

Catalogue of central stars of planetary nebulae

Expanded edition

Weidmann, W. A.^{1,2}, Mari, M. B.⁴, Schmidt, E. O.³, Gaspar, G.^{1,2}, Miller Bertolami, M. M.^{5,6}, Oio, G. A.³, Gutiérrez-Soto, L. A.⁴ Volpe M. G.³, Gamen, R.^{5,6}, Mast, D.^{1,2}

¹ Observatorio Astronómico de Córdoba. Universidad Nacional de Córdoba. Laprida 854, Córdoba, Argentina
e-mail: walter.weidmann@unc.edu.ar

² Consejo de Investigaciones Científicas y Técnicas de la República Argentina, Argentina

³ Instituto de Astronomía Teórica y Experimental. CONICET-UNC, Córdoba. Laprida 854, Córdoba, Argentina.

⁴ Observatório do Valongo, Universidade Federal do Rio de Janeiro, Ladeira Pedro Antonio 43, 20080-090 Rio de Janeiro, Brazil

⁵ Instituto de Astrofísica de La Plata, CONICET-UNLP, Buenos Aires, Argentina Paseo del Bosque s/n, FWA, B1900 La Plata, Buenos Aires, Argentina

⁶ Facultad de Ciencias Astronómicas y Geofísicas, UNLP, Buenos Aires, Argentina Paseo del Bosque s/n, FWA, B1900 La Plata, Buenos Aires, Argentina

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ABSTRACT

Planetary nebulae represent a potential late stage of stellar evolution, however the central stars (CSPNe) are relatively faint and therefore pertinent information is merely available for <20% of the Galactic sample. Consequently, the literature was surveyed to construct a new catalogue of 620 CSPNe featuring important spectral classifications and information. The catalogue supersedes the existing iteration by 25%, and includes physical parameters such as luminosity, surface gravity, temperature, magnitude estimates, and references for published spectra. The marked statistical improvement enabled the following pertinent conclusions to be determined: the H-rich/H-poor ratio is 2:1, there is a deficiency of CSPNe with types [WC 5-6], and nearly 80% of binary central stars belong to the H-rich group. The last finding suggests that evolutionary scenarios leading to the formation of binary central stars interfere with the conditions required for the formation of H-poor CSPN. Approximately 50% of the sample with derived values of $\log L$, $\log T_{\text{eff}}$, and $\log g$, exhibit masses and ages consistent with single stellar evolutionary models. The implication is that single stars are indeed able to form planetary nebulae. Moreover, it is shown that H-poor CSPNe are formed by higher mass progenitors. The catalogue is available through the Vizier database.

Key words. catalogs – planetary nebulae: general – stars: evolution

1. Introduction

Catalogues are an important tool in astrophysics. Numerous are the works in which the catalogues have helped researchers in the past. For example, Majaess et al. (2007) looked for a link between planetary nebulae (PNe) an open cluster, which led in part to the discovery of PN PHR 1315–6555 in the cluster Andrews-Lindsay 1 and a 4% distance solution (Majaess et al. 2014). Miszalski et al. (2009a) discovered 21 periodic binaries at the center of planetary nebulae by cross-matching PNe and OGLE microlensing survey catalogues. They also established that the close binary fraction was 10–20% in a independent sample of binary PNe and, in a follow up work (Miszalski et al. 2009b), they concluded that a fraction of at least 60% of post-common-envelope PNe are bipolar nebulae. Thus changing the fact that NGC 2346 being the only post-common-envelope canonical bipolar. More recently, Stanghellini et al. (2020) matched the astrometry of PNe with DR2 Gaia parallaxes, thus providing the parallax to 430 objects. Using these parallaxes they located the CS of the PNe and, together with effective temperatures and magnitudes from the literature, determined their masses. The catalogs were the starting points for some important determinations.

Regarding the central star of planetary nebulae (CSPNe), a complete catalogue but with limited information is Weidmann & Gamen (2011b). It has proven to be a useful tool for the astronomical community. But as during the last nine years there has been an increase in the number of CSPNe with new determined spectral types (or improved through better quality/resolution spectra as Weidmann et al. 2018), an upgrade of that catalogue becomes necessary. In addition, during these years many new developments have been published concerning the CSPNe. There are spectral types that no longer apply, for example the wels (Weidmann et al. 2015). Moreover, several [WN] stars could be confirmed, i.e. IC 4663 (Miszalski et al. 2012b), A 48, and probably at PB 8 (Todt et al. 2010). Also NGC 5189, a binary system whose primary star is of the [WR] type (Manick et al. 2015). With regard to the multiplicity of the CSPNe, it was possible to identify a triple system at the nucleus of the planetary nebula NGC 246 (Adam & Mugrauer 2014). This situation, which is speculated to be common, might happen in LoTr 5 and SuWt 2.

A catalogue would allow statistical analysis and provide observational limits to evolutionary models, such as the progenitor's mass of PNe. Although the range of masses of the progenitor star which would result in a PN is frequently es-

timated to be between 1–8 M_{\odot} , the observational evidence in support of this point is limited. Nevertheless, the confirmation of a PN associated to an open cluster, has a direct implication on the upper limit on the progenitor's mass. Fragkou et al. (2019a) and Fragkou et al. (2019b) have proved that the PNe PHR 1315–6555 and BMP J1613–5406 are physically linked to an open cluster. Consequently we have, for the first time, observational evidence that the upper limit of the initial stellar mass for the formation of a PN can be as high as $M_* \lesssim 5.0 M_{\odot}$. Another important step forward in the study of the formation of PNe came from the study of Hen 2–428, whose central star was found by Santander-García et al. (2015) to be composed of a double-degenerate core with a combined mass above the Chandrasekhar limit. Although later studies have put such high mass into question, favouring a much lower mass for the central stars (e.g. García-Berro et al. 2016; Reindl et al. 2018). Specifically, the detailed analysis of Reindl et al. (2020) indicates that the system might be composed of a $0.66 M_{\odot}$ post-AGB and a re-heated $0.42 M_{\odot}$ post-RGB star. The study of this peculiar object will certainly shed light on the formation process of PNe through common envelope events.

To establish an evolutionary sequence involving the spectral types of the CSPNe was not a simple task, and certainly, we still have a lot to learn about this topic. Proof of this is the case of Hen 3–1357. Reindl et al. (2017) observed that the CSPN of this object is evolving quickly, changing from B-type ($T_{\text{eff}} \sim 21 \text{ kK}$) object in 1971 to a $T_{\text{eff}} \sim 60 \text{ kK}$ peak in 2002. Since then it seems to be cooling and expanding back to the AGB at a rate of $770 \pm 580 \text{ K yr}^{-1}$, similar to that of FG Sge (350 K yr^{-1} Jeffery & Schönberner 2006) and providing further evidence of the existence of late helium flashes in the post-AGB evolution.

In summary, in the last years a series of extreme phenomena has been found in PNe that increase the complexity of these objects. Undoubtedly, the less understood stage of stellar evolution for low and intermediate mass stars is precisely the last one, i.e. from post-AGB to pre-WD. This is the main motivation to update and expand the catalogue of CSPNe. Thus, in this work we present a new catalogue of spectral types of CSPNe which supersedes the Weidmann & Gamen (2011b).

This paper is structured as follows: In Section 2 we present a summary of the different spectral types of CSPNe. An evolutionary sequence is described in Section 3. We detail the main body of the catalogue in Section 4. Results are presented in Section 5, while in Section 6 there is a summary of this work and we lay our conclusions. Finally, in the Appendix we focus on peculiar CSPNe.

2. Review of spectral classification

It is well known that the CSPNe are divided into two large groups. Those that present hydrogen absorption lines (H-rich) and those that do not (H-poor). One of the pioneering work in compiling CSPNe spectral information was Aller (1975). He reported the following types: O-type, WC, OVI (currently called [WO]), Of + WR, sdO and continuum.

There are few spectral types that are specific of CSPNe i.e. O(C), [WC]–PG 1159, and Of-WR(H). For the [WR], O and Of-type, the classification criteria for massive WC stars (or massive O-type stars) is used. Implementing an appropriate criteria for CSPNe requires a large number of good quality spectra.

It is appropriate to point out that this is a qualitative classification system in which the unknown stellar spectrum is compared with a grid of standard stars. In this sense, Dreizler (1999)

and Napiwotzki (1998) present a collection of spectra of different spectral types of evolved objects which represents a useful tool. In Table 1 we mention some key lines of each spectral type. Nevertheless, these do not replace the proper classification criteria of every type. Below we present a guide, with bibliographic references, that describes the spectrum (in the optical range) of each type of object mentioned in our catalogue.

- [WR] (subtype [WN], [WC] and [WO]): Crowther et al. (1998), Acker & Neiner (2003) and Miszalski et al. (2012b). The spectral type VL was implemented by Górný et al. (2009), which is in fact consistent with a late [WC].
- O(H): Although these objects follow the classification criteria for massive O-type stars, in Weidmann et al. (2018) some characteristics of the O-type stars that are CSPNe are described. In this type of stars it is possible to improve the spectral classification with qualifiers (Sota et al. 2011, 2014; Maíz Apellániz et al. 2016). Based on the ions identified in the spectrum, the CSPNe could be classified as O(H), O or H-rich (Weidmann et al. 2018).
- Of(H): This includes the O-type stars with emission lines. Historically, there was a distinction between the O-type and Of-type stars. Nevertheless, not all O-type star with emission lines are in fact an Of-type. To clarify this see Mendez et al. (1990); Smith & Aller (1969). In Sota et al. (2011) these objects are indicated with the qualifiers: f, f*, fc and f+.
- O(C): This type of star appears only in one member, i.e. K 3–67. Previously, Lo 4, wray 17–1, and IsWe 1 were included in this spectral type (Mendez 1991). Nowadays, these last three objects were reclassified as PG 1159.
- O(He): Reindl et al. (2014b), Rauch et al. (2008), Rauch et al. (2006) and Rauch et al. (1998).
- Of-WR(H): Mendez et al. (1990) and Mendez (1991).
- WD (subtype DA, DAO and DO): Napiwotzki (1999), McCook & Sion (1987), and McCook & Sion (1999).
- hgO(H): The classification hgO(H) was used exclusively for CSPNe (Mendez et al. 1986), these objects are essentially evolved objects like sdO or WD stars. For example Sh 2–68 have three classifications i.e. hgO(H), WD, and PG 1159 (Napiwotzki & Schönberner 1995).
- sdO, sdB: Jeffery et al. (1997) and Ahumada et al. (2019).
- PG 1159 (subtype A, E and Ig E): Werner (1992), Dreizler & Heber (1998) and Hügelmeyer et al. (2005).
- [WC]–PG 1159: Previously called Of-WR(C) (Mendez 1991). There are only two objects with this spectral type, A 30 and A 78.
- hybrid: Dreizler et al. (1996) and Napiwotzki (1999).
- symbiotic star (SySt): This is not strictly a spectral type (see Appendix A).
- B[e]: Oudmaijer & Miroshnichenko (2017) and Lamers et al. (1998).
- cont.: Weidmann et al. (2018). This is not strictly a spectral type. In general, objects with this designation are O-type stars.
- B2–M9: Objects later than a B1 does not have the required temperature to ionize the nebula. In this sense, objects classified with a late type are, in fact, candidates for binary systems whose hot component is hitherto undiscovered.
- wels: Classification implemented by Tylenda et al. (1993). This designation has been shown not to correspond to an independent spectral type. In general it contemplates hot O(H)-type stars (Weidmann et al. 2015).
- EL (Emission Line): Few objects in which the presence of emission lines of stellar origin have been reported. These objects do not always satisfy the wels criterion.

- Blue: The MASH catalogue identified CSPNe of some objects. Photometric observations indicate that these objects are blue. None of these objects have spectroscopic information.

3. Review of stellar evolution

The main parameter that defines the stellar evolution is the mass. It is commonly accepted that the mass range of a main sequence star that gives birth to a PN is $1.0 \text{ M}_\odot \lesssim M_* \lesssim 8.0 \text{ M}_\odot$. However, this mass range is not a strict limit.

Firstly, the minimum mass required to form a star is 0.07 M_\odot , the hydrogen burning mass limit (Chabrier & Baraffe 2000). Therefore, stars with mass in the range between $0.07 \text{ M}_\odot \lesssim M_* \lesssim 1.0 \text{ M}_\odot$ do not evolve to a PN. In fact, these stars did not have enough time to leave the main sequence (Miller Bertolami 2019). Saracino et al. (2016) estimated the globular cluster turn-off mass in about 0.88 M_\odot for NGC 6624. In this sense, it should not have progenitor CSPN with masses lower than 0.88 M_\odot .

A PN is obtained when the gas expelled in the AGB phase is ionized by the remaining object at its core. This requires a star with a certain minimum progenitor mass M_χ . Objects with mass less than M_χ will not result in a nebula. Observational data must be used to obtain M_χ . Globular clusters are the oldest objects in the galaxy and the lifetime of a PN is about 20 000 years. Hence, if it is possible to determine the progenitor mass of a PN that is physically linked to a globular cluster, this will be a good estimation for M_χ . Jacoby et al. (2017) showed that the progenitor mass of the PN JaFu 1 (planetary nebulae linked to the globular cluster Pal 6) is 0.8 M_\odot .

On the other hand, finding observational evidence for the upper limit on the stellar mass, required to originate a PN, is not so straightforward. An option is to determine the mass of the progenitor star of a PN linked to an open cluster. Fragkou et al. (2019b) showed that the progenitor mass of the planetary nebula BMP J1613–5406 (object linked to the open cluster NGC 6067) is 5 M_\odot .

Now, how is the evolutionary sequence for a main sequence star with mass between $0.8 - 5.0 \text{ M}_\odot$? Which is the spectral-type sequence it passes through? These questions still have no single answer. Iben (1991) developed a convincing theoretical model, but it does not contemplate the spectral types. Perhaps the sequence shown in Fig. 1 is the most classical picture (see, e.g., Leuenhagen & Hamann 1998; Zijlstra et al. 1994; Peña et al. 2001; Koesterke 2001; Werner & Herwig 2006). In addition, a more complex and complete (including several speculations) evolutionary path is presented by Danehkar (2014). The stellar post-AGB evolution divides into two major channels of H-rich and H-poor stars (Löbling et al. 2019). However, other evolutionary pathways exist (see, e.g. Fig. 14 of Frew et al. 2014). Nevertheless, it is necessary to clarify that these sequences are valid only for a single star.

The CSPNe with spectral type sdO, B[e], O(He), [WN], hybrid and Of–WR(H) are not included in this classical evolutionary picture.

The origin of the sdO is yet not clear. Probably, this object comes from low mass progenitors (Reindl et al. 2014a), and could end up as a WD (Aller et al. 2013). Aller et al. (2015a) observed that the sample of PNe with a sdO nucleus are faint and can be found at relatively high Galactic latitudes, which would suggest they are in a moderate or evolved stage and evolving from low-mass progenitors. In the work of Heber (2009), several evolutionary paths are considered.

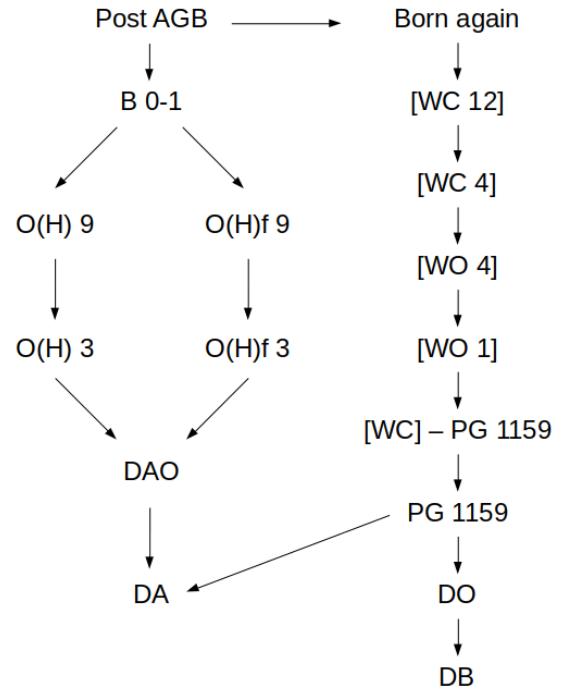


Fig. 1. An evolutionary sequence model, the classical picture.

The evolutionary state of B[e] CSPNe is unknown too. The nebulae that contain these stars are compact and with high-density. These nebulae are often classified as protoplanetary nebulae (PPNe) or young PNe (Clegg et al. 1989). These objects have stellar hydrogen emissions and are therefore considered to belong to the H-rich group. The O(He) stars are even more complicated, (see, e.g., Reindl et al. 2014b; Rauch et al. 1998) as they are speculated to have multiple possible evolutionary paths. One possible evolutionary path is Merger(CO WD + He WD) → RCrB → EHe → O(He) → DO (Reindl et al. 2014b). It is necessary to identify more objects of this type in order to clarify this point.

The same situation happens with the [WN] type. There are only three well-known objects, with an unclear evolutionary state. One possibility is that [WN] → O(He) (Todt et al. 2017).

The hybrid objects (or hybrid PG 1159-type) are strange objects (Löbling et al. 2019). This type include four objects, being one of them not in the core of a PN. Dreizler et al. (1996) suggest two possibilities: [WC 12] → hybrid → PG 1159 or [WC 12] → hybrid → DAO.

Finally, the Of–WR(H) CSPNe belong to the H-rich group. There are not references regarding its evolutionary status. They may be binary objects.

4. The catalogue of CSPNe

This new version of the catalogue contains 620 galactic objects, representing an increase of 25% compared to the previous version. However, it is not only in the number of objects that the real impact of the new version lies. We also report many spectral type changes. For example, the core of He 2–47 that was previously classified as a [WC], has now been catalogued as an O(H)-type star based on newer, better quality spectra. Besides, new high-quality spectra made possible to improve and refine the previous classification, as is the case of Sa 1–8 (from OB type to O(H)4–8 III). In addition, some objects were rejected in the new version because we currently know that they are not PNe.

