

A catalogue of high-mass X-ray binaries in the Galaxy: from the INTEGRAL to the *Gaia* era^{★,★★}

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ABSTRACT

Context. High-mass X-ray binaries (HMXBs) are a particular class of high-energy sources that require multi-wavelength observational efforts to be properly characterised. New identifications and the refinement of previous measurements are regularly published in the literature by independent teams of researchers and might, when they are collected in a catalogue, offer a tool for facilitating further studies of HMXBs.

Aims. We update previous instances of HMXB catalogues in the Galaxy and provide the community easy access to the most complete set of observables on Galactic HMXBs. In addition to the fixed version that is available in Vizier, we also aim to host and maintain a dynamic version that can be updated upon request from users. Any modification will be logged in this version.

Methods. Using previous HMXB catalogues supplemented by listings of hard X-ray sources detected in the past 20 yr, we produced a base set of HMXBs and candidates by means of identifier and sky coordinate cross matches. We queried in Simbad for unreferenced HMXBs. We searched for as many hard X-ray, soft X-ray, optical, and infrared counterparts to the HMXBs as we could in well-known catalogues and compiled their coordinates. Each HMXB was subjected to a meticulous search in the literature to find relevant measurements and the original reference.

Results. We provide a catalogue of 152 HMXBs in the Galaxy with their best known coordinates, the spectral type of the companion star, systemic radial velocities, component masses, orbital period, eccentricity, and spin period when available. We also provide the coordinates and identifiers for each counterpart we found from hard X-rays to the near-infrared, including 111 counterparts from the recent *Gaia* DR3 catalogue.

Key words. stars: massive – binaries: general – catalogues

1. Introduction

Since the birth of X-ray astronomy after the discovery of the first extrasolar X-ray source in the early 1960s, thousands of high-energy astrophysical objects were observed and revealed to be of various nature (see the broad review of accreting binaries in [Chaty 2022](#)). Of these, high-mass X-ray binaries (HMXBs) are powered by the accretion of material from a massive donor star ($M \geq 8 M_{\odot}$) onto a compact object, usually a neutron star (NS) and rarely a black hole (BH). HMXBs are usually divided into subclasses, of which BeHMXBs (see review by [Rivinius et al. 2013](#)) host a fast-rotating Be star, and sgHMXBs (see the review by [Chaty 2013](#)) host a supergiant companion. Before the launch of INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL), sgHMXBs used to be outnumbered about 1 to 10 compared to BeHMXBs. BeHMXBs transfer matter through the interaction of a compact object with a decretion disk, while sgHMXBs generally transfer mass via an intense stellar wind.

In some rare instances, accretion in sgHMXBs may take place via Roche-lobe overflow, which produces higher X-ray luminosities than wind-accreting systems. This is the case for Cen X-3, and was more recently suggested for IGR J08408-4503 at periastron ([Ducci et al. 2019](#)). Accretion through a Be disk is much more efficient at transporting angular momentum than via wind. The spin of the compact object spin is therefore correlated to the orbital period in BeHMXBs, but not in sgHMXBs (see e.g. [Corbet 1984](#)).

The INTEGRAL satellite (see numbers given in [Bird et al. 2016](#)) has a higher sensitivity at high energies than previous generations of hard X-ray observatories. sgHMXBs are therefore no longer a minority. Notably, INTEGRAL allowed the discovery of highly obscured sgHMXBs ([Filliatre & Chaty 2004](#)) and supergiant fast X-ray transients (SFXTs; [Negueruela et al. 2006b](#)).

The discovery and subsequent unambiguous identification of an HMXB requires several observations at various wavelengths. This is usually performed by independent teams of astronomers, and it can take several years before an HMXB is securely associated with a hard X-ray source. This is mainly due to the difficulty of associating soft X-ray, optical, infrared, and radio counterparts with high-energy detections as the astrometrical precision of hard X-ray observatories, which are physically unable to focus the radiation, is systematically outperformed by at least an order of magnitude compared to focusing observatories.

* Tables A.1 and A.2 are available at the CDS via anonymous ftp to [cdsarc.cds.unistra.fr](ftp://cdsarc.cds.unistra.fr) (130.79.128.5) or via <https://cdsarc.cds.unistra.fr/viz-bin/cat/J/A+A/671/A149>

** An online version of the catalogue is publicly available at <https://binary-revolution.github.io/HMXBwebcat> and the database in the associated GitHub repository will be continuously updated based on community inputs.

This leads to a lag in the information available on HMXBs and candidate HMXBs, which is spread within the literature; the more time passes, the more tedious it is to recover valuable parameters characterising the binaries, such as the various counterparts, the spectral type of the companion star, the orbital solution, or the detection of a pulse period. Collecting this information in a single place is necessary for a proper overview of the current observational knowledge on HMXBs, and catalogues dedicated to these peculiar sources have therefore been assembled in the past.

The first edition of such a catalogue was compiled by [Bradt & McClintock \(1983\)](#). Following this, [van Paradijs \(1995\)](#) proposed a second edition, which was then further improved by a third ([Liu et al. 2000](#)). Eventually, [Liu et al. \(2006\)](#) compiled the fourth and latest edition to date of the catalogue (although we note that [Raguzova & Popov 2005](#) proposed a similar work immediately before). We hereby present a catalogue of HMXBs in the Galaxy that covers new information brought during the era from INTEGRAL to *Gaia* (2006–2022).

We can identify various arguments towards the necessity of building an updated catalogue of HMXBs. Firstly, the aforementioned catalogues are still being used today, even though they have not been updated for more than 15 yr. However, the absence of any recent update pushed us to begin compiling recent information on HMXBs in [Fortin et al. \(2022b\)](#) to infer natal kick properties not only on individual systems, but on the population of BeHMXBs and sgHMXBs. We are still missing crucial parameters on many binaries, however, which narrows the number of systems available for population studies. This shows the need for such catalogues to identify good HMXB candidates to follow up and which information to look for in order to complete our knowledge on these sources. Secondly, with the arrival of the new generation of observing facilities dedicated to high-energy and/or transient astronomy such as the Space Variable Objects Monitor (SVOM), the Large Synoptic Survey Telescope (LSST), or eROSITA (for the latter, see e.g. [Maitra et al. 2023](#) for a study of a new BeHMXB in the Large Magellanic Cloud, LMC) and the nascent gravitational astronomy with LIGO¹, Virgo, KAGRA², and LISA³, having a contemporaneous view of the current HMXB landscape would be interesting in the scope of population studies. Catalogues of HMXBs have already been used to constrain their properties as a population (see e.g. [Coleiro et al. 2013](#) and [Fortin et al. 2022a](#)). HMXBs are also representatives of a source category that is directly related to supernova explosions as well as to compact binaries that finally merge as gravitational wave sources (see a recent review by [van den Heuvel 2019](#)). Comparing the current population of HMXBs with the population of gravitational mergers that is going to build up in the years to come may yield insightful results on stellar evolution in general.

We therefore suggest that for an evolutionary snapshot of the current population of HMXBs, it is necessary to compile measurements on intrinsic binary parameters (orbital period, eccentricity, and systemic radial velocity) as well as measurements of the individual components such as the mass of the compact object (M_x) and its spin period, and of the mass of the optical companion (M_o), its spectral type, and its luminosity class. The latest data release of the *Gaia* satellite ([Gaia Collaboration 2022](#)) has made the distances to Galactic

binaries now widely available, giving access to their 3D spatial distribution and therefore their place in the Galactic ecology.

We note that many HMXBs are known in the Magellanic Clouds (MCs) and that previous catalogues ([Liu et al. 2005](#)) may also benefit from an update. As stated in [Liu et al. \(2006\)](#), the sheer number of new data justifies splitting these works, especially in our case, where *Gaia* plays an essential role in the Galaxy (distance determination) that is not applicable to the MCs. The data-mining strategy to recover information about MC HMXBs should also be adapted. Lastly, the population of MC HMXBs is known to be quite different from the Galactic population and therefore deserves a dedicated discussion and paper.

In this paper, we build an updated catalogue of HMXBs and candidate HMXBs in the Galaxy. We also include systems identified as high-mass gamma-ray binaries (HMGB), which are thought to be powered by the spin-down of a pulsar and not by direct accretion onto it (see e.g. the review in [Dubus 2013](#)). Since the publication of the last HMXB catalogues, high-energy observations (e.g. INTEGRAL, *Chandra*, *XMM-Newton*, *Swift*, the Monitor of All-sky X-ray Image MAXI, the Nuclear Spectroscopic Telescope Array *NuSTAR*, *Suzaku*, or *Fermi*) and optical/near-infrared (nIR) follow-ups allowed astronomers to discover new HMXBs. Many of the parameters mentioned above, such as spectral type, period, or eccentricity, were accurately determined. While the catalogue contents proposed here will remain fixed (last updated in September 2022), we also host a dynamic version of the catalogue online that is regularly updated when new observations are performed on HMXBs to add new systems or complete the list of known parameters. We strive to find the original references for each measurement we present, and not just reference previous catalogues. In Sect. 2 we describe how the catalogue is built and how we attempted to automatise the search for the multi-wavelength counterparts to HMXBs. We briefly discuss the resulting catalogue and its uses in Sect. 3 before we conclude in Sect. 4.

2. Building the catalogue

We describe in this section the steps we took in order to build the catalogue. We first used existing catalogues dedicated to HMXBs and cross-matched them with more recent catalogues of hard X-ray sources. We used the services of the Centre de Données Astronomiques de Strasbourg (CDS), namely Simbad ([Wenger et al. 2000](#)) and VizieR ([Ochsenbein et al. 2000](#)), to search for updated content on the sources and searched for missing HMXBs. We semi-automatically searched for known counterparts from hard X-rays to the near-infrared. To complete this, we manually compiled all the known parameters available on the HMXBs that we were able to find in the literature and list the proper reference to the original papers.

The following Sect. 2.1 is quite similar to what is described in a previous work ([Fortin et al. 2022b](#)), in which we built what can be seen as a precursor to this catalogue. We provide a summary of what has been done and focus on the additions brought in the present work.

