Mon. Not. R. Astron. Soc. **370,** 2013–2024 (2006) doi:10.1111/j.1365-2966.2006.10628.x

A catalogue of close binaries located in the δ Scuti region of the Cepheid instability strip

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Accepted 2006 May 26. Received 2006 May 11; in original form 2006 January 23

ABSTRACT

A catalogue of close eclipsing binary systems (detached and semidetached) with at least one of the components located in the δ Scuti region of the Cepheid instability strip is presented. The positions of the stars in the instability strip are determined by their accurate temperatures and luminosities. Observationally detected binaries (20 semidetached, four detached and one unclassified) with oscillating components were included in the catalogue as a separate table. The primaries of the oscillating Algols tend to be located near the blue edge of the instability strip. Using reliable luminosities and temperatures determined by recent photometric and spectroscopic studies, we have found that at least one or two components of 71 detached and 90 semidetached systems are located in the δ Scuti region of the Cepheid instability strip. In addition, 36 detached or semidetached systems discovered by the *Hipparcos* satellite were also given as a separate list. One of their components is seen in the δ Scuti region, according to their spectral type or $B - V$ colours. They are potential candidate binaries with the δ Scuti-type pulsating components which need further photometric and spectroscopic studies in better precision. This catalogue covers information and literature references for 25 known and 197 candidate binaries with pulsating components.

Key words: binaries: eclipsing – stars: oscillations – δ Scuti.

1 INTRODUCTION

Although the first discoveries of δ Scuti-type pulsations in eclipsing binaries were made in the 1970s (Tempesti 1971; Broglia & Marin 1974; McInally & Austin 1977; Jøergensen & Grønbech 1978), the number of pulsating components known in detached and semidetached systems was merely a few, up to the year 2000. Today, the number reaches to 25 and most of them were discovered by the Central Asian Network (Mkrtichian et al. 2002) and South Korean Network (Kim et al. 2002a,b) groups. The advance in both photometric and radial velocity measurements in the last decade has led to the detection of small-amplitude variability in more faint stars.

δ Scuti stars are main-sequence or post-main-sequence stars with luminosity classes between III and V. Their spectral types range from A2 to F2. They are located in the lower part of the classical Cepheid instability strip in the Hertzsprung–Russell (HR) diagram. They cover a wide range in absolute visual magnitude, from the zero-age main-sequence (ZAMS) to about 2 mag above the main sequence. These objects include single and multimode radial and non-radial pulsational behaviour. They oscillate with periods of between 20 min and 8 h. The pulsation modes are usually low-order radial or non-radial p and possibly g modes. These oscillating modes are believed to be driven by the so-called κ-mechanism involving the second helium ionization zone. However, the excitation of g modes might be influenced by the ε-mechanism, which is associated with nuclear energy production. The photometric amplitudes are always less than 1 mag, and a typical value is about 0.02 mag. They are burning hydrogen predominantly by CNO-cycle, rather than the proton–proton chains of the Sun, either in a convective core, or in a shell outside the H-depleted core (Guzik 2000). Most δ Scuti stars belong to Population I stars but a few variables show low metal abundances and high space velocities, so they are classified as Population II stars and form the subgroup named as SX Phe stars. Photometric observations of the δ Scuti stars reveal more pulsation frequencies, so that the number may exceed 50 (Breger et al. 2005). A comparison of the measured oscillating frequencies of the pulsating δ Scuti stars with stellar models would enable refinement of interior structure models of the stars.

The aim of this work is (i) to present the physical properties of the eclipsing binaries with pulsating components, and (ii) to give a list of the eclipsing binaries with one or both of the components located in the δ Scuti region of the instability strip, according to their luminosity and temperature. The accurate astrophysical parameters, such as

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luminosities, masses, radii and effective temperatures of the eclipsing binary system components are collected from the astronomical literature. In Section 2, the general and pulsational properties of the known eclipsing binaries with δ Scuti components and their locations in the HR diagram are presented. In Section 3, we list the detached and semidetached eclipsing binary systems for which one or both components are most plausibly candidates for a δ Scuti-type pulsation. A statistical study is also performed, using the parameters of the eclipsing binary systems. Finally, we summarize the results which are obtained from statistical distributions.

2 DESCRIPTION

The catalogue is a data base composed of five separate tables. It contains tables for known and candidate eclipsing binary systems for δ Scuti-type pulsations (hereafter δEBs and CδEBs, respectively). Cataclysmic binaries, contact binaries and binaries with white dwarf, neutron stars and black holes were not considered. The CδEBs are divided into two classes: (i) detached CδEBs and (ii) semidetached CδEBs. Table 1 contains information on the general properties of the well-known 20 semidetached, and four detached, eclipsing binary systems. The primary component of the eclipsing binary HD 172189 included in Table 1 is probably an oscillating star. Not only the fundamental properties of this system, but also its classification, whether detached or semidetached, are not known yet. Mkrtichian et al. (2004) suggested the term 'oscillating eclipsing Algols' (oEAs) for pulsating mass-accreting main-sequence stars in semidetached Algol-type eclipsing binaries. Most of the systems in Table 1 are oEA type. All systems lie in the δ Scuti instability region and display the same properties as the pulsating single δ Scuti-type stars but they have a different evolutionary status than single ones. In Table 1, the second line for each system is related to the data for secondary components. The astrophysical parameters for 11 systems are not known yet. Further studies on these systems are urgently needed. The orbital periods and masses of the components of the systems (except IV Cas, RS Cha, WX Eri, V577 Oph and HD 172189), given in Table 1, are taken from Soydugan et al. (2006a). In addition to these, while the orbital periods of RZ Cas, AB Cas and AO Ser are adopted from Soydugan et al. (2006a), the masses of these systems are taken from Soydugan et al. (2006b), Mkrtichian et al. (2004) and Brancewicz & Dworak (1980), respectively. The parameters for HD 172189 are adopted from Martín-Ruiz et al. (2005). The brightness at maximum light, and depths of the primary and secondary eclipses for IV Cas, RS Cha, WX Eri and V577 Oph are taken from Malkov et al. (2006), and their orbital periods are chosen from Kreiner (2004). The spectral types and absolute parameters of the components are received from different sources (for IV Cas: Budding et al. 2004; for RS Cha: Malkov 1993 and Alecian et al. 2005; for WX Eri: Russo & Milano 1983; for V577 Oph: Zhou 2001).

Most of the eclipsing binaries listed in Table 1 are semidetached systems, where the oscillations are related to the primary components, since their fractional luminosities are high compared to the less-massive secondary components. On the other hand, four eclipsing binaries are detached systems, as can be seen in Table 1.

The pulsational properties of the eclipsing binary systems are listed in Table 2, where the full amplitude of the light variation corresponds to the most prominent frequency. The number of detected pulsating frequencies, N, is shown in column (5). As it is seen from Table 2, the secondary components of AI Hya and RS Cha are responsible for the δ Scuti-type light variations. Very recently, the existence of monoperiodic radial pulsations was confirmed for AB Cas (Soydugan et al. 2003; Rodríguez et al. 2004a) and for AI Hya (Jøergensen & Grønbech 1978). The primary components of Y Cam (Kim et al. 2002c), RZ Cas (Lehmann & Mkrtichian 2004; Soydugan et al. 2006b) and AS Eri (Mkrtichian et al. 2004) have shown multiperiodic non-radial pulsations. Three frequencies were detected by Kim et al. (2003) in AB Per, but the first and third frequencies are out of the frequency range of δ Scuti-type pulsators. Thus, we assume that AB Per has a single meaningful frequency as given in Table 2.

The four-colour photometric observations of RS Cha performed by Clausen & Nordström (1980) revealed that at least one of the components was an intrinsic variable, probably of the δ Scuti type. However, they were not able to decide definitively whether only one or both components are variable. They tended to think that the secondary component was responsible from the intrinsic light variations. However, Alecian et al. (2005), in their spectroscopic study, suggested that δ Scuti-type variations may be seen in both components of the RS Cha system. Using the residuals of the binary radial velocity curve for primary component, they derived an additional radial velocity change with a possible frequency of 22.079 cycles d^{-1} and an amplitude of 0.89 km s^{-1}. However, they insisted that this frequency determination is not very reliable.

Sarma & Abhyankar (1979) have announced that the system WX Eri shows δ Scuti-type light variations with two different cycles, of 6.0775 and 7.2881 cycles d^{-1}, with an amplitude larger than 0.015 mag. These variations are attributed to the primary component of WX Eri. Unfortunately, the two-night photometric observations made by Srivastava & Kandpal (1986) and photometric time-series observations obtained by Arentoft et al. (2004) do not support any additional light variation due to the existence of a variable component of the δ Scuti type.

