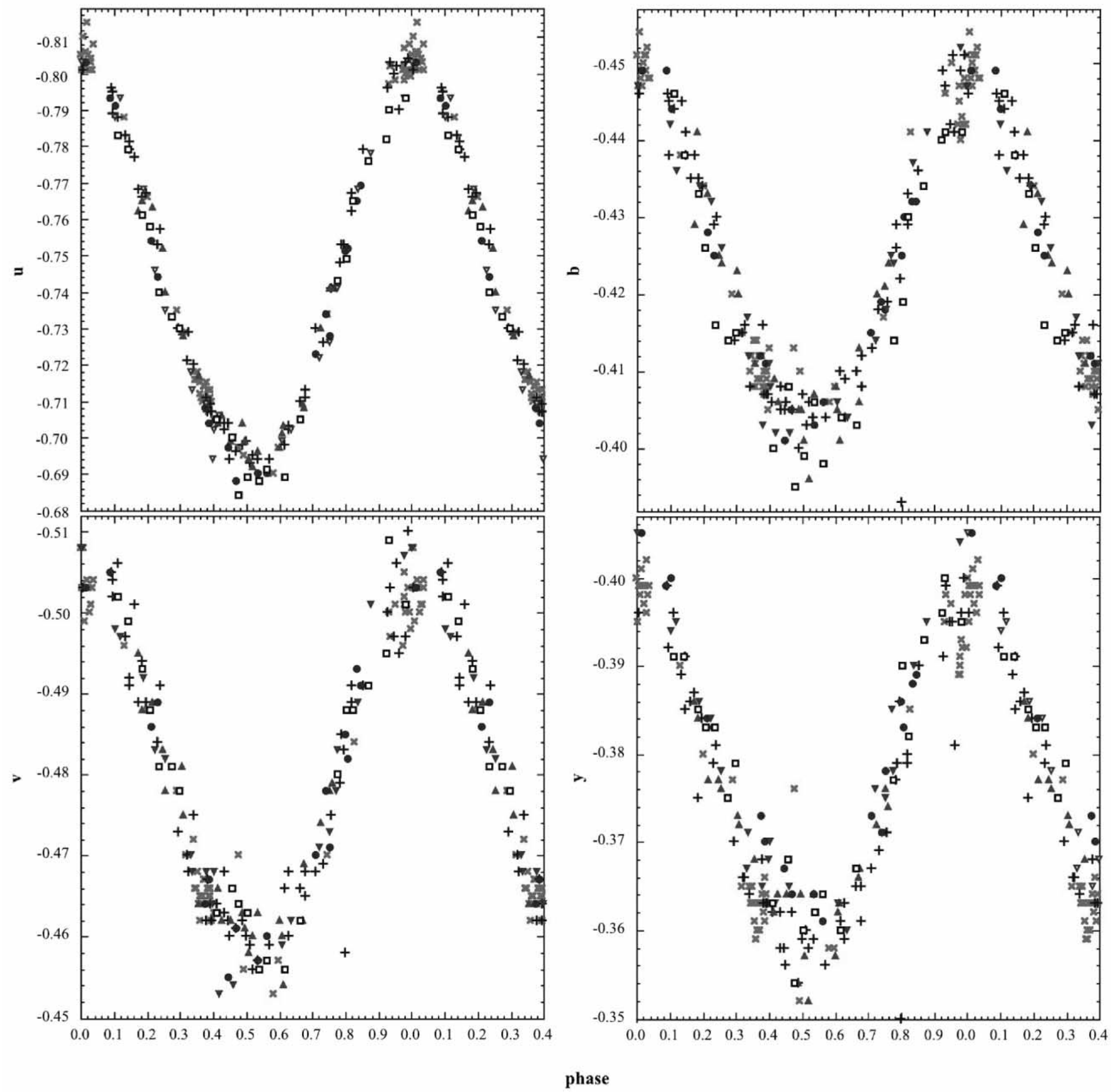

FIG. 1.—*uvby* photometry of BN Cam for observing seasons 2 (*open squares*), 4 (*downward-facing filled triangles*), 5 (*filled circles*), 15 (*upward-facing filled triangles*), 16 (*plus signs*), and 17 (*crosses*). The four Strömgren light curves are approximately in phase and similar to one another in shape. They were plotted with the ephemeris HJD(maximum light) $= 2{,}448{,}232.5843 + (2.73501 \pm 0.000025)E$. [*See the electronic edition of PASP for a color version of this figure.*]

