

The relations between main stellar parameters

B. V. Vasiliev

The theoretical consideration of the stellar substance equilibrium [1] allows to conclude that main stellar parameters are connected by the relation:

$$\mathbb{T}_0 \mathbb{R}_0 = Const \cdot \mathbb{M}^{5/4}. \quad (1)$$

Where \mathbb{M}, \mathbb{R}_0 and \mathbb{T}_0 are a mass of the star, its radius and temperature on its surface.

If to take into account the thermodynamic characteristics of stellar substance [1], one can see that this relation is effect of two other correlations:

$$\frac{\mathbb{M}^2}{\mathbb{R}_0^3} = const \quad (2)$$

and

$$\mathbb{T}_0 = const \cdot \mathbb{M}^{7/12}. \quad (3)$$

If main parameters are expressed through corresponding solar values $\tau \equiv \frac{\mathbb{T}_0}{\mathbb{T}_\odot}, \rho \equiv \frac{\mathbb{R}_0}{\mathbb{R}_\odot}$ and $\mu \equiv \frac{\mathbb{M}}{\mathbb{M}_\odot}$, that Eqs.(1), (2) and (3) can be rewritten as

$$\frac{\tau \rho}{\mu^{5/4}} = 1, \quad (4)$$

$$\frac{\rho}{\mu^{2/3}} = 1 \quad (5)$$

and

$$\frac{\tau}{\mu^{7/12}} = 1. \quad (6)$$

Simultaneously masses, radiuses and surface temperatures can be measured for close binary stars. The measuring data of these parameters are gathered in consolidated table in dissertation (in Russian) [2]. As a matter of convenience of readers, this table together with references on original studies is quoted [1]. On this base the Table of relations (4), (5) and (6) is gathered. It is not difficult to see that these relations wholly are satisfactorily executed for the majority of close binary stars.

Table.
The relations between main stellar parameters

N	Star		$\mu \equiv \frac{M}{M_{\odot}}$	$\rho \equiv \frac{R_{\odot}}{R_{\odot}}$	$\tau \equiv \frac{T_{\odot}}{T_{\odot}}$	$\frac{\rho}{\mu^{2/3}}$	$\frac{\tau}{\mu^{7/12}}$	$\frac{\rho\tau}{\mu^{5/4}}$
1	BW Aqr	1	1.48	1.803	1.043	1.38	0.83	1.15
		2	1.38	2.075	1.026	1.67	0.85	1.42
2	V 889 Aql	1	2.4	2.028	1.692	1.13	1.01	1.15
		2	2.2	1.826	1.607	1.08	1.01	1.09
3	V 539 Ara	1	6.24	4.512	3.043	1.33	1.04	1.39
		2	5.31	4.512	3.043	1.12	1.09	1.23
4	AS Cam	1	3.31	2.58	1.966	1.16	0.98	1.13
		2	2.51	1.912	1.709	1.03	1.0	1.03
5	EM Car	1	22.8	9.35	5.658	1.16	0.91	1.06
		2	21.4	8.348	5.538	1.08	0.93	1.00
6	GL Car	1	13.5	4.998	5.538	0.88	1.08	0.95
		2	13	4.726	4.923	0.85	1.1	0.94
7	QX Car	1	9.27	4.292	4	0.97	1.09	1.06
		2	8.48	4.054	3.829	0.975	1.1	1.07
8	AR Cas	1	6.7	4.591	3.111	1.29	1.02	1.32
		2	1.9	1.808	1.487	1.18	1.02	1.21
9	IT Cas	1	1.4	1.616	1.102	1.29	0.91	1.17
		2	1.4	1.644	1.094	1.31	0.90	1.18
10	OX Cas	1	7.2	4.69	4.068	1.25	1.29	1.62
		2	6.3	4.54	3.93	1.33	1.34	1.79
11	PV Cas	1	2.79	2.264	1.914	1.14	1.05	1.20
		2	2.79	2.264	2.769	1.14	1.05	1.20
12	KT Cen	1	5.3	4.028	2.769	1.32	1.05	1.39
		2	5	3.745	2.701	1.28	1.06	1.35
13	V 346 Cen	1	11.8	8.26	4.05	1.59	0.96	1.53
		2	8.4	4.19	3.83	1.01	1.11	1.12
14	CW Cep	1	11.8	8.263	4.051	1.04	1.06	1.11
		2	11.1	4.954	4.393	1.0	1.08	1.07
15	EK Cep	1	2.02	1.574	1.709	0.98	1.13	1.12
		2	1.12	1.332	1.094	1.23	1.02	1.26
16	α Cr B	1	2.58	3.314	1.555	1.76	0.89	1.57
		2	0.92	0.955	0.923	1.01	0.97	0.98
17	Y Cyg	1	17.5	6.022	5.66	0.89	1.06	0.95
		2	17.3	5.68	5.54	0.85	1.05	0.89