2.1 Structure of the tables

The columns of the Tables 1, 3 and 4 are arranged in a similar way. In Table 1, the depths of primary and secondary eclipses are given as fourth and fifth columns, respectively. The upper line gives physical characteristics of the primary components and the lower line gives the parameters of the secondaries in Table 1. The most plausible candidate component(s) for δ Scuti-type oscillations is/are given in Tables 3 and 4. p and s refer to the primary and secondary components, respectively.

A detailed description of the various columns in Tables 1–5 is as follows.

Table 1

(1) The name of the star, arranged in alphabetical order of constellation listing.

(2) The spectral type of the components.

(3) Magnitude of the system at the maximum light (Max).

(4) The depth of primary minimum (D1).

(5) The depth of secondary minimum (D2).

(6) Filters from which the maximum brightnesses or depths of the minima derived.

(7) Orbital period of the system (P_{orb}) in days, taken from Kreiner (2004).

(8) $M_{1,2}$: masses of the primary and secondary components.

(9) $R_{1,2}$: radii of the primary and secondary components.

(10) $L_{1,2}$: luminosities of the primary and secondary components.

(11) $T_{1,2}$: effective temperatures of the primary and secondary components.

(12) References.

Table 1. General properties of eclipsing binaries with pulsating components.

Object	Spectral type	Brightness at maximum light (mag)	D1 (mag)	D2 (mag)	Filter	P_{orb} (d)	M_1 M_2 $(\mathrm{M}_\odot)$	R_1 R_2 $(\mathrm{R}_\odot)$	L_1 L_2 $(\mathrm{L}_\odot)$	T_1 T_2 (K)	Reference
Y Cam[a]	A7V	10.50	1.75	1.50	*V*	3.3057	1.70	2.92	20.89	7219	1, 2, 3
	K1IV						0.40	2.95	3.24	4507	
R CMa[a]	FOV	5.70	0.64	0.08	*V*	1.1359	1.07	1.50	5.78	7310	3, 4, 5, 6
	K1IV						0.17	1.15	0.43	4355	
RZ Cas[a]	A3V	6.26	1.46	0.08	*V*	1.1953	2.28	1.62	12.88	8600	3.7, 8
	KOIV						0.77	1.99	1.41	4480	
AB Cas[a]	A3V	10.17	1.55	0.11	*V*	1.3669	2.30	1.97	19.05	8588	3, 9, 10, 11
	KOIV						–	–	–	–	
IV Cas[a]	A2	11.20	1.20	0.10	*B*	0.9985	2.60	2.00	22.49	8885	5, 12
	G1IV						1.24	2.22	7.33	6372	
RS Cha[b]	A8V	6.02	0.66	0.51	*V*	1.6699	1.89	2.15	14.13	7638	5, 13, 14, 15
	A8V						1.87	2.36	13.49	7228	
V346 Cyg[a]	A5	11.80	1.70	0.10	*B*	2.7433	–	–	–	–	3, 5, 12
	G4IV						–	–	–	–	
V469 Cyg[a]	A	12.80	1.10	0.10	*B*	1.3125	–	–	–	–	1, 3, 5
							–	–	–	–	
TW Dra[a]	A5V	8.00	2.50	–	*B*	2.8069	1.58	2.40	25.12	8355	3, 16, 17
	K2III						0.74	3.40	5.13	4320	
TZ Dra[a]	A7V	9.60	0.90	–	*B*	0.8660	–	–	–	–	3, 5, 12
	K2IV						–	–	–	–	
TZ Eri[a]	A5/6V	9.80	2.80	–	*V*	2.6062	1.97	1.69	9.39	7770	1, 3, 5, 18
	K0/1III						0.37	2.60	2.66	4570	
WX Eri[a]	F0V	9.38	0.90	0.22	*V*	0.8233	1.70	1.89	10.13	7499	5, 14, 19
	G5III-IV						0.56	1.39	1.14	5070	
AS Eri[a]	A3V	8.29	0.71	0.13	*V*	2.6641	1.92	1.57	11.48	8476	3, 5, 11, 20
	K0IV						0.21	2.19	2.95	5110	
TU Her[a]	A5	10.88	2.82	–	*V*	2.2669	–	–	–	–	3, 5
	–						–	–	–	–	
CT Her[a]	A3V	10.60	1.10	–	*B*	1.7864	–	–	–	–	3, 5, 12
	G3IV						–	–	–	–	
EF Her[a]	F0	11.00	1.00	–	*B*	4.7292	–	–	–	–	1, 3, 5
	KIV						–	–	–	–	
RX Hya[a]	A8	8.90	2.70	0.05	*V*	2.2817	1.68	1.70	8.77	7616	3, 5, 12, 21, 22
	K5IV						0.40	2.40	2.10	4484	
AI Hya[b]	F0	9.35	0.59	0.49	*V*	8.2897	1.98	2.77	17.38	7096	3, 5, 23
	F2						2.15	3.92	27.54	6699	
V577 Oph[b]	A?	10.98	0.64	0.51	*V*	6.0791	–	–	–	–	5, 14, 24
	A?						–	–	–	–	
AB Per[a]	A5V	10.40	1.00	0.10	*B*	7.1603	–	–	–	–	1, 3, 5
	G9IV						–	–	–	–	
IU Per[a]	A4	10.50	1.10	–	*V*	0.8570	–	–	–	–	3, 5, 25
	–						–	–	–	–	
AO Ser[a]	A2V	10.70	1.30	0.10	*V*	0.8793	2.56	1.80	18.68	8970	1, 3, 5, 12, 22
	G5IV						1.14	1.79	3.90	6090	
VV UMa[a]	A2V	10.13	0.78	0.13	*V*	0.6874	2.26	1.67	17.30	9106	3, 5, 26
	G1IV						0.68	1.31	1.50	5579	
HIP 7666[b]	A5	9.69	0.23	0.16	*V*	2.3723	–	–	–	–	3, 27
	F3-4						–	–	–	–	
HD 172189[c]	A2	8.85	0.12	–	*V*	5.7020	–	–	–	–	3, 28
							–	–	–	–	

[a] oEA. [b] Detached binary. [c] Unknown Kopal classification.

References: (1) Mkrtichian et al. (2005); (2) Broglia & Marin (1974); (3) Soydugan et al. (2006a); (4) Mkrtichian & Gamarova (2000); (5) Malkov et al. (2006); (6) Varricatt & Ashok (1999); (7) Soydugan et al. (2006b); (8) Rodríguez et al. (2004b); (9) Rodríguez & Breger (2001); (10) Soydugan et al. (2003); (11) Mkrtichian et al. (2004); (12) Budding et al. (2004); (13) Malkov (1993); (14) Kreiner (2004); (15) Alecian et al. (2005); (16) Qian & Boonrucksar (2002); (17) Sarma, Rao & Abhyankar (1996); (18) Barblan et al. (1998); (19) Russo & Milano (1983); (20) Cester et al. (1978a); (21) Giuricin et al. (1983); (22) Brancewicz & Dworak (1980); (23) Popper (1988); (24) Zhou (2001); (25) Samus et al. (2004); (26) Lázaro et al. (2002); (27) Escolá-Sirisi et al. (2005); (28) Martín-Ruiz et al. (2005).

Table 2. Pulsational properties of eclipsing binaries with pulsating components. N is the number of the pulsating frequencies.

Object	Component	P_{puls} (d)	A^{a}_{puls} (mag)	N	Reference
Y Cam	p	0.0665	0.0318 (V)	4	1
R CMa	p	0.0471	0.0088 (B)	1	2
RZ Cas	p	0.0156	0.013 (Y)	2	3
AB Cas	p	0.0583	0.0392 (V)	1	4
IV Cas	p	0.0265	0.01 (B)	1	5
RS Cha	s	0.0860	0.0168 (–)	2	6
V346 Cyg	p	0.0502	0.03 (B)	2	7
V469 Cyg	p	0.0278	0.02 (V)	1	8
TW Dra	p	0.0556	0.0042 (V)	1	9
TZ Dra	p	0.0194	–	1	10
TZ Eri	p	0.0534	–	1	10
WX Eri	p	0.1645	0.03 (–)	1	11
AS Eri	p	0.0169	0.0134 (V)	3	12
TU Her	p	0.0556	0.008–0.01(V)	1	13
CT Her	p	0.0192	0.03 (B)	1	14
EF Her	p	0.1042	0.06 (B)	1	14
RX Hya	p	0.0516	0.014 (B)	1	15
AI Hya	s	0.1380	0.02 (V)	1	16
V577 Oph	p	0.0695	0.0289 (V)	1	17
AB Per	p	0.1958	0.02 (B)	1	18
IU Per	p	0.0238	0.02 (B)	2	19
AO Ser	p	0.0465	0.02 (B)	1	20
VV UMa	p	0.0195	0.015 (B)	2	21
HIP 7666	p	0.0409	0.02 (V)	1	22
HD 172189	p	0.0510	–	2	23

[a] Passband used in the observation.