Table 1. Key optical lines to spectral classification of CSPNe. Upper panel represents narrow features, and lower, wide features. The ions are arranged by excitation potential. In the second column we propose a prototype with published spectrum.

| Spectral classif. | Example | ion/wavelength [Å] | | | | | | | | | | | |
|----------------------|------------------|--------------------|------|-------|-------|----------------|-------|------|------|------|------|------|------|
| | | H I | He I | C III | C III | He II | He II | C IV | C IV | N v | N v | O VI | O VI |
| | | 4340 | 4471 | 4649 | 5696 | 4686 | 5412 | 5806 | 4650 | 4603 | 4945 | 3822 | 5290 |
| early O(H) | NGC 5307 | A | A | - | - | A | A | E | - | A | - | E? | E |
| late O(H) | Cn 3-1 | A | A | A | - | A | A | A | - | - | - | - | - |
| early Of(H) | M 1-53 | A | A | E | - | E | A | E | - | A | - | ? | E |
| late Of(H) | IC 4593 | A | A | A | - | E | A | ? | - | - | - | - | ? |
| Of-WR(H) | NGC 6543 | A | ? | - | - | E ¹ | E | E | - | E | - | - | E |
| O(He) | He 2-64 | - | - | - | - | A | A | - | - | E | E | - | - |
| PG 1159 | Jn 1 | - | - | - | - | A | A | E | A | - | - | E | E |
| [WO] | NGC 2867 | - | - | - | - | E | E | E | E | - | - | E | E |
| [WC] | NGC 40 | - | - | E | E | E | E | E | - | - | - | - | - |
| [WN] | IC 4663 | - | - | - | - | E | E | - | - | E | E | - | E |
| DA | DeHt 5 | A | - | - | - | - | - | - | - | - | - | - | - |
| DAO | HDW 3 | A | - | - | - | A | - | - | - | - | - | - | - |
| DO | KPD ² | - | A | - | - | A | A | - | - | - | - | - | - |

Notes.¹ Wide line. ² KPD 0005+5106

This is the case, for example, of Sh 2-128 (Bohigas & Tapia 2003). Moreover, in this new version, we include physical parameters such as temperature, luminosity, and surface gravity, which were obtained from the available literature. On the other hand, we added the apparent magnitude (a key parameter for planning an observation), and a bibliography reference where the stellar spectrum is shown. This allows future researchers to re-evaluate the spectral classification or to obtain a better quality spectrum. In this sense, it is important to note that there are few spectra available in the literature, in particular of [WR]-type. Also, in general, the spectral classification of these objects has not been confronted with new observations. Crowther et al. (1998) and Acker & Neiner (2003) are perhaps the two most important works dealing with spectral classification of [WR]. Both works include important object samples however the published spectra do not allow to properly check the spectral classification. The catalogue is divided into two tables. The former with the spectral type and the second one with physical parameters. In the following sections, we describe each column of the two main tables.

4.1. Table 1: spectral types

- c1: The PN G designation, taken from SECGPN.
- c2: The flag indicates that the object could not be a PN.
- c3: The common name of the object, taken from SECGPN and MASH.
- c4-5: The equatorial coordinates (J2000.0). Frequently, it is not clear which is the CSPN either because the star is not at the geometric center of the nebula, due to the interaction with the ISM or because the object lies in crowded star fields. For example the PN Sh 2-71 (Močnik et al. 2015) or K 4-37 (Miranda et al. 2017). The problem worsens when the PN has a large angular size, which may lead to incorrect identification of the CSPN (e.g. Szymczka et al. 2009; Kwinter et al. 1988). A couple of articles that may be useful in identifying the position of a central star are Kerber et al. (2003) and Chornay & Walton (2020).
- c6-9: Spectral classification (SpT) of the CSPNe and reference (t.w. means this work). We use the most current SpTs,

unless there is a large discrepancy. In that case, we include both classifications. All of them are described in Section 2. We maintain the notation given by different authors, in this context we keep the classification wels. Nevertheless, the spectrum can change in a short period of time. Bond (2014) showed that the CSPN of Lo 4 had a short-time mass loss episode, manifested by the appearance of new emission lines.

- c10: Reference of multiplicity, taken from the actual web of Dr. David Jones¹. We do not included binaries detected by J or I-band excess.
- c11: Reference of the optical spectra.

4.2. Table 2: physical parameters

- c1: PN G designation. The first nine objects do not have PN G, then we use the *recno* number of Table 1.
- c2-3: Surface gravity ($\log g$, cm s⁻²) and reference. t.w. means this work. We computed $\log g$ according to equation 17 of Zhang & Kwok (1993) with data take from Gesicki & Zijlstra (2007).
- c4: The method by which the temperature was determined. We prefer the effective temperature (T_{eff}). Nevertheless, in the catalogue we include other temperatures, Zanstra temperatures T_Z (He I) or T_Z (He II) (Phillips 2003) or the photoionization (equivalent black-body) temperature (Gesicki et al. 2006). Hoare et al. (1995) show the different results obtained for CSPN temperature using different methods.
- c5-6: Temperature and reference. In the case of the H-rich group, it is possible to estimate the temperature inspecting the spectra and looking for He I absorption lines. The absence of these lines indicates that the central star is hotter than 70 k (Kepler et al. 2016).
- c7-8: Bolometric luminosity ($\log(L_*/L_\odot)$) and reference (e.g. Zhang & Kwok 1993).
- c9-10: The apparent magnitude and reference. We indicate the band in which the magnitude is reported. When available, the visual magnitude was preferred. For those objects catalogued as photometric variables, we report an average

¹ <http://www.drdjones.net/bCSPN/>

magnitude. For binary systems, it is probable that the reported magnitude corresponds to the bright source, which is not necessarily the ionizing source. Moreover, when the CSPN is binary, it is usual that it presents photometric variations.

The physical parameters that we report in the tables are the most up-to-date and post 1982. In addition, we include the uncertainty, only in cases where the original author published them. Nevertheless, there are objects that undergo a fast evolution of their physical parameters. For example He 3–1357 (Reindl et al. 2014a). In this sense, the physical parameters of the CSPN have importance from a statistical viewpoint.

4.3. Multiplicity vs. spectral type

CSPNe confirmed to be part of a binary system are described in Table 1 (column 10). It is known that many stars are binary, but in few cases it is possible to have the spectrum of the two stars separately. The criterion for describing the spectral type in these cases is $S pT_1 + S pT_2$. Where the first star is the brightest, not necessarily the ionizing star of the nebula. In the case in which the spectral type of a star is not known, it is indicated as $S pT_1+?$.

The fact that recently the number of CSPNe that are binary systems have been increased considerably, means that we have to rethink which component would be considered the CSPN. An appropriate response would be: the star of the binary system responsible for the ionization of the nebula. Nevertheless, it is possible that both stars of the binary system have enough temperature to ionize the nebula. This is the case of He 2–428, where the first star has $T_{eff}=48\pm7$ kk and the second star has $T_{eff}=46\pm7$ kk (Reindl et al. 2018).

Two objects require clarification because there are no references reporting its binarity: i) Cn 1–1: there is evidence indicating that this object is a D'-type symbiotic star (Gutierrez-Moreno et al. 1995a). ii) PHR J0905–4753: in the MASH catalogue the central star is identified with a spectral type A8. If this is correct, then it is indeed a binary system.

5. Results

5.1. Dichotomy between H rich and poor CSPNe

We separate the CSPNe of our sample according to their atmospheric hydrogen abundance into H-rich and H-poor (see Table 2). The ratio H-rich/H-poor in the present catalogue is 2:1, which is greater than the one found by Weidmann & Gamen (2011b). Nevertheless, it is still far from the value determined by Mendez (1991). The large number of objects included in our present catalogue reinforce the idea that the H-poor population is larger than previously thought.

Applying the Kolmogorov-Smirnov test to compare the Galactic latitude distributions of H-rich and H-poor populations, we find $D=0.2$ and a p -value=0.00049. This is in agreement with the results found by Weidmann & Gamen (2011b), which implies that the distribution in Galactic latitudes of H-rich and H-poor stars are different (Fig. 2). This is an indication that the progenitors masses and ages of both populations are different. The progenitors of H-deficient stars expected to be more massive and younger than those of their H-rich counterparts. It would be interesting to analyse whether this can be related to the observed dearth of H-deficient white dwarfs in old globular clusters (Moehler et al. 2004; Davis et al. 2009), as reasons behind this feature are still not clear (Williams et al. 2018).

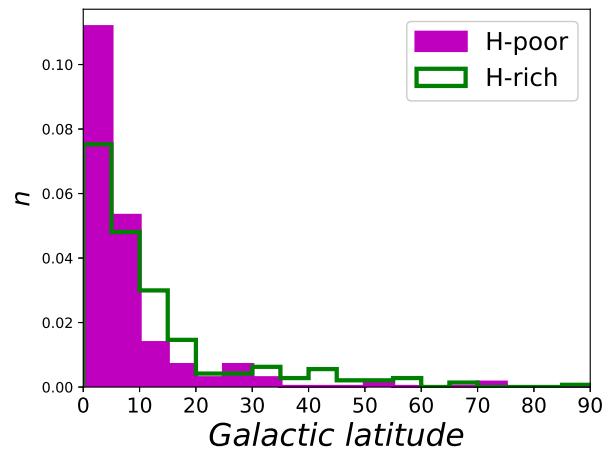


Fig. 2. Normalized distributions in Galactic latitude of CSPNe (of confirmed and possible PNe) that belong to H-rich and H-poor group. Each bin has a width of 5 deg.

The physical parameters that we have collected from the literature allow us to characterize the CSPNe population (Table 3). Although it is generally accepted that hydrogen requires a minimum temperature of 10 000 K to ionize, the minimum temperature of a CSPN is 13 000 K. This value agrees with what was expected.

According to the values presented in Table 3 (Figs. 3, 4, and 5), the H-poor population appears to have greater surface gravity than the H-rich one, except for the most evolved objects. With regard to the effective temperature, the H-poor group is clearly hotter. Luminosity shows a more complex situation. Still a trend can be appreciated in which more evolved H-poor objects display a higher luminosity.

Moreover, Fig. 6 shows the [WR] subtype distribution, where a dearth of objects with subtypes 5-7 is apparent. This feature is seen both in our restricted sample with definite spectral types (our "pure" sample), as well as in the complete sample that includes also uncertain spectral types. This result is consistent with previous results in the literature Todt (2009). Even more, given that our sample is significantly larger than that discussed by Todt (2009), we consider this result as a confirmation that the lack of subtypes 5-7 in [WR]-CSPNe is a real feature. In principle this gap could be explained in two different ways. On the one hand it could be the consequence of faster evolutionary speeds at that particular stage and, on the other, it could be the consequence that specific photospheric conditions are necessary for [WR]-CSPNe to be classified as [WC 5-7]. Interestingly, a concomitant gap is not apparent in the sample of H-deficient CSPNe with derived effective temperatures, suggesting that the latter might be the right explanation. This hypothesis will need to be tested by specifically tailored future studies.

Regarding Of-type CSPNe, within these objects early subtypes are predominant, with the coolest object being Hen 2–138, classified as O(H)7-9 f. Mendez et al. (1990) proposes that O stars are less luminous than the Of stars. However, we do not find a significant difference between both groups. We find that O-type CSPNe have $\langle L_\star/L_\odot \rangle = 5.3 \times 10^3$ and $\langle L_\star/L_\odot \rangle = 5.7 \times 10^3$ for Of-type.

A peculiar situation can be observed by comparing the number of objects with different spectral types. The number of objects classified as [WC 4-12] is larger than [WO 1-4]. We interpret this as a difference in evolutionary speeds. i.e., these objects spend more time in its earliest evolutionary stage than in

Table 2. Summary of the spectral types of CSPNe compiled in our catalogue, grouped by their atmospheric hydrogen abundance. We include confirmed and probable spectral types. Here, we have discarded 6 objects without any specific spectral type.

| H-rich | | H-poor | |
|----------|--------|--------|--------------|
| SpT | sample | SpT | sample |
| O3-B1 | 133 | cont. | 22 |
| Of | 31 | hybrid | 3 |
| Of-WR(H) | 3 | SySt | 11 |
| B2-M9 | 40 | Blue | 50 |
| DA, WD | 14 | EL | 8 |
| DAO | 28 | wels | 77 |
| sdO | 12 | | [WC]-PG 1159 |
| hgO(H) | 12 | | 2 |
| B[e] | 6 | | O(He) |
| H-rich | 11 | | O(C) |
| | | | DO |
| | | | H-poor |
| Total | 290 | Total | 171 |
| | | | Total |
| | | | 153 |

Notes.

- ¹The O3-B1 group include objects classified as O(H), O and OB.
- ²[WR] group include the two objects classified as [WN/C] and [WO]-[WC 8].

the subsequent ones. Interestingly, this is in clear contradiction with what is expected from the late thermal pulse scenario. Stellar evolution models are predicted to slow their evolution as they reach their maximum effective temperature (i.e. the "knee" of the evolutionary tracks in the HR-diagram, see the supplementary material in Guerrero et al. 2018). Alternatively, this could be a consequence of the larger luminosity expected during the earlier stellar evolution, which leads to a larger volume in which these stars can be detected. Volume limited samples are required to solve this issue. On the other hand, the distributions of the O-type CSPNe over the subtypes is different (Fig. 7). This distribution is in general flat, but with a remarkable number of objects classified as O3. This may be due to a selection effect. Since for the O-type CSPNe the spectral classification is more qualitative than in case of the [WR], many objects have doubtful classifications. But, in the case of the O3 CSPNe, these are easily identifiable by the absorption of the N V.

Nevertheless, this might be due to the saturation of a qualitative classification scheme, originally constructed for main sequence object, when applied to the much hotter CSPNe.

Finally, Figs. 8 and 9 display the distribution of spectral subtypes for both the H-poor and H-rich populations. According to the evolutionary sequence described in Fig. 1, stars are thought to evolve along evolutionary tracks, first increasing their effective temperature and then becoming dimmer and entering the white dwarf cooling sequence.

5.2. Binary CSPNe

While there are continuous efforts focused on the search for new binary in PNe (e.g., Douchin et al. 2015), the fraction of PNe with binary nuclei is still relatively small². In our catalogue there are 117 PNe with a confirmed binary system at its nuclei. We do not include the SySt stars. Eleven of them belong to the H-poor group ([WR], DO, H-poor, O(He), PG 1159, and [WN]), plus an object classified as [WR]/wels (VY 1–2). The O, O(H), O(H)f, sdO, H-rich, DAO, and hgO(H) stars totalize 62 objects, together

² A regularly updated catalogue of binary CSPNe is maintained by David Jones can be found at <http://www.drdjones.net/bcspn/>.

Table 3. Average physical parameter of our catalogue. We only included objects with accurate SpT, and exclude objects with confirmed binary nucleus. Between parentheses the number of objects is indicated.

| Population | $\log g$ | $T_{\text{eff}} \times 10^3$ | $(L_\star / L_\odot) \times 10^3$ |
|-----------------|-----------|------------------------------|-----------------------------------|
| [WC 4-12] | 4.17 (33) | 50 (41) | 6.3 (36) |
| [WO 1-4] | 5.37 (20) | 110 (23) | 4.2 (21) |
| PG 1159 | 6.68 (10) | 117 (14) | 0.7 (13) |
| O8 - B0 | 3.51 (13) | 38 (16) | 10 (14) |
| O3-7 | 4.52 (26) | 71 (29) | 5.9 (29) |
| hgO(H), DA, DAO | 6.93 (31) | 99 (33) | 0.1 (25) |

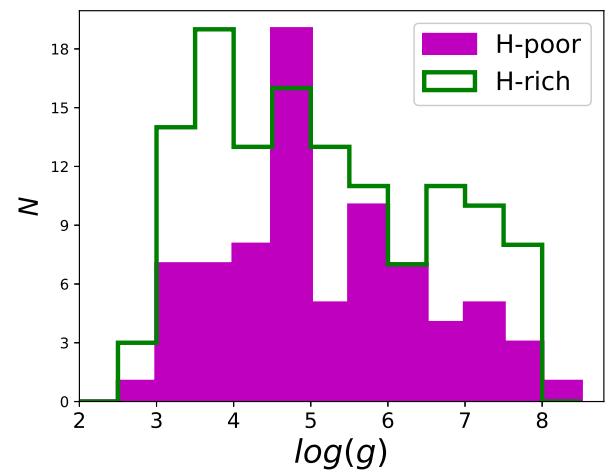


Fig. 3. Distribution in surface gravity of CSPNe.

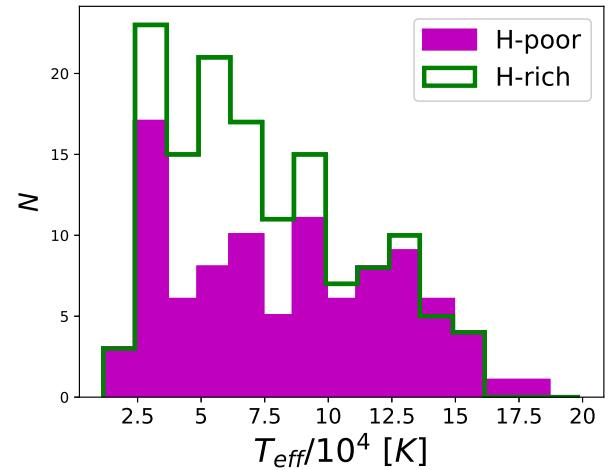
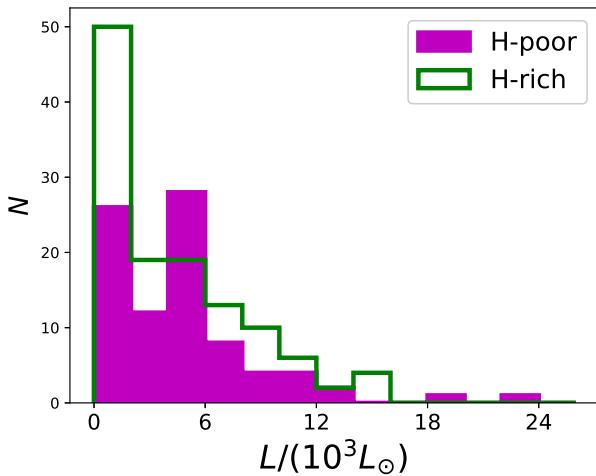
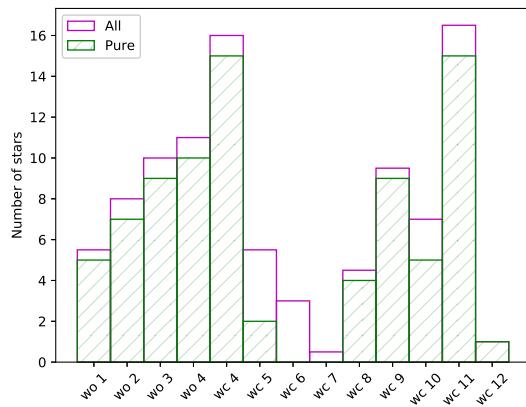


Fig. 4. Distribution in temperature of CSPNe.

with nine objects that do not have a specific spectral type. In addition, there are 34 objects with late spectral types.