2.1. Reference catalogues

[Liu et al. \(2006\)](#) is the most commonly referred catalogue of HMXBs, listing 114 systems in the Galaxy (including candidates). To build a working base, we added the sources seen by INTEGRAL as of 2016 to this catalogue ([Bird et al. 2016](#)). Many of the 939 hard X-ray sources presented in this catalogue are already identified, and nearly 40% are active galactic nuclei.

¹ Laser Interferometer Gravitational-Wave Observatory.

² Kamioka Gravitational Wave Detector.

³ Laser Interferometer Space Antenna.

We thus only added the sources labelled HMXBs, low-mass X-ray binaries (LMXBs), cataclysmic variables (CVs), or still unidentified. Misidentification in the exact type of X-ray binary is not unheard of, therefore we kept all X-ray binaries in this step, and discarded non-HMXB sources only after reviewing the new results published in the literature since then. We performed a positional cross-match using Topcat (Taylor 2005) to find the bulk of sources common to both catalogues, and we manually confirmed any duplicates or sources that were left out because of poor astrometrical constraints. Identifiers of the sources were especially useful in this task because they are often similar from one catalogue to the next. This produced a working base of 128 HMXBs.

In parallel, we queried the Simbad database for sources of the type (or subtype) labelled HXB, the identification associated with HMXBs in Simbad. We retrieved 1288 sources in this way. Most of them were extragalactic; they are usually bundled in very tight regions of the sky associated with close-by galaxies, forming dense patches of extragalactic HMXBs. A simple way to automatically detect and remove them is to discard sources with neighbours closer than $6'$. We verified that even in the Galactic plane, the sources we retrieved from Liu et al. (2006) and Bird et al. (2016) are typically twice as separated (around $15'$). This left us with 175 sources, several of which are isolated extragalactic HMXBs, which we discarded later. We note that only 109 of the base HMXBs were found in this way in Simbad; the remaining 19 are simply not labelled HXB. We individually investigated the 66 additional Simbad HXBs in order to supplement our catalogue.

In effect, a majority of these 66 Simbad HXBs are actually LMXBs. Their primary type in Simbad is still set to HMXBs, however, even though a spectral type is available many times and clearly corresponds to a cool main-sequence star. We discarded them, but kept the remaining entries even when no precise information on spectral type was available in Simbad because we performed a thorough manual search for this information later. At this point, we had a set of 145 HMXBs and candidate HMXBs.

2.2. Finding an unambiguous chain of counterparts

We considered that a secure identification of an HMXB partly comes from having an unambiguous list of its detections from hard X-rays down to the near-infrared. This ensures that none of them are blended with close-by high-energy sources, and it efficiently removes sources listed as HXMBs in the literature that were detected only once in hard X-rays 40 yr ago and have had no new detection since then.

Hence, we verified each of the HMXBs in the present catalogue for their counterparts at various wavelengths. In increasing typical astrometric precision, we cross-matched the available position of HMXBs with the catalogues listed in Table 1. Independently of the origin of the positional data that were retrieved, we first queried each catalogue in a cone whose angular size varied depending on (1) the typical astrometrical accuracy of the queried catalogue and (2) the accuracy of the initial positional data. If the positional data were more accurate than the queried catalogue, the cone size was set to the radii given in Table 1, which are about twice of the worst astrometric performance in the corresponding catalogue. If the astrometric precision of the queried catalogue was more accurate than the positional data, the cone size was set to the error available in the positional data.

Then, after reviewing the counterparts found at high energies, we performed a recursive search, from poorly accurate

Table 1. Queried catalogues for the counterpart search.

Catalogue	Reference	Radius
HEAO 1	Wood et al. (1984)	$20'$
Uhuru 4	Forman et al. (1978)	$20'$
Ariel V 3	Warwick et al. (1981)	$20'$
INTEGRAL	Bird et al. (2016)	$20'$
<i>Fermi</i>	Abdollahi et al. (2022)	$20'$
<i>BeppoSAX</i>	Capitanio et al. (2011)	$6'$
<i>Einstein</i> 2E	Harris et al. (1990)	$4'$
ROSAT	White et al. (2000)	$35''$
<i>Swift</i> 2SXPS	Evans et al. (2020)	$8''$
4XMM DR11	Webb et al. (2020)	$4''$
<i>Chandra</i> CSC 2	Chen et al. (2019)	$3''$
2MASS	Cutri et al. (2003)	120 mas
<i>Gaia</i> DR3	Gaia Collaboration (2022)	20 mas

counterparts to the most accurate catalogues (2MASS and *Gaia*). This allowed us to recover the chain of detection from high energies down to the optical/nIR wavelengths, as well as the soft X-ray detections whose astrometrical accuracies (particularly from *Chandra* and *XMM-Newton*) can rival optical telescopes.

There is a limit in this process because this automatic query can generate false counterparts because the typical astrometrical accuracies that we used are based on the worst performance of each facility, so that any systematic errors in the astrometric calibration between catalogues could be taken into account. Systematic errors in astrometry appear to be especially large in older catalogues (Uhuru, the High Energy Astronomy Observatory HEAO, or Ariel V) because we often find that the historical detections of high-energy sources are not exactly compatible with more recent detections (e.g. INTEGRAL or *Swift*) when considering their 90% positional uncertainty. We also note that for observing facilities with astrometrical accuracies of about $1''$ or lower (*Swift*, *XMM-Newton*, *Chandra*, 2MASS, and *Gaia*), we added $0.5''$ to the positional uncertainty when validating the chain of counterparts. For instance, some *XMM-Newton*, *Chandra*, 2MASS, and *Gaia* detections of the same source can be so precise that they are not technically compatible with one another; for Galactic sources, even when we look towards the Galactic plane in crowded regions, it is unlikely that two separate sources lie closer than $0.5''$. Using this value of systematic error was already successful in Fortin et al. (2022b), who searched for unambiguous *Gaia* counterparts to 2MASS sources.

We verified each individual result of this automatic counterpart search. We manually removed false detections of counterparts, and searched for actual counterparts in the literature when necessary. When we manually input coordinates from specific publications, we added a reference towards it in the online catalogue; they usually come from Astronomer's Telegrams⁴ and are therefore not necessarily present in the queried catalogues.

2.3. Retrieving binary parameters and new HMXBs

We made extensive use of NASA's Astrophysics Data System⁵ (ADS) to recover the parameters and their corresponding references. Some papers greatly facilitated the process as they already listed information on some HMXBs in our catalogue. Orbital periods, spin periods, and spectral types are found in

⁴ <https://www.astronomerstelegam.org/>

⁵ <https://ui.adsabs.harvard.edu/#>

Belczynski & Ziolkowski (2009), spin periods of pulsars are reported in Annala & Poutanen (2010), spectroscopic information on Ae/Be stars is given in Fairlamb et al. (2015), tabled data on BeHMXBs is presented in Tsygankov et al. (2017) and Reig et al. (2017), HMXBs detected by INTEGRAL are reported in Sidoli & Paizis (2018), an overview of SFXT candidates is given in Sguera et al. (2020), much information on radio pulsars is collected in van den Eijnden et al. (2021), *XMM-Newton* and *Swift* observations of sgHMXBs are reported in Ferrigno et al. (2022), and HMXBs seen by *Fermi* are presented in Harvey et al. (2022).

For each information we compiled (spectral type, systemic radial velocity, masses, orbital period, spin period, and eccentricity), we provide the reference to the paper that first reported the measurements. While the articles listed above greatly sped up the process, we still manually checked each and every listed source in ADS and Simbad to search for any missing measurement and/or reference. This step is crucial not only to gather the most complete set of data on HMXBs in one place, but also to ensure that we do not cite papers in which no actual measurement was made. This facilitates determining the original source.

Furthermore, we also searched for papers announcing the detection of new HMXBs between 2016 and 2022, and added any new entry to the catalogue after performing the same precautionary steps described in this section. We mention for instance HD 96670, which was recently identified as new BH HMXB candidate in Gomez & Grindlay (2021).

2.4. Contents of the catalogue

In Table A.1 we provide a single identifier that is either the historical name of the HMXBs, the most commonly used (e.g. for INTEGRAL sources), or the main identifier as queried in Simbad. This service can be used to retrieve other identifiers available for the HMXBs. The ‘‘Spectype’’ column refers to the spectral type of the donor star in the binary. We also provide an indication of the subclass of the HMXBs: Be, supergiant (sg), supergiant fast X-ray transient (SFXT), and a few peculiar subclasses such as sgB[e] or Wolf-Rayet (WR). Most of the subclass information comes from the spectral type of the companion; if no spectral type is provided, a reference may be available to motivate the choice of subclass. The sky coordinates of the most accurate counterpart we found are listed alongside their 90% positional error. We also include distance inferences from Bailer-Jones et al. (2021) when a *Gaia* DR3 counterpart is available. These distances are based on *Gaia* EDR3, and as a result, they cannot be directly retrieved using the *Gaia* DR3 identifiers we provide in the full catalogue; instead, we retrieved the *Gaia* EDR3 identifiers first using a cone sky match, and then queried the distances in Bailer-Jones et al. (2021). Finally, Table A.1 provides a variability flag (‘‘Var’’) that summarises whether the HMXBs were flagged as variable sources in the INTEGRAL, 4XMM DR11, or *Chandra* catalogues, or if the ratio of the peak to mean flux in the *Swift* 2SXPS catalogue is greater than 5. The detailed information about individual variability flags is given in the online version of the catalogue.

In Table A.2 we introduce the orbital characteristics of the catalogued HMXBs. We have separated this information from Table A.1 for readability, but the full online catalogue contains information from both tables together. First are given indications on the mass of the compact object (M_x) and the companion star (M_o). Companion masses that were broadly inferred from the spectral type by us are labelled with a dagger; we used the atlas of Be stars from Porter (1996) and the stellar parameters

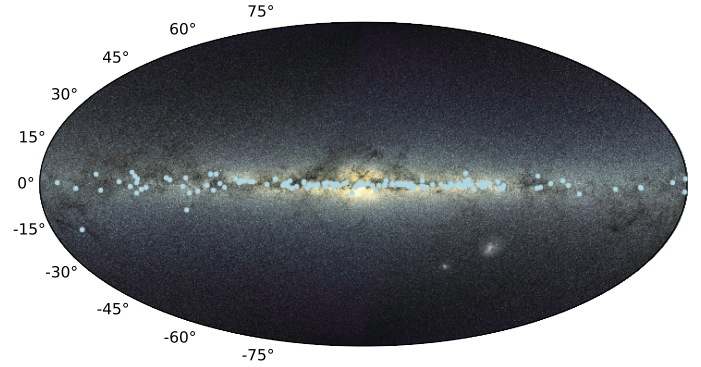


Fig. 1. Edge-on view of the 152 HMXBs in the Galaxy. Galactic latitudes are indicated in degrees. Background image credits: ESA/Gaia/DPAC.

for O stars available in Martins et al. (2005). The orbital period, eccentricity, spin period, and radial systemic velocity are given as available in the literature.

