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# Light-curve and period changes of AB Andromedae

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**ABSTRACT**

New photoelectric observations of AB And obtained between 1989 and 1992 have been used, together with all available light curves from the literature, to study the light-curve variation of the system and its probable connection with the orbital period variation. A long-term brightness variation in the light levels is detected. The maximum brightness occurred in 1970 ($\pm$3 yr). A period study based on all available times of minimum light (of which 22 are newly determined) reveals that the photometric period of the system oscillates around a mean value ($P_0 \approx 0.331\,890$ d) with an oscillation period of $\approx 88.0 \pm 0.2$ yr and a half-amplitude of 0.000 003 76 d. Such a variation can be caused by either (i) a period modulation due to the magnetic activity cycle of the active primary component, or (ii) a light-traveltime effect due to a third body in the system. It is shown that the third body, if it exists, can only be a white dwarf; this can be checked by ultraviolet spectroscopy.

The rms light variation of the system predicted by Applegate's theory of the magnetic activity modulation of the orbital period is found to be comparable with the observed amplitude of long-term brightness variations of the system. However, the brightness variation is found to be 90° out of phase with the O − C curve. Such a phase shift can be explained in terms of the damping effect of the convective zone. The theory predicts a subsurface magnetic field of 7.4 kG for the primary component of AB And.

**Key words:** stars: activity – binaries: eclipsing – stars: individual: AB And – stars: magnetic fields.

## 1 INTRODUCTION

AB Andromedae (BD + 36°5017, 8.1927[1]) has been one of the best studied W UMa systems since its discovery by Guthnick & Prager (1927). Photometric observations of the system have been reported by many authors (Table 1). Light-curve analyses have been performed by Kopal & Shapley (1956), Hinderer (1960), Kalchaev & Trutse (1965), Rigtering (1973), Lucy (1973), Ruciński (1974), Berthier (1975), Niarchos (1978), Jabbar (1983), Bell, Hilditch & King (1984), Rovithis-Livaniou & Rovithis (1986), Lafta & Gringer (1986) and Hrivnak (1988).

The light-curve solutions suffer from the cycle-to-cycle variation of the light curve and the non-uniqueness of the (adopted or derived) mass ratio $q$ of between 0.49 and 0.69. The usually adopted value of $q = 0.69$, which was obtained by Struve et al. (1950) from only seven spectra, was revised later to $q = 0.42$ by Hrivnak (1988), using the same data. New radial velocity curves were obtained by Hrivnak (1988) from the 52 high-resolution spectra. Simultaneous solution of the new radial velocity curves, together with Rigtering's (1973) $B$ and $V$ light curves and Jameson & Akıncı's (1979) $J$ and $K$ light curves, by using the Wilson & Devinney code revealed that $q \approx 0.49$ and that the system is a typical W-type contact binary (Hrivnak 1988). The light-curve variation of the system was first noted by Rigtering (1973).

The changing shape of the light curve and the period variation make AB And an interesting system to study. We therefore included AB And in our observing programme in 1989, and since then have obtained $B$ and $V$ light curves in every observing season. In the 1989 and 1992 observing seasons we also obtained $U$ light curves. Our observations, which will be published separately (Demircan et al., in preparation), are used here only for minima timing and for the definition of light levels at maxima and minima. The period variation of AB And was first announced by Oosterhoff (1950). He found that the residuals of 78 photographic epochs of minimum light from a linear ephemeris could be represented by a sine curve. He interpreted such a variation as being due to an orbital motion of the eclipsing system with

[1]Order No. in Astronomisches Jahresbericht.

**Table 1.** A list of the photometric observations of AB And.

| Year of obs. | Filter | Reference |
|---|---|---|
| 1930 | ph | Oosterhof (1950) |
| 1943 | ph | Woodward (1951) |
| 1948 | ph | Woodward (1951) |
| 1955 | B,V | Hinderer (1960) |
| 1958 | B,V | Binnendijk (1959) |
| 1962 | B,V | Kalchaev & Trutse (1956) |
| 1968 | B,V | Landolt (1969) |
| 1970 | B,V | Rigtering (1973) |
| 1976 | B,V | Tüfekçioğlu (1977b) |
| 1979 | B,V | Rovithis-Livaniou & Rovithis (1981) |
| 1979 | J,K | Jameson & Akıncı (1979) |
| 1981 | λ4686Å | Bell et al. (1984) |
| 1982 | λ4686Å | Bell et al. (1984) |
| 1989 | V | Maupomé et al. (1991) |
| 1989 | U,B,V | Demircan et al. (1993) |
| 1990 | B,V | Demircan et al. (1993) |
| 1991 | B,V | Demircan et al. (1993) |
| 1992 | U,B,V | Demircan et al. (1993) |

