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Publication date
2000

Published in
Astronomy and Astrophysics Supplement Series

ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

NOVEMBER II **2000**, PAGE 25

Astron. Astrophys. Suppl. Ser. **147**, 25–49 (2000)

A catalogue of high-mass X-ray binaries⋆

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Received June 15; accepted July 19, 2000

Abstract. We present a catalogue of high-mass X-ray binaries. The catalogue is an updated version of the catalogue of van Paradijs (1995). This new catalogue contains 130 sources, 61 new high-mass X-ray binaries in addition to the 69 sources listed in van Paradijs' catalogue. Most of the new sources are identified to be Be/X-ray binaries. Some sources, however, are only tentatively identified as high-mass X-ray binaries on the basis of a transient character and/or a hard X-ray spectrum. Further identification in other wavelength bands is needed to finally determine the features of these sources.

The aim of this catalogue is to provide the reader with some basic information on the X-ray sources and their counterparts in other wavelength ranges (UV, optical, IR, radio). In cases where there is some doubt about the high-mass nature of the X-ray binary this is mentioned. Some doubtful cases have not been included in the catalogue although they had been suggested by some authors to be high-mass X-ray binaries, for example GRS 1915+105 and 1WGA J1958.2+3232.

Key words: stars: massive star — stars: X-ray — stars: binaries — catalogs

1. Introduction

High-mass X-ray binaries (HMXBs) were among the very first X-ray sources detected and optically identified almost 30 years ago. These systems consist of a compact object, mostly a magnetized neutron star (NS) (X-ray pulsar) or a black hole, orbiting a massive star. The X-ray emission in these sources is due to accretion of matter from the early-type mass-losing star by the compact companion. Conventionally HMXBs can be further divided into two subgroups (van Paradijs 1983): those in which the primary is a Be star (Be/X-ray binary) and those in which the primary is a supergiant (SG/X-ray binary).

The majority of the known high-mass X-ray binaries are Be/X-ray systems. Most Be/X-ray binaries have relatively wide orbits with moderate eccentricity and their compact companions spend most of their time far away from the disc surrounding the Be stars (van den Heuvel & Rappaport 1987; Bhattacharya & van den Heuvel 1991; Apparao 1994). X-ray outbursts will be expected during the time of the neutron star's periastron passage, from a low-velocity and high-density wind around Be stars, and thus collectively termed Be/X-ray transients. Their X-ray spectra are usually hard. The hard X-ray spectrum along with the transience is an important characteristic of the Be/X-ray binaries.

In the second group of HMXB systems the compact star orbits a supergiant early-type star, deep inside the highly supersonic wind. The X-ray luminosity is either powered by pure stellar wind accretion or, in the case of the brighter systems, by Roche-lobe overflow via an accretion disk.

In 1983 the number of known HMXBs was about 30 (van Paradijs 1983). By the time of the previous catalogue the number of X-ray sources associated with massive stars had increased to 69 (van Paradijs 1995). The systematic study of ROSAT X-ray sources in the SMC and the LMC (Kahabka & Pietsch 1996; Haberl et al. 1999, 2000) and systematic programme of optical identifications (Schmidtke et al. 1994; Cowley et al. 1997; Motch et al. 1998; Stevens et al. 1999; Coe & Orosz 2000) increased the number considerably.

In this paper we present a new catalogue, which increases the number of known HMXBs to 130, including 61 newly discovered HMXBs as well as the 69 "old" ones listed in van Paradijs' catalogue.

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⋆ The catalogue and references are also available in electronic form at the CDS via anonymous
ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via
http://vizier.u-strasbg.fr/cgi-bin/qcat?J/A+AS/147/25

2. Description of the table

Table 1 lists the 130 HMXBs. The format of the table is similar to that of the previous one (van Paradijs 1995) and the well-known work of Bradt & McClintock (1983), of which the present catalogue is meant to be an update. In the table the sources are ordered according to right ascension; part of the (mainly numerical) information on a source is arranged in seven columns, below which for each source additional information is provided in the form of key words with reference numbers [in square brackets]. The columns have been arranged as follows.

In Col. 1 the first line contains the source name, with rough information on its sky location according to the convention hhmm ± ddd. Here hh and mm indicate the hours and minutes of right ascension, ddd the declination in units of 0.1 degree (in a small number of cases, the coordinates shown in the name are given with more, or fewer, digits). However, for a ROSAT source the name is always given in the form of hhmm.m ± ddmm. The prefix J indicates a name based on J2000 coordinates. Otherwise, 1950 coordinates were used in the name. Alternative source names are given in the second line. The third line of Col. 1 lists survey catalogues and experiments in which the source was listed and detected, respectively. The following abbreviations have been used.

- A: Ariel V sky survey;
- AS: ASCA;
- B: BeppoSAX;
- C: Compton γ-ray Observatory;
- E: Einstein Observatory;
- Exo: Exosat;
- G: Ginga;
- Gr: Granat;
- H: HEAO A-1 sky survey;
- Ha: Hakucho;
- K: Kvant;
- M: MIT OSO-7 sky survey;
- OAO: Orbiting Astronomical Observatory;
- R: ROSAT;
- S: SAS 3;
- SL: Space Lab;
- T: Tenma;
- U: Uhuru sky survey;
- V: Vela-5 and -6 satellites;
- X: Rossi XTE.

In the first line of Col. 2, the source types are indicated with a letter code, as follows:

- P: X-ray pulsar;
- T: transient X-ray source;
- U: ultra-soft X-ray spectrum. These sources include black-hole candidates; some "extreme ultra-soft" (EUS) source may be white dwarf (WD) on whose surface steady nuclear burning takes place.

In the third line of Col. 2, we provide some information on the type of observation from which the source position has been derived. The following abbreviations have been used: o, optical; x, X-ray; r, radio; IR, infrared. A reference on the source position is given below the columnar information under "*pos*.". In addition, we give an indication of the accuracy of this position, in the form of equivalent (90 percent confidence level) error radii, but in several cases this can only be considered an approximation (e.g. when the error box is not circular). When no accuracy is quoted, it is about one arcsecond or better.

Column 3 contains in the first two lines the right ascension (RA) and declination (DEC) of the source for epoch 1950 for usual name, and for epoch 2000 for the sources with the names of J2000 coordinates. RA is given as hhmmss.s to an accurcy of 0.1 s, DEC is given in $^\circ\,'\,''$, to an accuracy of $1''$. The third line gives the galactic longitude and latitude to an accuracy of 0.1° (except for sources close to the galactic center, where these coordinates are given to 0.01°).

The first and second lines of Col. 4 give names of an optical counterpart. The third line contains a reference to a finding chart. An asterisk followed by a number or letter refers to star numbers used in the finding chart; "star" refers a star in the finding chart that has not been assigned a number or letter. Many optical counterparts have been indicated with a variable-star name, as given in the *General Catalogue of Variable Stars* and in recent name lists of variable stars as published regularly in the *IAU Information Bulletin on Variable Stars*, or a number in a well-known catalogue (e.g., HD, SAO). For X-ray sources in globular clusters, the cluster name is here given, in addition to the name of a stellar optical counterpart.

The fifth column contains some photometric information on the optical counterpart. In the first line, the apparent visual magnitude, V, and the color indices $B-V$, and $U-B$, are listed. The second line contains the spectral type of the optical counterpart and an estimate of the interstellar reddening, E_{B-V}.

In Col. 6, the average X-ray flux, or the range of observed X-ray fluxes ($2-10$ keV, unless otherwise indicated), is given, in units of

$$1\ \mu\mathrm{Jy} = 10^{-29}\ \mathrm{erg\ cm^{-2}\ s^{-1}\ Hz^{-1}}$$
$$= 2.4\ 10^{-12}\ \mathrm{erg\ cm^{-2}\ s^{-1}\ keV^{-1}}.$$

The first line in Col. 7 gives the orbital period in days. The second line contains for X-ray pulsars the pulse period, in seconds.

3. Remarks on some individual objects

We wish to emphasize here that some sources listed in this catalogue are still uncertain. They need to be regarded

with caution in view of many further work necessary to be done. Some sources are tentatively classfied as massive X-ray binaries due to their X-ray transience and hard X-ray spectra. No counterpart at other bands has been found or no pulse period has been detected, or both. Also, the compact object in some weak or soft X-ray sources may be a white dwarf instead of a neutron star. If this is the case, they should be excluded from this catalogue.

Finally, we would like to make some remarks on several individual sources. We can't make sure whether these sources belong to HMXBs or not. The following three sources are listed in our catalogue, although some doubt has been reported in the literature on the nature of the high-mass X-ray binary.

1WGA J0648.0 − 4419: The weak X-ray source with a pulsation of 13 s was discovered by Israel et al. (1997) from ROSAT PSPC data. They believed that the system contained a hydrogen-depleted subdwarf O6 star and most likely a neutron star. But Bisscheroux et al. (1997) suggested the compact companion is a white dwarf star instead of a neutron star, mainly due to the ultrasoft spectrum of the X-ray source and the very close resemblance of the X-ray spectrum and luminosity with that of the soft intermediate polars.