For the vast majority of binary systems there are only spectroscopic data for the brightest star, so there are few systems in which we know the spectral type of the two stars of the system. No binary systems composed by stars with different H abundances in its atmosphere (i.e. H-rich + H-poor) are currently known. In this sense, and for statistical purposes, we adopt the criterion of using the H abundance of the brightest star.

With the above clarifications, we found that 10.3% of confirmed binaries belong to the H-poor group and 82.1% to the H-

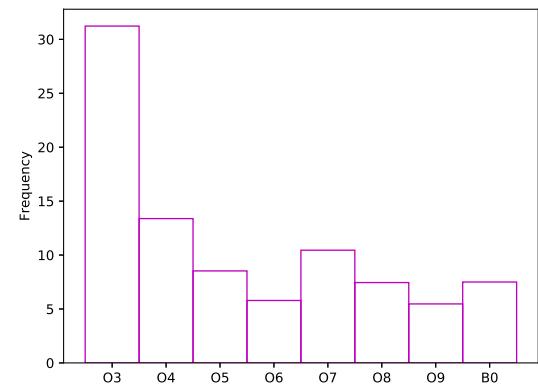
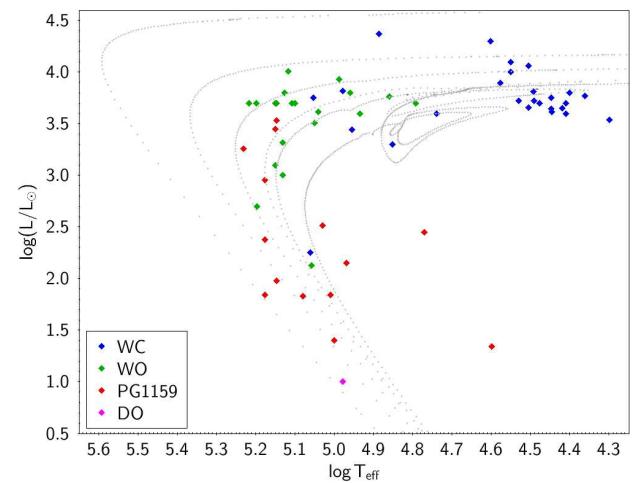
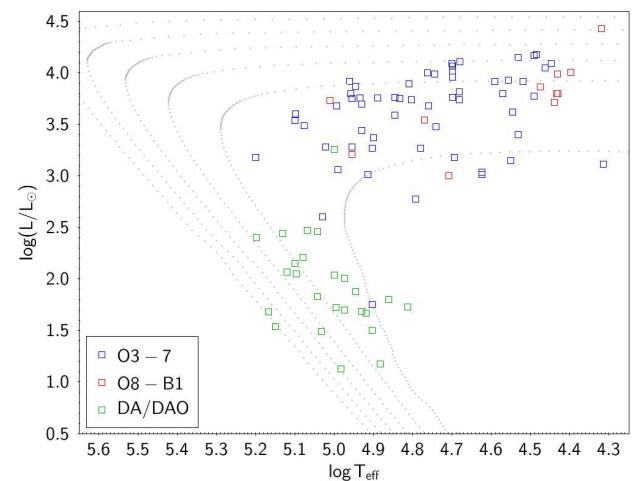
**Fig. 5.** Distribution in luminosity of CSPNe.**Fig. 6.** Distributions of the [WR] type CSPN over the subtype. The sample "Pure" exclude objects with imprecise classification (e.g. [WC 5-6]). The sample "All" includes these objects with the criteria: an object with classification [WC 5-6], adds 0.5 to the frequency of [WC 5] and adds 0.5 to the frequency of [WC 6].

rich group. Consequently, there is a pronounced tendency, even more so considering that the H-rich ones are twice as many in the general population, for binary stars to occur more frequently in stars with hydrogen in their atmosphere.

The lack of H-deficient central stars in binary systems is a natural expectation from the proposed scenarios for their formation, namely the merger and the late thermal pulse. This is particularly true given that close binary systems are much easier to be detected than wide binaries. Mass transfer in a close binary system is expected to prevent the natural occurrence of the TP-AGB phase, making the late thermal pulse scenario unlikely. And, while a merger after a common envelope phase is a possible outcome, if this merger leads to a H-deficient star it will be a single H-deficient star unless the original system was triple, and in a specific configuration.

5.3. Comparison with stellar evolution models. Stellar masses and ages

From the comparison of the surface $\log L_\star$, $\log g$, and $\log T_{\text{eff}}$ values of our catalogue stars with those predicted by stellar evolution models (Miller Bertolami 2016) it is possible to derive

**Fig. 7.** Distributions of the O-type CSPN over the subtype. Criterion used for objects with dubious classifications (e.g. O5-9) is the same as that described in Fig. 6.**Fig. 8.** HR diagram of H-poor CSPNe, according subtype. H-deficient tracks correspond to the post-VLTP sequences computed by Miller Bertolami & Althaus (2006), which display He, C, and O photospheric abundances similar to those of [WR]-CSPNe and PG 1159 stars ($M_{\text{CSPN}} = 0.515, 0.542, 0.584, 0.664$ y $0.870 M_\odot$, from right to left).**Fig. 9.** HR diagram of H-rich CSPNe, according subtype. H-rich track are described in Section 5.3.

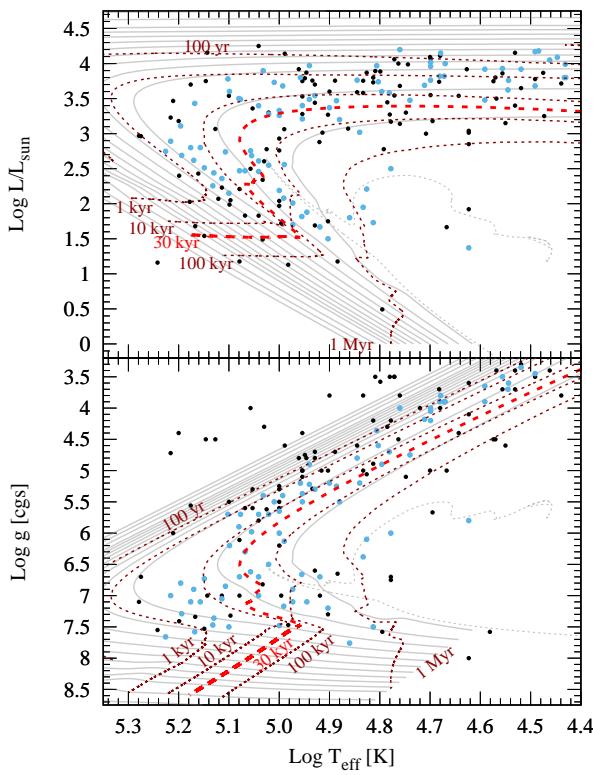


Fig. 10. Location of the selected sample of H-rich stars (213 objects in total) in both the HR (upper panel) and Kiel (lower panel) diagrams. Light blue points symbols show the location of the subsample for which interpolation in both diagrams indicate a consistent age and mass (88 objects, see text). Grey continuous lines show the location of interpolated tracks for different masses ($0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1, 1.1, 1.2, 1.3 M_{\odot}$, and $Z_0 = 0.01$, from right to left). Brown and red lines show isochrones in the post-AGB evolution. The dotted grey line indicates a typical post-EHB evolution.

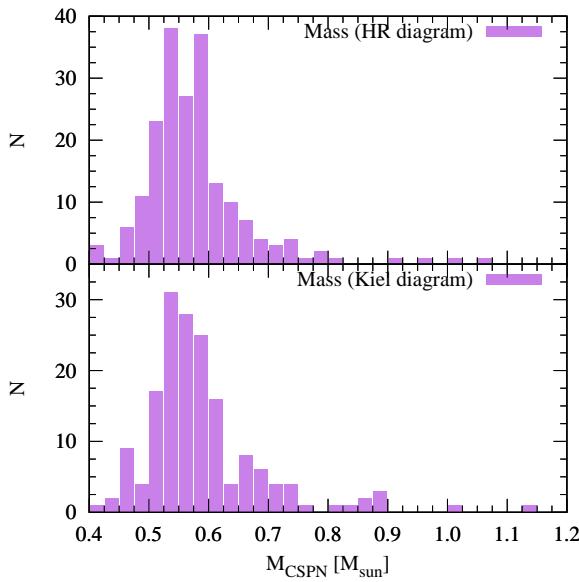


Fig. 11. Masses derived from interpolation of the full H-rich sample (213 objects, see Fig. 10) with the $Z = 0.01$ model grid of Miller Bertolami (2016). Upper panel: Masses derived from interpolation in the HR diagram. Lower panel: Masses derived from interpolation in the Kiel diagram ($\log g - \log T_{\text{eff}}$).

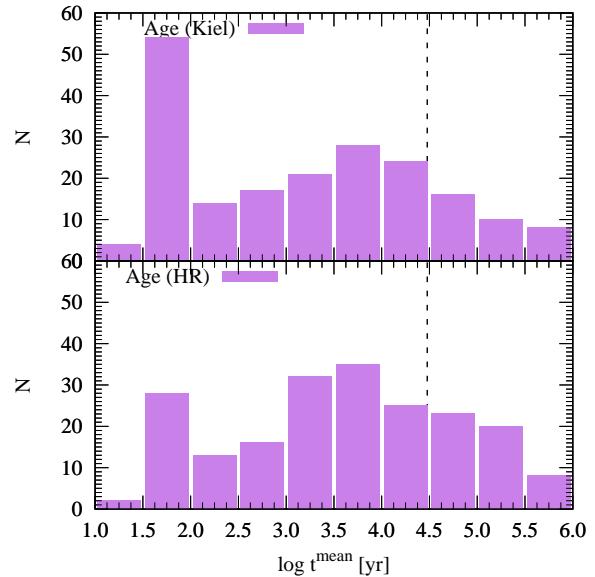


Fig. 12. Ages derived from interpolation of the full H-rich sample (213 objects, see Fig. 10) with the $Z = 0.01$ model grid of Miller Bertolami (2016). Upper panel: Masses derived from interpolation in the HR diagram. Lower panel: Masses derived from interpolation in the Kiel diagram ($\log g - \log T_{\text{eff}}$). The vertical dashed line indicates the canonical value of 30 Kyr value beyond which PNe are not expected to survive.

ages and masses for the CSPNe. Due to the absence of a grid of appropriate stellar evolution models for H-deficient stars, this can only be done for those with normal H/He surface compositions (i.e. those with solar-like H/He compositions). A comparison of 213 of our H-rich catalogue stars with the $Z = 0.01$ models of Miller Bertolami (2016) is shown in Fig. 10 both for the $\log L_{\star} - \log T_{\text{eff}}$ (i.e. HR diagram) and the $\log g - \log T_{\text{eff}}$ (i.e. Kiel diagram). From the total of 213 objects only 175 have values of all three surface parameters and can be plotted in both diagrams. In this sample we exclude doubtful PNe, SySt, hybrid and objects classified as "O?". Also there were excluded those objects where two contradictory spectral classifications are reported, i.e. H-rich and H-poor (e.g. IC 4776).

By interpolating the location of our sample stars in both the HR and Kiel diagrams we can estimate their masses (Fig. 11) and ages (Fig. 12). A couple of things are particularly noteworthy in the full H-rich sample shown in Fig. 10. On the one hand the masses of CSPNe inferred from the Kiel and HR diagram interpolations agree quite well with our current expectations from single post-AGB stellar evolution (see histograms in Fig. 11), with peaks around ($\sim 0.55 M_{\odot}$). Both diagrams show, however, slightly different pictures, while interpolation in the HR diagram shows a double peak, the Kiel diagram shows a wider peak between $0.525 M_{\odot}$ and $0.600 M_{\odot}$. On the other hand, some features are clearly at variance with expectation from stellar evolution models. One is the group of objects at low surface gravities, well beyond the most massive model (Fig. 10, lower panel). Such object would have masses well beyond the Chandrasekhar mass if they were post-AGB stars and should not be there. In addition, there is a rather large number of stars with inferred masses below $0.5 M_{\odot}$, something that is not expected from the point of view of single stellar evolution. Finally, interpolated/extrapolated ages and masses in the full H-rich sample show a relatively large number of objects beyond the 30 Kyr isochrone, i.e. well beyond

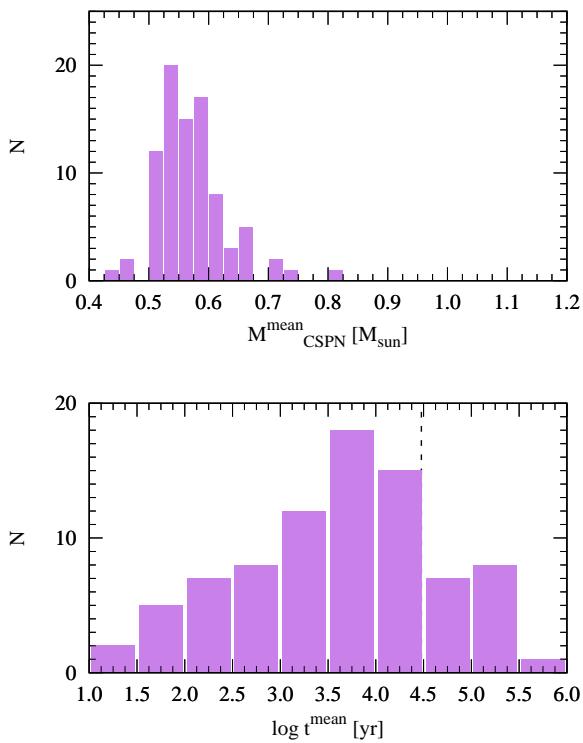


Fig. 13. Mean values of the ages and masses for the reduced sample of 88 objects (blue dots in Fig. 10) for which interpolation in the Kiel and HR diagrams yield consistent results. Age (mass) of each object is calculated as the geometric (arithmetic) mean of the values yield by the interpolation in each diagram. The vertical dashed line indicates the canonical value of 30 Kyr value beyond which PNe are not expected to survive.

the expected lifetime for true PNe, as well as a large number of young objects with interpolated ages below 100 yr (Fig. 12).

To analyse which of the previous features are real and which ones are artifacts due to poor determinations of the stellar parameters of individual stars, we restricted to those stars that have independent determinations of all three surface parameters ($\log L_*$, $\log T_{\text{eff}}$ and $\log g$). From these we selected the subsample for which both the HR and Kiel diagram interpolations give consistent values of age and mass³. This smaller sample is shown as light blue dots in Fig. 10. Consists of 88 objects out of the 175 objects (i.e. 50%) that have values of $\log L_*$, $\log T_{\text{eff}}$ and $\log g$. The consistency of the values of $\log L_*$, $\log T_{\text{eff}}$ and $\log g$ gives us confidence that no large errors are present in the derived masses and ages. Fig. 13 shows the masses and ages of this reduced sample. Remarkably, many of the weird features seen in the full sample (Figs. 11 and 12) disappear when we restrict ourselves to our internally consistent sample. Specifically, no low gravity objects remain, and the number of young CSPNe is strongly reduced. Also, the mass values of the smaller, and consistent, sample show a sharp cut-off at $\sim 0.5 M_{\odot}$ much consistent with the expectations from stellar evolution theory. Similarly, the post-AGB age distribution of CSPNe in this smaller sample shows a steady rise until the typical timescales of PNe (10 to 30 Kyr) and a clear drop afterwards.

³ Which we arbitrarily set to be in agreement within an order of magnitude for age and a difference of less than a 10% for mass.

Interestingly, we see that in this reduced sample a small group of objects with inferred low masses persist ($M_* < 0.5 M_{\odot}$). As such low masses, the objects cannot be post-AGB stars, and these extrapolated masses cannot be taken at face value but just as an indication of a different evolutionary origin. These low-mass objects correspond to the high-gravity/low-luminosity blue points in Fig. 10. These objects are in fact located where post extreme horizontal branch (EHB) stars (a.k.a. "AGB-manqué" stars) should be (e.g. Moehler et al. 2019). This alternative evolutionary path is displayed by the dotted grey line in Fig. 10. If these objects are indeed post-EHB stars then their masses should be close to $0.5 M_{\odot}$, and due to the long timescale of this evolutionary stage the "PN" around them is probably ionized interstellar gas that was not ejected by the star.