**Table 2.** New times of minimum light of AB And from our own observations (the first 16 rows) and from observations by Hinderer (1960) and Kalchaev & Turtse (1965).

| HJD (24400000+) | Mean Error | Band |
|---|---|---|
| 47836.3186 | 0.0004 | UBV |
| 47792.5095 | 0.0003 | UBV |
| 47793.5048 | 0.0003 | UBV |
| 47794.3339 | 0.0004 | UBV |
| 47795.3293 | 0.0005 | UBV |
| 48186.2986 | 0.0012 | BV |
| 48208.3701 | 0.0003 | BV |
| 48214.3447 | 0.0006 | BV |
| 48218.3268 | 0.0003 | BV |
| 48512.5474 | 0.0011 | BV |
| 48512.3812 | 0.0005 | BV |
| 48513.5434 | 0.0006 | BV |
| 48513.3777 | 0.0005 | BV |
| 48884.4321 | 0.0002 | UBV |
| 48885.2603 | 0.0002 | UBV |
| 48884.5958 | 0.0003 | V |
| 35371.6167 | 0.0002 | BV |
| 35370.4552 | 0.0001 | BV |
| 37905.2784 | 0.0005 | BV |
| 37906.2753 | 0.0008 | BV |
| 37907.2694 | 0.0004 | BV |
| 37908.2669 | 0.0006 | BV |
| 37908.4303 | 0.0004 | BV |
| 37934.3177 | 0.0012 | BV |

regard to a third body, and also noted some unexplained faster variation of the period with a smaller amplitude. The cyclic character of the period variation disappeared after the 1950s, and the variation was dominated by a period increase. Binnendijk's (1959) observed minima, for example, occurred about 50 min later than expected from Oosterhoff's (1950) ephemeris. The period increase was noted by Purgathofer & Prochazka (1967), by Landolt (1969), and finally by Maupomé et al. (1991). The continuous period increase, according to Maupomé et al. (1991), is at the rate of 0.83 s century$^{-1}$. However, Tüfekçioğlu (1977b), Panchatsaram & Abhyankar (1981) and Bell et al. (1984) have claimed that the orbital period of AB And has remained practically constant since the mid-1950s.

By using new additional data, we have decided to re-investigate the period variation of the system and its probable connection with the light-curve variations within the context of magnetic activity, and the third body in the system.

## 2 THE O − C VARIATION USING THE NEW DATA

From our observations, 16 (nine primary and seven secondary) new times of minimum light of AB And were calculated by the method of Kwee & van Woerden (1956). The new times of minimum, which are listed in Table 2, are all average values from observations in the *B* and *V* (or in the *U*, *B* and *V*) filters. All published times of minimum light available to us have been collected and used together with our new data. We have determined eight new times of minimum from the published original observations of Hinderer (1960) and Kalchaev & Trutse (1965). These are also listed in Table 2. We note that Tüfekçioğlu's (1977a) data used by Panchatsaram & Abhyankar (1981), and Bell et al.'s (1984) data used by Maupomé et al. (1991), are wrong [see the corrected data presented in Tüfekçioğlu (1977b), and the note added in proof at the end of Bell et al. (1984)]. The re-examined data of the new compilation, which are available on request from the authors, fill the gaps in the data considered by others and extend the observed minus calculated (O − C) diagram back to 1903 in one direction and up to 1993 in the other direction. The compilation, which altogether contains 650 times of minimum (132 photographic, 424 visual and 94 photoelectric), covers about 100 000 orbital periods, and thus should provide important information about the change of the orbital period of the system.

Knowing that the appearance of the O − C diagram for the times of minimum light depends very much on the choice of the light elements used in the calculation of the C-epochs, we formed O − C residuals by using different light elements (see Table 3). Three different O − C diagrams are shown in Fig. 1. The parabolic diagram with symmetrical branches in Fig. 1(c) is obtained by adjusting the light elements. Due to the large scatter, the visual data are not plotted in Fig. 1. The mean scatters in the visual, photographic and photoelectric data are approximately 0.02, 0.005 and 0.003 d, respectively. The scatter in the photoelectric data is much larger than the error in the determination of individual times of minimum, and may be due to the cycle-to-cycle variation of the light curves. Such variations in turn may be due to fluctuations in the mass-transfer rate or magnetic activity variations at the photospheric level. We note that the O − C residuals for the secondary minima are not statistically different from the others.