References: (1) Kim et al. (2002c); (2) Mkrtichian & Gamarova (2000); (3) Soydugan et al. (2006b); (4) Soydugan et al. (2003); (5) Kim et al. (2005a); (6) Clausen & Nordström (1980); (7) Kim et al. (2005b); (8) Caton (2004); (9) Kusakin, Mkrtichian & Gamarova (2001); (10) Mkrtichian et al. (2005); (11) Sarma & Abhyankar (1979); (12) Mkrtichian et al. (2004); (13) Lampens et al. (2004); (14) Kim et al. (2004a); (15) Kim et al. (2002a); (16) Jøergensen & Grønbech (1978); (17) Zhou (2001); (18) Kim et al. (2003); (19) Kim et al. (2005c); (20) Kim et al. (2004b); (21) Kim et al. (2005d); (22) Escolá-Sirisi et al. (2005); (23) Martín-Ruiz et al. (2005).

Table 2

(1) The name of the star.

(2) Responsible component from the oscillation.

(3) Pulsational period (P_{puls}) in days.

(4) Pulsational amplitude (A_{puls}) in mag.

(5) Number of detected pulsational frequencies (N).

(6) References.

Tables 3 and 4

(1) The name of the star, arranged in alphabetical order of constellation listing.

(2) Candidate component(s) for pulsation, p: primary, s: secondary.

(3) The spectral type of candidate component(s).

(4) Magnitude of the system at the maximum light (Max).

(5) Orbital period for the system (P_{orb}) taken from Kreiner (2004).

(6) and (7) $M_{1,2}$: masses of the primary and secondary components.

(8) and (9) $R_{1,2}$: radii of the primary and secondary components.

(10) and (11) $L_{1,2}$: luminosities of the primary and secondary components.

(12) and (13) $T_{1,2}$: effective temperatures of the primary and secondary components.

(14) References.

Table 5

(1) The name of the star.

(2) Number in the *Hipparcos* catalogue (ESA 1997).

(3) HD or BD numbers.

(4) Spectral types of the component(s) located in the instability strip.

(5) Orbital period for the system (P_{orb}) in days.

(6) Johnson V magnitude of the system at the maximum light (V).

(7) $B - V$ colour in the UBV system.

Tables 3 and 4 contain 71 detached and 90 semidetached CδEBs, respectively. The eclipsing binary systems discovered by the *Hipparcos* mission are listed in Table 5. Although there are no detailed light or radial velocity analyses yet, at least one of the systms' components is located in the δ Scuti region of the instability strip according to their $B - V$ colour. The absolute parameters of these systems are not known. Hence the format of Table 5 is different from the others (see Section 3.3). Accurate photometric and spectroscopic observations of these systems are urgently needed to determine their absolute parameters.

Fig. 1 shows positions of the pulsating primaries of the 14 eclipsing binaries in the instability strip. The parameters of these stars are known with great accuracy. The borders of the instability strip were taken from Rolland et al. (2002). The Claret & Giménez (1991) work was used for the borders of the ZAMS and the terminal-age main-sequence (TAMS). It is interesting to note that most of the pulsating components in the oEAs tend to gather near to the blue edge of the instability strip, as seen in Fig. 1. On the other hand, the primary component of R CMa, responsible for the oscillation, seems to be located out of the instability strip. Therefore, it should be the coolest δ Scuti-type pulsator in the oEA group detected up to now.

All detached and semidetached binaries with known absolute physical parameters were found from astronomical literature. The list of these systems for which one or two components were placed in the δ Scuti region is given in Tables 3 and 4. The primary components of 30 systems, the secondaries of 17 systems and both components of 24 systems fall into the instability strip (see Table 3). The primaries of 90 classical semidetached Algols fall into this strip, as is expected. The donors of the classical Algols are generally less-massive cool components that are located out of the instability strip. The parameters for detached eclipsing binaries were generally collected from the studies of Malkov (1993), Brancewicz & Dworak (1980) and Andersen (1991), omitting, of course, those binaries for which more recent data are available. The semidetached systems were compiled from Budding et al.'s (2004) study. We should note that the data on detached systems are the most accurate. The accuracy is correspondingly lower for mass-transferring semidetached Algols, because these are generally single-lined spectroscopic binary systems. In addition, their light curves may be distorted due to the mass transfer.

If the temperatures of the components are not given in the literature, we have computed the temperatures using the well-known relation, adopting the value of $T_{\mathrm{eff}} = 5780$ K for the Sun:

$$L/\mathrm{L}_{\odot} = (R/\mathrm{R}_{\odot})^{2}\,(T/\mathrm{T}_{\odot})^{4}$$

in solar units. In this way, the effective temperatures of component stars were included in Tables 3 and 4.

Table 3. Candidate detached systems for pulsation.

