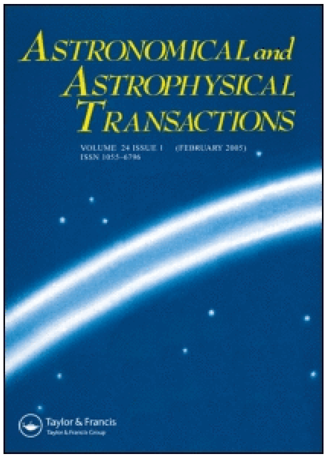

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Latest results on the period behaviour of the contact binary AB And

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Latest results on the period behaviour of the contact binary AB And

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The $O - C$ diagram of the contact eclipsing binary AB And was reanalysed, using data obtained up to now. It was thus found that the real period variations, presented by the $P(E) - P_e$ function, have changed; both P_{mod} and its amplitude continue to decrease. Moreover, assuming that the observed orbital period changes of AB And are due *only* to magnetic activity, the variation in the magnetic field and also P_{mod} were calculated. As their variability was found to be less than that of other examined cases, this is connected to the $O - C$ diagram shape of AB And.

Keywords: Binary star; Eclipsing star; Period changes

1. Introduction

The eclipsing binary AB And was the first system to which a new method [1] was applied in detail [2]. It was then shown that using two different ephemeris formulae the $P(E) - P_e$ function, presenting the real period changes, remains unchanged. Moreover, from the analysis of data up to 1992, two possible periodic terms were detected, together with a long-term variability. The periodic terms were ascribed to the possible existence of a third component, and to magnetic activity cycles [2].

As there remains a need to find out whether these first results continue to be valid or change with time as more data are added, AB And is under continuous observation, and here we present our new findings.

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2. $O - C$ analysis and results

The $O - C$ diagram of AB And (to which the data found up to now have been added) was analysed using the technique described in [1]. It was thus found that it is still approximated by a sixth-order polynomial, as in our previous analysis. The new polynomial's coefficients are slightly different, as expected, since more data were considered. Figure 1 presents this diagram, where the new data are indicated as open diamonds.

Then, the real period changes were computed, and the derived $P(E) - P_e$ function is presented in figure 2 as a solid curve; the dashed curve represents where the detected long-term variation of 6.864×10^{-11} days epoch^{-1} or 7.549×10^{-8} days year^{-1}, corresponding to 6.522×10^{-3} s year^{-1}, has been subtracted.

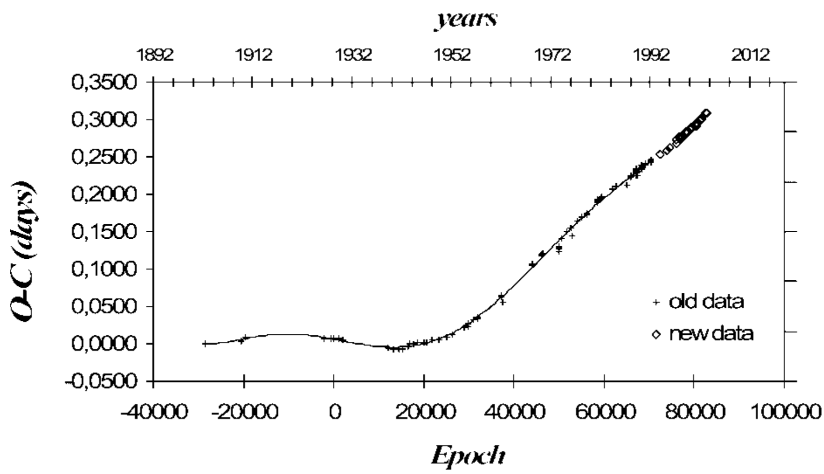

Figure 1. The $O - C$ diagram of AB And. The solid curve presents the sixth-order polynomial used for the best description of the the data up to 1992, while the new data are indicated by open diamonds.

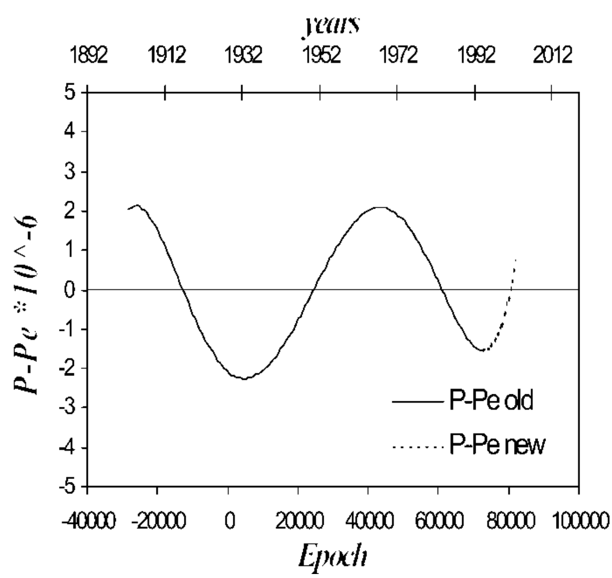

Figure 2. The real orbital period changes of AB And from the old and new analyses.