Initially, assuming an abrupt period increase in about 1950 and constant periods before and after 1950, we applied a linear least-squares fit to the pre- and post-1950 data separately. We thus found that the data can be repre-

**Table 3.** The linear light elements of AB And.

| $T_o$ (Min I HJD) | P(d) | Reference |
|---|---|---|
| 2425502.11989 | 0.331886486 | Oosterhoff (1950) |
| 25497.480 | 0.33188638 | Woodward (1951) |
| 24760.360 | 0.33188590 | Woodward (1951) |
| 36109.57835 | 0.33188940 | Binnendijk (1959) |
| 37915.0460 | 0.33188943 | Kalchaev&Truste (1965) |
| 40128.794474 | 0.3318922 | Landolt (1969) |
| 36109.57928 | 0.33189215 | Quester (1967) |
| 36109.5784 | 0.33189122 | Kukarkin et al. (1969) |
| 40128.79453 | 0.33189305 | Rigtering (1973) |
| 40128.7945 | 0.33189114 | Maupomé et al. (1991) |
| 48884.4315 | 0.33189121 | Present work |

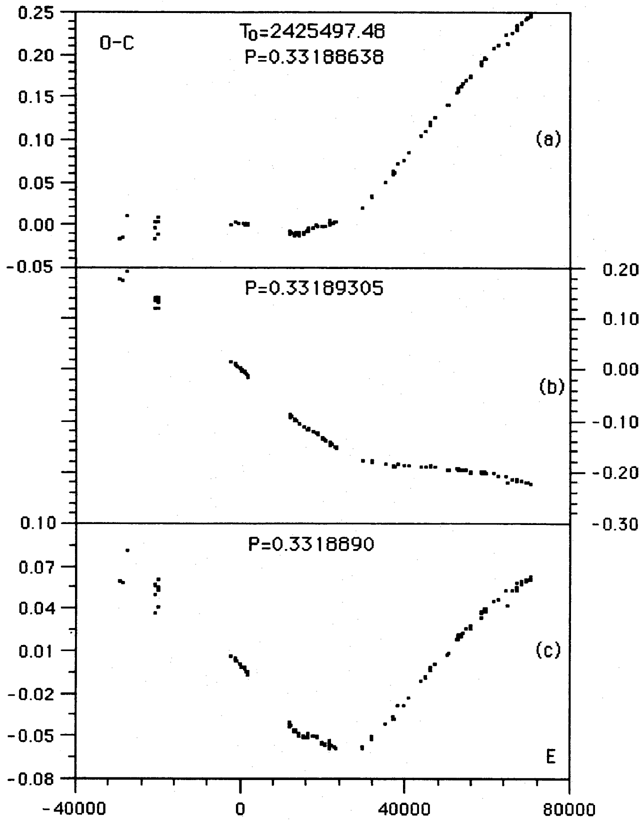


**Figure 1.** Three different O – C diagrams of AB And.

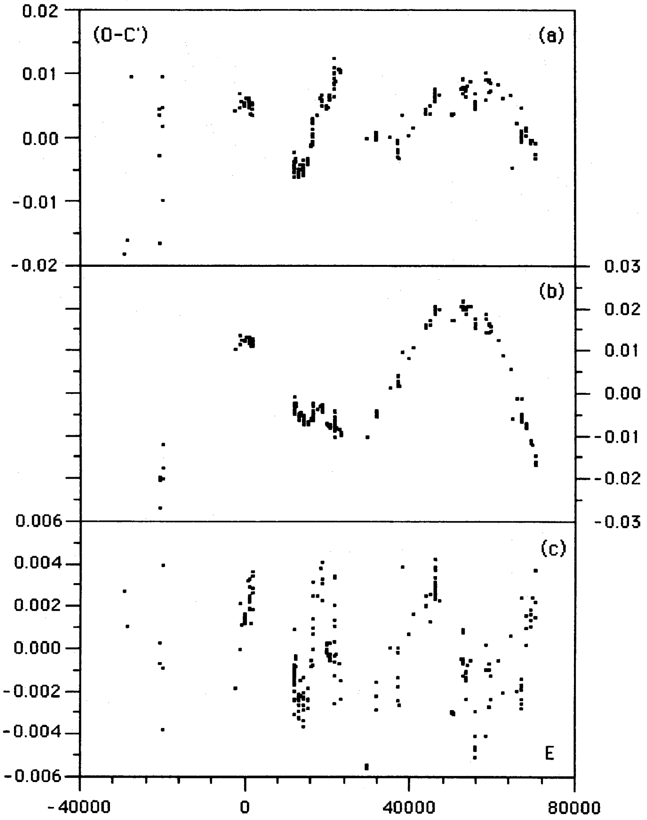


**Figure 2.** The O – C′ residuals obtained by using (a) two-component linear ephemerides, (b) the best-fitting quadratic ephemeris, and (c) the best-fitting sinusoidal ephemeris (see text).