When we investigated the best agreement among the *b* light curves of the four complete light curves, we had to allow for shifts in *b* scales of up to 0.005 mag. Even then, there are minor differences in the shapes; for example, in the width of the minimum and in the total amplitude. These are what one would expect for the precession of the rotational axis around the magnetic axis. Nevertheless, additional seasons with complete light curves are needed for confirmation. From experience, this means on order of 75 FCAPT values for EP Vir. For the ch-c FCAPT data, the standard deviations of the means are of an order of 0.007 mag.

As an example of the general shapes of the light curves and their suggestive differences, we show those for observing seasons 14 and 15 in Figure 2. Adding data for other observing seasons would make the diagrams much harder to interpret visually. The data from observing seasons 14 and 15 are shown

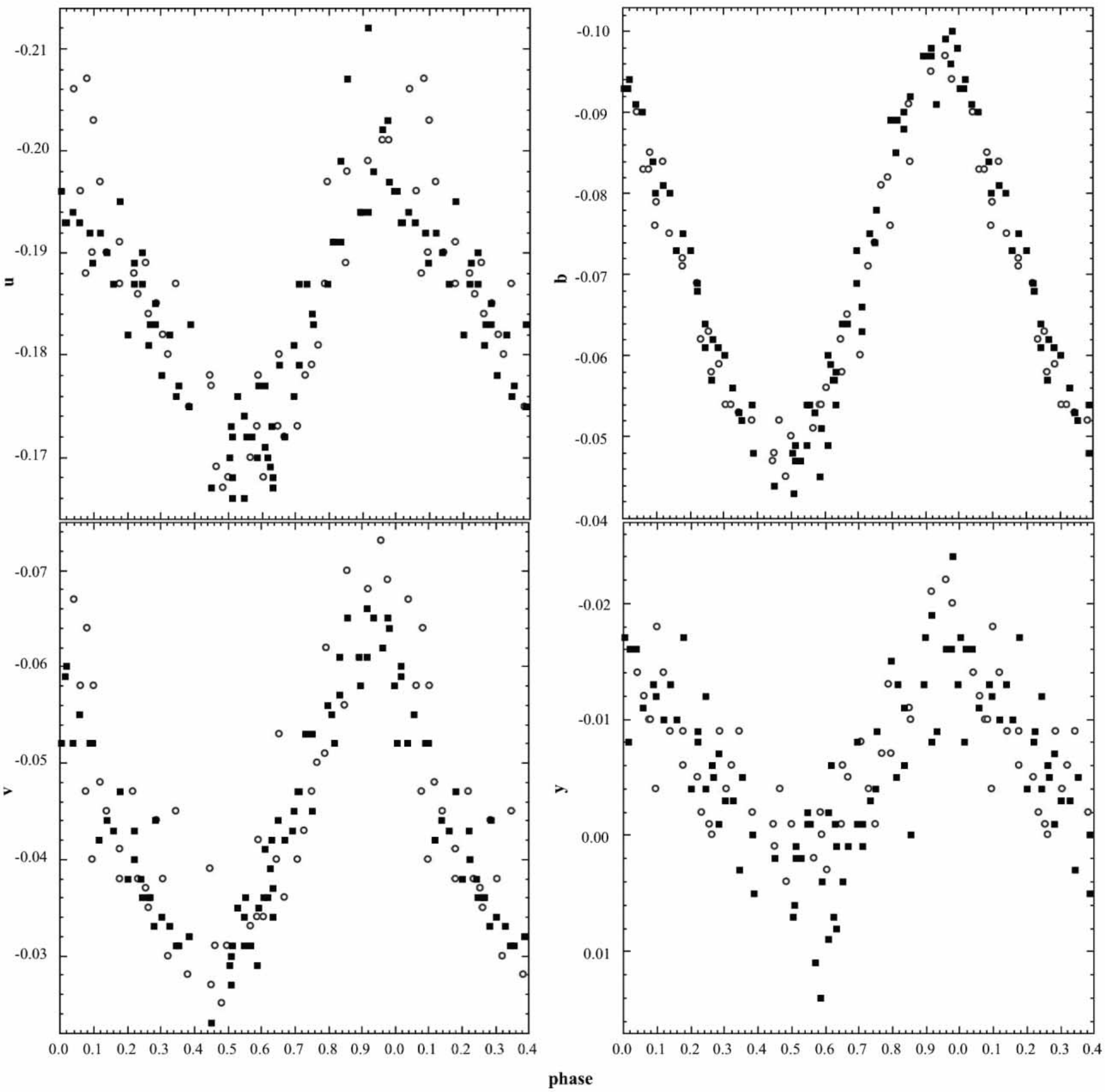

FIG. 2.—*uvby* FCAPT photometry of EP Vir for observing seasons 14 (*filled squares*) and 15 (*open circles*), plotted with the ephemeris HJD(light maximum) $= (2{,}440{,}640.10 \pm 0.10) + (16.3071 \pm 0.0002)E$. [*See the electronic edition of PASP for a color version of this figure.*]

as filled squares and open circles, respectively. Note that the phases of light minimum are slightly different, with those for *u* and *b* being close together, and those for *v* and *y* being slightly earlier and later in phase, respectively. The range of phases is 0.44 to 0.52. Furthermore, the four light curves have light maxima at slightly different phases, with the only one at phase 0.00 being that for *y*. This behavior suggests that EP Vir has a very complicated distribution of surface fluxes. For *u*, the five values that are 0.01 mag or greater than the mean light curve may have greater errors than the other values. Additional observing seasons with sufficient data to cover the variability well are needed to clarify the fine details of the light curves.

4. FF Vir

North & Adelman (1995) performed the most recent major photometric study of FF Vir (HD 126515, HIP 70553, BD +01

