Complementary Approaches to Double and Multiple Star Research, IAU Colloquium 135, ASP Conference Series, Vol. 32, 1992
Harold A. McAlister and William I. Hartkopf (eds.)

Cepheid Binaries — an Up-to-Date List

L. SZABADOS
Konkoly Observatory of the Hungarian Academy of Sciences,
H-1525 Budapest, XII. P.O. Box 67, Hungary

ABSTRACT: **Cepheid variables are exceptionally useful objects for astrophysics and cosmology but at the same time these stars are normal as far as their duplicity is regarded. A brief summary is given on the relevant data of the known spectroscopic-binary Cepheids and other potential binary Cepheids, duplicity of which is suspected on the ground of various photometric methods.**

1. INTRODUCTION

The fundamental stellar parameters (e.g., radius and mass) are usually determined with the help of either binary or intrinsically variable stars. Physical variable stars belonging to binary (or multiple) systems are even more important because the same physical property can be determined by two (or more) independent methods for these stars. In view of the role of Cepheids in the cosmological distance calibration (with the help of the period – luminosity relationship), accurate knowledge of their basic properties (especially luminosity) is essential.

2. FREQUENCY OF BINARIES AMONG CEPHEIDS

In fact, there is growing evidence that duplicity among Cepheids is a normal phenomenon. In order to estimate the real frequency of Cepheid binaries and the bias arising from the observational selection, duplicity status of more than 300 Cepheids brighter than 11^m was studied.

The observed distribution of binaries among Cepheids clearly indicates the following facts. *The frequency of binaries exceeds 50% for the brightest (i.e. best studied) variables.* The occurrence of known spectroscopic binaries continuously decreases towards fainter Cepheids, and the photometrically suspected Cepheid binaries become more important with decreasing brightness, while the spectroscopic binaries are underrepresented.

3. THE LIST OF CEPHEID BINARIES

In order to facilitate the selection of the objects to be studied, the relevant data on known and suspected Cepheid binaries are summarized here. The known spectroscopic-binary Cepheids are listed in Table 1, while the photometric- and visual-binary Cepheids are collected in Table 2.

https://doi.org/10.1017/S0252921100006795 Published online by Cambridge University Press

There have been several attempts to resolve Cepheids using interferometric techniques. Such data are available for eleven Cepheids (McAlister & Hartkopf 1988). The data listed in Table 1 are useful for selecting those Cepheids which, being long-period spectroscopic binaries, can be likely separated by interferometric techniques. Cepheids listed in Table 2 are worthy of both careful radial velocity study because a considerable part of those variables may turn out to be a spectroscopic binary, and high angular resolution measurements, since the presence of a photometric or visual companion is certain.

A more detailed version of this paper will be published elsewhere.

4. ACKNOWLEDGEMENTS

My thanks are due to the LOC, the IAU, and the Hungarian Soros Foundation for the grants kindly offered for me. Without this financial assistance my participation in the Colloquium would not have been possible.

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TABLE 1. Spectroscopic–binary Cepheids.

Name	*log* P	<V> (*mag*)	2K ($km\,s^{-1}$)	P_{orb} (day)	a *sin* i (AU)	Reference
U Aql	0.847	6.5	15.62	1856.4	1.31	Welch *et al.* (1987)
FF Aql	0.650	5.4	10.14	1429.72	0.66	Evans *et al.* (1990)
KL Aql	0.786	10.2	>45			Paper II
V496 Aql	0.833	7.8	>14	>1000		Paper I
η Aql	0.856	3.9	5	926 ?		Paper II
AN Aur	1.012	10.4				Paper II
RY CMa	0.670	8.1	>4			Moffett & Barnes (1987)
V Car	0.826	7.4	>7			Paper I
Y Car	0.561	8.1	17.0	993.0	0.69	Balona (1983)
YZ Car	1.259	8.7	18.8	850	0.73	Coulson (1983)
SU Cas	0.290	6.0	4	462.5 ?		Paper II
BY Cas	0.508	10.3	≈10			Szabados (unpubl.)
DL Cas	0.903	9.0	28.0	688.0	0.85	Harris *et al.* (1987)
V636 Cas	0.923	7.2	>5			Paper II
XX Cen	1.040	7.8	8.1	909.4	(0.34)	Szabados (1990)
AZ Cen	0.507	8.6	>15			Gieren (1982)
KN Cen	1.532	9.9	>10			Paper I
AX Cir	0.722	5.9	>15	4600 ?		Paper I
T Cru	0.828	6.6	12.5	774		Kovács *et al.* (1990)
BG Cru	0.524	5.5	>6			Paper I
X Cyg	1.214	6.4	>8			Paper II
SU Cyg	0.585	6.9	60.2	549.16	1.42	Evans (1988)
SZ Cyg	1.179	9.5	>8			Paper II
BZ Cyg	1.006	10.2	>20			Paper II
DT Cyg	0.398	5.8	4			Paper II
MW Cyg	0.775	9.5	>5			Paper II
V386 Cyg	0.721	9.7	>10			Paper II
V532 Cyg	0.516	9.1	>3			Paper II
V1334 Cyg	0.523	5.9	23	≤1240		Paper II
W Gem	0.898	7.0	>5			Paper II
RZ Gem	0.743	10.1	16	886 ?		Paper II
AD Gem	0.578	9.9	>5			Paper II
DX Gem	0.497	10.7				Burki (1985)
Z Lac	1.037	8.5	25			Paper II
RR Lac	0.807	8.9	8			Paper II
GH Lup	0.967	7.6	>5			Paper I
T Mon	1.432	6.2	>14	>64000		Gieren (1989)
V465 Mon	0.433	10.4				Burki (1985)
R Mus	0.876	6.3	7.1	982		Kovács *et al.* (1990)
S Mus	0.985	6.1	35.4	505.44	0.68	Evans (1990)
S Nor	0.989	6.4	>10	>3000		Paper I
Y Oph	1.234	6.2	3.2	1222.5	(0.18)	Paper I
BF Oph	0.609	7.4	4	4420	(0.81)	Paper I
RS Ori	0.879	8.4	>10			Paper II
SV Per	1.046	9.0	>5			Paper II
AW Per	0.810	7.5	22.8	13100	11.4	Welch & Evans (1989)
AP Pup	0.706	7.4	>30			Paper I
AT Pup	0.824	8.0	12.3	300	(0.17)	Kovács *et al.* (1990)
S Sge	0.923	5.6	30.24	676.2	0.91	Slovak & Barnes (1987)
U Sgr	0.829	6.7	4	4550 ?		Paper I
W Sgr	0.881	4.7	4.70	1780	0.33	Babel *et al.* (1989)