From the present analysis the following should be noted. Although the orbital period changes of AB And (from the analysis of the data up to 1992 and from the new data (dashed curve)) are in excellent agreement, the $P(E) - P_e$ function no longer shows the old sinusoidal variation; both P_{mod} and its amplitude continue to decrease, as is obvious from figure 2. It will be very interesting to see what their further behaviour is in the future.

Furthermore, and in order to check the existence of any possible periodic term, we applied Fourier transforms to the $P(E) - P_e$ function. This was performed with one periodic term (Fourier A) of $P_{mod} \approx 50$ years, with amplitude $\Delta P = 1.55 \times 10^{-6}$ days, and with two periodic terms (Fourier B) of $P_{mod,1} \approx 54.5$ years, with amplitude $\Delta P_1 = 1.76 \times 10^{-6}$ days, and $P_{mod,2} \approx 13.6$ years, with amplitude $\Delta P_2 = 8.63 \times 10^{-8}$ days. However, neither Fourier A nor Fourier B represents satisfactorily the $P(E) - P_e$ function. This means very possibly that the periodic terms are not real, or at least the longer periodic terms are not real. So, the magnetic activity cycles seem to offer a better explanation for the observed orbital period changes of AB And. This is consistent with the behaviour of its light curves also, as was shown

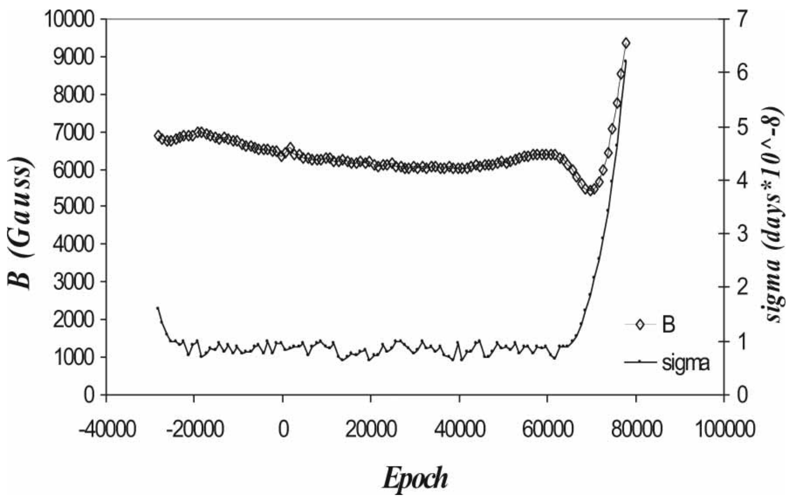

Figure 3. The variation in the magnetic field for the primary component of AB And, and its error σ.

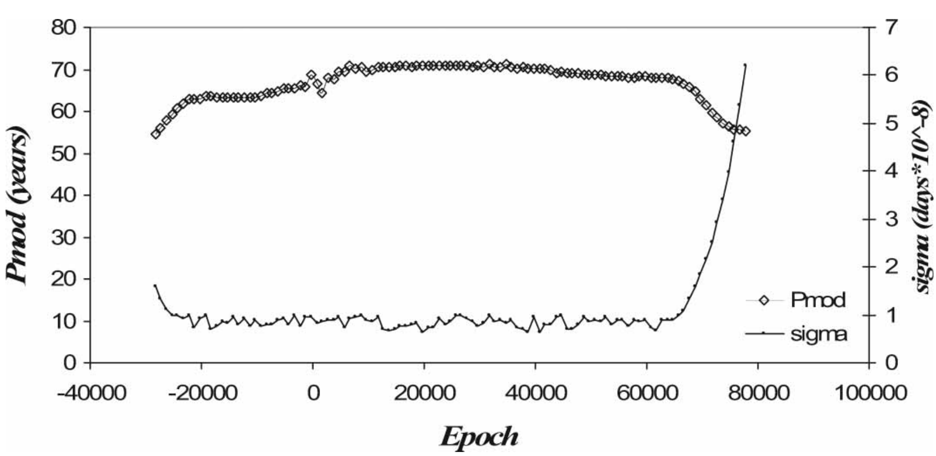

Figure 4. P_{mod} and its error σ.

from a long-term analysis (from 1968 to 1995) [3]. Thus, the new approach that we proposed recently [4] was applied.

According to this, assuming that the observed orbital period changes of AB And are due *only* to magnetic activity, we can find the variation in the magnetic field, and also P_{mod}, if we approximate the $P(E) - P_{\mathrm{e}}$ function by a variable sinusoidal term [4]. These are shown in figures 3 and 4, respectively. Although spots were found in both components [3], here we limited our results to showing those for the primary component, because the only difference in the case of the secondary star is that the magnetic field was found to be about 2000 G larger.

The features that are really interesting in these two figures, apart from the expected behaviour of the error σ at the two ends, are the very small change in B and the rather stable value of P_{mod} over a long time. This is not so in other examined cases [4, 5]. As the other cases concern RS CVn-type binaries while AB And is a contact system, it will be interesting to find out whether these differences are due to their different natures or whether they arise for another reason.

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