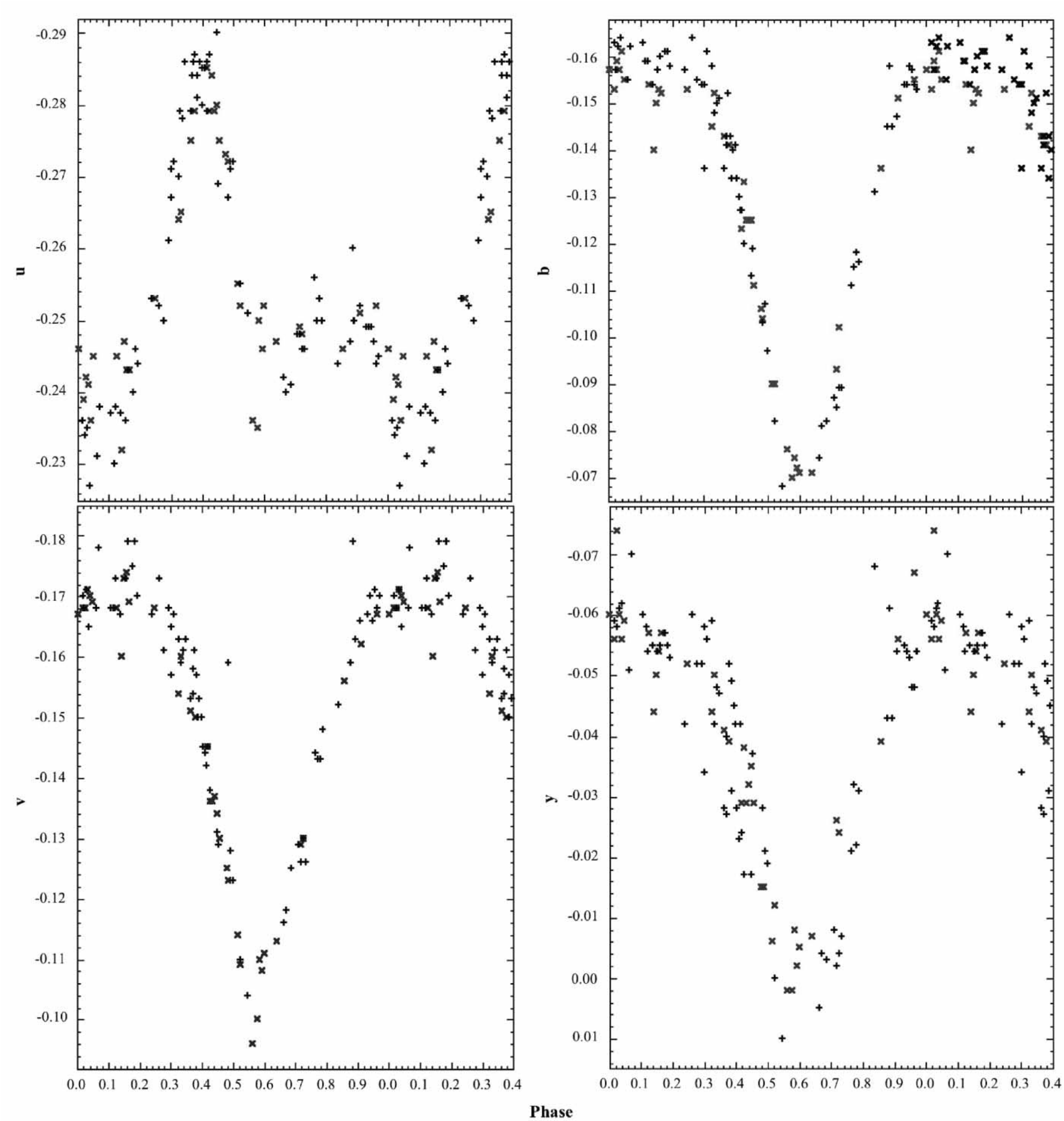

FIG. 3.—*uvby* FCAPT photometry of FF Vir for observing seasons 14 (*plus signs*) and 15 (*crosses*), plotted with the ephemeris HJD($V_{\max}$) = 2,448,703.905 + (129.99 ± 0.04)E. [*See the electronic edition of PASP for a color version of this figure.*]

2927, Preston's star), using both Strömgren and Geneva photometry. Preston (1970) found its period to be almost 130 days, which was confirmed by later studies (e.g., Catalano & Leone 1990; Mathys 1991; North & Adelman 1995). The last authors used the ephemeris