1E1024.0 − 5732: The source was discovered with Einstein Observatory. Caraveo et al. (1989) suggested that a highly reddened O5 star was the most likely optical counterpart, and therefore proposed the system was a HMXB. The source was listed in the previous catalogue. New optical and X-ray data, however, favour that the system contains a Wolf-Rayet star and an O-type star (Mereghetti et al. 1994; Reig 1999). The origin of the X-rays from this source is explained by the colliding wind binary model (Reig 1999).

1E1048.1 − 5937: Although the source was listed in van Paradijs's catalogue, the system can not be confirmed to be a HMXB or a LMXB. The compact star belongs to the "anomalous" X-ray pulsars, which are thought now to be related to the magnetars. Mereghetti et al. (1998) argued that if it has a companion this star must be either a white dwarf or a helium burning star instead of a main-sequence companion.

The following two sources are not listed in our catalogue, although some authors argued that the sources are Be/X-ray binaries.

GRS 1915+105: The source was listed in van Paradijs' catalogue of low-mass X-ray binaries (LMXBs). Its compact is well accepted as a black hole candidate. Mirabel et al. (1997) argued the system was a Be/X-ray binary according to its K-band infrared spectra. On the other hand, most characteristics are consistent with a LMXB. Therefore, we prefer to consider the source to be a LMXB as before.

1WGA J1958.2 + 3232: Israel et al. (1998) discovered ~ 12 min X-ray pulsations in this source. Further spectral observations of the optical counterpart made Israel et al. (1999b) conclude that the X-ray source is a likely new accreting neutron star in a Be/X binary system. Negueruela et al. (2000), however, found the optical spectrum is dominated by emission lines from an accretion disk and argued that the observed X-ray and the optical characteristics are consistent with the object being an intermediate polar.

PSR B1259 − 63/SS 2883 is also not listed in our catalogue. The source was discovered by Johnston et al. (1992a) to be a radio pulsar in a highly eccentric orbit around the massive star SS 2883 (Johnston et al. 1992b), with an eccentricity of 0.869. The pulsar rotation period is 47.76 ms and the orbital period is 1236.79 days. X-ray observations with ROSAT, ASCA and CGRO (Cominsky et al. 1994; Greiner et al. 1995; Kaspi et al. 1995; Grove et al. 1995; Tavani et al. 1996) showed X-ray luminosity of $10^{33} - 10^{34}$, assuming a distance of 2 kpc. No X-ray pulsation was detected. Optical observations of SS 2883 exhibited strong H-Balmer emissions and the star is of spectral type of about B2e, indicating its mass to be 10 $M_\odot$ and its radius 6 $R_\odot$ (Johnston et al. 1994). The system is the only known binary where a radio pulsar is observed to interact with gaseous material from a Be star. It may be the evolutionary missing link connecting the radio pulsars to the X-ray emitting Be binaries (for recent simple review, see Tavani & Arons 1997).

Note added in proof: While the paper was under referee, Haberl F. and Sasaki M. (2000, A&A 359, 573) reported that there are more than 20 new Be/X-ray binary candidates in the SMC, which are not listed in our catalogue.

Acknowledgements. QZL acknowledges the financial support from K.C. Wong fellowship of Chinese Academy of Sciences. This work is partially supported by The Netherlands Organization for Scientific Research (NWO) through Spinoza Grant 08-0 to E.P.J. van den Heuvel and by the National Project for Fundamental Research by the Ministry of Science and Technology of China (973 Project).

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Table 1. High-mass X-ray binaries

