ON THE PERIODS OF RV TAU STARS

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ABSTRACT. On the base of GCVS (General Catalogue of Variable Stars) sampling has been carried out the analysis of periods of RV Tau stars (87 RV Tau stars with the known periods). We have given an interpretation of the histogram of periods distribution of these stars on the base of mode composition. All the peaks were identified as a fundamental period, its first, second and other overtones and their harmonics. It was proposed a new classification of these variable stars according to their mode identifications.

Key words: Stars: δ Scuti, RR Lyrae, RV Tau, classical Cepheids, bimodal Cepheids, β Cep stars, histogram of periods distribution, mode identifications

On the base of the sampling (87 RV Tau stars with the known periods) taken from the fourth edition of the General Catalogue of Variable Stars (volumes 1-3, hereafter GCVS) we have constructed two histograms of periods distribution of these variable stars. They are given in Tables 1 and 2 and shown in Figures 1 and 2.

The intervals of periods in these two histograms are 5 and 2 days respectively. As we can see (Tab.1 and Fig.1), the main peak of periods distribution (with the amplitude N=11 stars) is at the mean period about 78 days. But more detailed histogram (see Fig. 2) shows two peaks at 75 and 80 days with the equal amplitudes. The ratio of these periods is equal 0.9375 - this rate coincides with one for a fundamental period P_f to double period P_s, the latter has found by us in frequency analysis of bimodal Cepheids and RR Lyrae - type stars (Bezdenezhnyi, 1997a, 1997b). So we have: P_f=75 days and $2P_s$=80 days.

The following significant peak is at the mean period about 62.5 days with the amplitude N=8 stars (see Fig. 1). It furcates in two peaks (see Fig. 2): at 61 and

Table 1: The histogram of RV Tau stars' periods distribution (dP=5 days)

ΔP	N	ΔP	N	ΔP	N
25 - 30	1	105 - 110	1	190 - 195	0
30 - 35	1	110 - 115	2	195 - 200	1
35 - 40	1	115 - 120	2	200 - 205	1
40 - 45	2	120 - 125	1	205 - 210	0
45 - 50	2	125 - 130	1	210 - 215	2
50 - 55	3	130 - 135	1	215 - 260	0
55 - 60	4	135 - 140	5	260 - 265	1
60 - 65	8	140 - 145	2	265 - 275	0
65 - 70	7	145 - 150	1	275 - 280	1
70 - 75	1	150 - 155	1	280 - 285	0
75 - 80	11	155 - 160	1	285 - 290	2
80 - 85	5	160 - 165	1	290 - 355	0
85 - 90	4	165 - 170	1	355 - 360	1
90 - 95	2	170 - 175	0	375 - 380	1
95 - 100	0	175 - 180	1		
100 - 105	4	180 - 185	0		

Table 2: The histogram of RV Tau stars' periods distribution (dP=2 days)

ΔP	N	ΔP	N	ΔP	N
28 - 30	1	74 - 76	5	120 - 122	1
30 - 32	0	76 - 78	1	126 - 128	1
32 - 34	1	78 - 80	5	130 - 132	1
34 - 36	0	80 - 82	4	134 - 136	4
36 - 38	0	82 - 84	1	136 - 138	1
38 - 40	1	84 - 86	1	142 - 144	2
40 - 42	2	86 - 88	2	146 - 148	1
42 - 44	0	88 - 90	1	150 - 152	1
44 - 46	0	90 - 92	1	156 - 158	1
46 - 48	1	92 - 92	1	162 - 164	1
48 - 50	1	94 - 96	0	168 - 170	1
50 - 52	2	96 - 98	0	174 - 176	1
52 - 54	0	98 - 100	0	194 - 196	1
54 - 56	3	100 - 102	1	200 - 202	1
56 - 58	0	102 - 104	2	210 - 212	1
58 - 60	2	104 - 106	0	212 - 214	1
60 - 62	5	106 - 108	0	260 - 262	1
62 - 64	2	108 - 110	1	278 - 280	1
64 - 66	4	110 - 112	1	284 - 286	1
66 - 68	2	112 - 114	1	286 - 288	1
68 - 70	2	114 - 116	0	352 - 354	1
70 - 72	1	116 - 118	1	374 - 376	1
72 - 74	0	118 - 120	1		

65 days. These ones are nearby to the periods P_e=60 days and P_r=66.7 days identified from multiple ratios with the fundamental period. The periods P_e and P_r were introduced by the author earlier (Bezdenezhnyi, 1994a, 1994b) for RR Lyrae-type and δ Scuti stars. To the left of these periods we find out the step with the mean period 57.5 days coincident to the theoretical first overtone P_{1H}=56.2 days.