sented by the following linear ephemerides:

$$\text{Min I} = \text{HJD } 242\,5497.4753(\pm 0.0007) + 0.331\,886\,32(\pm 4.3 \times 10^{-8})E \qquad \text{(before 1950)}$$

and

$$\text{Min I} = \text{HJD } 244\,0128.7951(\pm 0.0014) + 0.331\,892\,08(\pm 2.9 \times 10^{-8})E \qquad \text{(after 1950).}$$

The O – C′ residuals obtained by using these new ephemerides are shown in Fig. 2(a). The residuals scatter in a band of width 0.015 d, and we found that $\chi^2 = \Sigma(O - C')^2 \approx 0.0063$ as the goodness of fit. Next, assuming continuous period increase, we applied a quadratic least-squares fit to the photographic and photoelectric data (with the exception of the first 11 photographic data before 1911, which show relatively large scatter). The corresponding quadratic ephemeris is given by

$$\text{Min I} = \text{HJD } 242\,5497.4683(\pm 0.018) + 0.331\,886\,05(\pm 1.3 \times 10^{-7})E + 6.10 \times 10^{-11}(\pm 1.89 \times 10^{-12})E^2.$$

It should be noted that the goodness of fit of the parabolic representation, $\chi^2 = \Sigma(O - C')^2 \approx 0.0249$, is much worse than that of the previous linear one, and the corresponding O − C′ residuals oscillate in a band of width ≈ 0.025 d (see Fig. 2b).

A careful inspection of the O − C diagram in Fig. 1(c), particularly the ascending branch, indicates a shape more like a sine curve than a parabola. We thus also applied a sinusoidal fit of the form

$$O - C_s = A_s \sin\{[2\pi(E - T_s)/P_s] - \pi/2\}$$

to all photographic and photoelectric times of minimum light. Here, $A_s$, $P_s$ and $T_s$ are the half-amplitude (in days), the period (in orbital cycles), and a minimum time (in units of $E$) of the proposed sine curve of the O − C diagram. The $C_s$ estimates are obtained from the mean linear light elements $T_0$ and $P_0$ (see Table 3). All five parameters ($T_0$, $P_0$, $A_s$, $P_s$ and $T_s$) were adjusted to approach the best fit. The goodness of the fit was checked using $\chi^2$. The initial and best-fitting values of the parameters are listed in Table 4. The O − C′ residuals from the sinusoidal best fit, which are displayed in Fig. 2(c), oscillate in a band of width ≈ 0.008 d. The best-fitting parabolic and sinusoidal curves are displayed, superimposed on the observational data, in Fig. 3. By comparing the values of $\chi^2$ for the three possible representations, we found that the data are best represented by the following sinusoidal ephemeris:

$$\text{Min I} = \text{HJD } 242\,5497.4805 + 0.331\,8890E + 0.0580 \sin(0.000\,064\,91E - 3.115\,629).$$

## 3 THE CHARACTER OF THE PERIOD CHANGES

Based on the analysis in the previous section, we claim that the O − C variation, formed by the times of minimum light of AB And, is of a sinusoidal form, although only one cycle was covered. Since $P = P_0 + \mathrm{d}(O - C)/\mathrm{d}E$, the observed orbital period of the system also follows a sinusoidal variation. The analysis indicates a period decrease between about 1972 and 2016, which follows a period increase between about 1928 and 1972. The mean period $P_0$ in about 1928 and 1972 was found to be 0.331 8890 d. It was also found that $P_{max} = 0.331\,8928$ d in 1972, and $P_{min} = 0.331\,8852$ d in 1928 and 2016, with a half-amplitude of $\Delta P \approx 0.33$ s. The period of the cyclic variation is about 88.0 ± 0.2 yr. The character of the period variation is also seen by looking at the periods in the linear ephemerides listed in Table 3. We should note, before moving on, that the sinusoid O − C variation found by Oosterhoff (1950) is now understood to be the descending branch of our large-amplitude ($A \approx 0.0580$ d) sinusoidal variation. His study is equivalent to the representation of pre-1950 data by a straight line (see Fig. 2a). The cyclic variation of the deviations from the straight line is inevitable, and the period of Oosterhoff's (1950) sine curve is therefore about one-quarter of the period of the present complete cyclic variation. This is an important lesson to be learned in studying the period variations of eclipsing binaries based on incomplete data. We