Table(continuation).
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N	Star	n	$\mu \equiv \frac{M}{M_{\odot}}$	$\rho \equiv \frac{R_0}{R_{\odot}}$	$\tau \equiv \frac{T_0}{T_{\odot}}$	$\frac{\rho}{\mu^{2/3}}$	$\frac{\tau}{\mu^{7/12}}$	$\frac{\rho\tau}{\mu^{5/4}}$
18	Y 380 Cyg	1	14.3	17.08	3.54	2.89	0.75	2.17
		2	8	4.3	3.69	1.07	1.1	1.18
19	V 453 Cyg	1	14.5	8.607	4.55	1.45	0.95	1.38
		2	11.3	5.41	4.44	1.07	1.08	1.16
20	V 477 Cyg	1	1.79	1.567	1.46	1.06	1.04	1.11
		2	1.35	1.27	1.11	1.04	0.93	0.97
21	V 478 Cyg	1	16.3	7.42	5.09	1.15	1.0	1.15
		2	16.6	7.42	5.09	1.14	0.99	1.13
22	V 541 Cyg	1	2.69	2.013	1.86	1.04	1.05	1.09
		2	2.6	1.9	1.85	1.0	1.6	1.06
23	V 1143 Cyg	1	1.39	1.44	1.11	1.16	0.92	0.92
		2	1.35	1.23	1.09	1.0	0.91	0.92
24	V 1765 Cyg	1	23.5	19.96	4.39	2.43	0.67	1.69
		2	11.7	6.52	4.29	1.26	1.02	1.29
25	DI Her	1	5.15	2.48	2.91	0.83	1.12	0.93
		2	4.52	2.69	2.58	0.98	1.07	1.05
26	HS Her	1	4.25	2.71	2.61	1.03	1.12	1.16
		2	1.49	1.48	1.32	1.14	1.04	1.19
27	CO Lac	1	3.13	2.53	1.95	1.18	1.00	1.12
		2	2.75	2.13	1.86	1.08	1.01	1.09
28	GG Lup	1	6.24	4.12	2.64	1.03	1.08	1.11
		2	2.51	1.92	1.79	1.04	1.05	1.09
29	RU Mon	1	3.6	2.55	2.20	1.09	1.04	1.14
		2	3.33	2.29	2.15	1.03	1.07	1.10
30	GN Nor	1	2.5	4.59	1.33	2.49	0.78	1.95
		2	2.5	4.59	1.33	2.49	0.78	1.95
31	U Oph	1	5.02	3.31	2.80	1.13	1.09	1.23
		2	4.52	3.11	2.60	1.14	1.08	1.23
32	V 451 Oph	1	2.77	2.54	1.86	1.29	1.03	1.32
		2	2.35	1.86	1.67	1.05	1.02	1.07
33	β Ori	1	19.8	14.16	4.55	1.93	0.80	1.54
		2	7.5	8.07	3.04	2.11	0.94	1.98
34	FT Ori	1	2.5	1.89	1.81	1.03	1.06	1.09
		2	2.3	1.80	1.62	1.03	1.0	1.03

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N	Star	n	$\mu \equiv \frac{M}{M_{\odot}}$	$\rho \equiv \frac{R_{\odot}}{R_{\odot}}$	$\tau \equiv \frac{T_{\odot}}{T_{\odot}}$	$\frac{\rho}{\mu^{2/3}}$	$\frac{\tau}{\mu^{7/12}}$	$\frac{\rho\tau}{\mu^{5/4}}$
35	AG Per	1	5.36	3.0	2.91	0.98	1.09	1.06
		2	4.9	2.61	2.91	0.90	1.15	1.04
36	IQ Per	1	3.51	2.44	2.27	1.06	1.09	1.16
		2	1.73	1.50	2.27	1.04	1.00	1.05
37	ς Phe	1	3.93	2.85	2.41	1.14	1.08	1.24
		2	2.55	1.85	1.79	0.99	1.04	1.03
38	KX Pup	1	2.5	2.33	1.74	1.27	1.02	1.29
		2	1.8	1.59	1.38	1.08	0.98	1.06
39	NO Pup	1	2.88	2.03	1.95	1.00	1.05	1.05
		2	1.5	1.42	1.20	1.08	0.94	1.02
40	VV Pyx	1	2.1	2.17	1.49	1.32	0.96	1.27
		2	2.1	2.17	1.49	1.32	0.96	1.27
41	YY Sgr	1	2.36	2.20	1.59	1.24	0.96	1.19
		2	2.29	1.99	1.59	1.15	0.98	1.12
42	V 523 Sgr	1	2.1	2.67	1.42	1.63	0.92	1.50
		2	1.9	1.84	1.42	1.20	0.98	1.17
43	V 526 Sgr	1	2.11	1.9	1.30	1.15	0.84	0.97
		2	1.66	1.60	1.30	1.14	0.97	1.10
44	V 1647 Sgr	1	2.19	1.83	1.52	1.09	0.96	1.05
		2	1.97	1.67	4.44	1.06	1.02	1.09
45	V 2283 Sgr	1	3.0	1.96	1.67	0.94	0.88	0.83
		2	2.22	1.66	1.67	0.97	1.05	1.02
46	V 760 Sco	1	4.98	3.02	2.70	1.03	1.06	1.09
		2	4.62	2.64	2.70	0.95	1.11	1.05
47	AO Vel	1	3.2	2.62	1.83	1.21	0.93	1.12
		2	2.9	2.95	1.83	1.45	0.98	1.43
48	EO Vel	1	3.21	3.14	1.73	1.44	0.87	1.26
		2	2.77	3.28	1.73	1.66	0.95	1.58
49	α Vir	1	10.8	6.10	3.25	1.66	0.81	1.34
		2	6.8	4.39	3.25	1.22	1.06	1.30
50	DR Vul	1	13.2	4.81	4.79	0.83	1.06	0.91
		2	12.1	4.37	4.79	0.83	1.12	0.93

References

- [1] Vasiliev B.V.: Astro-ph/0802.1581
- [2] Khaliullin K.F.: *Dissertation*, Sternberg Astronomical Institute, Moscow, (Russian)(2004) (see Table in Appendix on <http://astro07.narod.ru>)