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
J0032.9 − 7348		00 32 56.1	*1	15.3, - -, - -	0.2	
		−73 48 19		Be, - -		
R	x 12.9″	304.7, −43.2	[657]	[354]	[354]	
Pos.: [255]; in SMC: [354]; very strong emission lines: [657]; another early-type star within error circle: [657].						
J0049 − 732	P	00 49 29.6			0.04	
		−73 10 56				9.1321
As	x 5.5″	303.1, −43.9			[327]	[327]
Pos.: [255]; in SMC: [327]; likely a Be: [255].						
J0049 − 729	TP	00 49 02.5	Be star		0.5 − 9	
J0049.1 − 7250		−72 50 52		Be, - -		74.676
AS, R, X	x 13.7″	303.2, −44.3	[657]		[354]	[132, 790]
Pos.: [255, 355]; in SMC: [354]; two Be stars within error circle: [104]; high variability: [355, 354].						
0050 − 727	T	00 50 19.5	*4	$\sim$ 14, −0.3, −1.0	$<$ 1 − 5	
SMC X−3		−72 42 24		O9 III-Ve, 0.03		
A, H, S, X	o 3″	302.9, −44.7	[95]	[7, 146]	[95]	
Pos.: [63]; transient: [95, 96]; projected rotational velocity $v_{\rm r}{\rm sin}i \sim 200$ km s^{-1}: [146].						
J0050.7 − 7316	P	00 50 44.7	Be star	15.44, −0.03, −0.95	0.16	1.416
J0051 − 733		−73 16 05		Be, - -	(0.7 − 10 keV)	323
R, AS	o 1″	303.0, −43.8	[141]	[104, 141]	[788]	[104, 788]
Pos.: [104]; in SMC: [141]; orbital period 0.708 days: [118, 616]; orbital solution: [104].						
J0051 − 722	TP	00 50 55.8	Be star	14.9, - -, - -	2.6	120
		−72 13 55		Be		91.1
X, R, B	x 10″	303.0, −44.9	[657]	[657]	[424]	[334, 461]
Pos.: [132]; in SMC: [461]; X-ray pulsation: [132, 334, 424]; strong emission lines: [657]; opt. spectrum: [657].						
J0051.8 − 7231	TP	00 51 53.0	*2		0.01 − 9	
2E0050.1 − 7247		−72 31 45		Be, - -		8.9
E, X, R, B	x 11″	302.9, −44.6	[657]		[354]	[330]
Pos.: [354]; in SMC: [354]; X-ray activity: [354]; neither AV111 nor star 1 is the opt. counterpart: [657].						
J0051.9 − 7311	T	00 51 51.4	B[e] star	14.4, - -, - -		
SMC 25		−73 10 38		B[e], - -		
R	x	302.9, −43.9	[141]	[141]		
Pos.: [141]; unassociated with the supernova remnent DEM 60: [141].						
J0052.1 − 7319	TP	00 52 13.9	SMC SC6 99923	14.667, −0.005, - -	0.024 − 4.7	
		−73 19 13		Be, - -		15.3
E, X, R	x 1.9″	302.8, −43.8	[702]	[702, 332]	[399]	[399]
Pos.: [255]; in SMC: [399]; highly variable X-rays: [353]; strong Hα emis. line: [332]; $P_{\rm orb}$ likely between 600 − 700 d: [702].						
J0052.9 − 7158	TU	00 52 54.0	Be star	15.46, −0.07, −0.99	2	
SMC 32		−71 58 08		Be, - -	(0.15 − 2.4 keV)	
R	x	302.8, −45.1	[141]	[141]	[141]	
Pos.: [141]; unlikely the supernova remnant IKT4: [141]; highly variable in X-rays: [141]; trans. supersoft source: [141].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
0053 − 739	T	00 52 53.1	*5	16.0, −0.3, −0.5	$< 1-7$	
SMC X−2		−73 57 19		B1.5 Ve, 0.03		
A, S	o	302.6, −43.4	[95]	[506]	[95]	
Pos.: [506]; transient: [95, 96]; southern component of a close pair: [506]; $v_{\rm r}\sin i \sim 200$ km s^{-1}: [146].						
0053+604		00 53 40.3	γ Cas	$1.6-3.0$, −0.15, −1.08	$5-11$	
		+60 26 47		B0.5 Ve, 0.05		
U, A, H, S, AS, B	o	123.6, −2.1	[177]	[489]	[63]	
Pos.: [63]; X-ray spectrum: [219, 505, 542]; UV observations: [51, 170, 261, 273, 455]; variable Be star: [235, 456, 739, 769]; radial-velocity variations: [343]; $v_{\rm r}\sin i \sim 300-500$ km s^{-1}: [304, 310, 489]; system velocity: [721]; comparison with X Per: [489, 764]; radio/mm obs.: [179, 747]; polarimetry: [101]; optical interferometry Hα envelope: [503, 687]; non-radial pulsations: [787]; wind structure: [746]; long-term periodic variability in UV absorption: [681]; a WD sys.: [249]; multiwavelength obs.: [292, 645a]; ISO IR spe. and envelope structure: [291].						
J0053.8 − 7226	TP	00 53 55.0			1.4	139
0053 − 724		−72 26 47		B1V		46.63
X, R	x 10″	302.7, −44.7			[132]	[132, 425]
Pos.: [132]; in SMC: [132]; X-ray pulsations: [132, 425]; possibly a Be star [425]; spectral type: see [513].						
J0054 − 720	TP	00 54.6			3.8	
		−72 04				169.3
X, B	x 10″	302.6, −45.0			[428]	[428]
Pos.: [428]; most likely a Be/X-ray system in SMC: [429].						
J0055 − 724	TP	00 54 56.17	Be star	15.28, −0.04, −0.78	1	65
J0054.9 − 7226		−72 26 27.6		B0-B1III-V, $0.06-0.28$		58.969
X, B, R, E	x 0.1″	302.6, −44.7	[621, 657]	[104, 279, 621]	[458]	[429, 458, 610]
Pos.: [104]; in SMC: [458]; orbital period 14.26 days: [104]; very strong emission lines: [657]; consistent with Einstein source 2E0053.2 − 7242: [610].						
J0058 − 72.0	P	00 57 48.4			0.1	
J0058 − 7203		−72 02 42			(0.7 − 10 keV)	280.4
AS, R	x 7.9″	302.2, −45.0			[788]	[788]
Pos.: [255]; HMXB in SMC (?): [255].						
J0058.2 − 7231		00 58 12.7	Be star	15.0, - -, - -		
		−72 30 45		Be, - -		
R	x	302.2, −44.6	[621]	[621]		
Pos.: [621]; very weak X-ray emission in SMC: [621].						
J0059.2 − 7138	TUP	00 59 11.3	Be star	14.1, 0.11, - -	3	
		−71 38 45		B1IIIe, 0.03	(0.2 − 2 keV)	2.7632
R, E	x 2.8″	302.1, −45.4	[650]	[650]	[299]	[299]
Pos.: [255]; in SMC: [299]; strong Hα emis. line: [299]; two components X-ray spe.: [299]; extremely ultrasoft X-ray sp.: [299].						
J0101.0 − 7206	T	01 01 01.1	Be star		0.1	
		−72 06 57		Be		
R, E	x 2.8″	301.9, −45.0	[657]		[354]	
Pos.: [354]; in SMC: [354]; very strong Hα emission line: [657].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
J0103 − 722	P	01 03 13.9	Be star	14.8, 0.089, - -	0.01 − 0.1	
J0103.2 − 7209		−72 09 14.0		O9-B1(III-V), 0.23	(0.2 − 2 keV)	345.2
R, A, B	o 0.1″	301.6, −44.9	[300]	[104, 300]	[300, 334]	[334]
Pos.: [104]; in SMC: [334]; consistent with the known supernova remnant SNR 0101 − 724 and the Einstein source 1E 0101.5 − 7225: [300]; strong Hα activity in the BeppoSAX error circle: [334].						
0103 − 762	T	01 07 45.1	Be star	17, - -, - -	2.3	
0107 − 750		−75 00 38		Be, 0.03		
H, V, R	o	301.9, −41.1		[698]	[781]	
Pos.: [698]; variable X-ray source: [698]; member SMC: [698].						
J0105 − 722	TP	01 05 08.9			0.1	
J0105.1 − 7211		−72 11 44				3.343
AS, R	x 6.6″	301.4, −44.9	[203]		[203]	[789]
Pos.: [255]; in SMC: [789]; containing six sources: [203]; likely a Be/X-ray binary: [203]; multiwavelenth obs.: [203].						
J0106.2 − 7205		01 06 15.1	Be star	16.7, - -, - -	0.005	
		−72 05 25		B2-B5 III-Ve,	(0.2 − 2 keV)	
				0.05 − 0.25		
R	x 15″	301.3, −45.0	[300]	[300]	[300]	
Pos.: [356]; consistent with the known supernova remnant SNR 0104 − 72.3 in SMC: [300]; opt/IR obs.: [605].						
J0111.2 − 7317	TP	01 11 08.4	Be star	15.32, 0.08, - -	15	
		−73 16 46		B0-2III-Ve, - -		31.0294
X, AS, C	o 1″	301.0, −43.7	[113]	[113]	[87]	[86]
Pos.: [113]; in SMC: [86]; optical outbursts: [113]; very strong emission lines: [332].						
0114+650	P	01 14 41.8	V662 Cas	11.0, 1.2, 0.1	4	11.6
		+65 01 32	LS I+65°010	B0.5 Ib, 1.4		10008
A, S, X	o 3″	125.7, +2.6	[177]	[3, 148]	[63]	[148, 210, 785]
Pos.: [63]; X-rays: [326, 619, 785]; the longest pulsation period: [133]; opt. spectra: [3, 148, 446, 421]; $v_{\rm r} \sin i \sim 45$ km s^{-1}: [3]; opt. polarimetry: [44]; review multi-wavelength behaviour: [231]; a magnetar: [416]; astrophys. parameters: [578]; opt. photometry: [680].						
0115+634	TP	01 15 13.8	V635 Cas	14.5 − 16.3, 1.4, 0.3	$< 2 - 350$	24.3
		+63 28 38		B0.2V, 1.7		3.61
U, M, H, S, C, X	o	125.9, +1.0	[347]	[345, 473, 513]	[63]	[508, 569]
Pos.: [347]; X-ray outbursts: [559, 590, 597, 673, 697]; recurrence time 3 yr (?): [770]; X-ray spectrum: [590, 765]; X-ray cyclotron line: [272, 511, 673]; opt. pre-outburst behaviour: [393, 473]; long-term opt. phot.: [473]; opt. spectra: [309, 706]; $v_{\rm r} \sin i \sim 365$ km s^{-1}: [309]; multiwavelength obs. during an outburst: [516].						
0115 − 737	P	01 15 45.6	Sk 160	13.3, −0.14, −0.98	0.5 − 57	3.89
SMC X−1		−73 42 22		B0 Ib, 0.03		0.71
U, M, A	o 3″	300.4, −43.6	[609]	[312, 753]	[63]	[508, 566, 623]
Pos.: [95]; highly variable X-ray source: [629]; pulse timing & X-ray orbit: [566]; aperiodic X-ray variability: [11]; long-term X-ray obs.: [54, 247]; X-ray sp. [762, 765]; opt. lt crv. & system parameters: [375, 417, 689, 725]; opt. spectrum & orbit: [312, 584]; $v_{\rm r} \sin i \sim 200$ km s^{-1}: [312]; UV obs.: [56, 262, 714]; magnetic field strength: [415]; orbital decay: [412].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
J0117.6 − 7330	TP	01 17 41.4	Be star	14.19, −0.07, - -	10	
		−73 30 49		B0.5IIIe, 0.03		22.07
C, R	x 0.6″	300.4, −43.5		[90, 649]	[439]	[439]

Pos.: [255]; in SMC: [98]; X-ray outburst: [98]; IR excess and strong Hα emission: [90, 112]; projected rotational velosity 145 km s^{-1}: [649]; mass of the Be star 18 $M_\odot$: [649]; opt. phot. & spectroscopy: [649]; soft X-ray spectrum: [98]; hard X-ray spectrum: [439]; black hole candidate: [98].

J0146.9+6121		01 43 32.6	LS I+61°235	11.33, 0.82, −0.39	1 − 3	
		+61 06 26		B1Ve, 0.87	(0.1−2.4 keV)	1404.2
R, AS, X, B	o 2″	129.2, −1.2	[267]	[143, 410, 579, 640]	[499]	[254]

Pos.: [267]; in open cluster NGC 663: [438]; $v_{\rm r}\sin i \sim 250$ km s^{-1}: [640]; X-ray obs.: [480]; new X-ray outburst: [254]; physical parameters and V/R veriability: [579].

0236+610		02 36 40.6	LS I+61°303	10.7, 0.8, −0.3	0.2	26.45
		+61 00 54	V615 Cas	B0e, 0.75	(0.2 − 5 keV)	
E	o, r	135.7, +1.1	[70, 267]	[180, 308, 600]	[48]	[677]

Pos.: [242]; X-ray source: [48]; radio outbursts: [677, 678]; four-year modulation radio outbursts: [185, 243, 534]; VLBI radio jet: [467, 679]; optical light curve: [472, 532, 533]; opt. spectra: [5, 308]; orbital solution: [308, 463]; $v_{\rm r}\sin i \sim 200$ km s^{-1}: [144]; system velocity: [721]; long-term optical obs.: [242, 423]; IR obs.: [157, 303]; distance: [216, 653]; UV obs.: [294, 307, 308, 445]; wind structure: [746]; related to γ source CG 135+1(?): [240, 276]; simultaneous X-ray/radio obs.: [268]; black hole candidate: [567]; long-term radio obs.: [572]; multiwavelength obs.: [652]; orbital period detected in photometry, X-ray and Hα emission line: [535, 536, 791].

0331+530	TP	03 31 14.9	BQ Cam	15.1 − 15.4, 1.6 − 2.3, - -	$< 0.5 - 1250$	34.25
		+53 00 24	O8.5Ve, 1.9		4.4	
V, T, Exo	o	146.1, −2.2	[381]	[128, 290, 513]	[655, 683]	[508, 655, 771]

Pos.: [381]; X-ray outbursts: [655, 683, 771]; X-ray obs.: [444]; rapid X-ray variability: [38]; X-ray cyclotron line: [443]; X-ray pulse phase sp.: [705]; optical id.: [42, 381]; optical spectrum: [661]; $v_{\rm r}\sin i \sim 150$ km s^{-1}: [128]; system velocity: [721]; Hα emission: [338]; IR obs.: [106]; wind structure: [746]; tilt between orbital and equatorial planes: [514]; QPO: [669].

