ORBITAL PERIOD CHANGES OF THE ECLIPSING BINARIES *OO AQUILAE* AND *V471 TAURI*

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Abstract
The orbital period changes of the systems ***OO Aql*** *and* ***V471 Tau*** *are investigated. Long variation terms –decreasing for the first and increasing for the latter system– were found. While, the detected periodic terms might not be real for both systems.*

Introduction

Continuing to study the orbital period behavior of close binaries, using the method we proposed ten years ago[1], we present here our results for the systems ***OO Aql*** and ***V471 Tau***.

OO Aql is a rare contact binary that belongs to the ***A*** *sub-class* of the well-known *W UMa*-type group. It is a *G5 V* binary with an unusually high mass-ratio, (*q= 0.843*).

V471 Tau is an eclipsing binary consisting of a *white dwarf* (of T≈35000K and R≈7000Km), and a *cool K2V* star (of T≈4900K and R≈520000Km). Moreover, its membership to the Hyades cluster[2], makes it very important to study various problems of stellar astrophysics.

2. Orbital Period Study of *OO Aquilae*

Using all times of minimum light of ***OO*** Aql, its (O-C) diagram was constructed based on the linear light elements[3]:

$$\text{Min I} = 2438239.664 + 0.5067887 \cdot E$$

Then, following the first continuous method[1], we found that this diagram can be best described by a fifth order polynomial, (Fig. 1), the coefficients of which are given at Table I. Then, the real orbital period changes of ***OO Aql*** –in terms of the ***P(E)-P$_e$***, where ***P$_e$*** is the constant period of 0.5067887 *days* used to construct the (O-C) diagram of the system- and its rate of change were calculated and are presented in Fig. 2 and Fig. 3, respectively.

Table I

Coefficients of the 5th order polynomial used for the (O-C) diagram description of OO Aql

c_0 = 0.0485	c_2 =-0.7174	c_4 = 1.7712
c_1 = 0.1403	c_3 = 0.4151	c_5 =-1.4913

scale constant $5x10^4$

From Fig. 2, where the ***P(E)-P$_e$*** function is presented, a *long-term variation* of the order of: ***–1.43x10****d/E*, corresponding to ***–1.03x10****d/y***,** or to ***–0.0088****s/y* was detected, (dashed straight line). Moreover, a periodicity of ***55*** years (or double) is obvious.