In addition to all the information in Tables A.1 and A.2, the online version of the catalogue provides a list of the multi-wavelength counterparts to each HMXB. For each counterpart, we provide the right ascension and declination in J2000, the 90% positional error, and the identifier as listed in the queried catalogues. This can facilitate any further cross match because sky matches can produce false associations, and identifiers help to identify any mistake in this matter.

The full catalogue content is available on Vizier in a fixed version. We also host it in a dynamic version that can be browsed online⁶, and which will be updated upon the request of users. New versions will be regularly published on the website and will be available for download in various formats.

3. Results, discussions, and byproducts

In this catalogue, we present 152 HMXBs and candidates in the Galaxy. This is a 33% increase from Liu et al. (2006) for the whole sample. We can also compare the increase in securely identified HMXBs because the 2006 catalogue mentions that only 63 were confirmed systems, the remaining 51 were candidates at that time. In the current catalogue, if we consider HMXBs for which we have a spectral type indicative of a massive star as confirmed, then we count 126 confirmed HMXBs. If we add to this those with a detected orbital period and spin period, this pushes the number of confirmed HMXBs to 134, more than twice the number of Liu et al. (2006). The Galactic sky map of HMXBs is shown in Fig. 1. We note that 111 of the HMXBs have a *Gaia* DR3 counterpart, of which 4 do not have a parallax estimation. We show the face-on Galactic distribution of HMXBs seen by *Gaia* in Fig. 2, which indicates a positional correlation between Galactic spiral arms and HMXBs that was recently explored in Fortin et al. (2022a) along with Galactic stellar clusters to retrieve the possible birthplaces and age of the binaries.

We find that the current number of BeHMXBs in the Galaxy is 74; there are 52 sgHMXBs, of which 21 are SFXT candidates, and 5 are sgB[e] systems. Two HMXBs have a Wolf-Rayet companion. We also note that the spectral type of the companion is poorly constrained in 28 HMXBs, which indicates that

⁶ Available at <https://binary-revolution.github.io/HMXBwebcat5/>

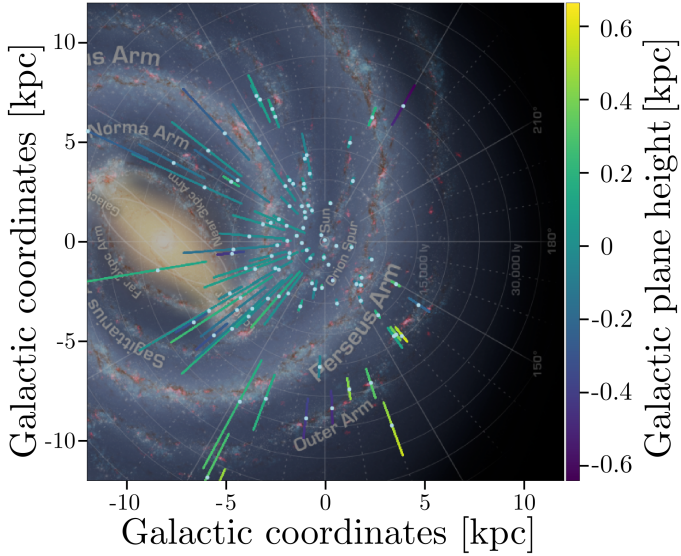


Fig. 2. Face-on view of the 107 Galactic HMXBs with *Gaia* parallaxes. Bars indicate the 68% confidence interval in distance. Background image credits: NASA/JPL-Caltech/R. Hurt (SSC/Caltech).

optical/nIR identification campaigns are still very necessary. Liu et al. (2006) listed 50 BeHMXBs and 16 sgHMXBs according to the listed spectral types. This means that we improve the census of these subclasses by 50% and more than 200%, respectively. The dramatic increase in known sgHMXBs over the past 15 yr is associated with the performances of the INTEGRAL satellite at high energies, which has at least in part lifted the observational bias we had towards BeHMXBs.

This catalogue was compiled to facilitate the retrieval of information on HMXBs and to allow for considerations to be made not only on individual systems, but on Galactic HMXBs as a population. We provide two examples of how this catalogue can be used for this purpose.

As a first example of how the data may be used is to build a Corbet diagram, shown in Fig. 3 with the 38 HMXBs in Liu et al. (2006; top panel) and the 75 HMXBs from the current catalogue (bottom panel), for which orbital period and spin period are determined. It is a great tool for visualising the effect of mass transfer in wind accretion versus decretion disk. Because the angular momentum is transferred very efficiently when an NS interacts with a decretion disk, BeHMXBs present a strong correlation ($P_{\text{spin}} \propto P_{\text{orb}}^2$, Corbet 1984); on the other hand, sgHMXBs do not show a significant correlation as wind accretion is inefficient at angular momentum transfer.

As expected, the updated Corbet diagram shows a dichotomy between sgHMXBs, which tend to have shorter orbital periods and host more slowly spinning NSs, and BeHMXBs with longer orbital periods but slightly faster-spinning NSs. Even with the greatly improved census on sgHMXBs, they do not show any particular correlation in the Corbet diagram, as opposed to BeHMXBs (see e.g. Cheng et al. 2014), whose orbital period generally increases with spin period. A few remarkable systems can be quickly identified: the two millisecond pulsars SAX J0635.2+0533 and PSR B1259-63 (the latter orbiting its companion in more than 1000 d), and at the opposite end, the very slowly rotating 1A 0114+650, IGR J19140+0951, 1H 1249-637, and 4U 1954+31. The last system is also peculiar because it is the only HMXB in the Galaxy with a confirmed MI massive supergiant donor star (Hinkle et al. 2020).

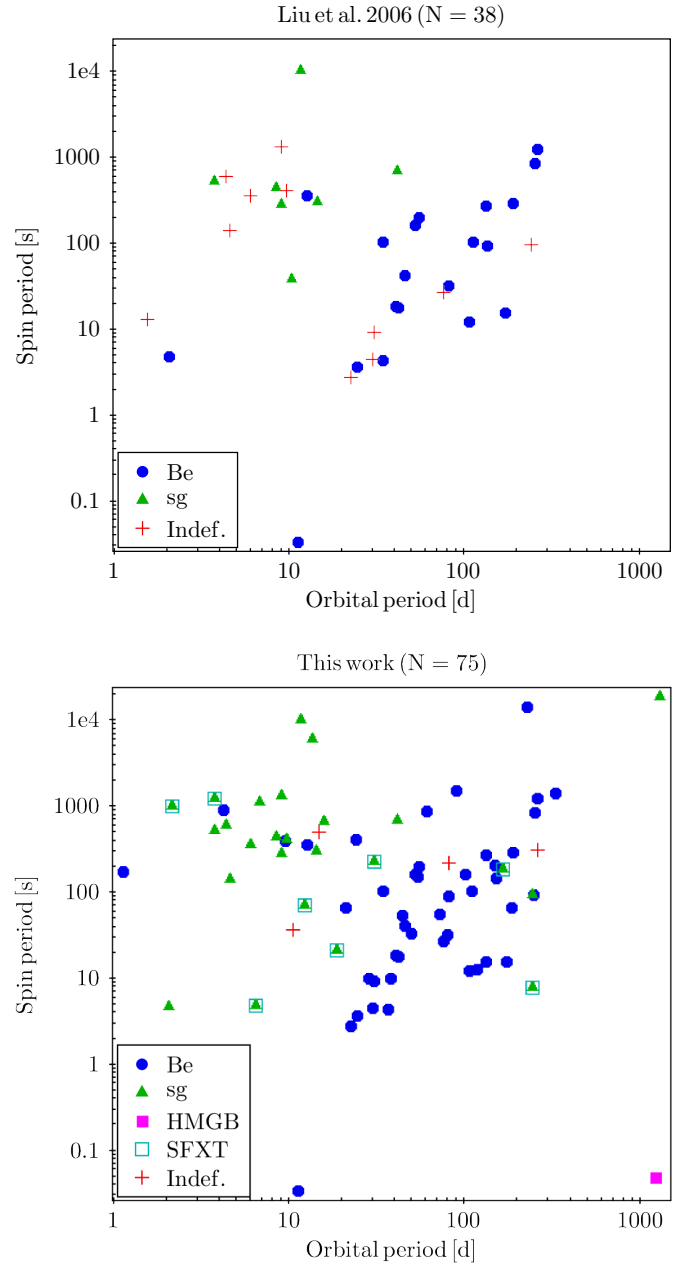


Fig. 3. Corbet diagram of the 38 HMXBs in the Liu et al. (2006) catalogue (top panel) and the 75 HMXBs in the current catalogue (bottom panel). BeHMXBs are shown as blue dots, sgHMXBs (SFXTs) are shown as green triangles (squares), HMGB are shown as pink squares, and the remaining HMXBs with a peculiar and/or unclear spectral type are shown as red crosses “Indef”.