0352+309	P	03 52 15.1	X Per	6.0 − 6.6, 0.29, −0.82	$< 9 - 37$	580?
		+30 54 01		B0 III-Ve, 0.4		835
U, M, A, H, S	o	163.1, −17.1	[64]	[311, 434, 489, 639]	[63]	[306, 508]

Pos.: [63]; X-rays: [591, 754]; X-ray sp.: [765]; optical id.: [71]; long-term optical record: [298, 422, 494]; reported 580 day period unlikely to be orbital: [306, 311, 548]; disappearance emission lines: [520]; system velocity: [721]; $v_{\rm r}\sin i \sim 250 - 400$ km s^{-1}: [306, 489, 761]; UV obs.: [43, 261]; stellar parameters: [190]; comparison with γ Cas: [489, 764]; opt. polarimetry: [396]; envelope structure: [682]; photometry and polarimetry obs. during disc loss: [595]; fundamental parameters: [434]; multiwavelength study: [594]; orbital period of 250.3 d: [Delgado-Marti H., et al., 2000, ApJ (submitted)].

J0421+560	T	04 19 46.0	CI Cam	9.25, 1.0, −0.4	2000	
		55 59 24		- -, 0.8		
X, B, C, AS	x 50″	149.2, +4.1		[100a, 323]	[40, 523]	

Pos.: [523]; X-ray outbursts: [643]; multi-wavelength obs.: [40]; optical outbursts: [593]; radio obs.: [287]; radio position: [285]; likely a black hole candidate: [40]; B[e]: [40]; an unusual symbiotic-type X-ray binary (?): [220]; distance ≥ 2 kpc: [40]; sgB[e] star: [100]; IR spe.: [100]; opt./IR/radio obs.: [100a]; long-term $UBVRIJHK$ obs.: [41a]; X-ray/opt. obs.: [219a].

J0440.9+4431	P	04 40 59.9	BSD 24 − 491	10.78, 0.61, −0.36	1	
		44 31 51		B0V-IIIe		202.5
R, X	x 17″	159.8, −1.3	[142]	[500]	[577]	[577]

Pos.: [500]; distance 3.2 kpc: [500]; optical spe.: [500].

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
J0501.6 − 7034		05 01 23.9	Be star	14.5, −0.07, - -		
CAL 9		−70 33 33		B0e, - -		
E, R	x 2.9″	281.9, −34.5	[618]	[618]		
Pos.: [612]; in LMC: [618]; opt. cpt. HV 2289: [618]; IUE ultraviolet obs.: [620].						
J0502.9 − 6626	TP	05 02 51.6	Be star	14.22, −0.10, - -	5.7	
CAL E		−66 26 25		B0e, - -		4.0635
E, R	x 1.2″	277.0, −35.4	[618]	[617]	[619]	[619]
Pos.: [612]; in LMC: [618]; highly variable X-ray emission: [618]; IUE ultraviolet obs.: [620].						
J0512.6 − 6717		05 12 41.8				
		−67 17 23				
R	x 40″	277.8, −34.3				
Pos.: [250]; a HMXB in LMC (?): [250]; weak source, hard X-ray spectrum: [250].						
J0516.0 − 6916	T	05 16 00.1	star 2	15.0, −0.1, −0.9	0.07	
		−69 16 09		B1e		
R	x 7.3″	280.1, −33.6	[141]	[141]	[141]	
Pos.: [612]; LMC member: [141].						
J0520.5 − 6932	T	05 20 30.3	Be star	14.4, - - , - -		
		−69 32 04		O8e, - -		
R	x 16.6″	280.3, −33.2	[618]	[618]		
Pos.: [250]; in LMC: [618]; IUE ultraviolet obs.: [620]; not detected with Einstein: [618].						
0521+373		05 19 10.7	HD 34921	7.51, 0.14, −0.86	1	
		+37 37 44	SAO57950	B0 IVpe, 0.42		
U, H	o	170.0, +0.7	[646]	[78, 555, 599]	[215, 781]	
Pos.: [646]; hard X-ray spectrum: [555]; UV/opt./IR obs.: [555, 599]; IR spe.: [100]; unclB[e] star: [100].						
J0529.8 − 6556	TP	05 29 48.4	GSC 8891.0213	$B = 14.5$, $R = 13.3$	0.17	
		−65 56 51		B2III-Ve, - -		69.5
R	x 8″	275.9, −32.9	[253]	[253]	[253]	[253]
Pos.: [253]; LMC member: [253]; opt. spectrum: [253].						
053109 − 6609.2	TP	05 31 09			1	25.4
		−66 09 12		Be?, 0.1		13.7
Exo, SL, B, R	x 10″	276.2, −32.7		[265]	[265]	[165]
Pos.: [530]; in LMC: [265]; hard X-ray spectrum: [265]; X-ray outburst: [75]; not detected with Einstein: [265]; optical cpt. probably Be star: [265]; orbital period between 4 and 40 days, mostly 25.4 days: [165].						
J0531.5 − 6518		05 31 36.1				
		−65 18 16				
R	x 18.8″	275.1, −32.7	[250]			
Pos.: [250]; HMXB in LMC: [250].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
$0532-664$	P	05 32 47.3	Sk-Ph	14.0, -0.1, -1.1	$<3-60$	1.40
LMC X$-$4		-66 24 13		O7 III-V, 0.1		13.5
U, M, A, H, AS, G, R	o 2″	276.3, -32.5	[93]	[280, 365, 431]	[63]	[365, 508]

Pos.: [63]; X-ray orbital parameters: [365, 411, 553]; X-ray eclipses: [413, 756]; 30 day period X-ray: [400]; X-ray spectrum: [665, 765]; rapid X-ray variability: [38]; X-ray flare: [553]; opt. light curve: [92, 271, 326]; opt. spectrum & radial velocity curve: [314]; $v_{\rm r}\sin i \sim 170$ km s^{-1}: [314]; opt. 30 day period: [271, 326]; precessing-disk model: [271]; UV obs.: [56, 714]; UV/X-ray obs.: [738]; orbital decay: [607, 780].

J0532.4 $-$ 6535		05 32 25.3	RGC 36	$J=11.9$, $H=11.1$, $K=10.7$	0.01	
		-65 35 09			(0.1$-$2.4 keV)	
R	x 17.4″	275.4, -32.6		[575]	[250]	

Pos.: [250]; hard X-ray spectrum: [250]; Be star in LMC: [250].

J0532.5 $-$ 6551	V	05 32 32.6	Sk-65 66	12.3, - -, - -	0.03	
		-65 51 40.8		OB	(0.1$-$2.4 keV)	
R	o	275.7, -32.6	[609]	[609]	[253]	

Pos.: [609]; in LMC: [253]; long-term X-ray variation [253]; Black hole candidate or a NS: [253].

J0535.0 $-$ 6700	T	05 35 05.9	RGC 28	18.1, - -, - -	0.04	241?
		-67 00 16		Be?, - -	(0.1$-$2.4 keV)	
R	x 4″	277.1, -32.2	[575]	[575]	[250]	[575]

Pos.: [250]; in LMC: [250]; IR photometry: [575]; Be/X-ray system: [250].

$0535-668$	PT	05 35 42.4	*Q	$12.3-14.9$, 0.1, -0.9	$<0.01-180$	16.7
$0538-66$		-66 53 39		B2 III-Ve, 0.1		0.069
A	o 2″	276.9, -32.2	[89, 350]	[89, 167, 431, 528]	[63]	[508, 636]

Pos.: [350]; in LMC: [348, 528]; X-ray outbursts: [348, 757]; X-ray pulsations: [637]; optical outbursts: [89, 126, 167, 636, 729]; long-term off states: [430, 528]; quiescent opt. phot. & spectroscopy: [126, 320, 641, 642, 709, 729]; very strong emission lines during outbursts: [89]; IR obs.: [8]; opt. polarimetry: [102]; UV obs.: [89, 295, 573]; wind structure: [746]; X-ray obs. during quiescence: [484]; accretion to magnetosph.: [130].

0535+262	TP	05 35 48.0	V725 Tau	$8.9-9.6$, $0.45-0.62$, -0.54	$<3-2800$	111
		+26 17 18	HD 245770	O9.7IIIe, 0.8		104
U, A, H	o	181.4, -2.6	[414]	[225, 449, 653, 660]	[63]	[508, 561]

Pos.: [63]; transient: [509, 598]; long-term X-ray obs.: [561]; hard X-ray obs.: [108, 371, 585, 628]; 55.7 *d* orbit?: [754]; long-term optical record: [41, 660]; opt. phot.: [266, 634]; opt. spectr.: [4, 313, 319]; $v_{\rm r}\sin i \sim 300$ km s^{-1}: [313]; system velocity: [721]; multi-wavelength obs.: [164, 341]; X-ray/opt. relation: [436]; UV obs.: [164, 546, 784]; accretion model: [498]; wind structure: [746]; 1992 review: [230]; disc loss & renewal: [257]; IR spe. obs.: [99a]; distance: [653]; long-term opt./UV spe.: [99]; cyclotron line: [20, 372]; QPO during a giant outburst: [208].