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TABLE 1. Spectroscopic–binary Cepheids (continued).

Name	*log* P	<V> (*mag*)	2K ($km\,s^{-1}$)	P_{orb} (day)	a *sin* i (AU)	Reference
X Sgr	0.846	4.6	5.9	507.25	(0.11)	Szabados (1990)
Y Sgr	0.761	5.8	>5	long		Paper I
AP Sgr	0.704	7.0	>10	long		Paper I
BB Sgr	0.822	7.0	>10			Paper I
V350 Sgr	0.712	7.5	24.0	1129	(1.24)	Szabados (1990)
RV Sco	0.783	7.1	>10	8000 ?		Paper I
V482 Sco	0.656	8.0	>5			Vinkó (1991)
V636 Sco	0.832	6.7	25.0	1318	1.46	Lloyd Evans (1982)
Y Sct	1.015	9.7	>10	long		Paper I
R TrA	0.530	6.7	>5	3500 ?		Paper I
α UMi	0.599	2.0	8.18	10900	3.15	Roemer (1965), Dinshaw *et al.* (1989)
V Vel	0.641	7.6	>4	7500 ?		Paper I
AH Vel	0.626	5.7	>5			Paper I
T Vul	0.647	5.8	6	1745	0.48	Paper II
U Vul	0.903	7.2	>8			Paper II
X Vul	0.801	8.9	>5			Paper II

TABLE 2. Visual– and photometric–binary Cepheids*

Name	log *P*	<V>	Feature	Name	log *P*	<V>	Feature
T Ant	0.771	9.3	blue [1]	BP Cir	0.380	7.5	blue
FN Aql	0.977	8.4	blue	SU Cru	1.109	9.8	red
RX Aur	1.065	7.7	red [2]	AG Cru	0.584	8.2	blue
YZ Aur	1.260	10.3	blue	VY Cyg	0.895	9.6	blue
RW Cam	1.215	8.7	blue	V402 Cyg	0.640	9.9	blue
RX Cam	0.898	7.7	blue	ζ Gem	1.006	3.9	VB
RZ CMa	0.629	9.7	blue	X Lac	0.736	8.4	blue
WZ Car	1.362	9.3	blue	Y Lac	0.636	9.2	blue
GI Car	0.647	8.3	blue	BG Lac	0.727	8.9	blue
CEa Cas	0.711	10.9	VB [3]	CV Mon	0.731	10.3	blue
CEb Cas	0.651	11.0	VB	SY Nor	1.102	9.5	VB; blue
DD Cas	0.992	9.9	blue	V440 Per	0.879	6.3	blue
TX Cen	1.233	10.5	VB; blue	AQ Pup	1.478	8.8	blue
UZ Cen	0.523	8.8	VB	RY Sco	1.308	8.0	VB; blue
VW Cen	1.177	10.3	blue	V500 Sco	0.969	8.8	blue
V659 Cen	0.750	6.6	blue	SZ Tau	0.498	6.5	blue
δ Cep	0.730	4.0	VB	T Vel	0.666	8.0	red
				BG Vel	0.840	7.7	red

* Known spectroscopic binaries from Table 1 have been omitted.
[1] blue companion
[2] red companion
[3] visual binary

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