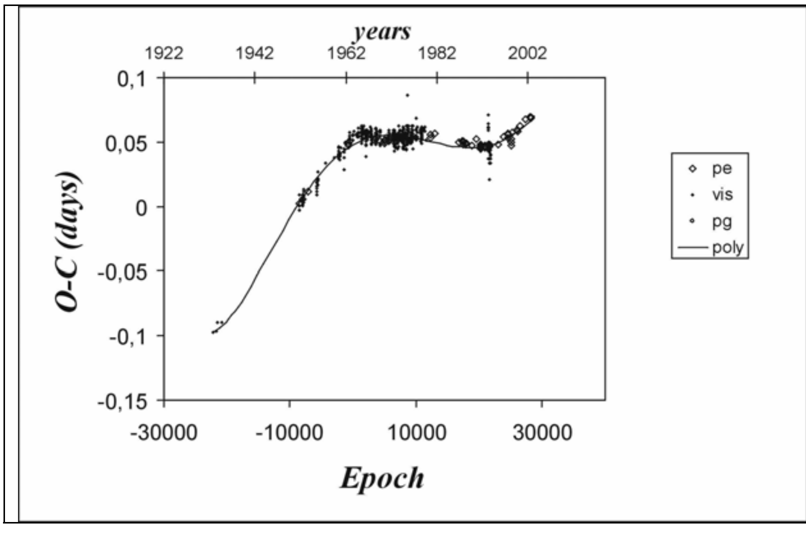

Fig. 1

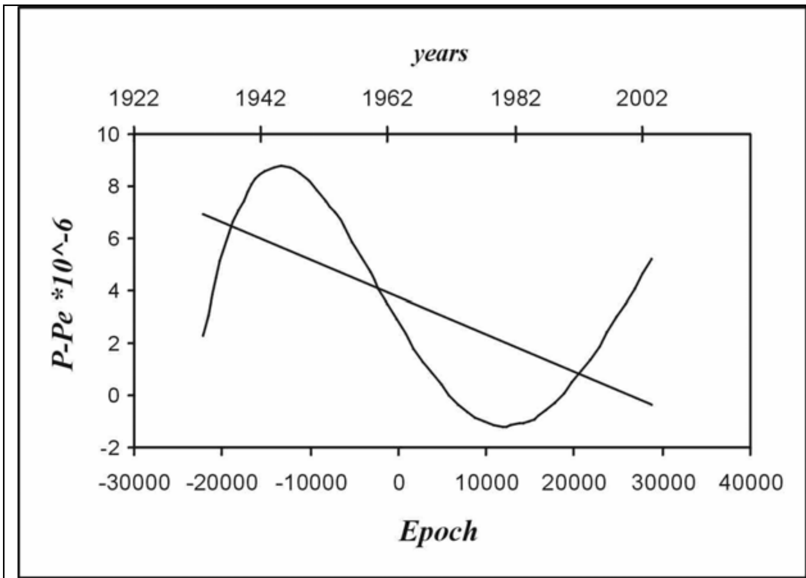

Fig. 2

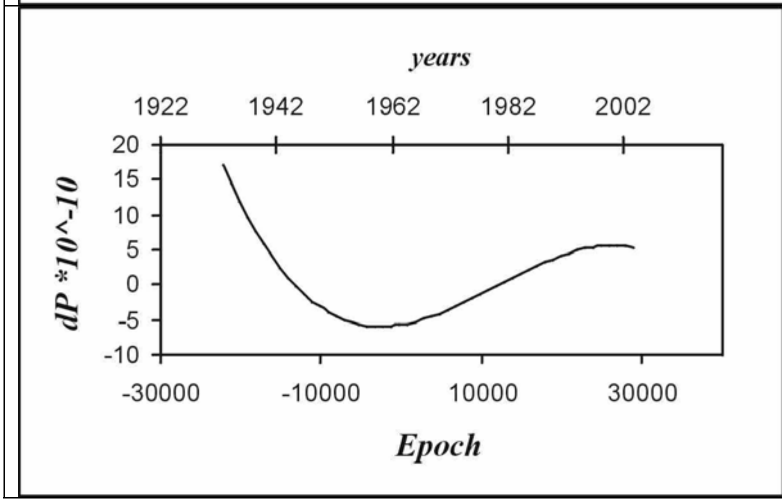

Fig. 3

3. Orbital Period Study of *V471 Tauri*

From all times of minimum light of ***V471 Tau***, its (O-C) diagram was constructed based on the linear light elements[4]:

$$\text{Min I} = 2440610.06413 + 0.52118334 \cdot E$$

Repeating the same procedure as previously, it was found that the (O-C) diagram of ***V471 Tau*** can be best described by a sixth order polynomials, (Fig. 4), the coefficients of which are given at Table II. While, Figs. 5 & 6 are similar to 2 & 3, presenting the real period changes and the rate of change but for ***V471 Tau***.

From Fig. 5, a *long-term variation* of the order of: ***4.03x10****d/E*, corresponding to ***2.82x10****d/y***,** or to ***0.0024****s/y* was detected, (dashed straight line). Moreover, a periodicity of about ***22.8*** years was detected by applying discrete Fourier transform to the ***P(E)-P****e* function of ***V471 Tau***.