**Table 4.** The parameters of the sinusoidal period variation of AB And.

| | $T_0$(HJD) | $P_0$(d) | $A_s$(d) | $T_s$(cycle) | $P_s$(cycle) | $\chi^2$ |
|---|---|---|---|---|---|---|
| Initial (graphical) | 2425497.4800 | 0.3318891 | 0.0600 | 23900 | 100000 | 7.29 $10^{-3}$ |
| Final (best fit) | 2425497.4805 | 0.3318890 | 0.0580 | 23800 | 96800 | 1.26 $10^{-3}$ |

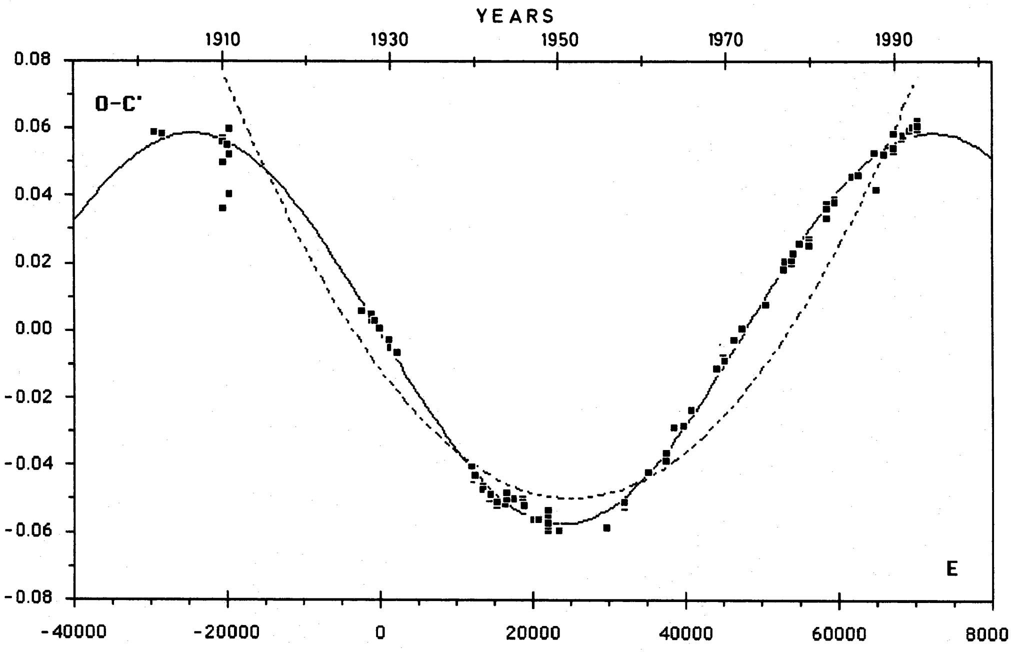


**Figure 3.** The best-fitting parabolic and sinusoidal curves superimposed on the O − C diagram.

believe that the present conclusion about the cyclic variation of the orbital period of AB And is almost certain, although the observational data cover only one cycle.

Apart from the large-amplitude sinusoidal variation of the orbital period, the relatively large scatter (with a peak-to-peak amplitude of about 0.008 d ≈ 11.5 min) of the residuals from the sinusoidal best fit as shown in Fig. 2(c) indicates seemingly semiregular (actually spurious), short-term, low-amplitude period changes. Such changes are probably due to cycle-to-cycle variations of the light curves.

## 4 THE LIGHT-CURVE VARIATIONS AND THEIR PROBABLE CONNECTION WITH THE PERIOD CHANGES

To study the light-curve variations of AB And, and their probable connection with the period changes, we first collected all available light curves, and plotted them on the same scale by using appropriate light elements from Table 3. Irregular variations in certain phase intervals, of up to 0.03 mag in the *V* filter and on a short time-scale (as short as a few cycles), were noted. Because of the gaps between observations, no sign of periodicity of the variations could be seen visually. The shape of the primary minimum and the slope of its flat bottom (when it exists) are also different in different light curves. The cycle-to-cycle variation of the light curve of up to 0.02 mag has already been noted by Rigtering (1973) between phases 0.60 and 0.70. Landolt's (1969) light curves clearly show a total primary eclipse and shoulders, evoking a detached or semidetached system. Similar shoulders, although less pronounced, are present in other light curves of the system. The flat bottom of the primary eclipse has a positive slope in Binnendijk's (1959) and Rigtering's (1973) *B* light curves, and a negative slope in Kalchaev & Trutse's (1965) and Rovithis-Livaniou & Rovithis's (1986) light curves. Since 1982, no totality has been evident in the primary eclipse of the light curves. We subsequently evaluated the light levels at the maxima and minima of all available light curves in the *B* and *V* filters. The light levels in differential $\Delta V$ observations and differential $\Delta(B-V)$ colours with respect to the same comparison star (BD + 35°4972) are plotted in Fig. 4. The error bars are the standard deviations from the mean brightness values. The differential colours were read at phase 0.75. We deduce the following characteristics.