As a second example, we built a distribution of soft X-ray luminosities of HMXBs in the Galaxy. The current catalogue does not list the common high-energy information such as X-ray fluxes, hardness ratio, or hydrogen column density. HMXBs can be variable sources or be obscured, and the modelling of their high-energy emission requires a case-by-case approach, which is why we do not provide such high-level information. However, with the provided list of their counterparts in soft and hard X-ray catalogues, users can easily find this information. First, we use the distances in Table A.1, which were queried in Bailer-Jones et al. (2021) using the *Gaia* DR3 positions. Then, we query the

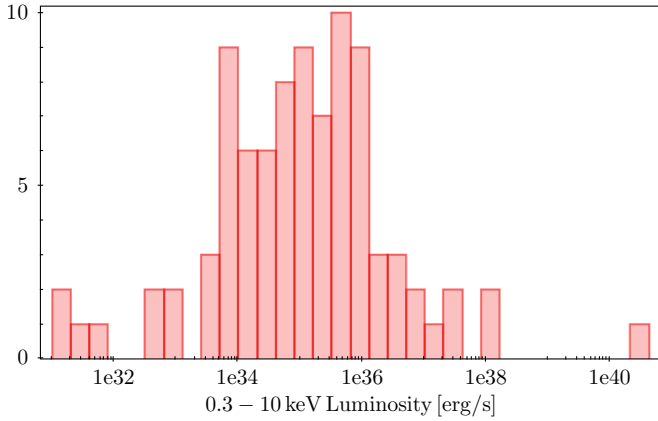


Fig. 4. Distribution of soft X-ray luminosities of the Galactic HMXBs seen by *Swift* and *Gaia* ($N = 89$).

Swift 2SXPS catalogue using their available *Swift* identifiers, and fetch the value of the unabsorbed flux in the 0.3–10 keV band (column *apex_flux_b*). In Fig. 4 we present the distribution of X-ray luminosities that can be derived from *Swift* and *Gaia* data. We note that the source showing extreme X-ray luminosity at $>10^{40}$ erg s $^{-1}$ is IGR J16318-4848, the prime example of an absorbed sgB[e]HMXBs (see Fortin et al. 2020 for recent broadband observations of this binary). This luminosity should clearly be considered with caution because of the uncertainty on the very high absorption in the line of sight and on the distance to the source. This is but a very crude example, as the users might wish to consider other X-ray bands or hardness ratios coming from their preferred observatories, or might consider the exact models used to infer fluxes (de-reddened or not, power law vs. black body, etc). There are many other possibilities of use for this catalogue depending on the user’s goal.

4. Conclusion

After more than 15 yr of multi-wavelength observation campaigns, the landscape of Galactic HMXBs has changed significantly. Much information about them is available throughout the literature. We present an updated catalogue of HMXBs in the Milky Way containing not only basic information such as identifiers, subclasses, and positions, but also multi-wavelength counterparts and orbital binary parameters. These are available from an in-depth both automatised and manual survey performed across published papers and catalogues of high-energy sources.

Compared to the last published catalogue of HMXBs by Liu et al. (2006), the total number of HMXBs known in the Galaxy has increased by roughly 33% (see Fig. 5), by a factor of two when considering confirmed systems, and by a factor of three in the particular case of sgHMXBs. The latter most definitely benefited from the capabilities of INTEGRAL and HMXBs in general, through many focused optical/nIR identification campaigns, as well as multiple follow-up efforts in the soft X-ray band, which are essential in the process of constraining the exact position of hard X-ray sources in the sky. In addition, the data collected by the *Gaia* satellite since 2015 offer unrivalled estimates of positions and velocities, including distances to HMXBs across two-thirds of the catalogue, which it was not possible to achieve at this scale before.

The search for new X-ray binaries and information on them is still active, and the arrival of new observing facilities will ensure continued interest in this field. The eROSITA, SVOM,

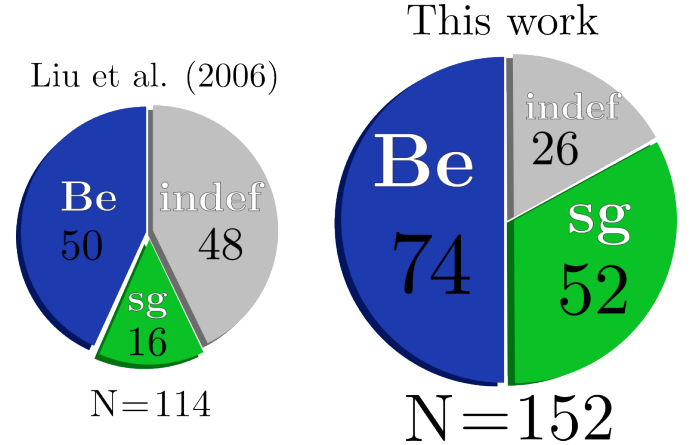


Fig. 5. Evolution of the number and nature of HMXBs in the Galaxy with an identified spectral type from 2006 (left) to 2022 (right).

and LSST observatories will not only contribute to studying currently known or new persistent systems, but will also provide much more information on transient sources and therefore provide insight into other stages of binary evolution such as supernova explosions or merger events. The addition of the gravitational messenger by the LIGO/Virgo/KAGRA observatories will work in synergy with electromagnetic transient sky facilities to constrain the endpoint of binary evolution; we will soon, if we do not already, have access to observational data on phases spanning the entire life of massive binary stars. The coming years will thus provide many opportunities for studying the evolution of massive stars in binaries, which contribute to the Galactic ecology by their X-ray emission, heavy nucleus formation, and possible retro-action on the interstellar medium.

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Appendix A: Catalogue of Galactic HMXBs

Table A.1: Catalogue of Galactic HMXBs: General information.

Main ID	Spectype	Class	RA [deg]	Dec [deg]	err [mas]	Distance [pc]	RV [km/s]	Var
IGR J00370+6122	BN0.7Ib [1]	sg	9.29013	61.36013	0.008	3401 ⁺¹⁸⁶ ₋₁₇₁	-80.0±3.0 [2]	Y
gam Cas	B0.5IVpe [3]	Be	14.17745	60.71672	1.834		-0.018±0.075 [4]	Y
EM* AS 14	B2 [5]		18.99604	59.15394	0.011	2592 ⁺¹⁵⁶ ₋₁₄₀		
2S 0114+650	B1Iae [6]	sg	19.51123	65.29162	0.007	4475 ⁺²¹⁷ ₋₁₈₃	-31.0±5.0 [7]	Y
4U 0115+634	B0.2Ve [8]	Be	19.63319	63.74252	0.011	5787 ⁺⁸¹⁷ ₋₄₅₃		Y
IGR J01363+6610	B1Ve [9]	Be	23.95772	66.21202	0.007	5816 ⁺⁴¹³ ₋₄₀₇		Y
RX J0146.9+6121	B1IIIe [10]	Be	26.75088	61.35657	0.012	2751 ⁺¹⁶² ₋₁₃₈		Y
IGR J01583+6713	B2IVe+ [11]	Be	29.57703	67.22318	0.009	6048 ⁺⁴⁶⁴ ₋₄₇₂		Y
LS I+61 303	B0Ve [12]	γ Be	40.13193	61.22933	0.007	2504 ⁺⁷² ₋₆₇	-41.41±0.6 [13]	Y
Swift J0243.6+6124	O9.5V [14]	Be	40.91843	61.43438	0.007	5189 ⁺²⁹¹ ₋₃₁₄		Y
V 0332+53	O8.5Ve [15]	Be	53.74963	53.17314	0.014	5584 ⁺⁷³⁰ ₋₅₀₆		Y
X Per	B1Ve [16]	Be	58.84615	31.04584	0.03	595 ⁺¹⁷ ₋₁₃	1.0±0.9 [17]	Y
XTE J0421+560	B0/2I[e] [18]	sgB[e]	64.92556	55.99936	0.013	4094 ⁺²⁷⁶ ₋₂₀₆	-51.0±2.0 [19]	Y
RX J0440.9+4431	B0.2Ve [20]	Be	70.24721	44.53034	0.012	2444 ⁺⁶⁰ ₋₇₇		Y
EXO 051910+3737.7	B0III-IVe [21]	Be	80.6468	37.67599	0.025	1317 ⁺⁵⁵ ₋₅₂	-20.5±4.4 [22]	
1A 0535+262	O9.5III-Ve [23]	Be	84.72739	26.31578	0.02	1793 ⁺⁷⁶ ₋₇₁	-30.0±4.0 [24]	Y
AAO+28 342	B5ne [25]	Be	88.97934	28.78511	0.025	1600 ⁺⁹⁵ ₋₇₃		
IGR J06074+2205	B0.5Ve [26]	Be	91.86089	22.0966	0.016	5989 ⁺⁵⁵⁹ ₋₆₀₃	18.9±4.1 [27]	Y
HD 259440	B0pe [28]	γ Be	98.2469	5.80032	0.018	1772 ⁺⁹³ ₋₈₆	36.9±0.8 [29]	
SAX J0635.2+0533	B2V-B1IIIe [30]	Be	98.82616	5.55174	0.012	6290 ⁺⁶⁵⁵ ₋₄₉₂		
3A 0656-072	O9.7Ve [31]	Be	104.56044	-7.21249	0.038	218 ⁺² ₋₂		Y
3A 0726-260	O5Ve [32]	Be	112.22324	-26.10802	0.009	7869 ⁺¹¹⁹⁹ ₋₁₀₈₂		Y
SGR 0755-2933	O6-8 [33]		118.92702	-29.56486	0.009	3356 ⁺¹⁵⁹ ₋₁₅₄		Y
RX J0812.4-3114	B0.2IVe [34]	Be	123.11815	-31.24781	0.007	6659 ⁺⁵²⁸ ₋₄₂₂		Y
IGR J08262-3736	OBV [35]	Be	126.55688	-37.61995	0.006	5124 ⁺²⁷⁹ ₋₂₂₈		Y
GS 0834-430	B0-2III-Ve [36]	Be	128.98108	-43.1856	60.0			
IGR J08408-4503	O8.5Ib-II(f)p [37]	SFXT	130.19919	-45.0584	60.0		15.3±0.5 [38]	Y
Vela X-1	B0.5Iae-1b [39]	sg	135.52856	-40.55465	0.011	1960 ⁺⁵⁷ ₋₅₂	-3.2±0.9 [40]	Y
GRO J1008-57	B0e [41]	Be	152.44564	-58.29321	0.012	3536 ⁺¹⁴⁸ ₋₁₅₂		Y
IGR J10101-5654	sgB[e] [42]	sgB[e]	152.54942	-56.92554	0.069	4474 ⁺¹⁰⁹⁴ ₋₁₁₇₁		Y
1FGL J1018.6-5856	O6V [43]	γ Be	154.73156	-58.94609	0.009	4324 ⁺²⁰⁹ ₋₂₀₄	55.3±13.1 [44]	Y
4U 1036-56	B0III-Ve [10]	Be	159.39717	-56.79886	60.0			Y
HD 96670	O7V(f)n [45]	Be	166.808	-59.8731	0.023	3131 ⁺²⁶⁸ ₋₂₅₃	-27.5±0.02 [46]	
1A 1118-615	O9.5III-Ve [47]	Be	170.23817	-61.91671	0.009	2899 ⁺⁸⁶ ₋₇₆		Y
Cen X-3	O6-7II-III [48]	sg	170.31286	-60.62378	0.012	6784 ⁺⁶³⁴ ₋₅₇₂	32.0±13.0 [49]	Y
IGR J11215-5952	B1Ia [50]	SFXT	170.44505	-59.86331	0.01	7175 ⁺⁵¹⁶ ₋₅₆₃		Y
IGR J11305-6256	B0IIIe [51]	Be	172.77874	-62.94692	0.036	1731 ⁺¹³⁹ ₋₁₁₁	-22.0±7.4 [52]	Y
IGR J11435-6109	B0.5Ve [42]	Be	176.00117	-61.1268	0.024	7863 ⁺¹³⁷³ ₋₁₂₁₇		Y
1E 1145.1-6141	B2Iae [53]	sg	176.86894	-61.95372	0.008	8097 ⁺⁶⁰³ ₋₅₆₆	-13.0±3.0 [54]	Y
2E 1145.5-6155	B1III-Ve [55]	Be	177.00003	-62.20691	0.014	2063 ⁺⁸⁰ ₋₈₇	-17.0±7.4 [52]	Y
EXMS B1210-645	B2V [56]	Be	183.31157	-64.87513	0.012	3352 ⁺¹⁸⁰ ₋₁₆₁		
GX 301-2	B1.5Iaeq [57]	sg	186.65645	-62.77036	0.012	3604 ⁺²⁰⁴ ₋₁₉₅	4.1±2.4 [58]	
IGR J12341-6143	[59]	SFXT?	188.467	-61.796	238800.001			Y
1H 1238-599			190.42741	-60.27217	4300.0			
1H 1249-637	B0.5IVpe [60]	Be	190.70932	-63.05864	0.053	439 ⁺¹⁵ ₋₁₅	22.0±7.0 [52]	Y
1A 1244-604			190.82482	-60.20152	70.0			
GX 304-1	B2Vne [61]	Be	195.3212	-61.60184	0.009	1856 ⁺³⁶ ₋₄₅		Y
IGR J13020-6359	B0-6Ve [62]	Be	195.49461	-63.96912	0.06	5952 ⁺²³⁷⁷ ₋₁₃₃₉		Y