$$\mathrm{HJD}(V_{\max}) = 2{,}448{,}703.905 + (129.99 \pm 0.04)E.$$

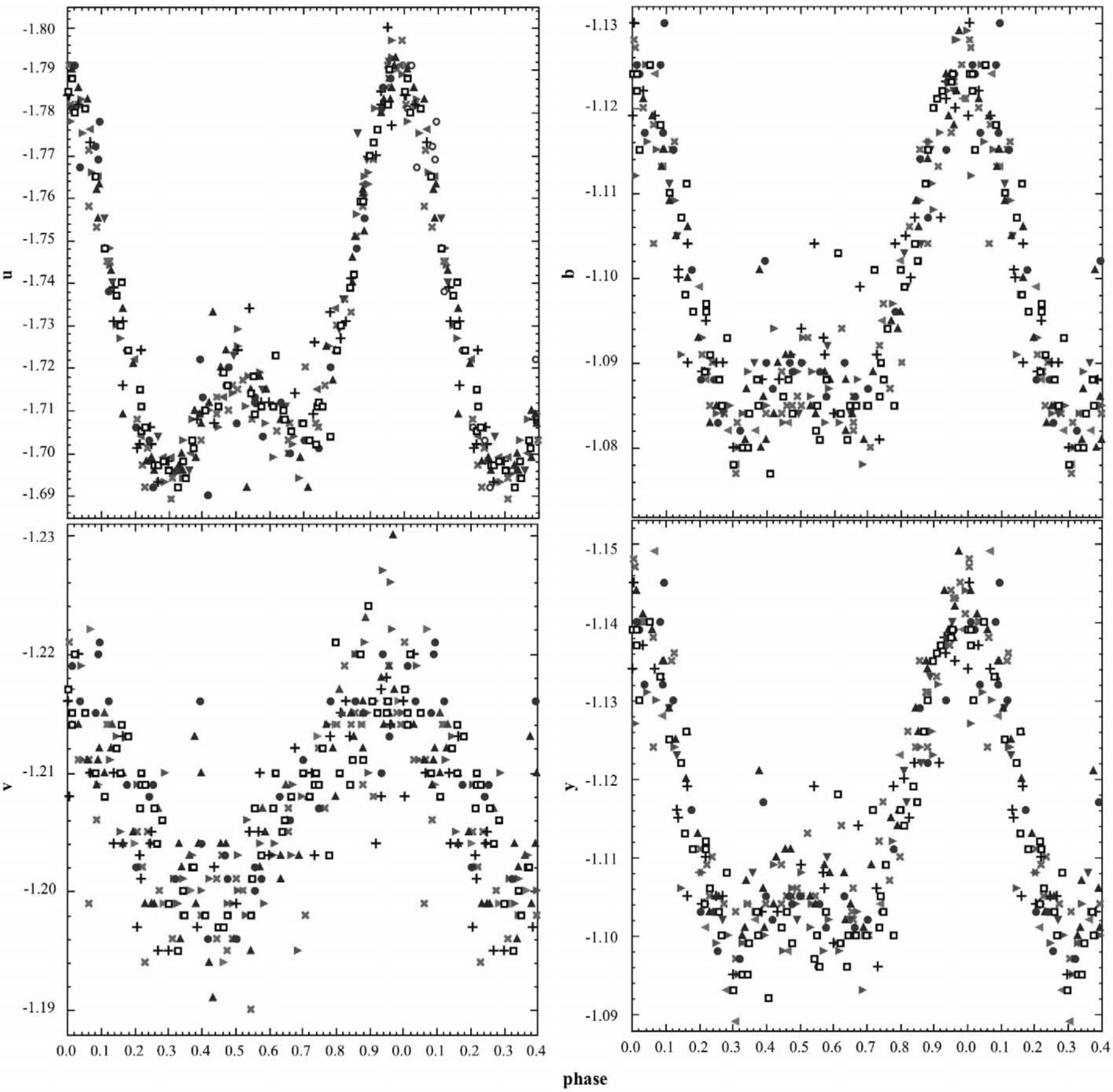

FIG. 4.—*uvby* FCAPT photometry of HD 184905 for observing seasons 1 (*open squares*), 3 (*filled circles*), 4 (*upward-facing filled triangles*), 5 (*downward-facing filled triangles*), 11 (*plus signs*), 14 (*crosses*), 16 (*right-facing filled triangles*), and 17 (*left-facing filled triangles*), plotted with the ephemeris $\mathrm{HJD}(y_{\max}) = (2{,}440{,}017.82 \pm 0.05) + (1.84535 \pm 0.00002)E$. [*See the electronic edition of PASP for a color version of this figure.*]

As it is very difficult to specify when the maximum in *y*, which is supposed to be the same as *V*, occurs, it would be better to use the minimum for *v*, *b*, and/or *y*. But we are not changing it, since comparison with older studies is useful. The light curves for *v*, *b*, and *y* are close to being in phase, but are very different from that for *u*. The *u*, *v*, *b*, and *y* amplitudes are respectively found to be 0.05, 0.065, 0.08, and 0.05 mag. Similar light curves are seen for most Geneva passbands, but a few are somewhat different. *V* and *y* behave similarly.