Name	Component	Spectral type	Brightness at maximum light[b] (mag)	P_{orb} (d)	M_1 ($\mathrm{M}_{\odot}$)	M_2 ($\mathrm{M}_{\odot}$)	R_1 ($\mathrm{R}_{\odot}$)	R_2 ($\mathrm{R}_{\odot}$)	L_1 ($\mathrm{L}_{\odot}$)	L_2 ($\mathrm{L}_{\odot}$)	T_1 (K)	T_2 (K)	Reference
CZ And	p, s	A6+	12.40 (*B*)	2.7172	2.42	2.04	1.76	1.35	9.87	5.58	7750	7670	1
CD Aqr	s		10.80 (*V*)	4.8378	2.22	1.52	3.19	1.49	46.84	6.63	8490	7620	1, 2
V409 Aql	p	F5	11.50 (*B*)	2.0494	1.58	1.42	3.04	3.23	19.00	17.59	6940	6610	1
V602 Aql	p, s	A2+	11.90 (*B*)	3.0126	2.78	1.71	2.47	2.45	31.24	13.28	8730	7060	1, 2
V805 Aql[a]	p, s	A2+A9	7.59 (*V*)	2.4082	2.11	1.63	2.11	1.75	17.78	7.24	8185	7178	1, 2, 3
SZ Ari	p	F0	11.30 (*V*)	1.7175	1.46	1.04	2.46	0.82	14.94	0.43	7270	5210	1
WW Aur[a]	p, s	A5m+A7m	5.821 (*V*)	2.5250	1.99	1.80	1.88	1.88	13.80	11.48	8128	7762	2, 4
CG Aur	p, s	A7+	12.10 (*B*)	1.8049	2.22	1.53	1.75	1.45	9.93	5.02	7780	7210	1
UW Boo	p	F0+	10.40 (*B*)	1.0047	1.48	1.08	1.51	1.03	5.01	1.33	7060	6120	1, 2
AL Cam	p, s	A2+	10.28 (*V*)	1.3283	2.76	1.65	2.52	1.66	32.68	6.57	8740	7200	1, 2
SW CMa[a]	p, s	A5V+A5V	9.15 (*V*)	10.0920	2.22	2.03	3.01	2.46	34.67	22.39	8070	8002	2, 5
CI Car	p	A2	11.80 (*B*)	2.8185	2.89	1.96	2.01	2.96	19.24	8.82	8570	5800	1
DP Car	p	A8	13.00 (*B*)	7.5637	2.40	1.92	2.98	5.69	25.19	22.85	7510	5310	1
V364 Cas	p, s	A7+	10.75 (*V*)	1.5431	2.47	2.13	2.24	2.25	16.32	16.53	7749	7756	1, 2
SZ Cen[a]	s	A7V	8.62 (*V*)	4.1080	2.32	2.28	4.56	3.63	66.83	46.03	7727	7889	2, 6
LP Cen	p	F0	10.37 (*V*)	2.4723	1.45	1.00	1.67	1.34	8.02	2.42	7550	6240	1
NP Cen	p, s	A5+	9.80 (*B*)	2.8530	2.40	1.97	3.19	2.90	37.43	17.54	8030	6960	1, 2
V348 Cen	p	A5	11.10 (*V*)	2.1524	2.03	0.96	1.71	1.88	13.83	5.15	8540	6370	1
V377 Cen	s		8.90 (*V*)	8.2517	2.10	1.24	2.33	2.56	34.80	21.54	9240	7810	1
WX Cep[a]	p, s	A2+A5	9.03 (*V*)	3.3785	2.33	2.54	2.71	4.00	40.74	63.10	8872	8147	2, 7
EG Cep	p	A3	9.51 (*V*)	0.5446	2.22	1.54	1.53	0.83	11.62	1.51	8650	7060	1, 2
EI Cep[a]	p	F2V	7.61 (*V*)	8.4394	1.69	1.79	2.43	2.92	12.02	15.14	6892	6661	2, 8
WY Cet	s		9.60 (*B*)	1.9398	2.47	1.88	2.16	2.16	29.07	23.48	9190	8690	1, 2
V454 CrA	p	A5	10.10 (*V*)	2.3969	2.23	1.55	1.76	1.41	12.41	4.35	8200	7060	1
V Crt[a]	p	A8V	10.27 (*V*)	0.7020	1.55	1.05	1.51	1.58	5.62	1.55	7230	5122	2, 9
GV Cyg	p	A5	13.20 (*B*)	0.9907	1.98	0.93	1.63	1.66	10.31	3.35	8150	6080	1, 2
MY Cyg[a]	p, s	F0m+FOm	8.34 (*V*)	4.0052	1.78	1.81	2.19	2.19	10.72	10.23	7047	6998	2, 10
QT Cyg	p	A5	14.80 (*B*)	3.3356	2.39	1.94	1.86	2.43	11.37	2.68	7810	4750	1, 2
V447 Cyg	p	A3	13.10 (*B*)	2.2056	2.24	1.57	1.45	1.23	11.58	2.22	8900	6400	1
V456 Cyg	p	A2	10.80 (*V*)	0.8912	3.01	2.26	1.36	1.02	8.25	2.72	8430	7390	1, 2
V466 Cyg	p	A8	10.53 (*V*)	1.3916	2.23	1.56	1.64	1.47	6.59	3.87	7260	6700	1, 2
V477 Cyg[a]	p	A3V	8.55 (*V*)	2.3470	1.80	1.35	1.60	1.42	13.18	3.31	8730	6531	2, 11
V689 Cyg	p	A5V	14.00 (*B*)	1.4553	2.35	1.84	1.84	2.08	11.37	2.13	7840	4850	1
YY Del	p, s	A3+	11.30 (*V*)	0.7931	2.21	1.51	1.52	1.33	11.61	4.15	8690	7160	1, 2
BW Del	p	F2	11.40 (*B*)	2.4232	1.40	0.88	2.51	1.70	12.76	3.75	6930	6190	1, 2
RX Dra	p, s	F0+F0	10.00 (*B*)	3.7864	1.71	1.29	2.52	1.58	15.57	5.49	7250	7070	1, 2
W Equ	p, s	A7+	11.80 (*B*)	4.2369	2.23	1.55	3.09	2.91	28.42	21.04	7610	7270	1
CW Eri[a]	p	F2	8.44 (*V*)	2.7284	1.59	1.33	2.08	1.56	8.51	4.07	6839	6561	2, 12, 13
TX Her[a]	p	A8	8.12 (*V*)	2.0598	1.62	1.45	1.58	1.48	6.31	3.98	7295	6714	2, 12
HS Her[a]	s	A4	8.61 (*V*)	1.6374	6.50	1.90	3.00	1.70	426.58	8.91	15 140	7646	2, 14, 15
V624 Her[a]	s	A7m	6.204 (*V*)	3.8950	2.28	1.88	3.03	2.21	36.31	17.38	8147	7943	2, 4, 16
KW Hya[a]	p	A3m	6.115 (*V*)	7.7500	1.98	1.49	2.13	1.48	16.60	4.47	7998	6886	2, 17
CM Lac[a]	p, s	A2V+F0V	8.22 (*V*)	1.6047	1.88	1.47	1.59	1.42	12.45	4.79	8595	7163	2, 10
V364 Lac[a]	p, s	A4+A3	8.36 (*V*)	7.3515	2.33	2.30	3.31	2.99	45.39	41.69	8250	8500	2, 18
TX Leo	s		5.67 (*V*)	2.4451	3.73	2.24	4.14	2.43	116.14	16.46	9360	7490	1, 2
WY Leo	s		11.00 (*V*)	4.9859	2.31	1.40	3.26	2.65	81.16	24.75	9640	7940	1, 2
RR Lyn[a]	p, s	A7V+F0V	5.54 (*V*)	9.9451	2.00	1.55	2.50	1.93	18.20	8.51	7586	7079	2, 12, 19
TZ Men[a]	s	A8V	6.18 (*V*)	8.5690	2.49	1.50	2.02	1.43	42.66	4.90	10 399	7194	2, 4
EP Mon	p, s	A3+	10.50 (*B*)	1.1481	2.45	2.09	2.76	2.06	35.16	18.18	8500	8340	1, 2
V456 Oph	p, s	A5:+	10.14 (*V*)	1.0160	2.23	1.54	2.19	1.99	19.64	9.04	8250	7130	1, 2
V846 Oph	s		9.90 (*V*)	3.1268	2.91	2.20	2.69	2.18	39.80	19.21	8890	8240	1
FT Ori[a]	s	A3V	9.30 (*V*)	3.1504	2.50	2.30	2.20	1.90	36.32	17.42	9550	8551	2, 19
V536 Ori	s		10.20 (*V*)	3.1633	2.99	2.23	2.37	1.72	29.73	11.71	8800	8150	1
V1031 Ori[a]	p, s	A6V+A3	6.06 (*V*)	3.4056	2.29	2.47	2.99	4.32	39.81	63.10	8400	7850	2, 10, 20
BO Peg	p	A4	11.50 (*B*)	0.5804	2.10	1.24	1.54	0.96	11.43	1.19	8580	6180	1, 2
EE Peg[a]	p	A3m	6.98 (*V*)	2.6282	2.16	1.34	2.09	1.31	22.39	2.69	8710	6457	2, 10
GH Peg	p	A3	9.10 (*B*)	2.5561	2.44	2.06	2.27	2.52	18.62	8.48	7990	6230	1, 2
OO Peg[a]	p, s	A2	8.33 (*V*)	2.9847	1.72	1.69	2.19	1.37	24.79	9.63	8770	8683	21
IQ Per[a]	s	A7	7.73 (*V*)	1.7436	3.53	1.72	2.47	1.53	134.90	7.59	12 512	7743	2, 22
IU Per	p, s	A4+	10.50 (*B*)	0.8570	2.42	2.03	1.88	1.74	13.78	11.39	8150	8060	1, 2
V337 Per	s		12.80 (*B*)	1.8861	2.86	1.71	2.86	3.32	46.18	26.87	8910	7240	1, 2

Table 3 – *continued*

Name	Component	Spectral type	Brightness at maximum light^b (mag)	P_{orb} (d)	M_1 ($\mathrm{M}_\odot$)	M_2 ($\mathrm{M}_\odot$)	R_1 ($\mathrm{R}_\odot$)	R_2 ($\mathrm{R}_\odot$)	L_1 ($\mathrm{L}_\odot$)	L_2 ($\mathrm{L}_\odot$)	T_1 (K)	T_2 (K)	Reference
V526 Sgr^a	s	A2	9.82 (*V*)	1.9194	2.27	1.68	1.89	1.56	33.88	12.59	10 139	8710	2, 23
V4089 Sgr^a	s		5.91 (*V*)	4.6283	3.28	1.57	4.00	1.63	72.44	7.08	8433	7413	24
V594 Sco	p	F0	10.56 (*V*)	3.6329	1.45	1.01	2.16	2.54	10.29	7.75	7070	6070	1
V626 Sco^a	p, s	A7+	11.40 (*B*)	1.0337	2.23	1.54	1.34	1.20	4.95	4.39	7470	7640	1
V634 Sco^a	s		11.70 (*B*)	1.2240	3.07	2.42	1.53	1.70	14.20	13.15	9100	8470	1
EW Tau	p	A9:	11.70 (*B*)	5.2693	2.22	1.54	2.39	2.57	12.55	11.66	7070	6680	1
RS Tri^a	p, s	A5+	10.26 (*V*)	1.9089	2.22	1.54	2.53	2.11	27.46	11.48	8350	7340	1, 2
RT UMi^a	p	F0	10.90 (*V*)	1.8420	1.70	0.50	2.70	2.20	17.38	1.45	7170	4269	2, 25
RR Vel	p	A5:	10.81 (*V*)	1.8542	2.50	1.50	1.81	2.32	11.33	6.88	7900	6160	1
AB Vul	p	A8:	12.40 (*B*)	1.4613	2.05	1.11	2.38	1.36	16.82	2.59	7600	6300	1, 2

[a] Detached binaries with more accurate data.[b] Passband used in the observation.