(i) A long-term light variation of the system is significant and has the same character at all light levels and in both the *B* and *V* filters.

(ii) The maximum brightness of the long-term variation occurred in 1970 (± 3 yr).

(iii) In the ~20 yr from about 1970 to about 1990, the brightness of the system (in *B* and *V*) decreased by about 0.10 mag at the level of the primary minimum and primary maximum, but by about 0.06 mag at the level of the secondary minimum and secondary maximum. Unfortunately, the span of the data does not allow us to estimate a period or amplitude of the long-term variation. If the variation were periodic, however, then the lower limits to the period and amplitude would be about 40 yr and 0.1 mag (in *B* and *V*) respectively.

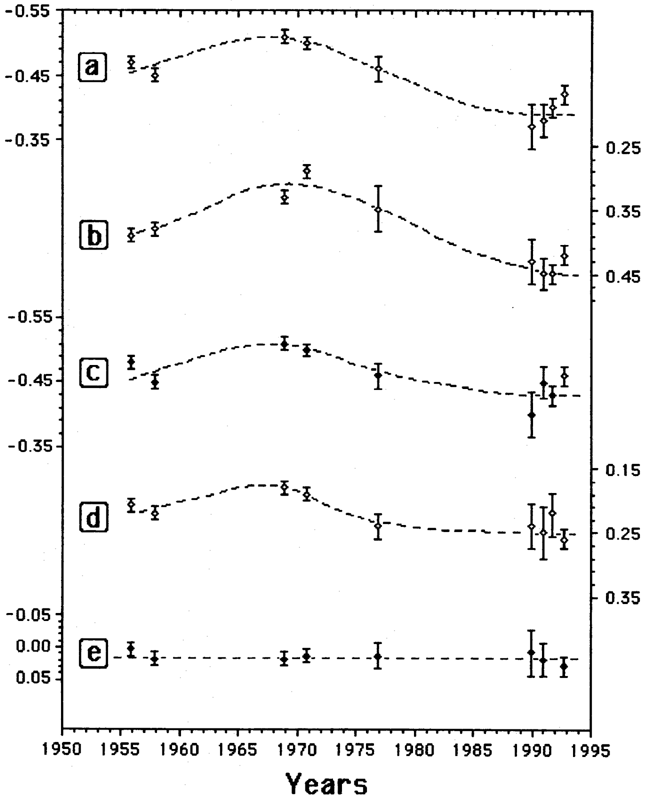


**Figure 4.** The long-term behaviour of the light levels [(a) the primary maximum; (b) the primary minimum; (c) the secondary maximum; (d) the secondary minimum] for the differential $\Delta V$ observations, and (e) the long-term behaviour of the differential $\Delta(B-V)$ colour at phase 0.75 of AB And, all with respect to the same comparison star (BD + 35°4972). The error bars are the standard deviations from the mean brightness values.

(iv) No significant long-term variation larger than ≈ 0.02 mag in $\Delta(B-V)$ is visible. The mean $\Delta(B-V) \approx 0.02 \pm 0.01$ mag.

(v) The short-term variations in the light levels of up to 0.03 mag are due to light-curve variations from cycle to cycle.

The long-term variation in the light levels cannot be explained by just the cyclic spot activity of the primary component, because the light levels at the secondary minima also show long-term variation. The light variation of the primary component is probably communicated everywhere around the system through the common convective envelope, although some damping arises at about phases 0.5 and 0.75.