FF Vir is especially difficult to study photometrically, as its phase increases only by 0.0077 per day. In shorter period stars, all the necessary observations can be obtained over a few nights with similar characteristics. Here one must use all good observations taken on apparently photometric nights over a 4 month period. What one obtains is quite weather dependent.

Landstreet & Mathys (2000) found an obliquity of FF Vir's magnetic axis of 20°, while its inclination is 78°. Departures from axisymmetry are also observed. Magnetic extrema occur near their phases of 0.0 and 0.5. Their ephemeris of

$$\mathrm{HJD}(\langle H\rangle) = 2{,}437{,}015.000 + (129.95 \pm 0.02)E$$

(Mathys & Hubrig 1997; Mathys et al. 1997) was derived from the considerable measurements of FF Vir's mean magnetic field modulus over a period of 38 years. There is an unusual anharmonicity of the variations of the longitudinal field. The photometric zero point is at magnetic phase 0.95 if a period of 129.99 days is adopted.

In this analysis, we use only the FCAPT *uvby* data used by North & Adelman (1995) and collected afterward. We did not use *Hipparcos* photometry (ESA 1997) to help define the period, as the Strömgren magnitudes are all not in phase. The same comparison and check stars were used for all the FCAPT photometry of FF Vir. However, there have been changes over time in the neutral-density filters that are used.

North & Adelman (1995) included *uvby* photometry from the first four observing season of the FCAPT (1990–1991 through 1993–1994). New observations were made in observing seasons 11–15 (2000–2001 through 2004–2005). The photometer and the neutral-density filters were replaced at the start of observing season 13. Some experimentation was done to see which combination of the new 1.25 mag neutral-density filters would get the highest signal in a 10 s integration. Thus, season 1, seasons 2, 3, 4, and 11, season 12, and seasons 13, 14, and 15 used different sets of filters.

Table 3 provides the numbers of high-quality values of Strömgren observations per observing season per filter, as well as comments. The most useful data sets have values near both light maximum and light minimum and permit the amplitude of variability to be checked. For *v*, *b*, and *y*, these are seasons 1, 4, 14, and 15. Data from seasons 2, 3, 11, 12, and 13 are less helpful for these bandpasses, but they can often be used to fill in the light curves. As the light minima of seasons 1, 4, 14, and 15 coincide in phase after permitting scale corrections, we concluded that the ephemeris of North & Adelman (1995) was valid. If instead of 129.99 days the period was 129.95 days, the phase shift between the first measurements in seasons 1 and 14 would be 0.011 greater. The period of FF Vir means that only three cycles can be observed each year. Thus, refining its period will take some time.

We primarily compared the *v* and *b* photometry. The agreement between observing seasons 4 and 15 is excellent. For the other combinations of data from seasons 1, 4, 14, and 15, there are minor differences in the phase range 0.0 to 0.25. Since from the printed black-and-white figures it can be difficult to see the differences between the observing seasons, we show only those for observing seasons 14 and 15 in Figure 3 as illustrations. The amplitudes found are the same as those in North & Adelman (1995), except for *b* and *y*, which are now 0.09 and 0.06 mag, respectively, a difference of 0.01 mag. The *v* and *b* data from observing seasons 14 and 15 are in better agreement than those seen for *y*.

TABLE 3
FF Vir Observations

Observing Season	Number of Good Values	Comments
1 (1990–1991)	57	Complete light curve.
2 (1991–1992)	32	Missing light minimum.
3 (1992–1993)	28	Missing light minimum.
4 (1993–1994)	35	Rising branch poorly covered.
11 (2000–2001)	18	Descending branch only.
12 (2001–2002)	25	Mainly descending branch.
13 (2002–2003)	35	Mainly descending branch.
14 (2003–2004)	69	Complete light curve.
15 (2004–2005)	37	Complete light curve.