Table A.1: continued.

Main ID	Spectype	Class	RA [deg]	Dec [deg]	err [mas]	Distance [pc]	RV [km/s]	Var
PSR B1259-63	O9.5Ve [63]	γ Be	195.69849	-63.83573	0.009	2170 ⁺⁶² ₋₅₈	0.0±1.0 [64]	
IGR J13186-6257	B0-6Ve [62]	Be	199.60662	-62.97081	0.056	3469 ⁺¹¹⁰² ₋₉₀₁		Y
SAX J1324.4-6200	Be? [65]	Be?	201.11105	-62.02198	110.0			Y
HD 119682	B0Ve [60]	Be	206.63567	-62.92339	0.017	1597 ⁺⁸⁰ ₋₆₅		Y
IGR J14059-6116	O6III [66]	γ	211.31006	-61.30784	80.0			Y
MAXI J1409-619			212.01132	-61.98389	70.0			
H 1417-624	B1e [67]	Be	215.30061	-62.69892	0.022	7428 ⁺³⁰⁹⁵ ₋₁₈₁₁		Y
IGR J14331-6112	BV-IIIe [68]	Be	218.28465	-61.26107	0.064	2551 ⁺⁶⁰⁹ ₋₅₆₅		
IGR J14488-5942	O-BVe [42]	Be	222.18009	-59.70382	70.0			Y
Cir X-1	B5-A0I [69]	sg	230.17018	-57.16674	0.1	7469 ⁺²³²⁰ ₋₂₁₀₃	26.0±3.0 [69]	Y
4U 1538-522	B0.2Ia [70]	sg	235.5973	-52.38601	0.011	5614 ⁺⁴⁸⁹ ₋₄₃₄	-158.0±11.0 [71]	Y
XTE J1543-568	Be? [72]	Be?	236.02206	-56.76167	0.085	5388 ⁺²⁶⁷⁵ ₋₁₉₂₅		Y
1H 1555-552	B2IIIIn [73]		238.59067	-55.32899	0.013	1327 ⁺²⁷ ₋₃₅		
H 1553-542	B1-2V [74]	Be	239.45139	-54.4151	2.229			Y
IGR J16195-4945	ON9.7Iab [42]	SFXT?	244.8841	-49.74183	0.042	2642 ⁺²⁷⁵ ₋₂₅₈		Y
IGR J16207-5129	B1Ia [75]	sg	245.19273	-51.50171	0.038	8582 ⁺²⁰¹⁶ ₋₁₇₁₈		Y
SWIFT J1626.6-5156	B0Ve [76]	Be	246.65219	-51.94182	60.0			Y
IGR J16283-4838	OBI [77]	sg	247.04513	-48.64891	110.0			Y
IGR J16318-4848	sgB[e] [78]	sgB[e]	247.95126	-48.81688	0.131	6663 ⁺⁴⁰⁵² ₋₂₀₃₄		Y
AX J1631.9-4752	O8I [79]	sg	248.00733	-47.87472	80.0			Y
IGR J16328-4726	O8Iafpe [42]	SFXT	248.15829	-47.39455	0.517	2131 ⁺¹⁷⁶⁹ ₋₁₀₁₂		Y
IGR J16327-4940	OBIII [35]		248.16638	-49.70383	0.041	13138 ⁺⁴⁴²⁶ ₋₃₂₅₆		Y
IGR J16374-5043	[59]	SFXT?	249.30624	-50.7246	0.493	4224 ⁺³⁴³³ ₋₁₇₉₉		Y
AX J163904-4642	BIV-V [80]	Be	249.77285	-46.70354	527.513			Y
IGR J16418-4532	BN0.5Ia [42]	SFXT?	250.46162	-45.54038	60.0			Y
IGR J16465-4507	O9.5Ia [75]	SFXT	251.6469	-45.11796	0.016	2912 ⁺²²⁴ ₋₁₄₈		Y
IGR J16479-4514	O9.5Iab [75]	SFXT	252.02734	-45.20189	60.0			Y
IGR J16493-4348	B0.5Ib [81]	sg	252.36231	-43.81918	60.0			Y
AX J1700-419			255.01813	-41.96822	0.296	3282 ⁺¹⁵⁶⁴ ₋₁₁₅₃		Y
AX J1700.2-4220	B0.5IVe [82]	Be	255.08037	-42.33864	727.403			
OAO 1657-415	Ofpe/WN9 [83]	WR	255.20368	-41.65596	60.0		-57.2±3.0 [84]	Y
4U 1700-377	O6Iafcp [37]	sg	255.98657	-37.84412	0.021	1499 ⁺⁵⁰ ₋₅₇	-60.0±10.0 [85]	Y
AX J1714.1-3912	[86]	sgB[e]/SFXT?	258.43297	-39.20157	1.785			Y
XTE J1716-389	sg? [87]	sg?	258.98525	-38.86493	80.0			Y
EXO 1722-363	B0-1Ia [83]	sg	261.29746	-36.28265	60.0		-6.5±3.8 [88]	Y
IGR J17354-3255	O9Iab [42]	SFXT	263.865	-32.93182	0.329	3826 ⁺¹⁵²³ ₋₁₇₆₉		Y
IGR J17375-3022	[59]	SFXT?	264.39208	-30.38806	900.0			Y
XTE J1739-302	O8Iab(f) [89]	SFXT	264.79813	-30.34381	0.04	1929 ⁺²⁰¹ ₋₁₆₅		Y
GRS 1736-297			264.88797	-29.72458	0.591	2271 ⁺¹⁷²³ ₋₉₉₅		Y
XTE J1743-363	O9I/GIII-I [87]	sg	265.75557	-36.37283	60.0			Y
1E 1740.7-2942			265.97848	-29.74528	218.139			Y
RX J1744.7-2713	B0.5V-IIIe [90]	Be	266.19069	-27.22903	0.02	1207 ⁺³³ ₋₂₉		Y
AX J1749.1-2733	B1-3V [91]	Be	267.2787	-27.54251	717.583			Y
AX J1749.2-2725	B3V [91]	Be	267.30167	-27.42729	728.882			Y
GRO J1750-27	Be? [92]	Be?	267.304	-26.64406	900.0			Y
IGR J17503-2636	sg? [93]	SFXT?	267.57526	-26.60467	60.0			
IGR J17544-2619	O9Ib [94]	SFXT	268.6053	-26.33127	0.022	2425 ⁺¹⁵⁶ ₋₁₃₄	-46.8±4.0 [95]	Y
GRS 1758-258	AV [96]	IMXB?	270.30197	-25.74328	0.919	4630 ⁺²⁵⁵⁴ ₋₁₉₉₈		Y
IGR J18027-2016	B1Ib [97]	sg	270.67474	-20.28817	0.105	8526 ⁺⁴¹¹⁹ ₋₂₄₃₈	51.7±2.4 [98]	Y
2MASS J18081689-1919395			272.07039	-19.32766	110.0			
SWIFT J1816.7-1613	B0-2e [99]	Be	274.178	-16.22283	765.639			Y
SAX J1818.6-1703	B0Iab [97]	SFXT	274.6579	-17.04668	0.151	2791 ⁺¹¹⁴⁵ ₋₇₆₂		Y
SAX J1819.3-2525	B9III [100]		274.84014	-25.40718	0.02	4738 ⁺⁷⁶⁵ ₋₆₀₁	72.7±3.3 [101]	Y
AX J1820.5-1434	B0-2IV-Ve [102]	Be	275.1254	-14.57302	80.0			Y

Table A.1: continued.