References: (1) Brancewicz & Dworak (1980); (2) Kreiner (2004); (3) Popper (1981); (4) Andersen (1991); (5) Lacy (1997a); (6) Balona (1994); (7) Popper (1987); (8) Cester et al. (1978b); (9) Liu (1993); (10) Malkov (1993); (11) Değirmenci et al. (2003); (12) Popper (1980); (13) Popper (1983); (14) Hall & Hubbard (1971); (15) Giuricin & Mardirossian (1981a); (16) Harmanec (1988); (17) Andersen & Vaz (1984); (18) Torres et al. (1999); (19) Petrova & Orlov (1999); (20) Andersen, Nordström & Clausen (1990); (21) Munari et al. (2001); (22) Değirmenci (1997); (23) Lacy (1997b); (24) North, Studer & Kunzli (1997); (25) Mardirossian & Giuricin (1981).

Table 4. Candidate semidetached systems for pulsation.

Name	Component	Spectral type	Brightness at maximum light^b (mag)	P_{orb} (d)	M_1 ($\mathrm{M}_\odot$)	M_2 ($\mathrm{M}_\odot$)	R_1 ($\mathrm{R}_\odot$)	R_2 ($\mathrm{R}_\odot$)	L_1 ($\mathrm{L}_\odot$)	L_2 ($\mathrm{L}_\odot$)	T_1 (K)	T_2 (K)	Reference
TW And^a	p	F0V	9.12 (*V*)	4.1228	1.68	0.32	2.19	3.37	11.55	3.14	7188	4184	1
CP And	p	A5	11.20 (*V*)	3.6089	2.14	1.34	2.56	3.44	23.47	14.66	7938	6087	1
RY Aqr^a	p	A8	8.86 (*V*)	1.9666	1.27	0.26	1.28	1.79	7.08	1.23	7600	4550	2, 3
CZ Aqr	p	A5p	11.10 (*V*)	0.8628	2.96	1.48	1.91	2.00	11.79	4.25	7780	5860	4
YZ Aql	p	A3	10.90 (*V*)	4.6725	3.13	2.56	3.20	6.64	42.35	10.32	8228	4013	1
QY Aql^a	p	F0g	12 (*V*)	7.2296	1.70	0.60	3.90	4.90	33.11	7.41	7009	4301	1
SS Cam	p	F5V	10.09 (*V*)	3.1268	1.72	2.28	2.79	8.15	18.86	36.26	7199	4960	1
TY Cap	p	A5	10.30 (*V*)	1.4235	2.50	2.06	2.89	2.57	28.92	1.19	7871	3759	1
CV Car^a	p	A3	10.40 (*V*)	14.4149	2.50	0.80	2.30	11.10	28.18	48.98	8766	4582	1
IS Cas	p	A2	11.60 (*B*)	1.8415	2.76	1.64	2.50	2.06	32.66	32.66	8724	9611	1
SY Cen	p	A5	10.92 (*V*)	6.6314	3.33	1.67	2.39	6.34	17.48	15.00	7632	4510	1
XX Cep^a	p	A8V	9.21 (*V*)	2.3373	2.03	0.33	2.12	2.25	13.50	1.79	7596	4449	1
EK Cep^a	p	A1V	7.88 (*V*)	4.4278	2.02	1.12	1.58	1.32	14.79	1.55	9002	5604	1
RW Cet	p	A5	10.09 (*V*)	0.9752	2.73	1.77	1.91	2.19	12.19	5.77	7801	6043	1
AT Cir	p	A5IV-V	8.40 (*B*)	3.2575	2.41	2.00	3.20	4.07	37.42	27.51	7978	6550	1
IS CrA	p	A2	10.90 (*B*)	3.2366	2.49	1.85	2.57	3.29	35.54	14.72	8788	6231	1
RW CrB^a	p	F0	10.21 (*V*)	0.7264	1.60	0.40	1.54	1.10	6.03	0.35	7286	4232	1
SY Cyg	p	A3	11.10 (*V*)	6.0055	2.14	0.86	2.21	4.82	26.98	8.89	8846	4538	1
UW Cyg	p	F0	10.68 (*V*)	3.4508	2.14	0.86	2.28	2.79	14.40	8.89	7444	5965	1
VW Cyg	p	A3e	10.36 (*V*)	8.4303	2.10	0.60	2.00	7.00	21.88	17.38	8824	4453	1
AE Cyg	p	A5	11.30 (*V*)	0.9692	1.54	0.85	1.91	2.54	16.79	15.06	8500	7170	4
BR Cyg^a	p	A5V	9.94 (*V*)	1.3326	2.50	1.00	2.30	2.40	28.18	4.79	8766	5510	5
KU Cyg^a	p	F4p	11.40 (*V*)	38.4388	3.85	0.48	3.38	17.1	38.02	46.77	7793	3649	6
V345 Cyg	p	A1	11.30 (*B*)	2.0755	2.88	1.96	2.34	4.60	31.00	28.43	8900	6212	1
V346 Cyg	p	A5	11.80 (*B*)	2.7433	2.34	1.83	3.75	4.74	61.76	38.94	8353	6620	1
V959Cyg	p	A5:	11.30 (*V*)	1.8398	2.22	1.52	2.96	2.64	40.75	18.97	8473	7411	1
Z Dra	p	A5	10.59 (*V*)	1.3574	1.40	0.38	1.56	1.56	12.45	0.96	8678	4573	1
RZ Dra	p	A5	10.40 (*V*)	0.5509	1.40	0.62	1.62	1.12	7.60	1.27	7527	5788	1
TZ Dra	p	A7V:	9.34 (*V*)	0.8660	2.12	0.28	2.03	1.72	14.14	2.52	7853	5543	1
U Gru	p	A5	11.67 (*V*)	1.8805	2.40	0.60	2.13	2.22	17.12	2.54	8042	4889	1
SZ Her^a	p	A5	9.92 (*V*)	0.8181	2.10	0.80	1.70	1.60	11.22	1.95	8100	5400	7
UX Her^a	p	A3	8.97 (*V*)	1.5489	2.70	0.60	2.00	1.94	19.50	1.05	8600	4200	7
AD Her^a	p	A4V	9.68 (*V*)	9.7666	2.90	0.90	2.60	7.70	33.11	23.98	8584	4601	1
BO Her	p	A7	11.10 (*V*)	3.0874	2.43	1.99	3.64	4.81	37.26	12.74	7472	4970	1
FN Her	p	A9	10.50 (*B*)	2.6913	1.99	1.46	2.22	2.08	10.51	6.38	6973	6358	1
MX Her	p	F5	11.40 (*B*)	2.3476	1.40	0.87	2.36	2.04	11.88	6.70	6973	6499	1
V338 Her	p	A9	10.21 (*V*)	1.3057	1.78	1.00	1.92	1.63	9.21	0.89	7254	4390	1
V359 Her	p	F0	10.03 (*V*)	1.7558	1.60	1.38	2.39	2.02	13.75	7.40	7187	6696	1
TT Hya	p	A3	7.31 (*V*)	6.9534	1.99	0.72	2.14	4.85	22.13	12.64	8555	4940	1