J0535.8 $-$ 6530		05 35 53.8			0.5	
		-653034			(0.1$-$2.4 keV)	
R	x 13″	275.3, -32.3			[250]	

Pos.: [250]; likely a HMXB in LMC: [250].

$0538-641$	U	05 38 39.7	*1	$16.7-17.5$, -0.2, -0.6	$<1.7-44$	1.70
LMC X$-$3		-64 06 34		B3 Ve, 0.1		
U, M, A, H, F, X	o 3″	273.6, -32.1	[716]	[136, 431, 708]	[63]	[136]

Pos.: [38]; X-ray obs.: [349]; long-term X-ray obs.: [545]; rapid X-ray variability: [38]; X-ray spectrum: [665, 693, 759, 766]; 199 d X-ray period: [138, 665]; opt. lt crv.: [50, 730]; mass function: [136, 395, 525]; $v_{\rm r}\sin i \sim 130$ km s^{-1}: [136]; UV obs.: [139, 694, 695]; X-ray/UV/opt. obs.: [695]; near IR sp.: [137].

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
0540 − 697	U	05 40 05.5	*32	14.5, 0.29, −0.70	3 − 25	4.22
LMC X−1		−69 46 04		O7-9 III, 0.37		
U, M, A, H, X	o 3″	280.2, −31.5	[135, 181]	[47, 318]	[63]	[322]
Pos.: [63]; ultra-soft X-ray spe.: [759]; X-ray spe. & QPO: [184]; rapid X-ray variability: [38]; X-ray obs.: [349, 665]; mass function: [322]; $v_{\rm r}{\rm sin}i \sim 150$ km s^{-1}: [318]; UV obs.: [47, 322]; in He III region: [527]; opt. cpt. uncertainty (O7III or supergiant R148): [140].						
J0541.4 − 6936		05 41 22.2	Sk−69 271	12.01, 0.00, - -		
		−69 36 29		B2SG, - -		
R	x 6.6″	280.0, −31.4	[612]	[335, 603]		
Pos.: [612]; supergiant in LMC: [612].						
J0541.5 − 6833		05 41 37.1	LMC BI267	14.02, −0.03, −1.04		
		−68 32 32		OB0		
R	x 4.5″	278.8, −31.4		[74]		
Pos.: [74]; LMC member: [612].						
0544 − 665		05 44 15.6	*1	15.4, −0.20, −0.96	1.8	
		−66 34 59		B1 Ve, 0.1		
H	o 3″	276.5, −31.4	[349]	[431, 715]	[349]	
Pos.: [38]; optical id. not completly certain: [715]; *1 member of LMC: [715].						
J0544.1 − 710	TP	05 44 06.3	Be star	15.33, 0.13, - -	0.14 − 0.36	
J0544.1 − 7100		−71 00 50		Be, 0.32	(2 − 10 keV)	96.08
B, R, E	x 3.3″	281.6, −31.0	[151]	[151]	[151]	[151]
Pos.: [250]; in LMC: [151]; very hard X-ray spectrum: [151]; pronounced Hα activity from a likely Be-type star: [151].						
0556+286		05 52 44.3	HD 249179	9.2, - -, - -	1.1	
		+28 46 41		B5ne, - -		
H	o	181.3, +1.9		[557, 698]	[781]	
Pos.: [698]; Be star: [739].						
J0635+0533	P	06 35 17.4		12.83, +0.98, - -	0.55	
		05 33 20.9		B2V-B1IIIe, 1.2		0.0338
B	x 1′	206.1, −1.0	[352]	[352]	[352]	[152]
Pos.: [352]; opt. emission line: [352]; within the error box of the GeV γ-ray source 2EG J0635+0521: [352]; distance $\sim 2.5 - 5$ kpc: [352].						
J0648.0 − 4419	P	06 48 04.6	HD 49798	8.27, −0.24, −1.18	0.03	1.55
		−44 18 54.4		sdO6, - -		13.1789
R, B	x 10″	253.7, −19.1	[329]	[344]		[329, 684]
Pos.: [768]; distance 650 pc: [329]; very soft X-ray spe.: [329]; ultraviolet spe.: [73]; likely a NS: [329]; compact being a WD(?): [49].						
0726 − 260	TP	07 26 50.0	LS 437	11.6, 0.3, −0.6	1.2 − 4.7	34.5
		−26 00 13		O8-9Ve, 0.6		103.2
U, A, E, H, R, X	o	240.3, −4.1	[654]	[515, 654]	[743, 781]	[131]
Pos.: [654]; distance 4.6 or 6.1 kpc: [124a, 515]; X-ray flare: [654]; opt./IR obs.: [515]; orbital and spin periods: [131].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
0739 − 529		07 46 09.8	HD 63666	7.62, 0.02, −0.24	0.7	
		−53 12 28	SAO235515	B7 IV-Ve, - -		
H	o	266.4, −13.7	[646]	[293, 437, 518, 698]	[781]	
Pos.: [698].						
0749 − 600		07 55 27.7	HD 65663	6.73, 0.05, −0.25	0.7	
		−60 57 54	SAO250018	B8 IIIe, 0.09		
H	o	274.0, −16.2	[646]	[153, 154, 698]	[781]	
Pos.: [698]; Be star: [739]; in open cluster NGC 2516: [153].						
J0812.4 − 3114	TP	08 12 28.4	LS 992	12.42, 0.41, −0.69	0.6	80
		−31 14 51		B0.5V-IIIe, - -		31.8851
R, X	x 21″	249.6, +1.6	[500]	[500]	[500]	[125, 577]
Pos.: [500]; distance 9.2 kpc: [500]; optical spectrum: [500].						
0834 − 430	TP	08 34 10	star *D	20.4, - -, - -	30 − 300	110
		−43 00.6		B0-2 III-Ve, 4.0		12.3
Gr, R, K, G, C	x 1′	262.0, −1.5	[334a]	[334a]	[239]	[239, 773]
Pos.: [269]; more accurate pos. for epoch 2000: 08 35 55.4, −43 11 11.9 (o 1″): [334a]; sequence X-ray outbursts: [774]; eccentricity $0.1 < e < 0.17$: [774]; strong Hα emission: [334a]; southern of two neighboring sources: [239, 440]; recurrent transient: [401]; distance 3 − 5 kpc: [334a]; not the same transient as MX 0836 − 42: [115, 453]; X-ray obs.: [16]; X-ray/opt. obs.: [39]; IR/opt obs.: [334a].						
0900 − 403	P	09 00 13.2	HD 77581	6.9, 0.47, −0.51	2 − 1100	8.96
Vela X−1		−40 21 25	GP Vel	B0.5 Ib, 0.7		283
U, M, A, H, B, X, AS, R	o	263.1, +3.9	[213]	[183, 495, 518, 717]	[63]	[162, 508, 711]
Pos.: [63]; X-ray sp.: [510, 891, 614, 765]; cyclotron line: [371]; pulse timing & X-ray orbit: [61, 62, 161, 162, 571, 696, 711]; X-ray eclipses: [213, 703]; limits on apsidal motion: [160]; rapid X-ray variability: [38]; orbital variation X-ray absorption: [251]; energy dependence pulse profile: [570]; opt. light curve: [374, 689]; long-term cycles (?): [559, 689]; opt. radial-velocity curve: [720, 726]; system velocity: [721]; $v_{\rm r} \sin i \sim 90 - 130$ km s^{-1}: [482, 689, 772]; UV obs.: [183, 357, 470, 546, 606]; high-resolution IUE obs.: [659]; opt. polarimetry: [173]; IR obs.: [232]; bow shock around the sys. [361]; polarization: [779].						
J1008 − 57	TP	10 09 46	star	15.27, −1.66, - -	1200	135
		−58 17 32		O9 − B1, 1.9 − 2.0		93.5
C, R, AS, Exo	x 15″	283.0, −1.8	[109]	[109, 587]	[663]	[550, 635, 663]
Pos.: [550]; IR and optical spectral obs.: [109]; 260 days orbital period: [206]; distance 5 kpc: [109]; large IR excess: [109].						
1024.0 − 5732	P	10 24 05.4	Wack 2134	12.7, 1.5, - -	1 − 10	
		−57 33 24	THα 35 − 42	O5:, 1.8	(0.2−4.5 keV)	0.061
E	o 6″	284.5, −0.2	[686]	[81]	[81]	[81]
Pos.: [81]; no optical pulsations: [169]; emission line star: [739]; a Wolf-Rayet star+ O star sys. rather than a HMXB: [576].						
1036 − 565		10 28 28.3	HD 91188	6.64, −0.10, −0.56	3.3	
4U1036 − 56		−56 49 14	SAO238130	B4 IIIe, - -		
A	o	284.6, +0.7	[646]	[221, 518]	[743]	
Pos.: [698]; probably the same source as RX J1037.5 − 5674: [500]; Be star: [739]; X-ray flare 1974 Nov.: [743]; periodic (2.924d) optical brightness variations reflect rotation of Be star: [27, 28]; IR spe.: [474].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
J1037.5 − 5647	P	10 37 35.2	LS 1698	11.3, 0.9, - -	0.17	
		−56 47 59		B0V-IIIe, 0.75		862
R	x 21″	285.4, +1.5	[500]	[500]	[577]	[577]
Pos.: [500]; distance 5.0 kpc: [500]; HD 91188 not the opt. cpt.: [500]; probably same source as 4U 1036 − 56: [500].						
1048.1 − 5937	P	10 48 09.0			$< 0.1-1$	
		−59 37 21				6.44
E	x 9″	288.2, −0.5	[477]		[632]	[124, 632]
Pos.: [477]; discovery: [632]; Be/X or LMXB (?): [124]; opt. phm. and sp. of possible counterparts: [477]; excluding Main-sequence companion: [479].						
1118 − 615	PT	11 18 45.2	He3 − 640	12.1, 0.96, −0.30	0.1 − 70	
		−61 38 31		O9.5 III-Ve, 1.2		405
A	o	292.5, −0.9	[339]	[339]	[63, 497]	[508]
Pos.: [63]; X-ray transient: [187, 336, 433]; opt. phot. & spe.: [339]; sys. velocity: [721]; $v_{\rm r}\sin i \sim 300$ km s^{-1}: [339]; X-ray/opt. obs.: [497]; opt. spe. after X-ray outburst: [556]; multiwavelength study: [109]; UV obs.: [105]; radio obs.: [297].						
1119 − 603	P	11 19 01.9	V779 Cen	13.3, 1.07, −0.04	10 − 312	2.09
Cen X−3		−60 20 57		O6.5 II-III, 1.4		4.84