The data from seasons 11 through 15 are given in Table 2. We have not applied any correction factors to the data. Since FF Vir is a very slow rotator, any changes produced by a precession of the rotational axis around the magnetic axis as seen for 56 Ari (Adelman et al. 2001) are not expected. Furthermore, it is an A2p star. Its photometry indicates it is hotter than the roAp stars. Nevertheless, it is appropriate to get one or more seasons of photometry with as complete coverage as possible with the FCAPT to be completely certain it has light curves of constant shape.

5. HD 184905

HD 184905 (V1264 Cyg, BD +43 3290, HIP 96292) is a well-known mCP star. Babcock (1958) discovered its magnetic field and subsequently its variability. Adelman et al. (1994) refined the photometric ephemeris of Burke & Thompson (1987) by using FCAPT *u*, *v*, *b*, and *y* and other photometry. Their revised ephemeris is

$$\mathrm{HJD}(y_{\max}) = (2{,}440{,}017.82 \pm 0.05) + (1.84535 \pm 0.00002)E.$$

The four Strömgren light curves are roughly in phase, except for the *v* curve. For both the *u* and *y* values, the broad minimum shows two narrower subminima. For *b*, the subminima are suggested and probably present. With a smaller amplitude, the *v* light curve shows no subminima. It agrees best with the other three light curves if it is shifted by 0.05 in phase.

The FCAPT data of Adelman et al. (1994) were taken in observing seasons 1, 2, 3, and the start of season 4 and are available electronically. Additional FCAPT data (Table 2) were obtained later in observing season 4 (the seven values from Adelman et al. 1994 are given for completeness). For observing seasons 4, 5, 11, 14, 16, and 17, we respectively obtained 49, 12, 34, 44, 43, and 12 good-quality observations. Between observing seasons, there are only minor differences in the means of the ch-c observations. Table 4 contains these shifts, which reflect filter changes and other slight changes that are most likely due to atmospheric extinction. Filters were changed between seasons 5 and 11, and 11 and 14. The data as plotted in Figure 4 are corrected for these shifts between observing seasons, to bring the data into best agreement, while the values in Table 2 were not corrected for these shifts. Data from season 2 were not included, as the values are so few.

The period was found using all the *u* photometry, with the result being the same ephemeris as that of Adelman et al. (1994), given above. As this result is based on data from Morrison & Wolff (1971) and observations made since that time in the Strömgren system, it implies constancy of the light curves, which Figure 4 shows for the FCAPT values, over a period of some 35 years. The amplitudes of the light curves from Adelman et al. (1994) and this paper are respectively 0.105 and 0.098 mag for *u*, 0.025 and 0.028 mag for *v*, and 0.045 and 0.045 mag for *b* and *y*, which is good agreement, as would be expected for a star with nonvariable light curves.

TABLE 4
HD 184905 Observations Offsets

Observing Season	*u*	*v*	*b*	*y*
1	0.000	0.000	0.000	0.000
3	0.005	−0.007	0.000	−0.010
4	0.005	−0.007	0.005	−0.010
5	0.010	0.000	0.003	−0.010
11	0.035	0.060	0.035	0.025
14	−0.215	−0.145	−0.010	−0.025
16	−0.215	−0.145	−0.010	−0.024
17	−0.235	−0.155	−0.010	−0.030

6. FINAL COMMENTS

BN Cam, FF Vir, and HD 184905 are stars whose *uvby* and other light curves appear to be the same for the past 35 years. Those of EP Vir suggest some variability. This is consistent with the known statistics. In assembling light curves, those from seasons with many values are the most useful. Furthermore, in assessing changes in the shapes of light curves, it is necessary to have well-covered maxima and minima, and if at all possible, have the data in the same photometric system.

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