The following step with the main period 52.5 days (to the left) in the histogram (see Fig. 1) coincident to the period P_g=2/3 P_f=50 days, that was introduced by us in above works (Bezdenezhnyi, 1994a, 1994b). We have the peak at period 51 days in the Fig. 2. And on to the left we have the step with the mean period about 45 days. It coincident to the second overtone period P_{2H}=0.6P_f=45 days. Then one can see (Fig. 2) the peak (with amplitude N=2) at period of 40 days equal to P_s=40 days and two periods with small amplitudes (N=1): at period of 33 days next to one $P_r/2$=33.3 days and at period of 29 days close to $P_e/2$=30 days.

Now let us identify the periods bigger than the main peak one (to the right). In the both pictures (Fig. 1 and 2) are seen distinct peaks at period of 102 days. It can be identified as double period P_g: $2P_g$=100 days. To the left of this one we can see the step (Fig.1) and the peak (Fig.2) coincident to period of the second overtone $2P_{2H}$=90 days. Then (to the right) follows three double periods: $2P_{1H}$=112 days, $2P_e$=120 days and a higher peak at 135 days coincident to $2P_r$=133.3 days. The mean of seven periods in the region of $2P_r$ is equal 133.8 days, that is close to the theoretical meaning 133.3 days. We can notice that the small peaks (N=1) at the multiple periods are present too: 2Pf=150 days, 4Ps=160 days, $4P_{2H}$=180 days, 4Pg=200 days, 4Pr=266.6 days and $8P_{2H}$=360 days.

Though the sampling of RV Tau stars with the known periods in GCVS is not large, we could identify the primary peaks in the histogram of periods distribution. The ratios of periods show that periods are commensurable (often - multiple ones), as in the case of other types pulsating stars. The histogram of RV Tau stars' periods distribution is similar to ones of δ Scuti, β Cep, RR Lyr stars, classical and bimodal Cepheids, and even of pulsars (Bezdenezhnyi, 1994b, 1997a,b,c,d,e, 2001a,b, 2004, 2005a,b). Individual values and mean peaks of periods of RV Tau stars confirm their commensurability with three splite primary periods: P_α=0.1081, P_β=0.1126 and P_γ=0.1042 days. One of this periods (0.1126 days) coincide with radial fundamental period of the Sun oscillation (Bezdenezhnyi, 2005b, in this volume). The ratios of these commensurabilities are in rather large ranges (260 - 3330), reflecting big differences in periods of RV Tau stars. At that point of view a lot of periods may be identify with radial ones without attracting non-radial oscillations.

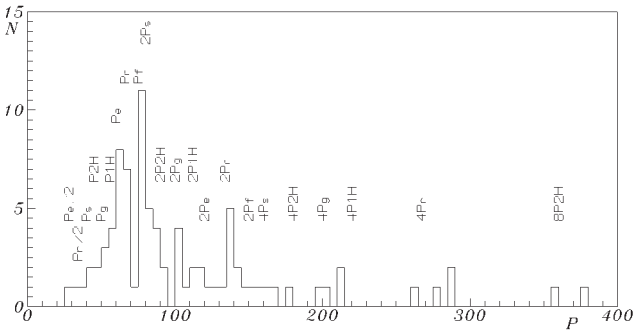

Figure 1: The periods distribution of RV Tau stars (dP=5 days)

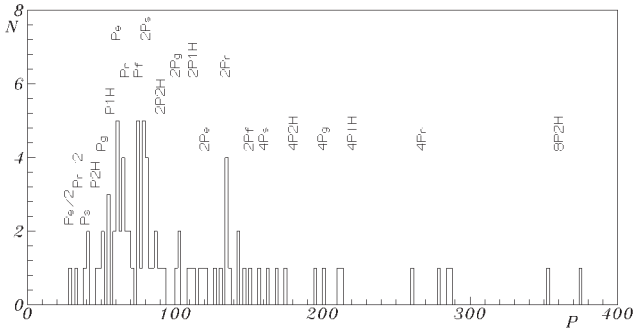

Figure 2: The periods distribution of RV Tau stars (dP=2 days)

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