U, M, A, H	o 3″	292.1, +0.3	[72, 394]	[315, 394, 586]	[63]	[366, 508]
Pos.: [63]; X-ray pulsations: [224, 696]; X-ray orbit: [366]; period decay: [188, 366]; X-ray spectrum: [25, 76, 432, 765]; long-term X-ray history: [246, 328, 558, 562, 624]; X-ray eclipses: [622]; X-ray obs.: [296, 504, 512]; aperiodic X-ray variability: [38]; QPO: [668]; opt. light curve: [373, 689, 727]; opt. radial-velocity curve: [315, 502, 524]; mass of the NS: [22]; $v_{\rm r}\sin i \sim 250$ km s^{-1}: [315]; system velocity: [721]; IR obs.: [232]; structure companion star: [97]; distance: [302]; outburst of GeV γ-ray emission: [733].						
1145 − 619	PT	11 45 33.6	Hen 715	9.3, 0.18, −0.81	4 − 1000	187.5
		−61 55 44	HD 102567	B1 Vne, 0.35		292.4
U, M, A, H, S	o	295.6, −0.2	[64]	[195, 518, 746]	[63]	[508, 748]
Pos.: [63]; X-ray spectrum: [765]; X-ray obs.: [475]; long-term X-ray history: [562, 748]; opt. spectrum: [340, 762]; $v_{\rm r}\sin i \sim 270$ km s^{-1}: [261, 340]; system velocity: [721]; coordinated X-ray/opt. obs.: [121]; UV obs.: [46, 163, 261, 546]; wind structure: [746]; multiwavelength obs.: [656].						
1145.1 − 6141	P	11 45 02.3	V830 Cen	13.1, 1.5, 0.15	4 − 40	5.65
		−61 40 33		B2Iae, 1.6		298
A, E, C	o 2″	295.5, −0.0	[316]	[166, 325]	[316]	[325, 508]
Pos.: [316]; X-ray pulsations: [762]; orbital periods 10.76 d from opt. sp.: [321]; system velocity: [721]; 15′ away from 1145 − 619: [397, 763].						
1223 − 624	PT	12 23 49.7	BP Cru	10.8, 1.76, 0.42	9 − 1000	41.59
GX 301 − 2		−62 29 37	Wra 977	B1 − 1.5 Ia, 1.8		696
U, M, A, H, S, AS, C	o 3″	300.1, −0.0	[64]	[59, 260, 688, 734]	[63]	[508, 613]
Pos.: [63]; X-ray spectrum: [765]; long-term X-ray record (recurrent outbursts near periastron): [560, 601, 749]; X-ray obs.: [248, 405, 588, 589, 760]; pulse-phase spectr.: [403]; pulse profile: [485]; X-ray orbit: [613]; X-ray dips: [404]; aperiodic X-ray variability: [38, 675]; rapid spin-up episodes: [383]; optical spectrum: [58, 260, 317, 539, 688]; optical photometry: [526, 723]; system velocity: [721]; IR obs.: [232]; a hypergiant (?): [360].						
1239 − 599	P	12 39 07.5			3 − 16	
		−59 55 39				191
A, H, S	x 30″	301.8, +2.6	[177]		[63, 743, 781]	[297]
Pos.: [177]; hard X-ray spectrum: [297]; see also: [82].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
$1244-604$	T	12 44 38			$<24-100$	
		-60 22.2				
A	x $6.2'$	302.5, +2.2			[82]	
Pos.: [82].						
$1246-588$	T	12 46 39			$<24-300$	
		-58 51.0				
U, A, H	x $4.5'$	302.7, +3.8			[82]	
Pos.: [82].						
$1249-637$		12 39 53.2	HD 110432	5.31, 0.27, -0.79	2.2	
		-62 47 06	SAO252002	B0 IIIe, 0.40		
H	o	302.0, -0.2	[646]	[103, 518]	[781]	
Pos.: [698]; Be star: [739]; UV obs.: [103]; interstellar abs. lines: [149]; optical obs.: [156, 196, 212]; variable radial velocity: [77, 685]; white-dwarf accretor(?): [745].						
$1253-761$		12 35 59.8	HD 109857	6.49, 0.08, -0.24	0.6	
		-75 05 43	SAO256967	B7 Vne, 0.20		
H	o	302.1, -12.5	[646]	[103, 518]	[781]	
Pos.: [698]; Be star: [739]; visual double (sep. $2.2''$): [201]; no optical brightness variations: [28]; white-dwarf accretor(?): [745].						
$1255-567$		12 51 39.6	μ^2 Cru	5.17, -0.12, -0.51	0.8	
		-56 53 50	HD 1120912	B5 Ve, 0.04		
H	o	303.4, +5.7		[518, 639]	[781]	
Pos.: [698]; Be star: [739]; $v_{\rm r}\sin i\sim 220$ km s^{-1}: [639]; visual double with μ^1 Cru: [288]; slow & small optical variability: [549].						
$1258-613$	PT?	12 58 11.8	V 850 Cen	$13.5-14.2$, 1.7, 0.8	$0.3-200$	133?
GX $304-1$		-61 19 58	*2 (MMV)	B2 Vne, 2.0		272
U, M, A, S	o $2''$	302.1, +1.2	[465]	[127, 256, 538]	[63, 554]	[508, 562]
Pos.: [465]; long-term X-rays: [559, 562]; X-ray off state: [554]; X-ray spectrum: [588, 765]; opt. spectrum: [123, 465, 688]; long-term opt. variations: [127, 256]; $v_{\rm r}\sin i\sim 600$ km s^{-1}: [538]; system velocity: [721]; IR obs.: [232].						
J1324.4 $-$ 6200	P	13 24 26.3			0.4	
1323 $-$ 6196		-62 00 53				170.84
B, AS, Exo, E	x $1.5'$	306.8, +0.61			[13]	[13]
Pos.: [13]; distance >3.4 kpc: [13]; hard X-ray spe.: [13]; likely a Be/X-ray system: [13].						
$1417-624$	PT	14 17 25.5	*7	17.2:, 0.7:1.7, 0.8	$2-43$	42.12
		-62 28 11		OBe, 2:		17.6
U, M, A, S, C	o	313.0, -1.6	[18]	[244]	[63]	[207, 508]
Pos.: [63]; X-ray obs.: [18, 207, 364]; opt. id: [244]; orbital parameters: [207]; Centaurus $1971-2$ transient (?): [115, 755]; 1994 II-type outburst: [207].						
J1452.8 $-$ 5949	P	14 52 49.3			0.04	
		-59 49 18				437.4
B	x $50''$	317.6, -0.44			[522]	[522]
Pos.: [522]; distance: [522]; probably a Be star: [522]; X-ray spe.: [522].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
$1538-522$	P	15 38 38.6	QV Nor	14.4, 1.9, 0.6	$<3-30$	3.73
		−52 13 37	*12	B0 Iab, 2.1		529
U, M, A, H, S	o	327.4, +2.1	[17]	[147, 324, 537]	[63]	[114, 508]
Pos.: [63]; X-ray obs.: [114, 150, 442, 592]; X-ray eclipses: [35, 159]; X-ray orbit: [442]; X-ray spectrum: [442, 765]; X-ray cyclotron line: [94]; long-term spin-up trend: [604]; opt. light curve: [529]; radial-velocity curve: [147, 583]; $v_{\rm r}\sin i\sim 200$ km s^{-1}: [147]; system velocity: [721]; opt. obs.: [537].						
$1553-542$	P	15 53 55.6			27	30.6
		−54 16 15				9.3
S	x 3.5″	327.9, −0.9	[17]		[63]	[367, 508]
Pos.: [63]; opt. counterpart likely a Be star: [367]; X-ray orbit: [367].						
$1555-552$		15 50 26.4	HD 141926	8.60, 0.56, −0.43	1.7	
		−55 10 54	SAO243098	B2nne, - -		
H	o	327.0, −1.2	[646]	[193, 293]	[781]	
Pos.: [698]; Be star: [739].						
$1657-415$	P	16 57 16.8	star		$4-42$	10.4
		−41 35 59		B0-B6Ia-Iab, - -		38
OAO, B	x 15″	344.4, +0.3	[21]	[84]	[63]	[84, 205, 508]
Pos.: [21]; error box ♯2: [21, 476, 540]; V861 Sco not the optical counterpart: [21]; X-ray obs.: [358]; X-ray spectrum: [765]; hard X-ray obs.: [476]; orbital solution: [84].						
$1700-377$		17 00 32.7	HD 153919	6.6, 0.27, −0.72	$<11-110$	3.41
		−37 46 29	V884 Sco	O6.5f, 0.52		
U, M, S, Gro, C, o B	o	347.8, +2.2	[351]	[259, 263, 547, 778]	[63]	[67, 251, 728]
Pos.: [63]; X-ray variability: [38, 175, 252]; hard X-ray spectrum: [211, 552]; no X-ray pulsations: [175, 236]; opt. light curve: [26, 91, 728]; opt. spectrum: [117, 155, 192, 274]; radial-velocity curve: [175, 258]; $v_{\rm r}\sin i\sim 140-300$ km s^{-1}: [117, 155, 305, 778]; system velocity: [721]; UV obs.: [182, 259, 263, 359]; soft X-ray Raman scattering: [359]; opt. polarimetry: [172, 173]; IR obs.: [232, 547]; system parameters: [270]; polarization: [779]; possibly 13.81 days period: [384].						
J170006 − 4157	P	17 00 5.3			0.4	
		−41 57 44				714.5
AS	x 1′	344.0, +0.25			[691]	[691]
Pos.: [691]; can't completely exclude the possibility that it is a WD binary: [691].						
$1722-363$	P	17 22 33			$0.2-5$	
		−36 22 05				413
Exo	x 9′	351.5, −0.6			[672, 676]	[508, 676]
Pos.: [744]; hard X-ray spectrum: [676]; limits on orbital period: [672].						
J1739 − 302	T	17 38 53			136	
		−30 15.6			(2 − 25 keV)	
X	x 3′	358.1, +0.56			[645]	
Pos.: [645]; radio obs.: [283]; probably a Be/X-ray sys.: [645]; X-ray spec. and short X-ray outburst: [645].						
J1739.5 − 2942		17 39 30.1			2	
		−29 42 07				
X, C	x 19.2″	358.6, −0.74	[501]		[501]	