We conclude that, when we restrict our sample to those stars for which $\log L_*$, $\log T_{\text{eff}}$ and $\log g$ yield a consistent picture, the derived masses and ages are in good agreement with the expectations of single star post-AGB evolution theory. We conclude that a 50% of our sample with values of $\log L_*$, $\log T_{\text{eff}}$ and $\log g$ (88 out of 175 objects) show masses and ages consistent with single stellar evolution models. Although some of this objects seem to have derived ages too large to host a PN, we believe that in view of the ongoing debate of whether single stars can form PNe (Jones & Boffin 2017; Boffin & Jones 2019), this is a remarkable result. This should not be taken as a claim that multiple systems do not form PNe or that companions do not play any role in the shaping of the PNe. But rather a hint that stars in isolation or in wide binaries, are able to form PNe as well. As mentioned before, common envelope events are the reason for the formation of PNe with close binary central stars (Ivanova & Nandez 2018; Boffin & Jones 2019). There have been suggestions that substellar companions (Sabach & Soker 2018) or triple systems (Soker 2016) might be involved in the formation or shaping of non-spherical PNe.

6. Summary and conclusions

In this paper we present a new CSPNe catalogue comprising 620 stars that could be spectrally classified in a reliable way. This catalogue represents an expansion of the first version (Weidmann & Gamen 2011b) with the inclusion of 128 new objects. In addition to updating all available information, this version includes new physical parameters for the CSPNe, as well as the visual magnitude and the corresponding bibliographic reference of the spectra used for spectral classification. The information collected and processed in this catalogue represents an essential contribution both in theoretical studies and in the planning of future observations. For all this we understand that it constitutes a fundamental tool both for the field of planetary nebula research in particular, and for stellar evolution studies in general.

In relation to the completeness of the information included in this catalogue, of the total number of objects: 56.3% have $\log g$, 69.8% have $\log T$, 60.5% have $\log L_*$, and 74.4% have magnitude.

It is important to note that the objects reported in this catalogue represent less than 20% of the total PNe known to date. Furthermore, almost 30% of these objects do not have any specific physical parameter determined. The origin of this lack of information is probably related to the low brightness of these objects, if we consider that 50% of the sample has a visual magnitude lower than 17. This reveals an important information gap in this area of research, a gap that can only be overcome with new large-scale studies using 8-10 m class telescopes.

The main conclusions can be summarized as follows:

- When we separate the CSPNe between H-rich and H-poor we find that the ratio H-rich/H-poor is 2:1. This value is greater than the one found by Weidmann & Gamen (2011b) but lower than the value determined by Mendez (1991).
- According to the distribution in galactic latitude we find evidence that the CSPNe H-rich and H-poor come from different populations, suggesting that H-deficient stars are preferentially formed in younger populations by higher mass progenitors.
- Our larger sample confirms the existence of a deficiency of [WR]-CSPNe with [WC 5-7] spectral types found by previous authors Todt (2009).
- Upper 80% of binary CSPNe belong to the H-rich group. We find a significant dearth of H-deficient stars in binary systems. This result suggests that evolutionary scenarios leading to the formation of binary central stars interfere with the conditions required for the formation of H-deficient CSPNe. This is in agreement with the expectations from both merger and late thermal pulse scenarios.
- We find that 50% of our sample with derived values of $\log L$, $\log T_{\text{eff}}$, and $\log g$ (88 out of 175 objects) shows masses and ages consistent with single stellar evolution models. This suggests that some single stars are indeed able to form PNe.

The task of building large catalogues is hard and time-consuming, but it is the only way to organize the knowledge achieved by the astronomical community and to promote new studies that will make progress in any area of research. We hope that the work presented here will constitute a mobilizer of ideas and a driving force for new projects that will result in an increase in our understanding of the final stages of ordinary mass stars.

7. Acronyms and bibliographical references of table 1 and 2

- AB2015 Akras et al. (2015)
 AC2007 Angeloni et al. (2007)
 AC2016 Akras et al. (2016)
 AD2016 Ali et al. (2016)
 AD2019 Ali & Dopita (2019)
 AE1985 Arkhipova et al. (1985)
 AE2008 Arkhipova et al. (2008)
 AG1985 Amnuel et al. (1985)
 AH2020 Akras et al. (2020)
 AI2013 Arkhipova et al. (2013)
 AK1985 Aller & Keyes (1985)
 AK1987 Aller & Keyes (1987)
 AK1988 Aller et al. (1988)
 AI1975 Aller (1975)
 AL2019 Aleman et al. (2019)
 AL2019a Aller et al. (2019)
 AM2013 Aller et al. (2013)
 AM2014 Adam & Mugrauer (2014)
 AM2015 Aller et al. (2015a)
 AM2015b Aller et al. (2015b)
 AN1999 Arkhipova et al. (1999)
 AN2003 Acker & Neiner (2003)
 AT2003 Arrieta & Torres-Peimbert (2003)
 AW2019 Ahumada et al. (2019)
 B1989 Balick (1989)
 B2008 Bohigas (2008)
 BA2016 Basurah et al. (2016)
- bc-CSPN binary for the cool CSPN
 BC1999 Bond & Ciardullo (1999)
 BC2003 Benetti et al. (2003)
 BC2012 Bilíková et al. (2012)
 BC2016 Bond et al. (2016)
 BD1982 Bateson & Dodson (1982)
 BH1994 Barstow et al. (1994)
 BJ2018 Boffin et al. (2018)
 BJ2019 Brown et al. (2019)
 BK2018 Barría et al. (2018)
 BM1986 Bhatt & Mallik (1986)
 BM2000 Belczyński et al. (2000a)
 BM2012 Boffin et al. (2012b)
 BM2012a Boffin et al. (2012a)
 BO2002 Bond et al. (2002)
 BP2002 Bond & Pollacco (2002)
 BP2003 Bond et al. (2003)
 C1973 Cudworth (1973)
 C1980 Chromey (1980)
 C1984 Cahn (1984)
 C1995 Corradi (1995)
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 CB2016 Chiotellis et al. (2016)
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 Cd1998 Crowther et al. (1998)
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 CG2009 Chu et al. (2009)
 cH1989 Clegg et al. (1989)
 CJ1987 Cohen & Jones (1987)
 CK2006 Clayton et al. (2006)
 CM2000 Cazetta & Maciel (2000)
 CP1985 Cerruti-Sola & Perinotto (1985)
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 CS2011 Corradi et al. (2011)
 CZ2001 Cidale et al. (2001)
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 d2006 De Marco (2006)
 d2009 De Marco (2009)
 D2014 Danehkar (2014)
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 dC2001 De Marco et al. (2001)
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 dM2002 de Araújo et al. (2002)
 dO2015 De Marco et al. (2015)
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 EP2005 Exter et al. (2005)
 F1994 Feibelman (1994)
 F1996 Feibelman (1996)
 FB2014 Frew et al. (2014)
 Fd2008 Frew (2008)
 FK1983 Feibelman & Kaler (1983)
 FK2001 Feibelman & Kondo (2001)
 FL1987 Ferguson et al. (1987)
 FL1999 Ferguson et al. (1999)
 FM1981 Ferguson et al. (1981)

- FM2010 Frew et al. (2010)
 FP2006 Frew et al. (2006)
 FP2016 Frew et al. (2016)
 G2014 Górnny (2014)
 GB1983 Grauer & Bond (1983)
 GB2010 Gianninas et al. (2010)
 GC2009 Górnny et al. (2009)
 Gd2013 Guerrero & De Marco (2013)
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 GG2014 García-Hernández & Górnny (2014)
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 GJ1989 Gillett et al. (1989)
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 GM2019b González-Santamaría et al. (2019)
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 GP2001 Gauba et al. (2001)
 GP2003 Gauba & Parthasarathy (2003)
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 GS2003 Górnny & Siódmiak (2003)
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 HA1999b Hyung et al. (1999a)
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 JE1969 Jones et al. (1969)
 JH2019 Jeffery & Hambach (2019)
 JP2019 Jones et al. (2019b)
 JT1996 Jasniewicz et al. (1996)
 JV2017 Jones et al. (2017)
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 KB2014 Keller et al. (2014)
 KH1997 Koesterke & Hamann (1997b)
 KH1997b Koesterke & Hamann (1997a)
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 KM1997 Kudritzki et al. (1997)
 Ko2001 Koesterke (2001)
 KO2015 Kilkenny et al. (2015)
 KP2016 Kepler et al. (2016)
 KS1988 Kilkenny et al. (1988)
 KS1990 Kaler et al. (1990)
 KS1993 Kaler et al. (1993)
 KV2015 Kawka et al. (2015)
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 L1984 Lutz (1984)
 LB2013 Liebert et al. (2013)
 LC2011 Lykou et al. (2011)
 LC2014 Leone et al. (2014)
 LF1988 Liebert et al. (1988)
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 LF2015 Latour et al. (2015)
 LH1994 Leuenhagen & Hamann (1994)
 LH1998 Leuenhagen & Hamann (1998)
 LH2005 Lisker et al. (2005)
 LH2013 Lee & Hyung (2013)
 LK1987 Lutz & Kaler (1987)
 LR1983 Law & Ritter (1983)
 LR2019 Löbling et al. (2019)
 LS2000 Liu et al. (2000)
 LS2007 Lee et al. (2007)
 LT1995 Liebert et al. (1995)
 LZ1998 Lamers et al. (1998)
 M1989 Méndez (1989)
 M1990 Mendez et al. (1990)
 M1991 Mendez (1991)
 M1997 Mal'Kov (1997)
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 MA2003 Marcolino & de Araújo (2003)
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 MASH-I Parker et al. (2006)
 MASH-II Miszalski et al. (2008)
 MB2012 Miszalski et al. (2012a)
 MB2013 Miszalski et al. (2013a)
 MB2013b Miszalski et al. (2013b)
 MC2006 Mampaso et al. (2006)

- MC2011 Miszalski et al. (2011a)
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 MM2011 Miszalski et al. (2011c)
 MM2013 Miszalski et al. (2013c)
 MM2014 Miszalski & Mikołajewska (2014)
 MM2015 Manick et al. (2015)
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Appendix A: Symbiotic stars?

Symbiotic stars (SySt) are binary systems composed by a cold giant (red giant or Mira star) and an evolved hot star (in most cases, a white dwarf), in which the giant transfers material to the white dwarf star via stellar wind (Mikolajewska 2010). The wind is ionized by the UV radiation field from the evolved companion, producing a spectrum with emission-lines typical of PNe. In addition to these emission-lines, SySt generally exhibit absorption features (e.g. TiO and VO) produced in the cool stellar photosphere of the giant (Corradi et al. 2003). Symbiotic stars allow to study physical processes such as the powering mechanism of supersoft X-ray sources (Jordan et al. 1996), the thermonuclear outbursts (Munari 1997), the collimation of stellar winds and formation of jets (Tomov 2003) or their relation with the formation of bipolar PNe (Corradi et al. 2003).

Another important aspect is that SySt are, probably, progenitors of Type Ia supernovae (see e.g. Whelan & Iben 1973; Hachisu et al. 1999; Lü et al. 2009; Di Stefano 2010; Chen et al. 2011). SySt are divided into three categories: (i) The S-type (*stellar*) in which the giant has a M-spectral type and dominates the emission in the near-IR, showing the presence of stellar photospheres at (3 000–4 000 K) (Belczyński et al. 2000b; Akras et al. 2019). (ii) The D-type systems (*dusty*) in which the cool companion is a Mira variable star and the near-IR emission corresponds to the dusty envelope around the systems. And (iii) D-type symbiotic stars which are characterized by a F, G or K type cool giant surrounded by a dust shell (Allen 1984). A new type of SySt namely S+IR, a S-type with an infrared excess in the 11.6 and/or 22.1 μm bands, was proposed by Akras et al. (2019).

Evolutionary links between PNe and symbiotic systems are likely. A kind of symbiotic outflow around D-type symbiotic Miras shows morphological similarities with bipolar PNe, indicating that symbiotic Miras, in an evolutionary phase, are a prelude to formation of genuine PNe. This transition occurs when the Mira variable of SySt loses its envelope and forms a PN (Corradi et al. 2003). Note that nebulae observed around symbiotic Miras are not PNe. On the other hand, many current symbiotic stars may have gone through the PN phase, when the current WD companion was at an early phase in its evolution. Similarly, many PNe with binary central stars may turn-up into symbiotic systems in the future when the companion star evolves into to AGB phase (Frew & Parker 2010).

Symbiotic stars can be discriminated from PNe using either near-IR colours or, in the optical spectra, the presence of the red continuum and strong [O III] $\lambda\lambda$ 4363 relative to λ 5007 in higher-excitation objects. Given that symbiotic stars are generally much denser than even the youngest PNe, Gutierrez-Moreno (1988) and Gutierrez-Moreno et al. (1995b) used the [O III] $\lambda\lambda$ 4363 / λ 5007 line ratio to separate PNe from symbiotics. Colour-colour diagrams using near-IR and optical colours were used (Schmeja & Kimeswenger 2001; Ramos-Larios & Phillips 2005; Corradi et al. 2008). Recently, Ihkiewicz & Mikolajewska (2017) also proposed a number of new diagnostic diagrams in the optical regime for discriminating SySt from PNe. For instance, they used diagnostic diagrams based on the He I recombination lines.

Our catalogue has eleven CSPNe classified as SySt, which are presented in Table A.1. Two objects of this list are classified as possible PNe (PM 1–322 and Mz 3) in the Hong Kong/AAO/Strasbourg H α PN database (HASH; Parker et al. 2016). The spectroscopy of these possible PNe is insufficiently conclusive due to the combination of low S/N spectra, low surface brightness and insufficient wavelength coverage. The spectrum of PM 1–322 presents the typical forbidden emission lines of a PN as well as the Balmer and Paschen recombination lines. The spectral characteristics indicate that PM 1–322 is a young PN, however, its high density and its position on the diagnostic diagram of Gutierrez-Moreno et al. (1995b) suggest a symbiotic nature (Pereira & Miranda 2005). Mz 3 is widely classified as a bipolar PN based on its optical spectral characteristics and morphology (Acker et al. 1992b). However, the position of Mz 3 on the near-IR colour diagrams strongly indicates that it has a symbiotic binary nucleus (Schmeja & Kimeswenger 2001).

M 1–44 and CTSS 2 are catalogued as true PNe in the HASH catalogue. They are confirmed PNe with multi-wavelength PN-type morphologies and PN spectral features (Parker et al. 2016). For M 1–44 the near-IR photometry indicates the possible presence of a cool component (G-K giant). However, the giant

may not be associated with the nebula (Belczyński et al. 2000a; Phillips 2007).

The source K 4–57 is presented as a PN candidate in HASH (Parker et al. 2016). It appears in the PNe catalogue by Acker et al. (1992b). However, its optical spectrum is similar to a SySt with nebular emission lines of low to high ionization species and a faint slow rising continuum (Rodríguez-Flores et al. 2014a). In addition, the location of the source in the high-density region of the optical diagram from Gutierrez-Moreno et al. (1995b), which is typical of symbiotic stars, reveals the possible presence of a symbiotic nebula.

Hen 2–442 was previously classified as PN (Acker et al. 1992b), however it is now catalogued as a true SySt (Parker et al. 2016). The near-IR spectrum exhibits the presence of a red giant and the optical one is dominated by nebular lines and shows a weak evidence of TiO bands (Yudin 1983), confirming its symbiotic nature (Rodríguez-Flores et al. 2014a).

The other five objects: H 2–43, Th 4–1, Hen 2–25, Hen 2–57 and 19w32 are classified as SySt candidates (Parker et al. 2016). Three of these objects (H 2–43, He 2–25, and 19w32) were previously classified as planetary nebulae. They were subsequently found to have near-IR colours which are consistent with symbiotic binary nucleus (Belczyński et al. 2000a; Schmeja & Kimeswenger 2001; Pereira & Miranda 2005; Phillips 2007). The spectra of Th 4–1 and Hen 2–57 indicate they are genuine PNe, but this spectroscopic information do not allow to totally rule out the possibility of being a symbiotic nature.

Table A.1 shows that these objects, in general, belong to the symbiotic class D/D' (Akras et al. 2019). D-type SySt are in more evolved phase than S-types. D-types contain AGB stars as the cold components whereas the S-type SySt have RGB stars (Muerset et al. 1996). The intense mass-loss generated during the end of the TP-AGB stage is responsible for the formation of the dusty shell in D-type SySt.

Table A.1. Sample of CSPNe classified as SySt.

| PN G | name | prev. class. | Akras class. |
|------------|-----------|--------------|--------------|
| #8 | PM 1–322 | ? | D' |
| 003.4–04.8 | H 2–43 | D | D |
| 004.9–04.9 | M 1–44 | S | S+IR |
| 007.5+04.3 | Th 4–1 | ? | ? |
| 044.1+05.8 | CTSS 2 | ? | ? |
| 061.8+02.1 | Hen 2–442 | D | D |
| 107.4–00.6 | K 4–57 | D | D |
| 275.2–03.7 | Hen 2–25 | ? | D' |
| 289.6–01.6 | Hen 2–57 | ? | D |
| 331.7–01.0 | Mz 3 | ? | D |
| 359.2+01.2 | 19w32 | D | D' |

Appendix B: Objects rejected from the catalogue

IRAS 17150–3224 (PN G353.8+02.9), strong evidence that is not PN. Hu et al. (1993) show the optical spectra and classify it as G2 I.

RE 1738+665 (PN G096.9+32.0), it is a faint, irregular HII region in the ISM (Frew 2008).

Zijlstra & Walsh (1996) proved that the PNe He 2–436 (PN G004.8–22.7) and WRAY 16–423 (PN G006.8–19.8) are not linked to our galaxy.

Sh 2–128 (PN G325.8+04.5), Bohigas & Tapia (2003) showed that this is an HII region.

Appendix C: Spectral classification of peculiar CSPNe

Thanks to the identification of certain ions in published spectra, it was possible to improve the spectral classification for several objects. In the cases when two or more different spectral classifications were available, the relevance of each one is discussed in the text.

2MASS J18482874–1237434: This object was classified as PN by Miszalski & Mikołajewska (2014) who reported He II absorption lines at 4540 and 4686 Å. According to our spectral classification system, this CSPN is an O-type.

A 41: This object requires special attention. On one hand, Włodarczyk & Olszewski (1994) reported that the primary component of the binary system is a sdB (they do not show spectra). On the other hand, Green et al. (1984) classified this CSPN as sdO, and show spectra where H β is clearly visible in absorption. As a more probable classification, we prefer a sdO type.