Table 4 – *continued*

Name	Component	Spectral type	Brightness at maximum light[b] (mag)	P_{orb} (d)	M_1 ($M_\odot$)	M_2 ($M_\odot$)	R_1 ($R_\odot$)	R_2 ($R_\odot$)	L_1 ($L_\odot$)	L_2 ($L_\odot$)	T_1 (K)	T_2 (K)	Reference
VY Hya	p	A3	10.37 (*V*)	2.0012	2.09	1.20	1.61	1.28	13.89	2.51	8779	6419	1
DE Hya	p	A2	11.00 (*B*)	4.2277	3.01	2.25	2.72	3.41	39.22	5.15	8755	4707	1
TW Lac	p	A2	11.50 (*B*)	3.0375	2.80	1.87	2.98	4.17	45.27	21.07	8670	6054	1
VX Lac	p	F0	10.55 (*V*)	1.0745	1.48	1.07	1.70	1.26	6.60	2.16	7093	6232	1
AU Lac	p	A5	11.10 (*V*)	1.3924	2.36	1.86	1.88	2.28	11.38	5.43	7729	5833	1
DG Lac	p	A5	10.80 (*B*)	2.2065	2.42	1.90	2.42	3.30	19.43	10.70	7787	5745	1
UU Leo	p	A2	11.70 (*V*)	1.6797	1.94	1.15	1.45	1.17	12.73	2.11	9051	6429	1
VZ Leo	p	A5	10.60 (*B*)	1.0899	2.39	1.93	1.91	2.59	11.39	1.16	7670	3721	1
SS Lib	p	A5	10.42 (*V*)	1.4380	2.41	2.00	2.29	3.16	21.64	13.90	8824	6267	1
SX Lyn	p	A2	10.00 (*B*)	2.0225	2.66	1.58	2.02	1.52	22.91	5.76	8882	7250	1
RV Lyr	p	A5:	11.50 (*B*)	3.5990	3.70	1.30	2.19	5.40	13.29	4.20	7444	3555	1
VY Mic	p	A3	8.40 (*B*)	4.4358	2.39	1.96	2.24	4.43	25.99	13.98	8705	5301	1
BO Mon	p	A2	10.80 (*B*)	2.2252	2.89	1.97	2.57	3.26	35.72	20.27	8799	6781	1
HO Mon	p	A5	11.50 (*B*)	7.8945	2.51	2.03	2.58	5.71	21.15	13.62	7704	4639	1
V391 Oph	p	A1	11.50 (*B*)	2.8956	2.55	1.13	1.86	2.10	13.65	4.26	8132	5720	1
V501 Oph	p	A5	11.30 (*V*)	0.9680	1.98	0.94	2.08	2.92	17.50	7.19	8183	5529	1
V535 Oph	p	A3	11.30 (*B*)	6.0553	1.98	0.92	1.81	3.16	18.36	11.79	8878	6015	1
EY Ori	p	A8V	9.49 (*V*)	16.7878	2.52	2.09	3.51	8.47	29.53	34.82	7179	4816	1
FK Ori	p	A2	12.00 (*B*)	1.9475	2.64	1.35	2.10	2.17	23.64	12.23	8780	7325	1
FL Ori	p	A3V	11.50 (*V*)	1.5510	2.88	1.93	2.12	2.17	18.62	3.21	8232	5243	1
TY Peg	p	A2	10.26 (*V*)	3.0922	3.30	0.50	3.02	3.06	47.52	4.77	8717	4875	1
UX Peg	p	A2	10.70 (*B*)	1.5446	2.75	1.62	1.86	2.01	17.50	6.18	8653	6417	1
AT Peg[a]	p	A4V	9.02 (*V*)	1.1461	2.22	1.05	1.86	2.15	15.49	2.40	8400	4900	8
BG Peg	p	A2	10.50 (*B*)	1.9524	2.53	1.29	2.40	3.35	32.20	22.49	8872	6865	1
DF Peg	p	A2	9.15 (*V*)	14.6987	2.87	1.90	2.16	3.15	22.63	14.26	8563	6318	1
DM Peg[a]	p	A8:	10.90 (*V*)	2.5890	2.00	0.96	1.60	2.73	6.58	7.36	7340	5770	4
RV Per	p	A2	11.10 (*V*)	1.9735	3.04	0.46	2.91	4.52	46.19	3.11	8818	3604	1
X Pic	p	A2	10.70 (*B*)	0.8619	2.50	1.00	1.74	2.03	16.53	3.65	8820	5598	1
RV Pic	p	A1V	9.65 (*V*)	3.9718	1.96	1.07	1.82	2.51	13.03	7.84	8126	6094	1
SW Pup	p	F0	9.01 (*V*)	2.7473	1.45	1.01	1.90	3.00	7.94	10.21	7027	5955	1
ZZ Pup	p	A2	9.43 (*V*)	6.3381	2.88	1.94	2.95	4.83	39.44	21.62	8419	5661	1
AK Ser	p	A5	11.40 (*V*)	1.9226	1.98	0.93	1.97	2.12	16.28	6.15	8258	6241	1
DE Sge	p	A2	11.90 (*B*)	2.8721	1.98	0.93	1.47	2.41	12.90	8.26	9019	6301	1
SX Sgr	p	A2	9.60 (*B*)	4.1540	2.90	1.59	3.04	5.02	24.37	13.38	7353	4925	1
XZ Sgr[a]	p	A3V	8.92 (*V*)	3.2755	1.90	0.30	1.50	2.50	35.48	2.09	8600	5000	1, 7
EG Sgr	p	A2	11.20 (*B*)	4.9724	2.91	2.03	3.77	4.58	68.41	22.34	8546	5862	1
AC Tau	p	F0	10.50 (*B*)	2.0434	1.45	0.99	2.30	2.90	12.56	5.84	7162	5267	1
AQ Tau	p	A5	11.80 (*B*)	1.2159	1.99	0.94	1.87	2.05	14.88	5.64	8287	6210	1
X Tri[a]	p	A3	9.00 (*V*)	0.9715	2.30	1.20	1.71	1.96	14.45	2.51	8600	5200	7
V Tuc	p	A2	10.69 (*V*)	0.8709	2.54	1.26	1.76	1.69	16.78	1.31	8803	4748	1
TT Vel	p	A5	10.74 (*V*)	2.1084	1.99	0.96	2.00	2.17	16.30	6.46	8198	6417	1
AS Vel	p	A3	8.704 (*V*)	1.5579	2.22	1.51	1.59	1.75	12.71	7.03	8640	7102	1
DX Vel	p	A5	10.74 (*V*)	1.1173	2.13	1.31	1.73	1.36	12.46	2.26	8242	6066	1
BD Vir	p	A5	9.91 (*V*)	2.5485	2.22	0.78	2.72	4.38	33.94	14.07	8444	5340	1
UY Vir	p	A7V	8.02 (*V*)	1.9945	2.22	1.54	2.60	2.17	23.54	11.50	7882	7213	1
RR Vul	p	A2	9.93 (*V*)	5.0507	3.15	2.05	2.10	4.39	21.24	14.09	8548	5335	1
AW Vul	p	F0	10.80 (*V*)	0.8065	1.48	1.08	2.11	1.79	11.44	4.89	7305	6413	1
AX Vul	p	A1V	11.30 (*V*)	2.0248	2.56	1.31	2.14	1.36	24.78	2.89	8800	6451	1
AY Vul	p	F0V	11.70 (*V*)	2.4124	1.39	0.85	2.00	2.75	9.96	4.95	7248	5190	1
BP Vul	p	A7	9.94 (*V*)	1.9403	2.29	1.69	1.87	1.55	10.35	4.78	7568	6853	1
EY Vul	p	A4	11.10 (*V*)	4.1031	2.10	1.22	2.76	3.52	34.42	14.30	8412	5981	1

[a] Semidetached binaries with more accurate data. [b] Passband used in the observation.

References: (1) Budding et al. (2004); (2) Popper (1989); (3) Helt (1987); (4) Brancewicz & Dworak (1980); (5) Giuricin & Mardirossian (1981b); (6) Olson, Etzel & Dewey (1995); (7) Giuricin et al. (1983); (8) Maxted, Hill & Hilditch (1994).

3 CANDIDATE ECLIPSING BINARIES FOR δ SCUTI-TYPE PULSATION

3.1 Detached eclipsing binaries

In Table 3, we present absolute dimensions of the detached binary systems, in which at least one of the components falls into the instability strip. The p and s in column (2) denote primary and secondary components, respectively, placed in the δ Scuti region. However, in some cases, both components of some detached systems are located in this strip. Fig. 2 shows the location of the 54 candidate primary components out of the 71 detached eclipsing binaries. The borders of the instability strip are the same as in Fig. 1. The triangles represent the primary components of detached systems whose

Table 5. Candidate eclipsing binaries selected from *Hipparcos* for pulsation. The errors of $(B - V)$ colours are given in brackets in the last column.