Pos.: [501]; likely a Be/X-ray binary: [501]; hard X-ray spec.: [501]; identical X-ray source $1736-297$(?): [501].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}, b^{\rm II}$	[FC]			
J1744.7 − 2713		17 44 45.4	HD 161103	8.4, 0.44, −0.64	0.06	
		−27 13 47		B2V-IIIe		
R	x 18″	1.36, +1.1				
Pos.: [500]; strong emission lines: [500]; distance 0.8 kpc: [500]; likely Be/X-ray binary: [500].						
J1749.2 − 2725	TP	17 49 10.1			1.36	
		−27 25 16				220.38
AS	x 1′	1.7, +0.1			[690]	[690]
Pos.: [690]; weak X-ray source: [690]; hard X-ray spe.: [690]; likely a NS: [690]; within error of a nearby WD: [690].						
J1750 − 27	P	17 49 12.0			27	29.8
		−26 38 50				4.45
C, AS	x 2′	2.4, +0.5			[777]	[176, 627]
Pos.: [176]; no optical counterpart reported: [627]; likely Be system: [627]; large spin-up: [627].						
1807 − 10	T	18 07.9			$< 2-10$	
		−10 53				
U	x 1.3°	18.6, +3.9			[215]	
Pos.: (large error box): [215]; uncertain if HMXB or LMXB.						
J1820.5 − 1434	P	18 20 29.5			1	
		−14 34 24				152.26
AS	x 0.5′	16.5, +0.07			[376]	[376]
Pos.: [376]; a highly obscured accretion-driven binary X-ray: [376].						
J1826.2 − 1450		18 26 14.9	LS 5039	11.23, 0.94, −0.16	0.3	
		−14 50 29		O7V((f)), 0.8		
R	x 22″	17.9, −1.29	[500]	[500]	[500]	
Pos.: [500]; distance 3.1 kpc: [500]; optical spe.: [500]; radio cpt.: [463a]; X-ray and radio obs.: [584a]; a γ-ray-emitting persistent microquasar: [536a].						
1833 − 076	PT	18 33 46.3			$1.6-200$	
Sct X−1		−07 38 54				111
A, H	x 30″	24.5, −0.2	[237]		[388, 563, 743]	[392, 508]
Pos.: [574]; alternative position (18 34 49.5, −07 38 05): [574]; X-ray obs.: [88, 278]; X-ray pulsations: [392]; hard X-ray spectrum: [122, 574]; long-term X-ray record: [563]; transient: [122].						
1839 − 06	T	18 39.0			1	
		−05.9				
G	x 30′	26.6, −0.5			[388]	
Pos.: [388].						
1839 − 04	PT	18 39.2			2.5	
		−04.5				81.1
G	x 24′	27.9, +0.1			[388]	[388]
Pos.: [388].						
1843+009	PT	18 43.0			$< 0.4-33$	
		+0.9				29.5
G, C, X, B	x 10′	33.1, +1.7			[388]	[388]
Pos.: [388]; X-ray obs.: [388, 389].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
$1845-03$	T	18 44.7			1	
		-03.2				
G	x $24'$	29.7, -0.5			[388]	
Pos.: [388].						
$1845-024$	PT	18 45 41.1			$1-44$	241
		-02 28 37				94.8
A, H, S, G, C, B	x $30''$	30.4, -0.4	[237]		[63, 388]	[792, 388]
Pos.: [63]; X-ray obs.: [178, 388, 390, 630]; distance: [792]; same sources as GS $1843-02$, X$1845-024$, and GRO J$1849-03$: [647]; likely a Be/X-ray: [647, 209]; X-ray outburst: [209]; high eccentricity (0.88): [209].						
$1845.0-0433$	T	18 45 02		13.96, 2.2, 1.04	45	
		-04 33 31		O9.5I, 2.45	$(0.7-10$ keV)	
AS	x $1'$	28.8, -1.22	[111]	[111]	[786]	
Pos.: [111]; discovery X-ray source: [786]; optical spectrum: [111]; distance 3.6 kpc: [111].						
$1855-02$	PT	18 55.4			2	
		-02.8				
G	x $10'$	31.3, -2.7			[388]	
Pos.: [388].						
J$1855-026$	P	18 55.7			6	6.1
		-02 37				361
X	x $6'$	31.1, -2.15			[460]	[134, 460]
Pos.: [460]; most likely a SG/X-ray system: [134]; BD-2 4786 not the opt. cpt.: [134]; X-ray spe.: [134].						
J1858+034	TP	18 58.6			25	
		03 21				221.0
X	x $2.5'$	36.7, -0.07			[582]	[670]
Pos.: [462]; QPO: [544]; probably a Be/X-ray sys.: [670]; very hard X-ray spec.: [462,544].						
1901+03	T	19 01.7			$<2-87$	
		+03 06.0				
	x $10'$	37.2, -1.4			[115]	
Pos.: [215]; transient 1971: [115, 214]; hard X-ray spectrum: [115].						
J1906+09	P	19 05 20			0.7	
		09 02.5				89.17
X	x $2'$	42.6, +1.04			[457]	[457]
Pos.: [667]; distance: [457]; likely a supergiant: [457]; not associated with the soft gamma-ray repeater SGR 1900+14: [671]; X-ray spec.: [457].						
1907+097	PT	19 07 15.1	star	16.4, 3.2, - -	$4-275$	8.38
		+09 44 54		B I, 3.3		438
U, M, A, H	o	43.7, +0.5	[625]	[625, 718]	[63]	[441, 508]
Pos.: [625]; long-term X-ray recod: [563]; 1980 outburst: [459]; orbital parameters: [120, 441]; orbital modulation X-ray flux: [459]; opt. spectrum: [337, 718]; $v_{\rm r}\sin i\sim 85$ km s^{-1}: [718].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
1909+048		19 09 21.3	SS433	14.2, 2.1, 0.6	$2-10$	13.1
		+04 53 54	V1343 Aql	pec, 2.6		
U, A, H, G	o, r	39.7, −2.2	[407]	[450, 507, 740]	[63]	[145]
Pos.: [63]; X-ray obs.: [30, 38, 68, 69, 245, 363]; Doppler shift X-ray Fe line: [468, 751]; extended X-ray lobes: [631, 750]; γ-ray obs.: [223, 398]; Doppler shifted opt. emission lines: [448, 451]; stationary emission lines from accretion disk: [204]; kinematic model precessing (164 d) high-speed jets: [6]; opt. spe.: [24, 191, 194, 386, 452]; opt. spectrophot.: [9, 385, 740]; opt. lt. curve: [14, 15, 23, 275, 406, 408, 409]; long-term optical phot. record: [275, 369, 469]; X-ray/opt. eclipse: [658]; IR obs.: [382, 742]; precession clock: [10]; radio structure: [31, 197, 198, 596, 651, 732]; radio variability: [57, 202]; distance 5.5 kpc: [284]; nature of the compact star: [171]; reviews: [447, 731, 793]; circularly polarized radio emissiom: [200]; VLBA multifreq. obs.: [531].						
1936+541		19 31 42.6	DM+53°2262	9.8, - -, - -	0.7	
		+53 46 12		Be, - -		
H	o	85.9, +15.9		[698]	[781]	
Pos.: [698]; Be star: [739].						
J1946+274	TP	19 45 38			$<1-25$	80
1942+274		27 21 38.0			(2 − 60 keV)	15.8
A, X, B	x 1′	63.2, +1.38			[666, 743]	[80, 644]
Pos.: [80]; transient Nov.-Dec. 1976: [743]; X-ray flare: [80]; likely a Be: [80]; very hard X-ray spec.: [644]; same as 3A 1942+274 and 1SAX J1946.5+2721: [80, 666].						
1947+300	T	19 47 36.3	*3	14.2, 0.9, −0.3	$<10-84$	
		+30 04 54		- -, 1.1		
K	o	66.1, +2.1	[238]	[234, 238]	[60]	
Pos.: [238]; Hα emission: [234]; likely, but not certain this is a HMXB: [234, 238]; see also [638].						
J1948+32	P	19 48			$27-53$	$35-70$
		32.0			(20 − 75 keV)	18.7
C	x	64.9, +1.8			[85]	[85]
Pos.: [85]; eccentricity <0.25: [85]; mass function: [85]; probably a Be: [85].						
1954+319		19 53 46.2			$<1.5-80$	
		+31 58 02				
U, A	x 15″	68.4, +1.9	[119]		[119, 743]	
Pos.: [186]; heavily reddened supergiant system (?): [699].						
1956+350	U	19 56 28.9	HD 226868	8.9, 0.84, −0.26	$235-1320$	5.
Cyg X−1		+35 03 55	V1357 Cyg	O9.7 Iab, 1.06		
U, M, A, H, X, G, C	o, r	71.3, +3.1	[568]	[116, 158, 518]	[63]	[227]
Pos.: [63]; hard X- and γ-ray obs.: [226, 419, 608, 626, 700, 701]; long-term X-ray obs.: [289, 565]; X-ray low/high states: [418, 674]; X-ray dips: [29, 378, 581]; rapid X-ray variability: [37, 38, 427, 471, 486, 487, 488, 602]; QPO: [218, 387, 735, 736]; chaotic (?): [426, 707]; 300 d period: [228, 368, 370, 565]; X-ray spectrum: [32, 33, 189, 379, 432, 737, 759]; γ-ray obs.: [420, 551]; radio obs.: [65, 66, 281, 286]; opt. spectra: [1, 2, 116, 229, 519, 648]; radial-velocity curve: [227, 228, 519]; $v_{\rm r}\sin i\sim 100$ km s^{-1}: [229]; system velocity: [721]; nature of the compact star: [52, 633, 752]; opt. light curve: [370, 435]; opt. UV polarimetry: [174, 217, 779]; UV obs.: [158, 182, 692, 783]; IR obs.: [402]; reviews (1977): [521]; fund. parameters: [277].						
2030+375	PT	20 30 22.1	*2	19.7, 3.3, - -	$<0.5-1400$	46.0
		+37 28 00		B0, 3.8		41.8
Exo, C, B, X, AS	o 2″	77.2, −1.3	[107, 496]	[107, 496]	[541]	[508, 541, 662]
Pos.: [496]; outburst: [541]; rapid X-ray variability: [38]; 0.2 Hz QPO: [12]; opt. spe.: [107, 342]; long-term opt./IR variability: [580].						