A 46: According to Pollacco & Bell (1994), this CSPN presents Balmer, He II, and N V λ 4603–19 lines in absorption. It also shows emission of C IV, C III, and N III. On the other hand, Mitchell et al. (2007b) classified it as M6 V. Moreover, De Marco (2009) report that the secondary star is a M6 V. There exists a possibility that the object is a sdO (Aller et al. 2015a). We classify this CSPN as O(H)3 + M6 V.

CRBB 1: According to the spectra shown by McCarthy et al. (1991) we classify this star as B0 III.

ESO 330–9: This object presents a distorted morphology. The CSPN is not at the geometric center. Hillwig et al. (2017b) show a spectrum where only an absorption of He II at 4686 Å is visible. Moreover, Fig. 1 of Boffin et al. (2012b) shows clear Hydrogen absorption lines, He II and N V (4603–19 Å) together with emission lines of C IV and O V⁴. In addition, the authors report that this planetary nebula nucleus is constituted by a double-degenerate central star. Both stars are responsible for the ionization of the nebula. We classify this CSPN as O(H)3–4.

H 2–1: The CSPN is classified as [WC 11] by Górný et al. (2009), who show a spectrum in the range 5200–7300 Å. However, in the spectrum taken by Mendez et al. (1988b) H γ is in absorption, He I, and He II are evident. We reclassify this CSPN as O(H)5–9.

Hb 12: Aller & Keyes (1985) suggest that the emission lines equivalent width does not correspond to a [WR]. The H α line presents broad emission (Arrieta & Torres-Peimbert 2002) and the spectrum does not present absorption lines (Arrieta & Torres-Peimbert 2003). This object could be in a previous stage to a PN. We keep both classifications, possible B[e] and possible [WN 7].

Hen 2–11: Górný & Siódmiak (2003) reported non-stellar emission lines, but Górný et al. (2004) classified this object as wels. However, the spectrum showed by Jones et al. (2014) displays subtle He II absorption at 5412 Å. In this context, we prefer an O-type.

Hen 2–108: Górný (2014) classified this CSPN as VL. However, the spectra display clear He II absorption at 5412 Å and subtle C IV absorption at 5806 Å. According to the spectrum shown by Hultsch et al. (2007), the CSPN shows He I, He II, and H γ absorption. We classify this object as O(H).

Hen 2–131: Górný (2014) classified this CSPN as VL. However, the spectra display clear He II absorption at 5412 Å and subtle C IV absorption at 5806 Å. Zuckerman & Aller (1986) re-

⁴ <https://science.scienmag.org/content/sci/suppl/2012/11/07/>

ported a Of8 spectral type and P-Cygni profile. Heap (1977) reported a O7(f)eq spectral type and showed the spectra where Balmer line absorption is visible. While Guerrero & De Marco (2013) reported Of(H) and Tylenda et al. (1993) classified it as wels. We prefer to adopt a spectral type O(H).

Hen 2–138: Mendez et al. (1988b) classified this object as Of(H), but considering these author spectra we propose a reclassification as O(H)7-9f.

Hen 2–146: There are two possible CSPNe in this object. Both display a late spectral type (Jones et al. 1969). To be consistent with this catalogue nomenclature, we prefer a classification K-M.

Hen 2–155: The spectra showed by Jones et al. (2015) display H absorption lines, He II, O v (at 5114Å), and C iv (at 5801–12Å). We classify this CSPN as O(H)3-5.

Hen 2–161: The spectra show Balmer absorption lines, He II λ 4542Å, He II λ 5412Å, N v λ 4603–19Å, O v at λ 5114, and C iv emission at λ 5801–12Å (Jones et al. (2015) and private communication with Jones). In addition I(4542)~I(4603), in this sense we suggest a spectral type O(H)3-4.

Hen 2–442: Arkhipova et al. (1985) reported that there are two stellar sources separated by 6 arcsec, and both sources produce PN-like emission spectra. A description of this objects is presented by Rodríguez-Flores et al. (2014b).

Hen 2–260: According to the spectrum shown by Hultsch et al. (2007), the CSPN shows He I, He II, and Balmer absorption. I(4471)>I(4542) implies a later star than O(H)7. Nevertheless, the intensity of the He II lines is significant. Si III absorption lines (at 4552, 4567 and 4574Å) are evident in the spectrum published by Kudritzki et al. (1997). According to this, we classify this star as O(H)7-8.

Hf 2–2: Hillwig et al. (2016a) indicate that Balmer and He II absorption lines are clearly visible in the spectrum. Moreover, in the spectrum shown by the authors, strong N v absorption lines at 4603–19Å are present. This features are typical of an O(H)3 star.

IC 2149: This CSPN is classified as O4f in SECGPN, and Guerrero & De Marco (2013) classify it as Of(H). Feibelman et al. (1994) reported stellar features at the optical range. We adopt the spectral type O(H)4f.

IC 2553: Ali & Dopita (2017) showed that the emission lines of N III 4631+4641Å, C III 4650Å, and O III+O V 5592Å are of nebular origin. The only line that could be stellar is 5806Å. These authors ruled out the wels classification. In this sense, we prefer to classify this CSPN as emission line.

IC 4776: Aller (1975) classified this CSPN as a possible [WC 6]. More recently, Miszalski et al. (2019b) analyzed and presented high resolution spectra. They ruled out a spectral type [WR] neither Of. Moreover, they could not affirm if the CSPN is H-rich or not. According to the strong He II absorption line we prefer an O-type spectral classification.

IC 4846: This CSPN displays H γ absorption lines and He II (4200, 4541Å) together with He II emission line at 4686Å (Hyung et al. 2001b). In addition García-Hernández & Górný (2014) reported C IV emission at 5806Å. We adopt a classification O(H)3-4 f.

IC 5217: Certainly the central star of this object requires further study. Cerruti-Sola & Perinotto (1985) classified this object as Of-WR, Hyung et al. (2001a) as WC(WNb ?), Tylenda et al. (1993) as wels, and Acker & Neiner (2003) as [WC 8-9]?. There is no spectrum published. Cautiously, we adopt a classification [WC]?

K 1–2: Exter et al. (2003) described this object but does not show the spectrum or classify it. They detected He II and H β stellar features. In addition, they mentioned that H β absorption is wide. On the other hand, De Marco (2009) reported that the secondary star of the binary system is a K2 V (or earlier). We classify it as O(H) + K2 V.

M 1–12: Previously, in Weidmann & Gamen (2011b) we classified this CSPN as [WC 10-11]. Nevertheless, in a spectra showed by Kniazev (2012) an absorption at 5412Å is clear. So, we prefer a classification O-type.

M 1–37: According to the spectrum shown by Hultsch et al. (2007), the CSPN shows He I, He II, and H γ absorption. Taking into account that it is a noisy spectrum, we can say that the star is O(H) type. The spectrum presented by Kudritzki et al. (1997) shows strong P-Cygni-type profiles at 4471Å. Although this object was classified as [WC 11] by Gesicki et al. (2006), this classification is discarded because of the H γ feature. On the other hand, the object was classified as a peculiar star by HP2007.

M 1–38: Górný et al. (2009) classified this object as [WC 11], but its spectra is not conclusive. On the other hand, Hultsch et al. (2007) showed an spectrum with clear Balmer, He I, and He II absorption lines. Moreover, I(4471)>I(4542). We classify this star as O(H)7-8.

M 1–44: Seemingly the object is not well identified. Lutz & Kaler (1983) did one of the first identifications and mentioned two stars that are separated by 2 arcsec. Later, Stenholm & Acker (1987) classified this star as possible PN, and possible SySt is the conclusion of Belczyński et al. (2000a). A deeper investigation is required for this object.

M 1–77: Object classified as possible OB star by SECGPN. De Marco (2009) showed some absorption lines, i.e., H δ , O II, and He I. This information is not enough to classify it. We assume these are the most intense lines in the spectrum. The O II features are especially important in B1 type star (Walborn & Fitzpatrick 1990). Hence, we classify this star as B1.

M 2–12: According to the spectrum shown by Hultsch et al. (2007), the CSPN displays He I and He II absorption lines, with I(4471)>I(4542). The presence of Balmer features is not evident. Górný et al. (2004) classified this objects as [WC 11], although the spectrum shown by Hultsch et al. (2007) discards this classification. We classify this star as an O7-8.

M 2–54: It is a variable star with a magnitude variation amplitude of up to 0.3 mag in Johnson V band (Handler 1999). It could also be a post-AGB star (Gauba & Parthasarathy 2003). Nevertheless, the same authors classify it as O9 V.

M 3–1: We could not detect any stellar feature in this object (Weidmann & Gamen 2011b). But in the spectra showed by Jones et al. (2019a) absorptions at H β and 5412Å are evident. We classify this CSPN as O(H).

M 3–2: Spectra showed by Kniazev (2012) display clear Balmer absorption lines. We classify this CSPN as H-rich.

My 60: Basurah et al. (2016) classified this CSPN as O(H), however they only observed O VI emission lines at 3811–34Å. On the other hand, Górný (2014) has classified it as wels. In this situation we prefer to classify it as emission line.

MyCn 18: This object received different types of classifications, Mendez (1991) and Miszalski et al. (2018b) classified the CSPN as Of(H). On the other hand, Peña et al. (2013) report a spectral type [WC]–PG 1159. While Lee et al. (2007) with high quality spectra did not detect Balmer absorption and classified this object as Of(c). Based on the quality of the published spectra we choose the classification Of(c).

NGC 1360: CSPN classified as O(H) by Mendez (1991). Nevertheless, in the spectra showed by Mendez et al. (1988b) strong absorption of He II at 4686Å is visible. On the other hand, in the spectra presented by Herald & Bianchi (2011) no He I absorption can be appreciated. In this sense, we classified this CSPN as O(H)3-4.

NGC 1535: In the spectrum showed by Mendez et al. (1988b) the H absorption is evident, and it is confirmed by Guerrero & De Marco (2013). According to this, we classify this CSPN as O(H)5.

NGC 3211: Basurah et al. (2016) classified this CSPN as O(H). Nevertheless, they did not observe the Balmer series; they only detected O VI emission lines at 3811-34Å. In this situation we prefer to classify this object as emission line.

NGC 5979: Basurah et al. (2016) observed this CSPN and classified it as O (H). However, according to the features displayed in their spectra, in particular C IV at 5806Å and O III at 5592Å, we prefer to classify this object as O(H)3-4. It is noteworthy that the spectrum obtained by Basurah et al. (2016) shows clear O VI emission lines. These lines are typical of [WO] stars.

NGC 6026: WD2011a reported a spectral type O(H)7. For their part, Hillwig et al. (2010) classified this object as O7 V. So we classify this CSPN as O(H)7 V.

NGC 6058: Object classified previously by Pottasch (1984) as O9, and by Guerrero & De Marco (2013) as O(H). Nevertheless, in the spectra showed by Herald & Bianchi (2011) strong H, He II, and N V absorptions are revealed. We classify this CSPN as O(H)3.

NGC 6210: Object classified by Pottasch et al. (1978) as O6, and as O(H) by Guerrero & De Marco (2013). Nevertheless, in the spectra showed by Herald & Bianchi (2011) strong H, He II, and N V absorption are revealed. We decided to classify this CSPN as O(H)3.

NGC 6629: This CSPN was classified as possible [WC 4] (Acker & Neiner 2003) and as wels by (Tylenda et al. 1993). Nevertheless, in the spectra showed by Mendez et al. (1988b) and Leone et al. (2014), the Balmer series together with the He II absorption are present. According to this, we propose a spectral type O(H) for this CSPN.

NGC 6778: Previously classified as cont. by (Feibelman 1994). Miszalski et al. (2011b) showed a high quality spectra where the absorptions at H β , He II, and N V (4603-19Å) are evident. We classify this CSPN as O(H)3-4.

Pa 5: García-Díaz et al. (2014) classified the central star of this new PN as PG 1159. They reported He II, Balmer series, and Ca II photospheric lines. On the other hand De Marco et al. (2015) classified the star as O(He). We consider that the lines identified by these authors are insufficient to classify this object as a PG 1159. We prefer a spectral classification O(H).

PRTM 1: Peña & Ruiz (1998) reported that the central star have an O(H) spectral type. Later, the high quality spectra obtained by Boffin et al. (2012a) display absorption lines of He II (5412 and 4686Å), O V (5114Å), N V (4603-19Å), and emission lines of C IV (4658, 5801-12Å) O V (4930Å), N V (4945Å). All of this features are compatible with an O(H)3-4 type. In this sense, it is surprising that the line N IV at 5200-03Å does not appear. In addition, the authors identified an emission line at 5292Å, that they associated to O VI. Nevertheless, the NIST Atomic Spectra Database (Kramida et al. 2019) do not include this line for O VI. Instead, we consider that this line better match with Ne IV.

SkAc 1: The CSPN of this object was identified in a WD survey (Kepler et al. 2016). Although the authors did not assign a

spectral classification to the spectrum, the Balmer series together with He II absorption at 4686 and 5412Å are clearly seen. We opt for a spectral classification DAO.

TC 1: SECGPN reported a spectral type Of(H), and in the spectra showed by Mendez et al. (1988b) the He I lines are clear and strong. Zuckerman & Aller (1986) reported P-Cygni profile. For this reason, we prefer a classification O(H)5-9f.

TS 01: Tovmassian et al. (2004) classified this CSPN as WD/NS, nevertheless in the spectrum that these author showed, the Balmer series is clear but the He II stellar lines are not. With this evidence, we prefer a classification H-rich. De Marco (2009) reported that the secondary star is a WD/NS or sdB. Finally, Tovmassian et al. (2010) showed a spectra with H and He II, 4686Å line, detectable in both emission and absorption. According to the log g of the optical component, determined by Tovmassian et al. (2010), the CSPN is indeed a sdO star.

Table 1. Catalogue of CSPNe. Description of the columns is in Section 4.1.

| PN G | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----|--------------------------|---------------------|----------------------|-------------------|---------|----------|--------|---------|----------------------|
| #1 | * | KPD 0005+5106 | 00 08 18.4 | +51 23 19.0 | DO | D1999 | | | | DL1985 DW1996 |
| #2 | * | PG 0108+101 | 01 11 06.6 | +10 21 39.2 | DO | D1999 | | | | WG1985 |
| #3 | * | PG 0109+111 | 01 12 22.9 | +11 23 36.6 | DO | D1999 | | | | WG1985 DW1996 |
| #4 | * | PG 1034+001 | 10 37 04.0 | -00 08 20.0 | DO + ? | HI2004 | | | | WG1985 WD1995 |
| #5 | * | Hen 2-139 | 15 54 44.5 | -55 29 34.1 | B[e] | LZ1998 | SySt? | MZ2002 | AL2019a | MZ2002 |
| #6 | * | 2MASS 18482 ⁵ | 18 48 28.7 | -12 37 43.5 | O | t.w. | | | | MM2014 |
| #7 | * | Kn 61 | 19 21 39.0 | +38 18 56.9 | PG 1159 (lg E) | GD2014 | | | | GD2014 |
| #8 | * | PM 1-322 | 20 14 50.9 | +12 03 50.0 | SySt | MV2010 | | | | - |
| #9 | * | BD+28 4211 | 21 51 11.0 | +28 51 50.4 | sdO | LF2015 | | | | LF2015 H1999 |
| 000.0-06.8 | | H 1-62 | 18 13 17.9 | -32 19 43.0 | [WC 10-11] | WG2011b | | | | WG2011b |
| 000.1+17.2 | | PC 12 | 16 43 49.3 | -18 56 33.0 | O | WG2011b | | | | WG2011b |
| 000.2-01.9 | | M 2-19 | 17 53 45.6 | -29 43 46.9 | O(H)6-8 III-V + ? | WG2018 | | | | WG2018 |
| 000.3+12.2 | | IC 4634 | 17 01 33.6 | -21 49 32.8 | O(H)3 If* | WM2015 | | | | WM2015 |
| 000.4+04.4 | | K 5-1 | 17 29 52.4 | -26 11 14.0 | wels | GS2004 | | | | - |
| 000.4-01.9 | | M 2-20 | 17 54 25.4 | -29 36 08.2 | [WC 5-6] | AN2003 | | | | AN2003 |
| 000.7+04.7 | | H 2-11 | 17 29 25.9 | -25 49 06.6 | wels | GS2004 | | | | - |
| 000.7+08.0 | | MPA J1717-2356 | 17 17 09.0 | -23 56 29.0 | Blue | MASH-II | | | | - |
| 000.7-02.7 | | M 2-21 | 17 58 09.6 | -29 44 20.1 | wels | GC2009 | | | | DP2011 |
| 000.9-02.0 | | Bl 2-13 | 17 56 02.8 | -29 11 16.2 | wels | GS2004 | | | | - |
| 001.2-03.0 | | H 1-47 | 18 00 37.6 | -29 21 50.5 | [WC 11]? | GS2004 | | | | - |
| 001.2-05.6 | | PHR J1811-3042 | 18 11 02.7 | -30 42 12.0 | [WO 1-2] | DP2011 | | | | DP2011 |
| 001.5-06.7 | | SwSt 1 | 18 16 12.3 | -30 52 08.1 | [WC 9]pec | AN2003 | Of-WR(c) | MH1991 | | LH1998 MH1991 dC2001 |
| 001.7-04.4 | | H 1-55 | 18 07 14.6 | -29 41 24.5 | [WC 11] | GC2009 | | | | GC2009 |
| 001.7-04.6 | | H 1-56 | 18 07 53.9 | -29 44 34.3 | O? | WG2018 | | | | WG2018 |
| 001.8-02.0 | | PHR J1757-2824 | 17 57 42.2 | -28 24 07.0 | O(H) + ? | WG2018 | | | | WG2018 |
| 001.8-03.7 | | PHR J1804-2913 | 18 04 28.5 | -29 13 57.2 | O(H) + ? | WG2018 | | | | WG2018 |
| 002.0-06.2 | | M 2-33 | 18 15 06.6 | -30 15 33.3 | O(H)5f | HP2007 | wels | AN2003 | | HP2007 |
| 002.0-13.4 | | IC 4776 | 18 45 50.6 | -33 20 32.0 | O + ? | t.w. | [WC 6]? | | Mv2019 | Mv2019 |
| 002.1-02.2 | | M 3-20 | 17 59 19.4 | -28 13 48.2 | Of | AK1987 | wels? | GC2009 | | - |
| 002.2-02.7 | | M 2-23 | 18 01 42.6 | -28 25 44.2 | Of | AK1987 | | | | - |
| 002.2-06.3 | | H 1-63 | 18 16 18.5 | -30 07 35.8 | O? | WG2011b | | | | WG2011b |
| 002.2-09.4 | | Cn 1-5 | 18 29 11.7 | -31 29 59.2 | [WO 4]pec | AN2003 | | | | AN2003 |
| 002.4+05.8 | | NGC 6369 | 17 29 20.5 | -23 45 34.8 | [WO 3] | AN2003 | | | | MP2006 AN2003 |
| 002.4-03.7 | | M 1-38 | 18 06 05.8 | -28 40 29.3 | O(H)7-8 | t.w. | | | | GC2009 HP2007 |
| 002.6+05.5 | | K 5-3 | 17 30 41.2 | -23 45 00.4 | [WC 4] | GS2004 | | | | GS2004 |
| 002.6+08.1 | | H 1-11 | 17 21 17.7 | -22 18 35.1 | wels | AN2003 | | | | - |
| 002.6-03.4 | | M 1-37 | 18 05 25.8 | -28 22 04.3 | O(H) | t.w. | pec. | HP2007 | | HP2007 |
| 002.7-04.8 | | M 1-42 | 18 11 05.0 | -28 58 59.1 | cont. | AK1987 | | | | - |
| 002.7-52.4 | | IC 5148 | 21 59 35.2 | -39 23 08.0 | hgO(H) | SEC-GPN | | | | BK2018 |
| 003.1+02.9 | | Hb 4 | 17 41 52.8 | -24 42 08.1 | [WO 3] | AN2003 | | | | D2014 dM2002 |
| 003.2-04.4 | | KFL 12 | 18 10 30.8 | -28 19 22.9 | wels | GC2009 | | | | GC2009 |
| 003.3+66.1 | | SkAc 1 | 14 16 21.9 | +13 52 24.2 | DAO | t.w. | | | | KP2016 |
| 003.3-04.6 | | Ap 1-12 | 18 11 35.1 | -28 22 36.6 | B0 I-III | WG2018 | | | | WG2018 |
| 003.4-04.8 | * | H 2-43 | 18 12 48.0 | -28 19 59.7 | SySt | BM2000 | wels? | GC2009 | | GC2009 |
| 003.5-02.4 | | IC 4673 | 18 03 18.5 | -27 06 22.7 | O(H)8 | WG2018 | | | | WG2018 |
| 003.6+03.1 | | M 2-14 | 17 41 57.3 | -24 11 16.1 | wels | GS2004 | | | | - |