Main ID	Spectype	Class	RA [deg]	Dec [deg]	err [mas]	Distance [pc]	RV [km/s]	Var
IGR J18214-1318	B0V-O9I [103]	Be/sg	275.33234	-13.31089	0.23	4209 ⁺¹⁷⁰⁹ ₋₁₂₈₆		Y
IGR J18219-1347	Be? [104]	Be?	275.47837	-13.79074	745.065			Y
IGR J18246-1425			276.09842	-14.41551	3600.0			
IGR J18256-1035			276.43262	-10.58389	1.012	3775 ⁺²⁷⁵⁹ ₋₂₂₇₄		
LS 5039	ON6.5V(f) [105]	γ Be	276.56277	-14.84844	0.013	1898 ⁺⁵⁹ ₋₅₄	17.3 \pm 0.5 [106]	Y
XTE J1829-098	[59]	SFXT?	277.43329	-9.85645	738.219			Y
ATO J278.3657-10.5901	B0.5Ve [107]	Be	278.3657	-10.59012	0.154	1021 ⁺²⁵⁵ ₋₁₄₄		Y
SNR 021.5-00.9	B0Ve [108]	Be	278.36792	-10.40243	0.024	1996 ⁺¹¹² ₋₁₁₅		Y
AX J1838.0-0655			279.51928	-6.90243	8.636			
AX J1841.0-0536	B1Ib [75]	SFXT	280.28017	-5.58165	0.016	2828 ⁺¹⁴³ ₋₁₂₉	74.4 \pm 2.1 [109]	Y
GS 1839-06			280.39706	-5.84236	24000.0			
IGR J18450-0435	O9.5I [110]	SFXT	281.25662	-4.56576	0.019	5436 ⁺⁶⁴⁵ ₋₆₄₁	61.0 \pm 1.4 [109]	Y
GS 1843+009	B0-2IV-Ve [102]	Be	281.40347	0.86316	0.168	5097 ⁺⁴¹⁹² ₋₁₉₀₄		Y
IGR J18462-0223	OBI? [111]	SFXT	281.55377	-2.37469	0.236	6784 ⁺⁴⁰⁴⁸ ₋₂₈₃₉		Y
IGR J18482+0049			282.06417	0.79257	120.0			
3A 1845-024	OBI? [112]	sg?	282.07035	-2.42361	425.859			Y
IGR J18483-0311	B0.5Ia [113]	SFXT	282.07169	-3.17137	0.137	2722 ⁺¹⁴⁷³ ₋₇₆₁		Y
XTE J1855-026	B0Iaep [114]	sg	283.87668	-2.60468	0.014	7731 ⁺¹⁰⁹⁰ ₋₇₃₅		
XTE J1858+034	K-M? [115]		284.68191	3.43475	80.0			Y
XTE J1859+083	B0-2Ve [116]	Be	284.75681	8.24567	60.0			
4U 1901+03	B8-9IV [117]	Be	285.91413	3.20436	0.194	5575 ⁺²³⁰² ₋₁₇₈₇		Y
XTE J1906+090	Be? [118]	Be?	286.19777	9.04491	0.559	6370 ⁺³⁴⁷¹ ₋₁₉₆₅		Y
4U 1907+097	O9.5Iab [75]	sg	287.40853	9.82978	0.026	5351 ⁺⁸⁶⁶ ₋₈₅₈		Y
AX J1910.7+0917	BI [119]	sg	287.68168	9.27476	70.0			Y
4U 1909+07	O7.5-9.5If [120]	sg	287.70087	7.59766	0.663	4965 ⁺³⁸⁵⁰ ₋₂₀₉₂		
IGR J19113+1533	sgB[e] [35]	sgB[e]	287.82131	15.55377	0.573	3582 ⁺²¹³⁸ ₋₁₆₀₀		Y
SS 433	A7Ib [121]	sg	287.95651	4.98271	0.018	7290 ⁺¹¹⁸⁶ ₋₈₅₇	69.0 \pm 4.7 [122]	Y
IGR J19140+0951	B1Iab [75]	sg	288.51761	9.88286	0.304	4020 ⁺¹⁸²⁶ ₋₁₆₈₁		Y
IGR J19149+1036			288.73635	10.61015	1.514	1101 ⁺²⁷⁰ ₋₂₄₂		
IGR J19294+1816	B1Ve [123]	Be	292.48293	18.31061	0.649	3189 ⁺¹⁹⁸⁰ ₋₁₂₄₁		Y
1RXS J194211.9+255552	OB [124]		295.54652	25.93489	0.032	9057 ⁺³⁸⁹⁵ ₋₂₃₁₇		
XTE J1946+274	B0-IIV-Ve [125]	Be	296.41397	27.3654	0.017	13139 ⁺³³⁸⁰ ₋₂₃₃₂		Y
KS 1947+300	B0Ve [126]	Be	297.39784	30.20881	0.009	15126 ⁺³¹⁴⁸ ₋₂₆₃₄		Y
IGR J19498+2534	B1a [127]	SFXT	297.48095	25.56659	0.013	5991 ⁺¹¹²⁵ ₋₈₇₄		Y
4U 1954+319	MI [128]	sg	298.9264	32.09693	0.016	3432 ⁺²⁶¹ ₋₂₄₉		Y
Cyg X-1	O9.7Iabpvar [129]	sg	299.59029	35.20158	0.011	2146 ⁺⁶⁴ ₋₅₃	-7.0 \pm 5.0 [130]	
IGR J20006+3210	BV-III [68]	Be	300.09105	32.18974	0.014	8356 ⁺¹⁷⁶⁶ ₋₁₁₉₉		
W63 X-1	Be? [131]	Be?	304.79994	45.66718	0.196	767 ⁺¹⁵⁷ ₋₁₀₇		
RX J2030.5+4751	B0.5V-IIIe [10]	Be	307.6285	47.86407	0.014	2293 ⁺⁹⁵ ₋₈₅		
EXO 2030+375	B0Ve [132]	Be	308.06363	37.63743	0.061	2410 ⁺⁴⁹⁷ ₋₃₉₁		Y
Cyg X-3	WN4/5-6/7 [133]	WR	308.10742	40.95776	60.0			Y
GRO J2058+42	O9.5-B0IV-Ve [9]	Be	314.69806	41.77698	0.011	8861 ⁺¹⁰⁶⁵ ₋₉₂₇		
SAX J2103.5+4545	B0Ve [134]	Be	315.89877	45.75153	0.011	6218 ⁺⁵⁷⁶ ₋₄₄₈		Y
IGR J21347+4737	B3V [56]	Be	323.58487	47.63338	0.011	8300 ⁺⁸⁵¹ ₋₈₀₅		Y
Cep X-4	B1-B2Ve [135]	Be	324.87785	56.98622	0.012	7446 ⁺⁵⁷⁶ ₋₄₉₂		
1H 2202+501	Be [136]	Be	330.40919	50.16795	0.011	1116 ⁺¹⁴ ₋₁₆	-16.8 \pm 2.5 [27]	
4U 2206+543	O9.5Vep [137]	Be	331.98429	54.51843	0.012	3104 ⁺¹³³ ₋₁₃₅	-54.5 \pm 1.0 [138]	Y
SAX J2239.3+6116	B0Ve [139]	Be	339.83683	61.27405	0.012	7387 ⁺⁸⁵⁵ ₋₆₇₅		
MWC 656	B1.5-B2IIIe [140]	Be	340.73874	44.72172	0.013	1984 ⁺⁸⁰ ₋₇₆	-14.1 \pm 2.1 [140]	
2MASS J22535512+6243368	BIII [141]		343.47967	62.72688	0.015	9748 ⁺¹⁶⁷⁶ ₋₁₁₆₆		Y

Notes. Spectype refers to the spectral type of the donor star in the binaries, Class indicates the general category of HMXB (γ indicates a HMGB), Right Ascension (RA) and Declination (Dec) are given in J2000 alongside the 90% positional error radius, Distance is queried from [Bailer-Jones et al. \(2021\)](#), RV is the systemic radial velocity, and Var is the variability flag as detailed in Section 2.4.