Table 1. continued

Name(s)	type	RA	Opt. Ctp.	V, $B-V$, $U-B$	F_x	$P_{\rm orb}$(d)
		DEC		Sp. type, E_{B-V}	μJy	$P_{\rm pulse}$(s)
	Pos.	$l^{\rm II}$, $b^{\rm II}$	[FC]			
2030+407		20 30 37.6	V1521 Cyg	$I = 20.0$	$90-430$	0.20
Cyg X−3		+40 47 13		Wolf-Rayet, 6.3		
U, M, A, H, CX	r	79.9, +0.7	[741]	[493, 719, 741]	[63]	[543]
Pos.: [63]; distance: [168]; orb. period change: [380, 712]; long-term X-ray obs.: [289, 564]; no X-ray pulsations: [380, 782]; orbital X-ray curve: [55, 377]; aperiodic variability: [38]; X-ray halo: [490]; transient QPO: [713]; radio outbursts: [241, 282, 346, 492]; quiescent radio flares (period 4.95 h?): [491]; radio jet & lobes: [55, 222, 664]; IR phot.: [36, 464, 466]; IR spectra (secondary helium star): [362, 719]; no X-ray pulsations: [782]; X-ray spectrum: [377, 758]; 1989 review (incl. TeV/PeV γ-rays: [53]; spe. variability during outburst and quiescence: [199]; VLBI obs. during outburst: [615].						
J2030.5+4751		20 30 30.6	SAO 49725	9.27, 0.38, −0.65	0.04	
		47 51 46		B0.5V-IIIe, - -		
R	x 18″	85.2, +5.02	[500]	[500]	[500]	
Pos.: [500]; strong emission lines: [500]; distance 2.2 kpc: [500]; likely Be/X-ray binary: [500].						
J2058+42	TP	20 59.0			320	110
		41 43				198
C, X	x 4′	83.5, −2.75	[83]		[775]	[775]
Pos.: [775]; orbital period 54 days: [129]; giant outburst in 1995: [775]; most likely a Be/X-ray sys.: [775]; one of two stars likely opt. ctp.: [83].						
J2103.5+4545	P	21 03 33			20	12.68
		45 45.0				358.61
B, X	x 2.5′	87.1, +0.71			[34]	[34, 301]
Pos.: [301]; distance 4 kpc: [34]; eccentricity 0.4: [34]; HD 200709 not opt. cpt.: [34]; X-ray spe.: [301].						
2138+568	PT	21 38.0	star		$<6-100$	
Cep X−4?		+56 50.0		B1		66.2
M, H, G	x 7′	99.0, +3.3		[53a]	[391]	[391, 508]
Pos.: [391]; likely Be/X-ray system: [391]; X-ray obs.: [391]; X-ray cyclotron line: [481]; same as Cep X−4(?): [454, 704]; X-ray outburst: [776]; orbital period $23-147.3$ days: [776].						
2202+501		21 59 44.1	DM+49°3718	8.8, - -, - -	0.7	
		+49 55 35	SAO51568	Be, - -		
H	o	97.3, −4.0	[646]	[698]	[781]	
Pos.: [698]; Be star: [739].						
2206+543		22 06 07.4	star	9.9, 0.2, −0.6	$0.6-5.5$	
		+54 16 23		B1e, 0.5		392(?)
U, M, A, H	o 2″	100.6, −1.1	[654]	[654]	[743, 781]	[611]
Pos.: [654]; X-ray observations: [611]; Hα emission: [123].						
2214+589		22 24 47.8	GG3 71	11, - -, - -	0.5	
		+60 58 59		B[e], - -		
H	o	106.4, +3.1	[233]	[264, 698]	[781]	
Pos.: [698]; Be star: [739]; Herbig Ae/Be candidate: [264]; associated with IRAS source 22248+6058: [264].						
J2239.3+6116	T	22 39 20.90	star	15.1, 1.4, - -	16	262
		+61 16 26.8		B0V-B2IIIe, 1.4		
B, A, U, X	o0.3″	107.7, +2.3	[327a]	[327a]	[327a]	[327a]
Pos.: [327a]; distance of 4.4 kpc: [327a]; position coincided with 4U 2238+60 and 3A 2237+608: [327a].						