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Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----|------------------|---------------------|----------------------|-------------|---------|------------|--------|---------|---------------|
| 003.7–04.6 | | M 2–30 | 18 12 34.4 | –27 58 11.6 | wels | GC2009 | | | | GC2009 |
| 003.9–02.3 | | M 1–35 | 18 03 39.3 | –26 43 33.9 | wels | DP2011 | | | | DP2011 |
| 003.9–14.9 | | Hb 7 | 18 55 38.0 | –32 15 47.1 | O3 | GP2001 | wels | TA1993 | | – |
| 004.0–03.0 | | M 2–29 | 18 06 40.9 | –26 54 56.0 | O(H)f + ? | MM2011 | H-poor + ? | PT1992 | GH2001 | PT1992 MM2011 |
| 004.2–04.3 | | H 1–60 | 18 12 25.2 | –27 29 12.8 | wels | TA1993 | | | | – |
| 004.6+06.0 | | Hen 2–244 | 17 33 37.6 | –21 46 25.0 | wels | AN2003 | | | | – |
| 004.9+04.9 | | M 1–25 | 17 38 30.3 | –22 08 38.8 | [WC 5–6] | AN2003 | | | | D2014 AN2003 |
| 004.9–04.9 | * | M 1–44 | 18 16 17.4 | –27 04 32.5 | SySt | BM2000 | K2 III | SECVPN | bc-CSPN | – |
| 005.0+03.0 | | Pe 1–9 | 17 45 36.9 | –23 02 26.6 | O(H) + ? | WG2018 | | | MA2009 | WG2018 |
| 005.1–08.9 | | Hf 2–2 | 18 32 30.9 | –28 43 20.3 | O(H)3 + ? | t.w. | | | HB2016 | HB2016 |
| 005.8–06.1 | | NGC 6620 | 18 22 54.2 | –26 49 17.2 | cont. | AK1987 | | | | – |
| 005.9–02.6 | | MaC 1–10 | 18 09 12.9 | –25 04 33.3 | [WC 8] | GS2003 | | | | GS2004 |
| 006.0–03.6 | | M 2–31 | 18 13 16.1 | –25 30 05.3 | [WC 4] | AN2003 | | | | MA2003 |
| 006.0–41.9 | | PaRu 1–1 | 21 05 53.6 | –37 08 40.3 | O(H) | PT1992 | CV | KO2015 | | PT1992 |
| 006.1+08.3 | | M 1–20 | 17 28 57.6 | –19 15 53.9 | wels | OK2013 | | | | – |
| 006.3+04.4 | | H 2–18 | 17 43 28.8 | –21 09 51.3 | Of? | AK1987 | | | | – |
| 006.4+02.0 | | M 1–31 | 17 52 41.4 | –22 21 57.0 | wels | TA1993 | | | | – |
| 006.5–03.1 | | H 1–61 | 18 12 34.0 | –24 50 00.5 | wels | GS2004 | | | | – |
| 006.7–02.2 | | M 1–41 | 18 09 29.9 | –24 12 23.5 | (WN)? | SECVPN | | | | – |
| 006.8+04.1 | | M 3–15 | 17 45 31.7 | –20 58 01.8 | [WC 4] | AN2003 | | | | D2014 AN2003 |
| 006.9–05.1 | | MPA J1820–2524 | 18 20 57.7 | –25 24 22.0 | Blue | MASH-II | | | | – |
| 007.0–06.8 | | Vy 2–1 | 18 27 59.6 | –26 06 48.3 | wels | TA1993 | | | | MA2003 |
| 007.5+04.3 | * | Th 4–1 | 17 46 20.8 | –20 13 48.3 | SySt | GG2014 | | | | GG2014 |
| 007.5–05.0 | | BMP J1822–2449 | 18 22 10.4 | –24 49 54.0 | Blue? | MASH-II | | | | – |
| 007.8–03.7 | | M 2–34 | 18 17 15.9 | –23 58 54.5 | [WC] | SECVPN | | | | – |
| 007.8–04.4 | | H 1–65 | 18 20 08.9 | –24 15 05.0 | O(H)8–9 I | WG2018 | | | | WG2018 |
| 008.0+03.9 | | NGC 6445 | 17 49 15.2 | –20 00 34.5 | cont. | SECVPN | | | | – |
| 008.1–04.7 | | M 2–39 | 18 22 01.1 | –24 10 40.2 | wels | GS2004 | | | | DP2011 |
| 008.2+06.8 | | Hen 2–260 | 17 38 57.1 | –18 17 35.0 | O(H)7–8 | t.w. | | | | Hv2015 |
| 008.2–04.8 | | M 2–42 | 18 22 32.1 | –24 09 27.7 | wels: | DP2011 | | | | DP2011 |
| 008.3–01.1 | | M 1–40 | 18 08 26.0 | –22 16 53.3 | wels | GS2004 | | | | – |
| 008.3–07.3 | | NGC 6644 | 18 32 34.7 | –25 07 44.2 | wels | GS2004 | | | | AK1988 |
| 009.4–05.0 | | NGC 6629 | 18 25 42.4 | –23 12 10.6 | O(H) | t.w. | | | | LC2014 MA2003 |
| 009.6+10.5 | | A 41 | 17 29 02.0 | –15 13 04.4 | sdO + ? | GL1984 | sdB | WO1994 | GB1983 | GL1984 |
| 009.6+14.8 | | NGC 6309 | 17 14 04.3 | –12 54 37.7 | O(He)? | WM2015 | | | | WM2015 |
| 009.6–10.6 | | M 3–33 | 18 48 12.1 | –25 28 52.4 | wels | GS2004 | | | | – |
| 009.8–04.6 | | H 1–67 | 18 25 05.0 | –22 34 52.6 | [WO 2] | GS2004 | | | | GS2004 |
| 009.8–07.5 | | IRAS 18333–2357 | 18 36 22.9 | –23 55 19.7 | sdO | RD1998 | O(C) | PT1992 | | GJ1989 HP1993 |
| 010.4+04.4 | | SAKURAI's object | 17 52 32.7 | –17 41 07.9 | born-again | DB1996 | | | | AN1999 |
| 010.7–06.4 | | IC 4732 | 18 33 54.7 | –22 38 41.0 | Of | AK1987 | | | | – |
| 010.8+18.0 | | M 2–9 | 17 05 38.0 | –10 08 34.6 | B[e] | LZ1998 | | | | B1989 TA2010 |
| 010.8–01.8 | | NGC 6578 | 18 16 16.5 | –20 27 02.7 | Of | AK1987 | wels | TA1993 | | H1996 PA1998 |
| 011.1–07.9 | * | SB 17 | 18 40 19.9 | –22 54 29.4 | [WC 12] | Ko2001 | | | | MW1990 LH1994 |
| 011.3–09.4 | | H 2–48 | 18 46 35.1 | –23 26 48.2 | O III-V | WG2018 | | | | WG2018 |
| 011.4+17.9 | | DHW 1–2 | 17 06 55.0 | –09 46 59.0 | DAO | SW1997 | | | | SW1997 |
| 011.7–00.6 | | NGC 6567 | 18 13 45.2 | –19 04 34.2 | wels | TA1993 | [WC] | AK1987 | | PA1998 |
| 011.7–06.6 | | M 1–55 | 18 36 42.5 | –21 48 59.4 | O? | SECVPN | | | | – |
| 011.9+04.2 | | M 1–32 | 17 56 20.0 | –16 29 04.0 | [WO 4]pec | AN2003 | | | | D2014 AN2003 |
| 012.1–11.2 | | PPA J1855–2328 | 18 55 04.9 | –23 28 12.8 | O(H)6 III-V | WG2018 | | | | WG2018 |

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Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----------------|----------------|---------------------|----------------------|-------------|---------|------|--------|---------|---------------|
| 012.2+04.9 | | PM 1–188 | 17 54 21.1 | -15 55 52.0 | [WC 10] | AN2003 | | | | LH1998 |
| 012.5–09.8 | | M 1–62 | 18 50 26.1 | -22 34 22.8 | wels | TA1993 | | | | - |
| 012.9+06.6 | | BMP J1749–1429 | 17 49 39.7 | -14 29 18.0 | Blue? | MASH-II | | | | - |
| 013.1+05.0 | | Sa 3–96 | 17 55 45.1 | -15 03 42.8 | H-rich? | WG2018 | | | | WG2018 |
| 013.7–10.6 | | Y–C 2–32 | 18 55 30.6 | -21 49 39.0 | wels | GS2004 | | | | - |
| 014.0–05.5 | | V–V 3–5 | 18 36 32.3 | -19 19 28.0 | A + ? | SECVPN | | | bc-CSPN | - |
| 014.2+03.8 | | PMR 4 | 18 02 38.3 | -14 42 02.8 | wels | AN2003 | | | | PM2003 |
| 014.3–05.5 | | Sa 2–352 | 18 37 11.1 | -19 02 21.9 | wels | AN2003 | | | | - |
| 014.4–06.1 | | SB 19 | 18 39 40.1 | -19 14 12.0 | wels | GS2004 | | | | - |
| 014.6–04.3 | | M 1–50 | 18 33 20.9 | -18 16 37.1 | cont.? | SECVPN | | | | - |
| 014.8–08.4 | | SB 20 | 18 49 24.3 | -19 52 16.0 | O(H)3-4 | WG2018 | | | | WG2018 |
| 015.4–04.5 | | M 1–53 | 18 35 48.2 | -17 36 08.4 | O(H)3 If | WM2015 | | | | WM2015 |
| 015.5+02.8 | | BMP J1808–1406 | 18 08 35.1 | -14 06 43.0 | Blue | MASH-II | | | | - |
| 015.9+03.3 | | M 1–39 | 18 07 30.7 | -13 28 47.6 | cont. | K1994 | | | | - |
| 016.2–03.7 | | PM 4 | 18 02 38.3 | -14 42 03.5 | [WC 8] | PM2003 | | | | PM2003 |
| 016.4–01.9 | | M 1–46 | 18 27 56.3 | -15 32 54.6 | O(H)7 I(fc) | WG2018 | | | | WG2018 |
| 016.8–01.7 | | BMP J1827–1504 | 18 27 50.8 | -15 04 24.0 | [WC 4] | MASH-II | | | | DP2011 |
| 017.3–21.9 | | A 65 | 19 46 34.2 | -23 08 12.9 | O(H) + ? | HF2015 | Op k | SECVPN | HP2013 | WW1996 |
| 017.6–10.2 | | A 51 | 19 01 01.4 | -18 12 15.3 | O(H)3-5Vz | WG2018 | sdO8 | HA1987 | | WG2018 |
| 017.9–04.8 | | M 3–30 | 18 41 14.9 | -15 33 43.6 | [WO 2] | AN2003 | | | | D2014 AN2003 |
| 019.4–05.3 | | M 1–61 | 18 45 55.1 | -14 27 37.9 | wels | AN2003 | | | | AN2003 |
| 019.7–04.5 | | M 1–60 | 18 43 38.1 | -13 44 48.9 | [WC 4] | AN2003 | | | | - |
| 019.7–10.7 | | MPA J1906–1634 | 19 06 32.8 | -16 34 00.0 | Blue | MASH-II | | | | - |
| 019.7–10.7 | | MPA J1906–1634 | 19 06 32.8 | -16 34 00.2 | DAO | AW2019 | | | | AW2019 |
| 020.4–07.0 | | MPA J1854–1420 | 18 54 14.7 | -14 20 19.0 | Blue? | MASH-II | | | | - |
| 020.7–05.9 | | Sa 1–8 | 18 50 44.2 | -13 31 02.4 | O(H)4-8 III | WG2018 | | | | WG2018 |
| 020.7–08.0 | | MPA J1858–1430 | 18 58 19.3 | -14 30 26.0 | O(H)3-5Vz | WG2018 | | | | WG2018 |
| 020.9–01.1 | | M 1–51 | 18 33 28.9 | -11 07 26.4 | [WO 4]pec | AN2003 | | | | AN2003 |
| 021.0–04.1 | | PMR 7 | 18 44 07.7 | -12 26 51.0 | [WC 4] | PM2003 | | | | PM2003 |
| 023.8–06.2 | | BMP J1857–1054 | 18 57 09.8 | -10 54 51.0 | Blue | MASH-II | | | | - |
| 025.3+40.8 | | IC 4593 | 16 11 44.5 | +12 04 17.1 | O(H)5f | SECVPN | | | | KM1997 HB2011 |
| 025.4–04.7 | | IC 1295 | 18 54 37.2 | -08 49 39.1 | hgO(H) | NS1995 | | | | NS1995 |
| 025.8–17.9 | | NGC 6818 | 19 43 57.8 | -14 09 11.9 | wels + ? | TA1993 | WNb? | HA1999 | BC2003 | MA2003 |
| 025.9–10.9 | | NA 2 | 19 18 19.5 | -11 06 15.4 | wels | MA2003 | | | | MA2003 |
| 027.6+04.2 | | M 2–43 | 18 26 40.1 | -02 42 57.3 | [WC 7-8] | AN2003 | | | | LH1998 dM2002 |
| 027.6+16.9 | | DeHt 2 | 17 41 40.9 | +03 06 57.3 | sdO | AM2015 | | | | AM2015 |
| 027.6–09.6 | | IC 4846 | 19 16 28.2 | -09 02 36.5 | O(H)3-4 f | t.w. | | | | GG2014 |
| 028.0+10.2 | | WeSb 3 | 18 06 00.8 | +00 22 38.6 | PG 1159? | NS1995 | | | | - |
| 029.0+00.4 | | A 48 | 18 42 46.9 | -03 13 17.3 | [WN 4] | FB2014 | | | | FB2014 |
| 029.2–05.9 | | NGC 6751 | 19 05 55.6 | -05 59 32.9 | [WO 4] | AN2003 | | | | AN2003 AI1975 |
| 030.6+06.2 | * ⁶ | Sh 2–68 | 18 24 58.4 | +00 51 35.9 | hybrid | WH2006 | DAOZ | GB2010 | | GB2010 |
| 032.0–03.0 | | K 3–18 | 19 00 34.8 | -02 11 58.0 | [WC 9] | MM2014 | SySt | GS2011 | | MM2014 |
| 033.2–01.9 | | Sa 3–151 | 18 58 51.7 | -00 32 54.3 | A + ? | SECVPN | | | bc-CSPN | - |
| 034.1–10.5 | | HDW 11 | 19 31 07.2 | -03 42 31.5 | hgO(H) | NS1995 | | | | NS1995 |
| 034.3+06.2 | | K 3–5 | 18 31 45.8 | +04 05 09.3 | EL | WG2018 | | | | WG2018 |
| 034.5–06.7 | | NGC 6778 | 19 18 24.9 | -01 35 47.4 | O(H)3-4 + ? | t.w. | | | MJ2011 | MJ2011 |
| 034.6+11.8 | | NGC 6572 | 18 12 06.4 | +06 51 13.0 | Of-WR(H) | WM2015 | | | | WM2015 |
| 035.9–01.1 | | Sh 2–71 | 19 01 59.3 | +02 09 18.0 | B8V + ? | ML2015 | | | JP2019 | ML2015 |