Name	HIP	HD or BD	Spectral type	$P_{\rm orb}$ (d)	V (mag)	$(B - V)$ (mag)
V342 And	817	556A	A3+	2.6393	7.51	0.251 (12)
CU Tuc	2933	3495	F0V	0.8658	9.90	0.453 (32)
V363 And	7122	+35 287	A2	1.2780	9.05	0.272 (21)
BH Scl	7323	9673	A5V	2.0451	7.89	0.236 (12)
V773 Cas	8115	10543	A3V	1.2937	6.18	0.131 (6)
DP Cet	10099	13285	A2	3.1748	6.79	0.240 (11)
V405 Cep	12805	16324	A2	1.3737	8.72	0.279 (14)
FK Eri	12833	17186	F3V	2.2323	9.15	0.514 (20)
FO Eri	13396	18022	A1V	4.3929	8.49	0.105 (13)
CU Cam	17133	22220	A0	3.3637	7.88	0.118 (13)
GT Eri	19062	25925	F0V	0.9014	8.58	0.311 (17)
GW Eri	19571	26591	A1V+(F-G)	3.6586	5.80	0.165 (7)
V1149 Tau	21621	29403	A0	4.9074	8.45	0.223 (22)
V417 Aur	24350	33671	A0	1.8655	7.90	0.100 (15)
AV Dor	26760	38372	F0V	1.0948	9.65	0.440 (29)
IO CMa	29455	42968	A1m-A5-F2	2.8721	8.40	0.286 (4)
CL Lyn	38684	+54 1180	A5	1.5861	9.72	0.309 (30)
OZ Hya	49177	87052	F2V	2.0487	9.43	0.460 (39)
FK Leo	54711	97306	F5III	1.7372	8.50	0.466 (29)
KP Vir	60812	108489	A2	2.2772	8.39	0.123 (140)
V340 Hya	61836	110157	A0V	3.8175	8.24	0.071 (12)
LL Mus	61882	110152	A0V	1.3658	8.93	0.183 (21)
V948 Cen	63979	113689	A9V	0.9751	9.00	0.434 (18)
IO UMa	64636	115268	A3	5.5200	8.18	0.241 (10)
DV Boo	70287	126031	A2	1.2609	7.54	0.343 (4)
CG Cir	71313	–	A0	5.9500	10.31	0.424 (49)
EW Boo	73612	+38 2613	A0	0.9063	10.25	0.207 (45)
V948 Her	85057	+29 2999	F2	1.2752	8.93	0.393 (18)
V1002 Her	92374	229631	A0	1.6042	8.95	0.174 (17)
V2083 Cyg	96011	184242	A3	1.8674	6.87	0.279 (8)
V1461 Aql	97065	186264	A0	1.7630	8.83	0.416 (26)
HZ Dra	97263	187708	A0	0.7729	8.13	0.212 (14)
BV Mic	102256	197189	F0V	3.0180	9.86	0.506 (46)
V2154 Cyg	105584	203839	F0	2.6306	7.78	0.441 (4)
V398 Lac	109193	210180	A0	5.4057	8.73	0.140 (15)
V821 Cas	118223	224557	A0	1.7698	8.26	0.110 (15)

parameters were determined by combining the results of the light curve and radial velocity analyses. The plus symbols correspond to the primary components for which the parameters were estimated from their spectral types. So, the triangles show the positions of the primaries more accurately than the plus symbols.

Fig. 3 displays the positions of the 41 secondary components of the 71 detached eclipsing binary systems given in Table 3. The symbols have the same meaning as given above. The secondary components of the three systems (WX Cep, V1031 Ori and SZ Cen) seem to have completed their main-sequence evolution. If both components in a detached system are located in the instability strip and they have been pulsating, the determination of their pulsational properties may be very difficult, because light variation due to the pulsation of the components will be superimposed on each other.

3.2 Semidetached eclipsing binaries

For the semidetached eclipsing binaries, only the classical Algols were taken into consideration. In Algols, the light contribution of the secondary components to the total light is generally rather small in optical wavelength. Therefore, the absolute parameters of the less-massive secondaries could not be obtained with great accuracy. Fig. 4 shows the positions of the candidate primary components of classical Algols in the HR diagram. The symbols have the same meanings as those used for the detached systems.

3.3 Algol-type binaries discovered by *Hipparcos*

New Algol-type binaries discovered by *Hipparcos* (ESA 1997) are listed in Table 5. According to their $(B - V)$ colour and spectral types, these systems are approximately located in the instability strip. Because the absolute parameters of these systems have not been determined yet, we do not attempt to show their locations in the instability strip.

4 RESULTS AND DISCUSSION

Basic physical parameters of the close binary systems with at least one of the components being a δ Scuti-type pulsator, or a candidate, were collected from contemporary literature and presented as four separate tables. In Tables 1 and 2, we give general properties and pulsational properties of the 25 well-known eclipsing close binary

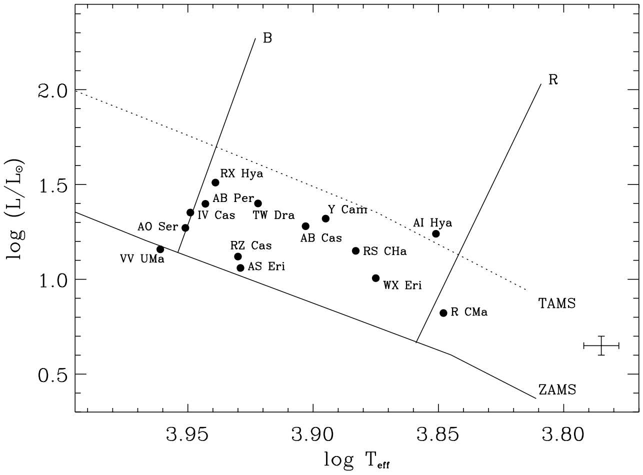

Figure 1. Positions of the δ Scuti-type pulsating components of the eclipsing binary systems in the HR diagram. The solid and dotted lines represent the ZAMS and TAMS, respectively. The observational blue (B) and red (R) borders of the δ Scuti instability strip are shown by diagonal lines.

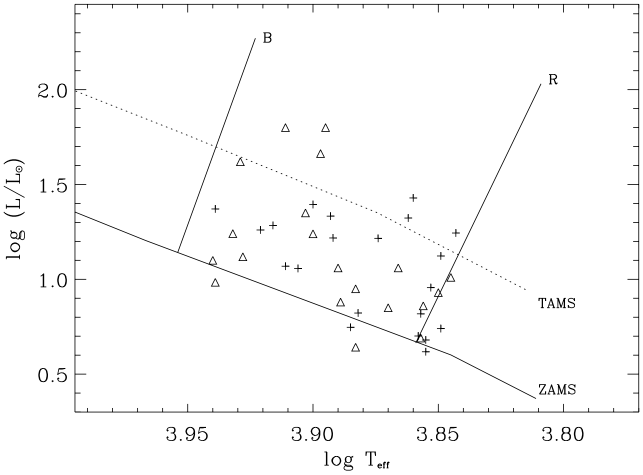

Figure 3. Positions of the 41 secondary components of the detached binary systems in the HR diagram. The triangles indicate more accurate data (see the text). The borders are the same as in Fig 1. The B and R borders of the δ Scuti instability region are observational, while the lines for the ZAMS and TAMS are theoretical.

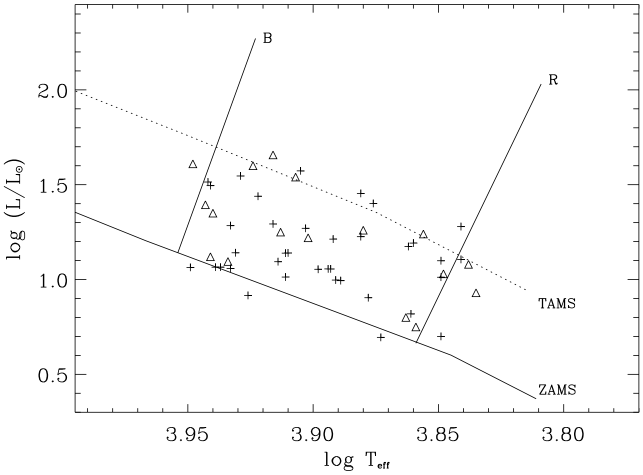

Figure 2. Positions of the 54 primary components of the detached eclipsing binary systems in the HR diagram. The triangles indicate more accurate data (see the text). The borders are the same as in Fig 1. The B and R borders of the δ Scuti instability region are observational, while the lines for the ZAMS and TAMS are theoretical.

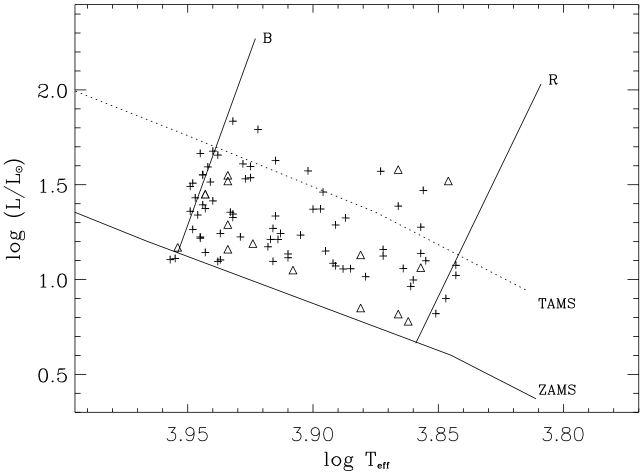

Figure 4. Positions of the 90 primary components of the semidetached binary systems in the HR diagram. The triangles indicate more accurate data. The borders are the same as in Fig 1. The B and R borders of the δ Scuti instability region are observational, while the lines for the ZAMS and TAMS are theoretical.

systems with pulsating components. We present the data for 71 candidate detached eclipsing binary systems in Table 3. At least one of the components of these systems is located in the lower part of the instability strip. Table 4 covers the data of candidate semidetached classical Algols. Accurate astrophysical data of 186 eclipsing binary systems are compiled in Tables 1, 3 and 4. Although there are, so far, few detailed studies on most of the eclipsing Algols discovered by the *Hipparcos* mission, we made a selection from them by taking their $B - V$ colours into account and have listed our findings in Table 5. This table includes 36 eclipsing binary systems located in the instability strip.