References. [1]González-Galán et al. (2014); [2]Grunhut et al. (2014); [3]Shenavrin et al. (2011); [4]Nemravová et al. (2012); [5]Brodskaya (1960); [6]Krtićka et al. (2015); [7]Koenigsberger et al. (2003); [8]Negueruela & Okazaki (2001); [9]Reig et al. (2005b); [10]Motch et al. (1997); [11]Kaur et al. (2008); [12]Hutchings et al. (1981); [13]Aragona et al. (2009); [14]Reig et al. (2020); [15]Negueruela et al. (1999); [16]Zamanov et al. (2019); [17]Grundstrom et al. (2007); [18]Hynes et al. (2002); [19]Aret et al. (2016); [20]Reig et al. (2005a); [21]Polcaro et al. (1990); [22]Gontcharov (2006); [23]Wang & Gies (1998); [24]Hutchings (1984); [25]Popper (1950); [26]Reig et al. (2010); [27]Chojnowski et al. (2017); [28]Jaschek & Egret (1982); [29]Moritani et al. (2018); [30]Kaaret et al. (1999); [31]Pakull et al. (2003); [32]Maíz Apellániz et al. (2016); [33]Reed (2003); [34]Reig et al. (2001); [35]Masetti et al. (2010); [36]Israel et al. (2000); [37]Sota et al. (2014); [38]Gamen et al. (2015); [39]Houk (1978); [40]Stickland et al. (1997); [41]Coe et al. (1994); [42]Coleiro et al. (2013); [43]Strader et al. (2015); [44]van Soelen et al. (2022); [45]Garcia (1993); [46]Gomez & Grindlay (2021); [47]Janot-Pacheco et al. (1981); [48]Ash et al. (1999); [49]van der Meer et al. (2007); [50]Vijapurkar & Drilling (1993); [51]Garrison et al. (1977); [52]Kharchenko et al. (2007); [53]Densham & Charles (1982); [54]Hutchings et al. (1987); [55]Pacheco et al. (1982); [56]Masetti et al. (2009); [57]Hutchings et al. (1982); [58]Kaper et al. (2006); [59]Sguera et al. (2020); [60]Levenhagen & Leister (2006); [61]Parkes et al. (1980); [62]Fortin et al. (2018); [63]Negueruela et al. (2011); [64]Johnston et al. (1994); [65]Mereghetti et al. (2008); [66]Corbet et al. (2019); [67]Grindlay et al. (1984); [68]Masetti et al. (2008); [69]Jonker et al. (2007); [70]Parkes et al. (1978); [71]Abubekerov et al. (2004); [72]in't Zand et al. (2001a); [73]Vieira et al. (2003); [74]Lutovinov et al. (2016); [75]Nespoli et al. (2008b); [76]Reig et al. (2011); [77]Pellizza et al. (2011); [78]Filliatre & Chaty (2004); [79]Rahoui et al. (2008); [80]Chaty et al. (2008); [81]Nespoli et al. (2008a); [82]Negueruela & Schurch (2007); [83]Mason et al. (2009); [84]Mason et al. (2012); [85]Gies & Bolton (1986); [86]Sidoli et al. (2022); [87]Ratti et al. (2010); [88]Mason et al. (2010); [89]Negueruela et al. (2006a); [90]Lopes de Oliveira et al. (2006); [91]Karasev et al. (2010); [92]Bildsten et al. (1997); [93]Masetti et al. (2018); [94]Pellizza et al. (2006); [95]Nikolaeva et al. (2013); [96]Martí et al. (2016); [97]Torrejón et al. (2010); [98]Mason et al. (2011); [99]Nabizadeh et al. (2019); [100]Orosz et al. (2001); [101]Lindstrøm et al. (2005); [102]Israel et al. (2001); [103]Butler et al. (2009); [104]Karasev et al. (2012); [105]Townsend et al. (2011); [106]Casares et al. (2011); [107]Motch et al. (2003); [108]Mathew & Subramaniam (2011); [109]González-Galán (2015); [110]Coe et al. (1996); [111]Sguera et al. (2013); [112]Nabizadeh et al. (2022); [113]Rahoui & Chaty (2008); [114]Negueruela et al. (2008); [115]Tsygankov et al. (2021); [116]Salganik et al. (2022); [117]McCollum & Laine (2019); [118]Göğüş et al. (2005); [119]Rodes-Roca et al. (2013); [120]Morel & Grosdidier (2005); [121]Hillwig et al. (2004); [122]Picchi et al. (2020); [123]Rodes-Roca et al. (2018); [124]Masetti et al. (2012); [125]Verrecchia et al. (2002); [126]Negueruela et al. (2003); [127]Hare et al. (2019); [128]Hinkle et al. (2020); [129]Sota et al. (2011); [130]Gies et al. (2003); [131]Rho et al. (2004); [132]Motch & Janot-Pacheco (1987); [133]van Kerkwijk et al. (1996); [134]Reig et al. (2004); [135]Bonnet-Bidaud & Mouchet (1998); [136]Hardorp et al. (1964); [137]Blay et al. (2006); [138]Stoyanov et al. (2014); [139]Reig et al. (2017); [140]Casares et al. (2014); [141]Masetti et al. (2013);

Table A.2: Catalogue of Galactic HMXBs: Orbital data.

Main ID	Mx [M_{\odot}]	Mo [M_{\odot}]	Period [d]	Sup. orbital period [d]	Eccentricity	Spin period [s]
IGR J00370+6122		22.0 [1]	15.66±1e-3 [2]		0.48±0.03 [1]	674.0 [2]
gam Cas		13.0 [3]	203.37±0.089 [4]		0.26±0.035 [3]	
EM* AS 14						
2S 0114+650		16.0±2.0 [5]	11.6±6e-4 [6]	30.76±0.03 [7]	0.18±0.05 [8]	10008.0±36.0 [9]
4U 0115+634		17.5 [10]†	24.32±4e-4 [11]		0.34±5e-3 [11]	3.6 [12]
IGR J01363+6610		12.5 [10]†	159.0±2.0 [13]			
RX J0146.9+6121		9.6 [10]†	330.0 [14]			1407.4±3.0 [15]
IGR J01583+6713		12.5 [10]†				469.2 [16]
LS I+61 303		12.5 [17]	26.5±3e-3 [18]	1628.0±48.0 [19]	0.54±0.034 [20]	
Swift J0243.6+6124			28.3±0.2 [21]		0.09±7e-3 [21]	9.8661±3e-4 [22]
V 0332+53		18.8 [23]†	36.5±0.29 [11]		0.42±7e-3 [11]	4.4 [24]
X Per		15.5 [25]	250.3±0.6 [26]		0.11±0.018 [26]	837.6712±3e-4 [26]
XTE J0421+560			19.41±0.02 [27]			
RX J0440.9+4431		17.5 [10]†	150.0 [28]			202.5±0.5 [29]
EXO 051910+3737.7		17.5 [10]†				
1A 0535+262		20.0 [30]	110.3±0.3 [30]		0.47±0.02 [31]	103.4±0.02 [32]
AAO+28 342						
IGR J06074+2205		14.6 [10]†				373.226±0.013 [33]
HD 259440	1.4 [34]	15.7±2.5 [34]	317.3±0.7 [35]		0.62±0.16 [36]	
SAX J0635.2+0533		9.6 [10]†	11.2±0.5 [37]		0.29±0.09 [37]	0.034 [38]
3A 0656-072		15.6 [23]†	101.2 [39]			160.4±0.4 [40]
3A 0726-260		38.1 [23]†	34.55±1e-2 [41]			103.144±1e-3 [42]
SGR 0755-2933		25.29 [23]†	260.0 [43]			307.8±0.04 [43]
RX J0812.4-3114		17.5 [10]†	80.39±3.0 [44]			31.908±9e-3 [44]
IGR J08262-3736						
GS 0834-430		13.5 [10]†	105.8±0.4 [45]		0.14±0.04 [45]	12.3203±2e-3 [46]
IGR J08408-4503		33.0 [47]	9.54±2e-4 [47]		0.63±0.03 [47]	
Vela X-1	2.12±0.16 [48]	26.0±1.0 [48]	8.96±4e-4 [49]		0.11±0.079 [49]	283.0 [50]
GRO J1008-57		17.5 [10]†	247.8±0.4 [51]		0.68±0.02 [51]	93.587±5e-3 [52]
IGR J10101-5654						
1FGL J1018.6-5856	1.4 [53]	23.0±3.0 [53]	16.55±4e-4 [54]		0.53±0.033 [54]	
4U 1036-56		17.5 [10]†	60.9 [14]			860.0±2.0 [29]
HD 96670	6.2±0.9 [55]	22.7±5.2 [55]	5.28±5e-4 [55]		0.12±1e-2 [55]	
1A 1118-615		18.0 [23]†	24.0 [39]			405.3±0.6 [56]
Cen X-3	1.34±0.16 [57]	20.2±1.8 [57]	2.03±0.029 [58]		0.0 [59]	4.80188±9e-5 [58]
IGR J11215-5952			164.6±0.1 [14]		0.8 [14]	186.78±0.03 [60]
IGR J11305-6256		17.5 [10]†	120.83±0.34 [61]			
IGR J11435-6109		14.6 [10]†	52.46±0.06 [62]			161.76±1e-2 [63]
1E 1145.1-6141	1.7±0.3 [64]	14.0±4.0 [64]	14.36±2e-3 [65]		0.2±0.03 [65]	298.0±4.0 [66]
2E 1145.5-6155		12.5 [10]†	187.5 [14]		0.5 [14]	292.274±1e-3 [67]
EXMS B1210-645		9.6 [10]†	6.7±5e-4 [68]			
GX 301-2		43.0±10.0 [69]	41.5±2e-3 [69]		0.46±0.014 [69]	680.0 [70]
IGR J12341-6143						
1H 1238-599						191.0 [71]
1H 1249-637		9.6 [72]	226.0±6.0 [73]			14200.0±1400.0 [74]
1A 1244-604						
GX 304-1		9.6 [10]†	132.5 [39]			272.0 [75]
IGR J13020-6359		17.5 [10]†				700.0 [76]
PSR B1259-63		22.5±7.5 [77]	1236.72±6e-6 [77]		0.87±6e-8 [77]	0.04776 [78]
IGR J13186-6257		17.5 [10]†				
SAX J1324.4-6200			1.13 [79]			172.84 [80]
HD 119682		17.5 [10]†	90.0 [81]			1500.0±100.0 [82]
IGR J14059-6116		34.53 [23]†	13.71±2e-3 [83]			
MAXI J1409-619			14.7±0.4 [84]			503.0±10.0 [85]

Table A.2: continued.