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Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----|-----------------|---------------------|----------------------|------------------|---------|-----------------|---------|---------|---------------|
| 036.0+17.6 | | A 43 | 17 53 32.3 | +10 37 24.2 | hybrid | WH2006 | | | | LR2019 |
| 036.1-57.1 | | NGC 7293 | 22 29 38.6 | -20 50 13.6 | DAO + ? | NS1995 | | | AL2019a | GB2010 |
| 036.4-01.9 | | IRAS 19021+0209 | 19 04 38.5 | +02 14 23.0 | B[e] | WG2018 | | | | WG2018 |
| 037.5-05.1 | | A 58 | 19 18 20.6 | +01 46 58.8 | [WC 4-7] | SECVPN | | | | CK2006 |
| 037.7-06.0 | | MPA J1921+0132 | 19 21 44.5 | +01 32 40.0 | [WO 3-4] | MASH-II | | | | DP2011 |
| 037.7-34.5 | | NGC 7009 | 21 04 10.9 | -11 21 48.3 | O(H) | SECVPN | | | | LC2014 |
| 037.8-06.3 | | NGC 6790 | 19 22 57.0 | +01 30 46.6 | WN? | SECVPN | wels | WG2011b | MB2012 | WG2011b |
| 038.1-25.4 | | A 70 | 20 31 33.2 | -07 05 18.0 | G8 IV-V + hot WD | MB2012 | | | MB2012 | MB2012 |
| 038.2+12.0 | | Cn 3-1 | 18 17 34.1 | +10 09 03.3 | O(H)7 Ib(f) | WM2015 | | | | WM2015 |
| 038.4-03.3 | | K 4-19 | 19 13 22.6 | +03 25 00.2 | B1 I | WG2018 | | | | WG2018 |
| 039.0-04.0 | | IPHAS191716 | 19 17 16.4 | +03 34 47.0 | O(H) III-V(e) | WG2018 | | | | WG2018 |
| 039.5-02.7 | | M 2-47 | 19 13 34.5 | +04 38 04.0 | O3-6 | WG2018 | | | | WG2018 |
| 041.8+04.1 | | K 3-15 | 18 51 41.5 | +09 54 52.6 | [WC 11]/VL | GG2014 | | | | GG2014 |
| 041.8-02.9 | | NGC 6781 | 19 18 28.1 | +06 32 19.3 | DAO | Fd2008 | | | | - |
| 042.0+05.4 | | K 3-14 | 18 48 32.8 | +10 35 50.7 | O8-9 | WG2018 | | | | WG2018 |
| 042.5-14.5 | | NGC 6852 | 20 00 39.2 | +01 43 40.1 | PG 1159 | WH2006 | | | | NS1995 |
| 042.9-06.9 | | NGC 6807 | 19 34 33.5 | +05 41 02.5 | Of | AK1987 | | | | - |
| 043.1+03.8 | | M 1-65 | 18 56 33.6 | +10 52 09.7 | EL | K1994 | | | | K1994 |
| 043.1+37.7 | | NGC 6210 | 16 44 29.5 | +23 47 59.7 | O(H)3 | t.w. | EL ⁷ | MV1997 | | MV1997 |
| 044.1+05.8 | * | CTSS 2 | 18 50 46.8 | +12 37 29.8 | SySt | GG2014 | | | | GG2014 |
| 044.3-05.6 | | K 3-36 | 19 32 39.6 | +07 27 51.6 | O? | WG2018 | | | | WG2018 |
| 045.4-02.7 | | Vy 2-2 | 19 24 22.2 | +09 53 56.7 | B[e] | LZ1998 | | | | - |
| 045.7-04.5 | | NGC 6804 | 19 31 35.1 | +09 13 31.4 | O9 | SECVPN | | | | - |
| 046.4-04.1 | | NGC 6803 | 19 31 16.5 | +10 03 21.7 | wels | TA1993 | WN? | LH2013 | | - |
| 046.8+03.8 | | Sh 2-78 | 19 03 10.1 | +14 06 58.9 | PG 1159 | WH2006 | | | | NS1995 |
| 047.0+42.4 | | A 39 | 16 27 33.7 | +27 54 33.5 | DAO | ZR2012 | sdO | HA1987 | | NS1995 |
| 047.1+04.1 | | K 3-21 | 19 02 40.4 | +14 28 48.8 | cont. | WG2018 | | | | WG2018 |
| 048.7+01.9 | | Hen 2-429 | 19 13 38.4 | +14 59 19.1 | [WC 4] | AN2003 | | | | dM2002 |
| 049.4+02.4 | | Hen 2-428 | 19 13 05.2 | +15 46 39.8 | O5 + ? | RC2001 | | | SR2015 | RF2018 |
| 051.0+02.8 | | WhMe 1 | 19 14 59.7 | +17 22 46.0 | B9 V + ? | SECVPN | | | bc-CSPN | - |
| 051.3+01.8 | | PM 1-295 | 19 19 18.7 | +17 11 48.9 | O(H)9 I | WG2018 | | | | WG2018 |
| 051.4+09.6 | | Hu 2-1 | 18 49 47.6 | +20 50 39.5 | WNb + ? | vH1981 | | | MT2001 | - |
| 051.9-03.8 | | M 1-73 | 19 41 09.3 | +14 56 58.8 | O(H)3.5 If | WM2015 | | | | MA2003 WM2015 |
| 052.2+07.6 | | K 4-10 | 18 59 03.7 | +20 37 01.1 | O3-4 | WG2018 | | | | WG2018 |
| 052.2-04.0 | | M 1-74 | 19 42 18.9 | +15 09 08.2 | WN b? | SECVPN | | | | - |
| 052.5-02.9 | | Me 1-1 | 19 39 09.8 | +15 56 48.2 | K1-2 II + ? | PM2008 | Of | AK1987 | PM2008 | SL2004 |
| 052.7+50.7 | | Nap 1 | 15 51 59.9 | +32 56 54.3 | O(H)7 + ? | NH1994 | | | | VH2014 |
| 053.3+24.0 | | Vy 1-2 | 17 54 23.0 | +27 59 58.1 | [WR]/wels + ? | AB2015 | | | | AB2015 |
| 053.8-03.0 | | A 63 | 19 42 10.4 | +17 05 14.5 | sdO + ? | WW1993 | M4 V | SECVPN | MP2007 | WW1993 |
| 054.1-12.1 | | NGC 6891 | 20 15 08.8 | +12 42 15.6 | O(H)3 Ib(f*) | WM2015 | | | | WM2015 |
| 054.2-03.4 | | IRAS 19417+1701 | 19 43 59.5 | +17 09 00.9 | H-poor + ? | MB2013 | | | MB2013 | MB2013 |
| 054.4-02.5 | | M 1-72 | 19 41 33.9 | +17 45 17.4 | cont. | WG2018 | | | | WG2018 |
| 055.1-01.8 | | K 3-43 | 19 40 25.9 | +18 49 14.2 | M + ? | SF1987 | | | bc-CSPN | - |
| 055.4+16.0 | | A 46 | 18 31 18.3 | +26 56 12.9 | O(H)3 + ? | t.w. | O9k | SECVPN | MO2007 | PB1994 |
| 055.5-00.5 | | M 1-71 | 19 36 26.9 | +19 42 24.1 | wels | TA1993 | | | | - |
| 055.6+02.1 | | Hen 1-2 | 19 26 37.7 | +21 09 26.9 | O9 - B0 I | WG2018 | | | | WG2018 |
| 057.2-08.9 | | NGC 6879 | 20 10 26.7 | +16 55 21.4 | O(He)3 f | WM2015 | | | | WM2015 |
| 058.3-10.9 | | IC 4997 | 20 20 08.8 | +16 43 53.6 | wels | TA1993 | [WC10] | ZA1986 | | MA2003 |

Continued on next page

⁷ Emission at H α

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|-------------------------|----|-----------------|---------------------|----------------------|-----------------|------------------|--------------|--------|---------|----------------------|
| 058.6+06.1 | | A 57 | 19 17 05.6 | +25 37 32.9 | O(H) | dP2013 | | | | - |
| 059.7–18.7 | | A 72 | 20 50 02.1 | +13 33 29.5 | PG 1159 | dP2013 | | | | - |
| 060.0–04.3 | | A 68 | 20 00 10.6 | +21 42 55.4 | H-rich cont. | WG2018 CP1985 | | | | WG2018 |
| 060.1–07.7 | | NGC 6886 | 20 12 42.8 | +19 59 22.6 | [WC 11] | SECVPN | | | | - |
| 060.4+01.5 | | PM 1–310 | 19 38 52.1 | +25 05 32.6 | | | | | | P2005 |
| 060.5+01.8 | | Hen 2–440 | 19 38 08.4 | +25 15 41.0 | wels? | GG2014 | | | | GG2014 |
| 060.8–03.6 | | NGC 6853 | 19 59 36.3 | +22 43 16.1 | DAO + | NS1995 | | | C1973 | GB2010 |
| 061.0+08.0 | | K 3–27 | 19 14 30.0 | +28 40 45.5 | G0: + ? | L1977 | | | bc-CSPN | - |
| 061.3+03.6 | | M 1–91 | 19 32 57.5 | +26 52 41.0 | Be? + ? | AT2003 | | | RC2001 | TA2010 |
| 061.4–09.5 | | NGC 6905 | 20 22 22.9 | +20 06 16.8 | [WO 2] | AN2003 | | | | MP2006 |
| 061.8+02.1 | * | Hen 2–442 | 19 39 43.4 | +26 29 33.1 | SySt | BM2000 | | | | - |
| 061.9+41.3 | | DDDM 1 | 16 40 18.2 | +38 42 20.0 | O(H) | PT1992 | | | | HK2008 PT1992 |
| 062.4+09.5 | | NGC 6765 | 19 11 06.5 | +30 32 42.5 | PG 1159 | WH2006 | | | | NS1995 |
| 063.1+13.9 | | NGC 6720 | 18 53 35.1 | +33 01 45.0 | hgO(H) | UL2014 | | | | NS1995 |
| 064.6+48.2 | | NGC 6058 | 16 04 26.6 | +40 40 56.1 | O(H)3 | t.w. | | | | HB2011 |
| 064.7+05.0 | | BD+30 3639 | 19 34 45.2 | +30 30 58.9 | [WC 9] | AN2003 | | | | dM2002 |
| 065.0–27.3 | | Ps 1 | 21 29 59.4 | +12 10 26.3 | sdO | RH2002 | O(H)-C | PT1992 | | OH2015 |
| 066.7–28.2 | | NGC 7094 | 21 36 53.0 | +12 47 19.0 | hybrid | WH2006 | | | | NS1995 |
| 066.8+02.9 | | IPHAS194751 | 19 47 51.9 | +31 18 18.3 | B0 I | WG2018 | | | | WG2018 |
| 068.1+11.0 | | ETHOS 1 | 19 16 31.5 | +36 09 47.9 | wels + ? | MC2011 | | | | MC2011 |
| 068.3–02.7 | | Hen 2–459 | 20 13 57.9 | +29 33 55.9 | [WC 9] | AN2003 | | | | LH1998 |
| 068.7+01.9 | | K 4–41 | 19 56 34.0 | +32 22 12.9 | wels? | GG2014 | | | | GG2014 |
| 068.7+14.8 | | SP 4–1 | 19 00 26.6 | +38 21 07.3 | O? | WG2018 | | | | WG2018 |
| 069.4–02.6 | | NGC 6894 | 20 16 24.0 | +30 33 53.2 | WD? | SZ1997 | | | | - |
| 072.7–17.1 | | A 74 | 21 16 52.3 | +24 08 51.8 | DAO | NS1995 | | | | NS1995 |
| 075.7+35.8 | | Sa 4–1 | 17 13 50.4 | +49 16 11.0 | O(H)3 V | WG2018 | | | | WG2018 |
| 075.9+11.6 | | AMU 1 | 19 31 08.9 | +43 24 57.7 | O(H)3 Vz + ? | WG2018 | sdO | AM2013 | AM2013 | WG2018 |
| 076.3+14.1 | | Pa 5 | 19 19 30.5 | +44 45 42.7 | O(H) + ? | t.w. | PG 1159 | GD2014 | dO2015 | GD2014 dO2015 |
| 077.6+14.7 | | A 61 | 19 19 10.2 | +46 14 52.0 | DAO | dO2015 | | | | NS1995 |
| 078.5+18.7 | | A 50 | 18 59 20.0 | +48 27 55.2 | O(H) III-V | WG2018 | | | | WG2018 |
| 079.9+06.4 | | K 3–56 | 20 06 55.4 | +44 14 18.6 | wels? | GG2014 | | | | GG2014 |
| 080.3–10.4 ⁸ | | MWP 1 | 21 17 08.3 | +34 12 27.5 | PG 1159 | WH2006 | | | | MW1993 |
| 081.2–14.9 | | A 78 | 21 35 29.4 | +31 41 45.3 | [WC]-PG 1159 | GT2000 | | | | PC2005 TG2015 WK1992 |
| 082.1+07.0 | | NGC 6884 | 20 10 23.7 | +46 27 39.8 | WN b? | SECVPN | | | | - |
| 082.5+11.3 | | NGC 6833 | 19 49 46.6 | +48 57 40.2 | Of | AK1987 | | | | - |
| 083.5+12.7 | | NGC 6826 | 19 44 48.2 | +50 31 30.3 | O(H)3f + ? | SECVPN | | | LR1983 | KM1997 |
| 084.7–08.0 | | Kn 26 | 21 23 09.3 | +38 58 11.0 | Blue | GM2013 | | | | - |
| 084.9–03.4 | | NGC 7027 | 21 07 01.8 | +42 14 10.0 | cont. | HH1994 | | | | - |
| 085.4+52.3 | | Jacoby 1 | 15 21 46.6 | +52 22 04.0 | PG 1159 | WH2006 | | | | DH1998 |
| 086.9–03.4 | | Ou 5 | 21 14 20.0 | +43 41 36.0 | K + ? | CR2014 | | | | - |
| 089.0+00.3 | | NGC 7026 | 21 06 18.2 | +47 51 05.4 | [WO 3] | AN2003 | | | | SK1995 |
| 089.3–02.2 | | M 1–77 | 21 19 07.4 | +46 18 47.2 | B1 | t.w. | | | | d2009 |
| 089.8–05.1 | | IC 5117 | 21 32 31.0 | +44 35 48.5 | [WR] | SECVPN | | | | - |
| 093.4+05.4 | | NGC 7008 | 21 00 32.5 | +54 32 36.2 | O7 + ? | SECVPN | | | | - |
| 093.9–00.1 | | IRAS 21282+5050 | 21 29 58.4 | +51 03 59.8 | [WC 11] + ? | LH1998 | O7(f)-[WC11] | CJ1987 | HZ2019 | LH1998 |
| 094.0+27.4 | | K 1–16 | 18 21 52.2 | +64 21 54.3 | PG 1159 (lg E) | WH2006 | [WO] | SK1994 | | YL2013 |
| 095.2+00.7 | | K 3–62 | 21 31 50.2 | +52 33 51.6 | wels? | GG2014 | | | | GG2014 |
| 096.3+02.3 | | K 3–61 | 21 30 00.7 | +54 27 27.5 | [WC 4-6] | TA1993 | | | | - |

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⁸ Another designation is PN G080.8–10.6