The statistical distribution of the masses, radii and luminosities of the components of the listed eclipsing binary systems is examined in Fig. 5. Fig. 5(a), (b) and (c) show the distribution of the components of detached systems from Table 3. The black- and grey-shaded histograms represent the primary and secondary components of detached systems. There are only a few components in the range 1–1.5 $M_{\odot}$, because these systems are difficult to detect, due to low luminosity and late spectral type. More than 50 per cent of the primary components have masses between 2 and 2.5 $M_{\odot}$. From the peak value in the bin 2–2.5 $M_{\odot}$, the number of primary components per bin is seen to decrease sharply. However, the 54 per cent of the secondaries are in the mass range 1.5–2 $M_{\odot}$. Fig. 5(a) shows that the number of the secondary components drops suddenly to about zero for masses greater than 2.5 $M_{\odot}$. There is only one star with mass higher than 3 $M_{\odot}$, due to the cut-off of the high-mass border. Considerable proportion of the primary stars have radii in the range 1.5–2 $R_{\odot}$. About 57 per cent of the primary stars have luminosities in the range 10–20 $L_{\odot}$. The peak value of the distribution of the luminosity for the primary and secondary stars is seen in the bin 10–20 $L_{\odot}$.

The distribution of the primaries of semidetached systems is shown in Fig. 5(d), (e) and (f). A peak is present in the range

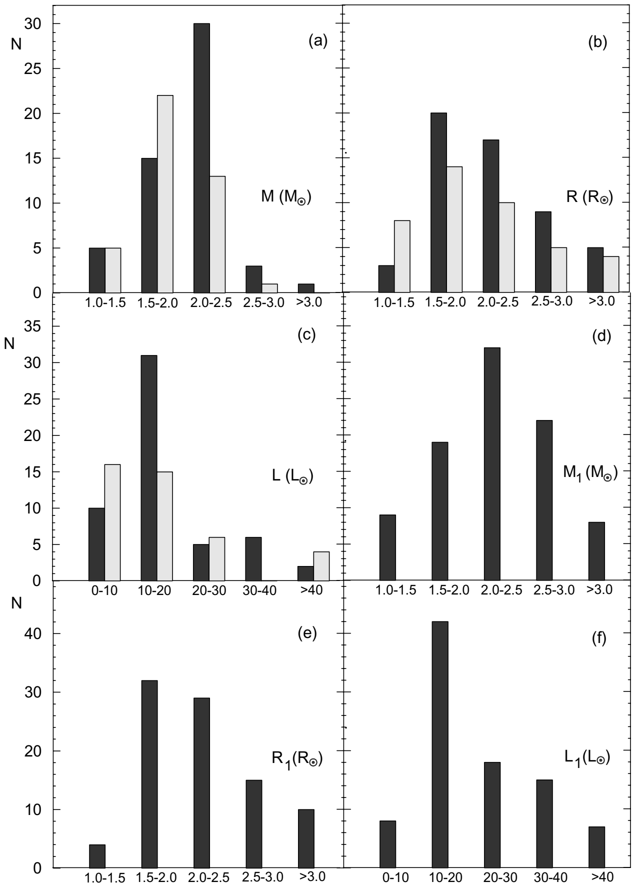

Figure 5. Distribution of the candidate components for pulsation as a function of the masses, radii and luminosity in solar units. Panels (a), (b) and (c) represent the detached systems listed in Table 3. The black- and grey-shaded histograms represent the primary and secondary components, respectively. Panels (d), (e) and (f) represent the semidetached systems listed in Table 4.

2–2.5 M$_\odot$ in the distribution of the primary star masses, as was found for the primary components of detached systems. The distribution of the luminosities looks like that of primaries in the detached systems but the percentage of the primaries in the range 10–20 L$_\odot$ is higher. In addition, the distribution of the radii is very similar to that of primaries in the detached systems. About 68 per cent of the stars have radii in the range 1.5–2.5 R$_\odot$. The primary components of the semidetached binary systems are mass-gaining stars. Their radii may be larger, due to mass transfer from the less-massive secondary components. In addition, as was known for a long time, these mass-gaining primaries rotate faster than the Keplerian velocity.

Fig. 6(a) represents the spectral type distribution of all candidate stars. More than 40 per cent of the candidate stars have a spectral type in the range A3–A5 and there is a gradual decrease towards earlier and later spectral types.

The pulsation period distribution of the oscillating components in the eclipsing binary systems is given in Fig. 6(b). The majority of the stars (80 per cent) pulsate with periods shorter than 2 h. Thirty-six per cent of the stars are found in the range 0–1 h and 44 per cent in the range 1–2 h. However, the oscillation periods of the single δ Scuti pulsators show a different distribution (Rodríguez, López-González & López de Coca 2000). About 68 per cent of the variables have periods in the range 0.05–0.15 d (1.2–3.6 h) and the number of variables decreases with both increasing and decreasing periods. This result may be explained by longer period stars being more evolved, because of the existence of a period–luminosity relation. On the other hand, the majority of short-period stars on the main sequence may have amplitudes that are too small to be detected by moderate telescopes.

The percentage of all δ Scuti pulsators known up to the 10th magnitude, in multiple systems, was given by Rodríguez & Breger (2001) as 22 per cent. This percentage is very low when compared to the percentage of more than half of all stars that are expected to be members of multiple systems. As listed in Table 2, the pulsation amplitudes of the pulsating stars in eclipsing binary systems are generally small. This small-amplitude light variation is suppressed with the large variations produced by the binarity. On the other hand, pulsation and multiplicity may produce radial velocity variability. Very accurate radial velocity measurements obtained in a long time-interval are required to separate these effects. However, we can expect that it will be difficult to measure accurate δ Scuti-type light and radial velocity variations in close binary systems, taking into account large light and velocity variation produced eclipses, proximity effects and orbital motion.

The study of δ Scuti pulsators among eclipsing binaries is very attractive for several reasons. Since the orbital inclination in such systems is close to 90°, the near equator-on view of the stellar surface gives an opportunity for the detection of sectoral modes. The components act as a special filter during the eclipses which makes mode identification more accurate. We should be able to identify

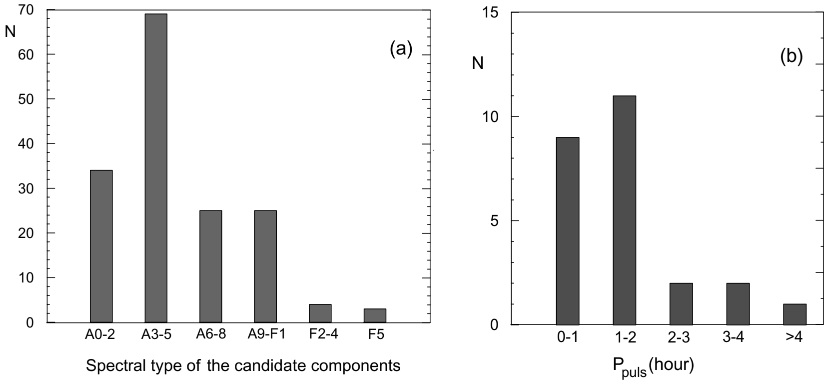

Figure 6. Panel (a): Distribution of the candidate components for pulsation listed in Tables 3 and 4 as a function of the spectral type; panel (b): distribution of the pulsating components listed in Table 2 as a function of the pulsational period.

which component of the binary is responsible for the pulsation by inspection to the light variations during the minima. In addition, pulsating stars in eclipsing binary systems are important, not only for accurate determinations of basic parameters, but also for studying the tidal effects on the pulsation. As a result, since the binarity can provide more stringent constraints on the pulsation characteristics than in the case of single δ Scuti stars, such objects may be considered as privileged targets for future asteroseismic space missions.

ACKNOWLEDGMENTS

This work was partly supported by TÜBİTAK (the Scientific and Technical Resource Council of Turkey) and Çanakkale Onsekiz Mart University Research Foundation. The authors are also grateful to the anonymous referee whose critical comments improved the presentation of this catalogue. We thank Professor Edwin Budding for his careful proofreading of the English grammar in this paper.

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