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ON THE INTERCONNECTION OF THE PULSATIONAL AND ORBITAL PERIOD VALUES FOR BINARY SYSTEMS

We pay attention to the existence of the unusual "synchronization" between pulsational and orbital motion in the close eclipsing and spectroscopic binaries containing pulsating components of different types: the orbital period contains almost an integer of pulsation cycles. Earlier several authors have already noticed the same effect for individual stars: Delta Scuti star AB Cas (O.A. Chekanikhina, M.S. Frolov, B.N. Irkaev, Inf. Bull. var. Stars, No. 1382, 1978), RR Lyrae stars V 80 in the dwarf galaxy Ursa Minor and RW Ari (K.A. Sidorov, Var. Stars 20, 557, 1978). Probably RW Ari is single RR Lyrae star according to recent observations.

We have prepared the list of known Delta Scuti, Beta Canis Majoris and Cepheid pulsating stars in the short period eclipsing or spectroscopic binary systems. This list contains 27 objects with both orbital and pulsation periods known (in the case of multiperiodicity we prefer the period corresponding to the highest light amplitude). For 16 of these having the error of the ratio $N=P_{orb}/P_{puls}$ not exceeded ± 0.05 we have calculated the value $\Delta = |P_{orb}/P_{puls} - A|$, where A is the nearest integer. Δ is the measure of deviation rate from the case of the exact synchronization ($\Delta=0$).

It stands to reason that the error of the ratio P_{orb}/P_{puls} depends not only on the period errors but also on the ratio value itself. Therefore one can say nothing on this effect in the case of wide pairs.

The data on 16 binaries with pulsating components are given in Table I; eclipsing systems are denoted by asterisks. V 80 in UMi is the unique really eclipsing RR Lyrae star known to-day, which has been discovered by P.N. Kholopov (Var. Stars 18, 117, 1971).

EN Lac is the first known to-day eclipsing system with the Beta CMa pulsating star. Both components of the spectroscopic binary Delta Del are Delta Scuti variables.

Table I

No.	Name	Type	$N=\frac{P_{orb}}{P_{puls}}$	$\Delta=\left\|\frac{P_{orb}}{P_{puls}}-A\right\|$
1*	V 80 (UMi)	RR	4.15	0.15
2	FF Aql	Cep	320.96	0.04
3	BL Tel	Cep?	11.95	0.05
4	KW Aur	Delta Sct	43.01	0.01
5*	Y Cam	Delta Sct	49.74	0.26
6	Delta Del	Delta Sct	{299.38 261.82	{0.38 0.18
7	V 644 Her	Delta Sct	102.98	0.02
8*	AI Hya	Delta Sct	60.06	0.06
9	BS 8210	Delta Sct	49.75	0.25
10	Nu Cen	Beta CMa	15.00	0.00
11	Beta Cep	Beta CMa	57.18	0.18
12	V 600 Her	Beta CMa	25.27	0.27
13*	EN Lac	Beta CMa	71.51	0.49
14	Psi Ori	Beta CMa?	8.20	0.20
15	Gamma Peg	Beta CMa	45.01	0.01
16	Alpha Vir	Beta CMa	23.10	0.10

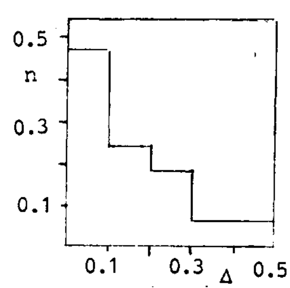

Figure 1

In Fig. 1 we show the distribution in number versus the value Δ for these objects. One can see that the case of the strict synchronization (Δ=0) is the most probable state for these systems.

Maybe our result on Y Cam, one of the eclipsing binaries with a Delta Sct pulsating component, is the evidence of the unusual pulsation in the presence of the close companion. We have observed this object photoelectrically during three nights JD 2444222-4 by using the 48-cm reflector of the Alma-Ata High Altitude station of the Sternberg Astronomical Institute. We have confirmed the results which had been received earlier by P. Broglia and F. Marin (Astron. Astrophys., 34, 89, 1974) on Delta Scuti nature of the brighter component of this Algol system (Fig. 2). The light amplitude is strongly changing during our short time observing in-

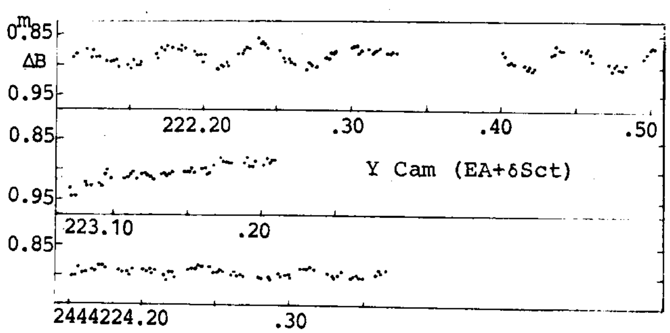

Figure 2

terval from $0^m.05$ to about $0^m.01$ in B light. The period also varies from $0^d.056$ to $0^d.073$.

We have determined the average period for the pulsating component $0^d.066458$ on the basis of long series of observations published for Y Cam (P. Broglia, P. Conconi, Milano-Merate Publ. No. 27, 1973) by using S. Yu. Shugarov's programme for period determination. The observations during minima were excluded. We were surprised that it was possible to obtain the mean curve based on only single period during 13000 pulsation cycles for such a "semiregular" star. This mean light curve is shown in Fig. 3.

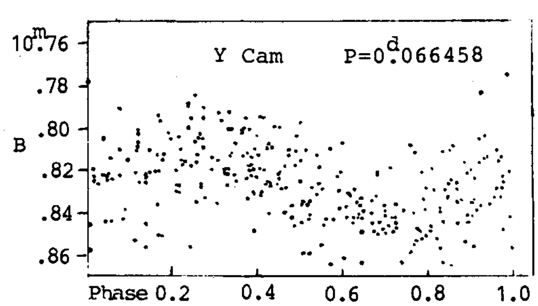

Figure 3

Maybe, just the presence of the close companion makes the star pulsate much more regularly than in the single case.

What is the reason of the "synchronization" between the pulsation of the component and the orbital movement in shortperiodic binaries?

Maybe, this is an effect of the tidal action of the close companion on the pulsational process in accordance with the well known Fitch's hypothesis. Maybe, however, this is the coincidence of the P_{puls} and not the P_{orb} but the axial rotation period P_{rot} of the same pulsating star. Indeed, $P_{orb}=P_{rot}$ for many binaries. If so, the binarity is only the good tool for discovering the coincidence because P_{rot} is unknown for the single pulsator due to the "sin i" factor.

In the light of the second hypothesis one can suppose that the range of dispersion seen in Fig. 1 must be smaller in reality: for several systems possibly $P_{orb} \neq P_{rot}$. Just in these cases the large values of Δ (poor synchronization) can occur. It would be interesting to test this; maybe Delta Del is one of such systems.

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