Next, in order to study the possible connection between the cycle-to-cycle variation of the light curve and the low-amplitude short-term period changes, we found the depths of the minima, *D1* and *D2*, and the magnitude differences between maxima, $\Delta max = max1 - max2$, and between minima, $\Delta min = min1 - min2$, by using the light levels of all available light curves of AB And. The variation of these quantities in the *V* filter is shown in Fig. 5, together with the O − C′ residuals from the sinusoidal O − C variation. It can be seen that no general trend in the variations of *D1*, *D2*,

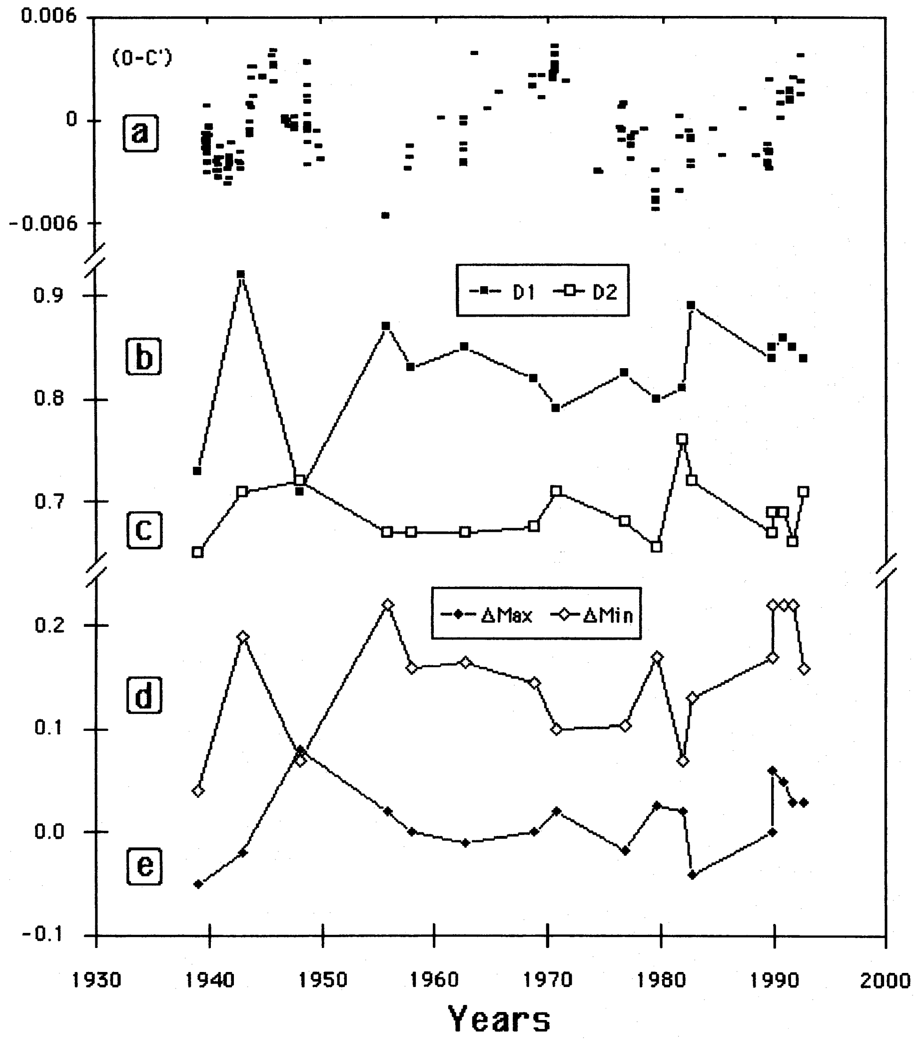


**Figure 5.** The variations of (a) the O – C′ residuals from the sinusoidal best fit to the O – C diagram, (b) the depths *D1* of the primary minima, (c) the depths *D2* of the secondary minima, (d) the difference between two maxima, $\Delta max$, and (e) the difference between two minima, $\Delta min$ (see text).



$\Delta max$ and $\Delta min$ is significant. We noted in our observations that a night-to-night variation of the light curves could occur over a few cycles, which is very much shorter than the time intervals between the published light curves of AB And. It is therefore clear that a large fraction of the scattering displayed in Fig. 5 is achieved in just a few cycles of orbital revolution. Although no significant connection between *D1*, *D2*, $\Delta max$ and $\Delta min$ and the short-term semiregular period variations is seen (due to insufficient and unevenly distributed data), we think that the connection exists. Only future systematic and continuous observations may help to reveal the connection.