Table II

Coefficients of the 6th order polynomial used for the (O-C) diagram description of V471Aql

c_0 = 0.0006	c_2 = 0.0025	c_4 = 0.6962
c_1 = 0.0061	c_3 =-0.2318	c_5 =-0.7859
	c_6 = 0.3136	scale constant 1.7×10^4

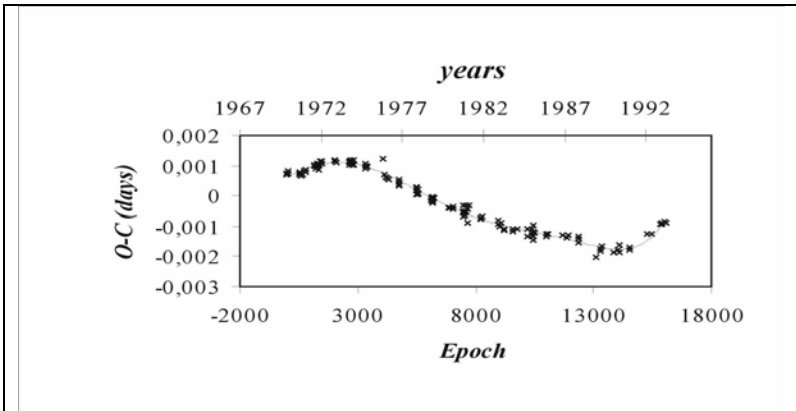

Fig. 4

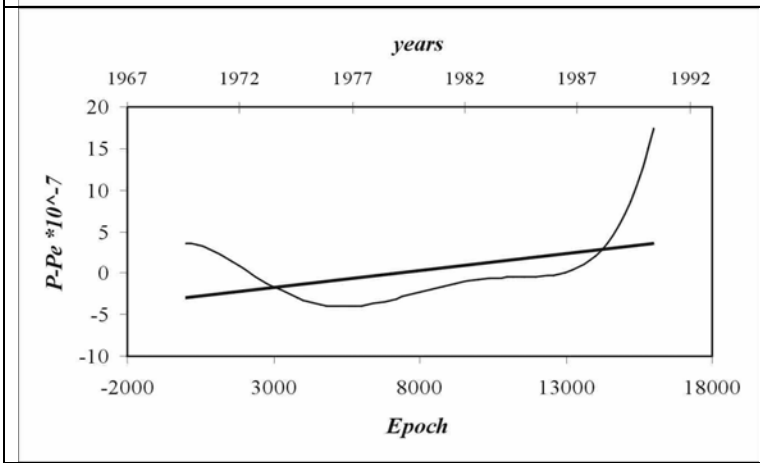

Fig. 5

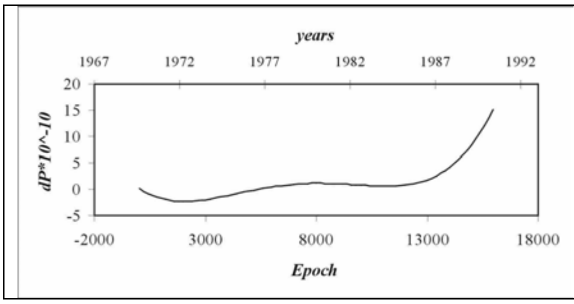

Fig. 6

4. Discussion

The orbital period changes of both systems presented here, have been also studied by some other investigators[3],[2]. Considering our and their results, we note that although the sets of observational data used -in both cases- were not the same, the detected periodic terms correspond to either the time interval covered by the analyzed observations, or to half of it. ***So, they might be not real***. For this reason, we limit ourselves to present the period changes (and their rates of changes) only.

Moreover, for ***OO Aql***, as is obvious from Fig. 2, there is not any period jump around 1963, as has been reported[3]. And it is better to wait and see if its observed period variations are due to the presence of a third body, to magnetic activity cycles[5], or if there is not any periodic term at all.

The same is true for ***V471 Tau***, although if the periodicity is real and suppose that is due to the light-time effect, it yields to a very interesting result concerning the third body's mass: it is very small, a sub-solar mass like that of a *brawn dwarf*. But even so, we have to wait to get reliable results.

Acknowledgements

This work was partly financial supported by the Athens University (grant no. 70/4/3305).

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