Main ID	Mx [M_{\odot}]	Mo [M_{\odot}]	Orbital period [d]	Sup. orbital period [d]	Eccentricity	Spin period [s]
H 1417-624		12.5 [10]†	42.12 [86]		0.45 [86]	17.64 [87]
IGR J14331-6112						
IGR J14488-5942			49.63±0.05 [88]			33.419±1e-3 [88]
Cir X-1			16.68±0.15 [89]		0.45±0.07 [89]	
4U 1538-522	1.18±0.29 [90]	20.0 [90]	3.73±2e-5 [91]	14.91±3e-3 [92]	0.18±1e-2 [48]	526.42±0.07 [91]
XTE J1543-568			75.56±0.25 [93]		0.03 [93]	27.12156±6e-4 [93]
1H 1555-552		19.4±5.0 [94]				
H 1553-542		10.8 [10]†	30.6±2.2 [95]			9.282155±3e-6 [96]
IGR J16195-4945		27.8 [23]†	16.0 [39]			
IGR J16207-5129			9.73 [97]			
SWIFT J1626.6-5156		17.5 [10]†	132.89±0.03 [98]		0.08±1e-2 [98]	15.346577±1e-6 [98]
IGR J16283-4838			287.6±1.7 [99]			
IGR J16318-4848			80.09±0.012 [100]			
AX J1631.9-4752		33.7 [23]†	8.96±1e-2 [101]		0.2±1e-2 [102]	1309.0±40.0 [103]
IGR J16328-4726		33.7 [23]†	10.07±2e-3 [104]			
IGR J16327-4940						
IGR J16374-5043						
AX J163904-4642			4.24±1e-5 [105]	14.99±1e-2 [7]		908.79±1e-2 [105]
IGR J16418-4532			3.75±4e-3 [106]	14.73±6e-3 [7]		1246.0 [107]
IGR J16465-4507		27.8 [23]†	30.24 [14]			228.0 [107]
IGR J16479-4514		27.8 [23]†	3.32±1e-3 [108]	11.88±2e-3 [7]		
IGR J16493-4348			6.78±4e-4 [109]	20.06±7e-3 [110]	0.0 [109]	1093.1036±4e-4 [109]
AX J1700-419						714.5±0.3 [111]
AX J1700.2-4220		14.6 [10]†	44.03±0.03 [88]			54.22±0.03 [112]
OA0 1657-415	1.42±0.26 [113]	14.3±0.8 [113]	10.45±1e-4 [114]		0.11±1e-3 [115]	37.03322±1e-4 [116]
4U 1700-377	1.96±0.19 [48]	46.0±5.0 [48]	3.41±4e-6 [117]		0.03±0.02 [117]	
AX J1714.1-3912						
XTE J1716-389			99.1±0.4 [118]			
EXO 1722-363	1.91±0.45 [48]	18.0±2.0 [48]	9.74±4e-4 [119]		<0.19 [119]	414.8±0.5 [120]
IGR J17354-3255		29.6 [23]†	8.45±2e-3 [121]			
IGR J17375-3022						
XTE J1739-302		33.7 [23]†	51.47 [14]			
GRS 1736-297						
XTE J1743-363		29.63 [23]†				
1E 1740.7-2942	5.0±1.1 [122]		12.61±0.06 [123]			
RX J1744.7-2713		14.6 [10]†				3245.0±350.0 [124]
AX J1749.1-2733		9.6 [10]†	185.5±1.1 [125]			66.09±0.07 [125]
AX J1749.2-2725		7.7 [10]†				220.38±0.2 [126]
GRO J1750-27			29.81±1e-3 [127]		0.36±2e-3 [127]	4.45349±2e-5 [127]
IGR J17503-2636						
IGR J17544-2619	1.4 [128]	23.0±2.0 [128]	12.17±7e-3 [129]		0.44±0.14 [129]	71.49±0.02 [130]
GRS 1758-258			18.45±0.1 [131]			
IGR J18027-2016	1.5±0.4 [132]	20.0±3.0 [132]	4.57±9e-4 [132]		<0.2 [132]	139.612±6e-3 [133]
2MASS J18081689-1919395						
SWIFT J1816.7-1613		12.5 [10]†	151.1±0.5 [88]			143.6863±2e-4 [134]
SAX J1818.6-1703			30.0 [14]			
SAX J1819.3-2525	10.2±1.5 [135]	6.8±1.4 [135]	2.82±2e-3 [136]			
AX J1820.5-1434		12.5 [10]†	54.0±0.4 [137]			152.26±0.04 [138]
IGR J18214-1318			5.42±4e-4 [139]		0.17 [139]	
IGR J18219-1347			72.44±0.3 [140]			56.468±3e-4 [141]
IGR J18246-1425						120.0 [142]
IGR J18256-1035						
LS 5039		23.0 [143]	3.91±8e-5 [144]		0.35±0.03 [144]	
XTE J1829-098			244.2±0.2 [145]			7.847089±2e-5 [146]
ATO J278.3657-10.5901		14.6 [10]†				
SNR 021.5-00.9		17.5 [10]†				

Table A.2: continued.

Main ID	Mx [M_{\odot}]	Mo [M_{\odot}]	Orbital period [d]	Sup. orbital period [d]	Eccentricity	Spin period [s]
AX J1838.0-0655						0.07049821±3e-5 [147]
AX J1841.0-0536			6.45±2e-3 [148]		0.16±0.11 [148]	4.7394±8e-4 [149]
GS 1839-06						
IGR J18450-0435		29.6 [23]†	4.74±3e-4 [148]		0.34±0.11 [148]	
GS 1843+009		13.5 [10]†				29.4764±8e-4 [150]
IGR J18462-0223			2.14 [151]			997.0±1.0 [152]
IGR J18482+0049						
3A 1845-024			242.18±1e-2 [153]		0.88±1e-2 [153]	94.7171±3e-4 [154]
IGR J18483-0311			18.55±3e-3 [155]		0.4 [156]	21.0526±5e-4 [157]
XTE J1855-026			6.07±4e-3 [158]			361.1±0.4 [158]
XTE J1858+034			81.0 [159]			218.393±2e-3 [159]
XTE J1859+083		12.5 [10]†	37.97±0.09 [160]		0.13±9e-3 [160]	9.79156±1e-5 [161]
4U 1901+03			22.58±2e-4 [162]		0.04±3e-4 [162]	2.761±1e-3 [163]
XTE J1906+090			81.4±0.1 [88]			89.17±0.02 [164]
4U 1907+097		27.8 [23]†	8.38±3e-4 [165]		0.28±0.1 [165]	437.5 [166]
AX J1910.7+0917						36200.0±110.0 [167]
4U 1909+07		32.0 [23]†	4.4±9e-4 [168]	15.18±3e-3 [7]	0.02±0.039 [168]	603.6±0.1 [169]
IGR J19113+1533						
SS 433	4.2±0.4 [170]	11.3±0.6 [170]	13.08 [171]	23.23±5e-3 [172]	0.05±1e-2 [173]	
IGR J19140+0951			13.56±4e-3 [174]			5937.0 [175]
IGR J19149+1036			22.25±0.05 [176]			
IGR J19294+1816		12.5 [10]†	117.2±0.2 [177]			12.44 [178]
1RXS J194211.9+255552			166.5±0.5 [179]			
XTE J1946+274		15.0 [10]†	172.7±0.6 [180]		0.25±9e-3 [180]	15.78801±4e-5 [181]
KS 1947+300		17.5 [10]†	40.42±7e-3 [182]		0.03±7e-3 [182]	18.7 [183]
IGR J19498+2534						
4U 1954+319		9.0±4.0 [184]	1296.64 [184]			18612.0 [185]
Cyg X-1	21.2±2.2 [186]	40.6±7.7 [186]	5.6±1e-4 [187]		0.0 [187]	
IGR J20006+3210						889.7±4.7 [188]
W63 X-1						36.0 [189]
RX J2030.5+4751		14.6 [10]†	46.02 [14]		0.41 [14]	
EXO 2030+375		17.5 [10]†	46.02±5e-4 [190]		0.42±2e-3 [190]	41.306±3e-3 [191]
Cyg X-3	7.2 [192]		0.2±3e-8 [193]			
GRO J2058+42		18.0 [72]	55.0 [194]			195.25±0.02 [195]
SAX J2103.5+4545		17.5 [10]†	12.67±9e-4 [196]		0.41±3e-3 [196]	358.61±0.03 [197]
IGR J21347+4737		12.5 [10]†				322.7±0.6 [198]
Cep X-4		10.8 [10]†	20.85±0.05 [199]			65.3508±1e-4 [200]
1H 2202+501						
4U 2206+543		18.0 [72]	9.56±0.04 [201]		0.3±0.02 [201]	392.0 [202]
SAX J2239.3+6116		17.5 [10]†	262.0±5.0 [203]			1247.2±0.7 [204]
MWC 656		7.8±2.0 [205]	60.37±0.04 [205]		0.1 [206]	
2MASS J22535512+6243368						46.753±3e-3 [207]

Notes. M_x and M_o refer to the mass of the compact object and the companion star, respectively. Sup. orb. period is the super-orbital period of the system.

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(2018); [37]Kaaret et al. (2000); [38]Cusumano et al. (2000); [39]Walter et al. (2015); [40]McBride et al. (2006); [41]Corbet et al. (2016); [42]Roy et al. (2020); [43]Doroshenko et al. (2021); [44]Zhao et al. (2019); [45]Wilson et al. (1997); [46]Belloni et al. (1993); [47]Gamen et al. (2015); [48]Falanga et al. (2015); [49]Stickland et al. (1997); [50]McClintock et al. (1976); [51]Coe et al. (2007); [52]Stollberg et al. (1993); [53]Waisberg & Romani (2015) and Strader et al. (2015); [54]van Soelen et al. (2022); [55]Gomez & Grindlay (2021); [56]Ives et al. (1975); [57]van der Meer et al. (2007); [58]Shirke et al. (2021); [59]Raichur & Paul (2010b); [60]Sidoli et al. (2020); [61]La Parola et al. (2013b); [62]Corbet & Remillard (2005); [63]in't Zand & Heise (2004); [64]Hutchings et al. (1987); [65]Ray & Chakrabarty (2002); [66]Lamb et al. (1980); [67]Cook & Warwick (1987); [68]Coley et al. (2014); [69]Kaper et al. (2006); [70]White et al. 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(2006); [107]Walter et al. (2006); [108]Jain et al. (2009); [109]Pearlman et al. (2019); [110]Coley et al. (2019); [111]Torii et al. (1999); [112]Markwardt et al. (2010); [113]Mason et al. (2012); [114]Barnstedt et al. (2008); [115]Jenke et al. (2011); [116]Sharma et al. (2022); [117]Islam & Paul (2016); [118]Wen et al. (2006); [119]Thompson et al. (2007); [120]Zurita Heras et al. (2006); [121]Sguera et al. (2011); [122]Stecchini et al. (2020); [123]Stecchini et al. (2017); [124]Lopes de Oliveira et al. (2006); [125]Zurita Heras & Chaty (2008); [126]Torii et al. (1998); [127]Shaw et al. (2009); [128]Bikmaev et al. (2017); [129]Nikolaeva et al. (2013); [130]Drave et al. (2012); [131]Smith et al. (2002); [132]Mason et al. (2011); [133]Hill et al. (2005); [134]Nabizadeh et al. (2019); [135]Orosz et al. (2001); [136]Lindstrøm et al. (2005); [137]Segreto et al. (2013); [138]Kinugasa et al. (1998); [139]Cusumano et al. (2020); [140]La Parola et al. (2013a); [141]O'Connor et al. 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