## 5 INTERPRETATIONS AND DISCUSSION

The large-amplitude sinusoidal variation of the observed orbital period of AB And can be caused by either (i) the period modulation due to the magnetic activity cycle of one or both component stars, or (ii) the light-traveltime effect due to a third body in the system. If mechanism (i) applies, we predict that (1) the secular light variation and the O – C curve formed by the times of minimum light should have the same cycle length, (2) extrema in one should coincide with extrema in the other, and (3) the colour of the system should become bluer as the star brightens (cf. Applegate 1992). A long-term brightness variation of the AB And system with a maximum in 1970 was deduced in the previous section. Unfortunately, it is not known whether the variation has a cyclic nature. Moreover, the maximum of this variation does not coincide with the extremum, but coincides with a reflection point of the O – C curve when the orbital period is a maximum. No significant long-term colour variation larger than ≈ 0.02 mag has been seen in the last 40 years. It is known that the orbital period extrema occur 90° in phase after the extrema of the O – C curve, and the phase of the luminosity variation in Applegate's (1992) theory depends on the sense of the differential rotation of the component star causing the period modulation. If the outside of the star spins faster than the inside then the luminosity and O – C diagram are 180° out of phase; the luminosity maximum occurs at the O – C minimum. If, on the other hand, the inside spins faster than the outside, the luminosity and O – C diagram will be in phase (Applegate 1992). Clearly, neither case is valid for AB And, where the luminosity and O − C diagram are 90° out of phase. Such a phase shift can be explained in terms of the response of the convective envelope to the variable energy input. If the response is not fast enough, the variations in the heat flow will be damped and such a damping should produce a phase shift between the O − C diagram and the luminosity variation. In the case of CG Cyg, which is a short-period RS CVn system, Hall (1991) found no phase shift between the O − C diagram and the luminosity variation. This means that no damping is applied to the luminosity variation by the convective zone of the active star in CG Cyg.

We further investigate the possibility of period modulation due to the magnetic activity cycle of a component of AB And. The mechanism requires that the active star be variable. Assuming that the long-term variation of the luminosity is originally due to an active primary, and by using the absolute dimensions derived by Hrivnak (1988) in Applegate's (1992) formulation, an angular momentum transfer of $\Delta J \approx 3.13 \times 10^{47}$ g cm$^2$ s$^{-1}$ is required to produce the observed large-amplitude cyclic period change of $\Delta P \approx 0.33$ s (or $\Delta P/P \approx 11.5 \times 10^{-6}$). If the energy requirement of $\Delta E \geq 2.34 \times 10^{41}$ erg is supplied by the nuclear luminosity with no energy storage in the convective zone, the active primary will be variable with an rms luminosity variation of $\Delta L \geq 0.07$ $L_\odot$. Although no damping by the convective zone is applied, the minimum values of the quantities $\Delta E$ and $\Delta L$ are estimated by Applegate's (1992) formulation. It is also assumed in defining $\Delta E$ that the mass of a thin outer shell, which determines the quadropole moment, is only one-tenth of the mass of the star. The minimum $\Delta L$ estimate corresponds to about 0.1 mag as the full amplitude of the brightness variation of the system, which is surprisingly similar to the observed minimum amplitude of the long-term variation as deduced in Section 4. Finally, Applegate's (1992) formulation gives a mean subsurface magnetic field of 7.4 kG. Thus the numbers imply that Applegate's (1992) theory explains the observations.

The second mechanism to explain the long-term sinusoidal period variation requires an orbital motion of AB And about a third component star in the system. In this case the secondary orbit should be circular, and most probably coplanar with the binary orbit. The predicted period ($P_s \approx 88.0$ yr) and semi-amplitude ($A \approx 0.0580$ d) of the long-term sinusoidal O − C variation in Fig. 3 lead to a mass function of $f(m_3) \approx 0.13$ $M_\odot$ for the hypothetical third body. With the assumption of a circular and coplanar orbit for the third body, we obtain $m_3 \approx 0.9$ $M_\odot$ by using the absolute dimensions given by Hrivnak (1988). The third body, if it exists, revolves far beyond the outer Lagrangian points of AB And, and its orbit should be stable. Assuming that the third body is a main-sequence star, the mass–luminosity function $M_b = (4.67 - 9.79) \log m$ (cf. Demircan & Kahraman 1991) for $m > 0.7$ $M_\odot$ yields a bolometric absolute magnitude of the third body of $M_b \approx 5.1$ mag, which is only 0.8 mag fainter than AB And. We estimate that the photometric effect of such a bright companion does not allow the formation of deep eclipses in the light curves of AB And. Therefore the third body, if it exists, can only be a low-luminosity white dwarf. It should be noted that, in a recent spectroscopic study of AB And by Hrivnak (1988), there is no mention of any feature attributable to the hypothetical third component. If it exists, the position of the third body at present should be very close to the line of sight, which is the worst position in terms of Doppler shift and astrometric detectability. In about 20 yr, in the 2010s, the angular separation of the third body from AB And will be about 0.2 arcsec. However, the easiest way to detect the white dwarf component – if it exists – is to study ultraviolet spectra of the system. Unfortunately, AB And has not been observed to date in the ultraviolet with the *IUE* satellite (*IUE* Merged Log, up to 1992, June 30).

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