Table 1 – continued from previous page

| PNG | f _— | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|-----------------|--------------------------|---------------------|----------------------|-------------------------|--------|-----------------------|--------|---------|----------------------|
| 096.4+29.9 | | NGC 6543 | 17 58 33.4 | +66 37 59.5 | Of-WR(H) | WM2015 | | | | WM2015 |
| 096.9+32.0 | * ⁹ | RE 1738+665 | 17 38 02.6 | +66 53 47.9 | DA | N1999 | | | | BH1994 |
| 100.0–08.7 | | Me 2–2 | 22 31 43.7 | +47 48 03.9 | Of | AK1987 | | | | - |
| 100.6–05.4 | | IC 5217 | 22 23 55.7 | +50 58 00.5 | [WC]? | t.w. | | | | - |
| 102.9–02.3 | | A 79 | 22 26 17.3 | +54 49 38.2 | F0 V + ? | B2008 | | | bc-CSPN | - |
| 103.7+00.4 | | M 2–52 | 22 20 30.7 | +57 36 21.6 | Non-[WC] | PM2002 | | | | - |
| 104.2–29.6 | | Jn 1 | 23 35 53.3 | +30 28 06.4 | PG 1159 (E) | WH2006 | | | | NS1995 |
| 104.4–01.6 | | M 2–53 | 22 32 17.7 | +56 10 26.1 | WN a? | SECVPN | | | | - |
| 104.8–06.7 | | M 2–54 | 22 51 38.9 | +51 50 42.4 | B? + ? | H2003 | O9V | GP2003 | bc-CSPN | - |
| 106.5–17.6 | | NGC 7662 | 23 25 53.6 | +42 32 06.0 | O(H) | HB2011 | cont. | CP1985 | | HB2011 |
| 107.4–00.6 | * | K 4–57 | 22 48 34.3 | +58 29 08.3 | SySt | GG2014 | | | | GG2014 |
| 107.6–13.3 | | Vy 2–3 | 23 22 57.9 | +46 53 58.1 | O(H)3–4 I | WG2018 | | | | WG2018 |
| 107.7+07.8 | | IsWe 2 | 22 13 22.5 | +65 53 55.5 | DA | NS1995 | | | | NS1995 |
| 107.7–02.2 | | M 1–80 | 22 56 19.8 | +57 09 20.7 | cont. | SECVPN | | | | - |
| 107.8+02.3 | | NGC 7354 | 22 40 19.8 | +61 17 08.7 | cont. | F1994 | | | | - |
| 111.0+11.6 | | DeHt 5 | 22 19 33.7 | +70 56 03.1 | DA | NS1995 | | | | NS1995 |
| 111.8–02.8 | | Hb 12 | 23 26 14.8 | +58 10 54.7 | B[e]? + ? | LZ1998 | WN7? | SECVPN | HI2006 | HI2006 |
| 114.0–04.6 | | A 82 | 23 45 47.8 | +57 03 58.5 | K0 IV + ? ¹⁰ | CB1999 | | | bc-CSPN | - |
| 118.0–08.6 | | Vy 1–1 | 00 18 42.2 | +53 52 20.0 | O(H) | N1999 | [WC] | AK1985 | | - |
| 118.8–74.7 | | NGC 246 | 00 47 03.3 | –11 52 18.9 | PG 1159 (lg E) + ? | WH2006 | PG 1159 ¹¹ | AM2014 | BC1999 | WR1994 W1992 SH2014 |
| 119.6–06.7 | | Hu 1–1 | 00 28 15.6 | +55 57 54.7 | A? + ? | SECVPN | | | bc-CSPN | - |
| 120.0+09.8 | | NGC 40 | 00 13 01.0 | +72 31 19.1 | [WC 8] | AN2003 | | | | TR2019 MP2006 |
| 120.2–05.3 | | Sh 2–176 | 00 31 53.3 | +57 22 49.0 | DA | NS1995 | | | | NS1995 |
| 120.3+18.3 | * | Sh 2–174 | 23 45 02.3 | +80 56 59.6 | DAO + ? | NS1993 | | | GB2010 | GB2010 |
| 123.6+34.5 | | IC 3568 | 12 33 06.9 | +82 33 49.0 | O(H)3 | SECVPN | O5f | P1984 | | M1990 |
| 124.0+10.7 | | EGB 1 | 01 07 07.6 | +73 33 23.1 | DA | NS1995 | | | | NS1995 |
| 125.9–47.0 | * | PHL 932 | 00 59 56.7 | +15 44 13.8 | hgO(H) | SECVPN | sdB | FM2010 | | MG1988 N1999 |
| 126.6+01.3 | | IPHAS PN-1 ¹² | 01 25 07.9 | +63 56 52.7 | EL + ? ¹³ | MC2006 | | | MC2006 | - |
| 128.0–04.1 | | Sh 2–188 | 01 30 33.1 | +58 24 50.7 | DAO | NS1995 | | | | GB2010 |
| 130.2+01.3 | | IC 1747 | 01 57 35.9 | +63 19 19.4 | [WO 4] | AN2003 | | | | SK1994 |
| 130.3–11.7 | | M 1–1 | 01 37 19.4 | +50 28 11.6 | cont. | ZA1986 | | | | - |
| 130.9–10.5 | | NGC 650–1 | 01 42 19.9 | +51 34 31.2 | PG 1159 (E) + ? | WH2006 | | | | NS1995 |
| 133.1–08.6 | * | M 1–2 | 01 58 49.7 | +52 53 48.5 | G2 Ib + ? | M1989 | SySt | HM2008 | AE2008 | MS2012 |
| 135.6+01.0 | | WeBo 1 | 02 40 14.4 | +61 09 16.8 | K0 III + ? | SB2007 | | | BP2003 | BP2003 |
| 135.9+55.9 | | TS 01 | 11 53 24.7 | +59 39 56.9 | sdO + ? | t.w. | | | NT2005 | TN2004 TY2010 |
| 136.3+05.5 | | HFG 1 | 03 03 47.0 | +64 54 35.7 | sdO + ? | CB2016 | F9 V | EP2005 | EP2005 | NS1995 EP2005 |
| 138.1+04.1 | | HDW 2 | 03 11 01.3 | +62 47 45.1 | A + ? | SECVPN | | | bc-CSPN | - |
| 138.8+02.8 | | IC 289 | 03 10 19.3 | +61 19 01.0 | O(H) | N1999 | WD? | CG2009 | | - |
| 143.6+23.8 | * ¹⁴ | EGB 4 | 06 29 34.0 | +71 04 36.3 | H-rich + ? | NS1995 | | | | NS1995 |
| 144.5+06.5 | | NGC 1501 | 04 06 59.2 | +60 55 14.3 | [WO 4] | AN2003 | | | | SK1994 AN2003 |
| 144.8+65.8 | | BE Uma | 11 57 44.8 | +48 56 18.7 | sdO + ? | FL1999 | | | FM1981 | LT1995 FL1987 SB2008 |
| 146.7+07.6 | | M 4–18 | 04 25 50.9 | +60 07 12.8 | [WC 11] | AN2003 | | | | MP2006 |

Continued on next page

⁹ HII region?¹⁰ The true central star is unidentified (Kaler & Feibelman 1985).¹¹ PG 1159 + K2-5 + M5-6¹² PRINCIPES DE ASTURIAS¹³ H α and CaII emission¹⁴ Nebula around CV

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|--------------------------|----|-------------|---------------------|----------------------|-------------------------|---------|------------------|--------|---------|----------------|
| 147.4–02.3 | | M 1–4 | 03 41 43.4 | +52 17 00.3 | Of | AK1987 | | | | - |
| 147.8+04.1 | | M 2–2 | 04 13 15.0 | +56 56 58.4 | cont. | AK1987 | | | | - |
| 148.4+57.0 | | NGC 3587 | 11 14 47.7 | +55 01 08.5 | DAO | WR2019 | | | | NS1995 |
| 149.4–09.2 | | HDW 3 | 03 27 15.4 | +45 24 20.5 | DAO | NS1995 | | | | GB2010 |
| 149.7–03.3 | | IsWe 1 | 03 49 05.9 | +50 00 14.8 | PG 1159 (A) | GT2000 | | | | NS1995 |
| 156.3+12.5 | * | HDW 4 | 05 37 56.2 | +55 32 16.0 | DA | NS1995 | | | | NS1995 |
| 156.9–13.3 | | HaWe 5 | 03 45 26.6 | +37 48 51.8 | DA | NS1995 | | | | NS1995 |
| 158.6+00.7 ¹⁵ | | Sh 2–216 | 04 43 21.3 | +46 42 05.8 | DAO | NS1995 | | | | GB2010 |
| 158.8+37.1 | | A 28 | 08 41 35.6 | +58 13 48.4 | DAH: | KK2013 | O(H) | dP2013 | | YL2013 |
| 158.9+17.8 | | PuWe 1 | 06 19 34.3 | +55 36 42.3 | DAO | NS1995 | | | | GB2010 |
| 159.0–15.1 | | IC 351 | 03 47 33.1 | +35 02 48.5 | O(H)f | WM2015 | | | | WM2015 |
| 161.2–14.8 | | IC 2003 | 03 56 22.0 | +33 52 30.6 | [WC 3]? | TA1993 | [WC7-8] | SECVPN | | SK1995 |
| 164.8+31.1 | | JnEr 1 | 07 57 51.6 | +53 25 17.0 | PG 1159 (E:) | WH2006 | | | | LF1988 |
| 165.5–06.5 | | K 3–67 | 04 39 47.9 | +36 45 42.6 | O(C) | SECVPN | EL ¹⁶ | TS1987 | | - |
| 165.5–15.2 | | NGC 1514 | 04 09 17.0 | +30 46 33.5 | A0 + sdO | AM2015b | | | JV2017 | MK2016 |
| 166.1+10.4 | | IC 2149 | 05 56 23.9 | +46 06 17.3 | O(H)4f | t.w. | | | | - |
| 167.4–09.1 | | K 3–66 | 04 36 37.2 | +33 39 30.0 | O | WG2018 | | | | WG2018 |
| 169.6+00.0 | | IC 2120 | 05 18 10.3 | +37 33 27.4 | G + ? | ZP1990 | | | bc-CSPN | - |
| 170.3+15.8 | | NGC 2242 | 06 34 07.4 | +44 46 38.1 | O(H) | PT1992 | | | | PT1992 |
| 171.3–25.8 | | Ba 1 | 03 53 36.5 | +19 29 38.6 | [WO]? | KS1990 | | | | KS1990 |
| 184.0–02.1 | | M 1–5 | 05 46 50.0 | +24 22 02.8 | EL | WG2018 | | | | WG2018 |
| 189.1+19.8 | | NGC 2371–72 | 07 25 34.7 | +29 29 26.4 | [WO 1] | AN2003 | [WC]-PG 1159 | Gd2013 | | KS1993 |
| 189.8+07.7 | | M 1–7 | 06 37 21.0 | +24 00 35.4 | [WO]-[WC 8] | SECVPN | | | | - |
| 190.3–17.7 | | J 320 | 05 05 34.3 | +10 42 22.7 | O(H)3 V(f:) | WM2015 | | | | WM2015 |
| 191.4+33.1 ¹⁷ | | Ton 320 | 08 27 05.5 | +31 30 08.6 | DAO | N1999 | | | | GB2010 |
| 193.6–09.5 | | H 3–75 | 05 40 45.0 | +12 21 23.3 | G-K + ? | BP2002 | | | bc-CSPN | - |
| 194.2+02.5 | | J 900 | 06 25 57.3 | +17 47 27.2 | wels | TA1993 | | | | - |
| 196.6–10.9 | | NGC 2022 | 05 42 06.2 | +09 05 10.3 | O(H) | N1999 | | | | - |
| 197.4–06.4 | | WeDe 1 | 05 59 24.9 | +10 41 40.4 | DA | NS1995 | | | | NS1995 |
| 197.8+17.3 | | NGC 2392 | 07 29 10.8 | +20 54 42.5 | O(H)6f + ? | SECVPN | | | MM2019 | MK1988 HB2011 |
| 197.8–03.3 | | A 14 | 06 11 08.7 | +11 46 43.8 | A5 + ? | AH2020 | | | bc-CSPN | WG2011a AH2020 |
| 199.4+14.3 | | PM 1–29 | 07 20 01.5 | +18 17 25.9 | B0.5 I | WG2018 | | | | WG2018 |
| 203.1–13.4 | * | Te 11 | 05 45 58.2 | +02 21 06.0 | M2 V + WD ¹⁸ | MW2016 | | | MW2016 | TS2012 |
| 204.1+04.7 | | K 2–2 | 06 52 23.2 | +09 57 55.7 | hgO(H) | NS1995 | | | | NS1995 |
| 205.1+14.2 | | A 21 | 07 29 02.7 | +13 14 48.4 | PG 1159 (E) | WH2006 | | | | NS1995 |
| 206.4–40.5 | | NGC 1535 | 04 14 15.8 | –12 44 22.0 | O(H)5 + ? | t.w. | | | CB1999 | MK1988 HB2011 |
| 208.5+33.2 | | A 30 | 08 46 53.5 | +17 52 45.5 | [WC]-PG 1159 + ? | GT2000 | | | CB1999 | - |
| 211.2–03.5 | | M 1–6 | 06 35 45.1 | –00 05 37.4 | O6-9 I | WG2018 | | | | WG2018 |
| 211.4+18.4 | | HDW 7 | 07 55 11.3 | +09 33 09.3 | hgO(H) | SECVPN | | | | YL2013 |
| 211.9+22.6 | | EGB 5 | 08 11 12.8 | +10 57 17.1 | hgO(H) + ? | SECVPN | | | KV2015 | MK1988 |
| 214.9+07.8 | | A 20 | 07 22 57.7 | +01 45 32.8 | O(H) | SECVPN | | | | RK1999 |
| 215.2–24.2 | | IC 418 | 05 27 28.2 | –12 41 50.3 | O(H)f | SECVPN | O7f | ZA1986 | | SH2014 |
| 215.5–30.8 | | A 7 | 05 03 07.5 | –15 36 22.7 | DAO + ? | NS1995 | | | CB1999 | GB2010 |
| 215.6+03.6 | | NGC 2346 | 07 09 22.5 | –00 48 23.6 | A5 IV + sdO | GM2019 | | | BJ2019 | SH2014 |

Continued on next page

¹⁵ Another designation is PN G158.5+00.7¹⁶ C IV+He II emission¹⁷ Another designation is PN G191.4+33.0¹⁸ Eclipsing dwarf nova

Table 1 – continued from previous page

| PNG | f _— | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|-----------------|------------------------|---------------------|----------------------|-------------|---------|-----------------|---------|---------|----------------------|
| 215.7–03.9 | | BMP J0642–0417 | 06 42 18.4 | –04 17 49.0 | Blue | MASH-II | | | | – |
| 216.0+07.4 | | PHR J0723+0036 | 07 23 48.1 | +00 36 48.0 | [WC 4]: | DP2011 | | | | DP2011 |
| 218.9–10.7 | * ¹⁹ | HDW 5 | 06 23 37.2 | –10 13 23.7 | hgO(H) | SEC GPN | * ²⁰ | LS2007 | | LS2007 |
| 219.1+31.2 | | A 31 | 08 54 13.2 | +08 53 53.1 | DAO + ? | WR2019 | sdO6 | HA1987 | CB1999 | NS1995 |
| 219.2+07.5 | | RWT 152 | 07 29 58.4 | –02 06 37.5 | sdO + ? | AM2015 | O4–5 V | C1980 | AL2019a | AM2015 |
| 219.5+02.8 | | BMP J0713–0432 | 07 13 51.0 | –04 32 51.0 | Blue? | MASH-II | | | | – |
| 220.3–53.9 | | NGC 1360 | 03 33 14.6 | –25 52 18.0 | O(H)3–4 + ? | t.w. | WD/MS | d2006 | MM2018a | MK1988 HB2011 |
| 221.0–01.4 | | PHR J0701–0749 | 07 01 09.3 | –07 49 21.0 | wels | MASH-I | | | | – |
| 221.3–12.3 | | IC 2165 | 06 21 42.8 | –12 59 14.0 | wels | AN2003 | | | | – |
| 221.5+46.3 | | EGB 6 | 09 52 59.0 | +13 44 34.9 | DAOZ + ? | BC2016 | | | LB2013 | BC2016 |
| 222.1+03.9 | | PFP 1 | 07 22 17.7 | –06 21 46.0 | pre-WD? | PF2004 | | | | – |
| 222.5+07.6 | | BMP J0736–0500 | 07 36 23.1 | –05 00 20.0 | Blue | MASH-II | | | | – |
| 222.8–04.2 | | PM 1–23 | 06 54 13.4 | –10 45 38.0 | [WC 8] + ? | DP2011 | | | HZ2010 | HZ2010 |
| 224.9+01.0 | | We 1–6 | 07 17 26.0 | –10 10 37.7 | hgO(H) | SEC GPN | | | | – |
| 225.5–02.5 | | MPA J0705–1224 | 07 05 37.2 | –12 24 52.0 | Blue | MASH-II | | | | – |
| 228.0–00.4 | | MPA J0717–1334 | 07 17 57.5 | –13 34 08.0 | Blue? | MASH-II | | | | – |
| 228.2–22.1 | | DeHt 1 | 05 55 06.7 | –22 54 02.2 | K1 III + ? | TJ2013 | | | TJ2013 | TJ2013 |
| 231.1+03.9 | | BMP J0739–1418 | 07 39 50.6 | –14 18 26.0 | Blue | MASH-II | | | | – |
| 231.8+04.1 | | NGC 2438 ²¹ | 07 41 50.5 | –14 44 07.7 | O(H) + ? | N1999 | hgO(H) | MK2015 | | RK1999 |
| 232.0+05.7 | * | SaSt 2–3 | 07 48 03.5 | –14 07 42.6 | B | WG2011b | | | | WG2011b |
| 232.8–04.7 | | M 1–11 | 07 11 16.7 | –19 51 02.9 | [WC 10–11] | WG2011b | | | | WG2011b |
| 233.5–16.3 | | A 15 | 06 27 01.9 | –25 22 49.6 | O(H) | SEC GPN | sdOp | HA1987 | | MK1985 |
| 234.3–07.2 | | MPA J0704–2221 | 07 04 23.0 | –22 21 52.0 | Blue | MASH-II | | | | – |
| 234.8+02.4 | | NGC 2440 | 07 41 54.9 | –18 12 29.7 | cont. | ZA1986 | | | | – |
| 234.9–01.4 | | M 1–14 | 07 27 56.5 | –20 13 23.4 | O(H)7–9 | WG2018 | | | | WG2018 |
| 234.9–09.7 | | MPA J0656–2356 | 06 56 00.0 | –23 56 49.0 | Blue | MASH-II | | | | – |
| 235.3–03.9 | | M 1–12 | 07 19 21.5 | –21 43 55.4 | O | t.w. | [WC10–11] | WG2011b | | WG2011b K2012 |
| 236.9+08.6 | | PHR J0809–1650 | 08 09 01.4 | –16 50 03.0 | O(H) III–V | WG2018 | | | | WG2018 |
| 237.0+00.7 | | PHR J0740–2055 | 07 40 22.9 | –20 55 54.4 | DAO | AW2019 | | | | AW2019 |
| 237.3–08.4 | | BMP J0705–2528 | 07 05 45.5 | –25 28 50.0 | Blue | MASH-II | | | | – |
| 237.4–09.6 | | BMP J0700–2607 | 07 00 51.8 | –26 07 18.0 | Blue | MASH-II | | | | – |
| 238.0+34.8 | | A 33 | 09 39 09.1 | –02 48 32.0 | DAO + ? | WG2018 | sdOp | HA1987 | CB1999 | WG2018 |
| 239.6+13.9 | | NGC 2610 | 08 33 23.3 | –16 08 57.7 | WD? + ? | CG2009 | | | CB1999 | – |
| 240.3+07.0 | | Y–C 2–5 | 08 10 41.7 | –20 31 32.9 | wels | WG2011b | | | | WG2011b |
| 240.3–07.6 | | M 3–2 | 07 14 49.9 | –27 50 23.2 | H-rich | t.w. | | | | K2012 BJ2018 |
| 240.8–19.6 | * | KLSS 1–9 | 06 24 36.4 | –33 04 49.0 | OB | WG2011a | | | | W2009 |
| 241.0+02.3 | | M 3–4 | 07 55 11.2 | –23 37 45.6 | cont. | WG2011a | | | | – |
| 242.6–11.6 | | M 3–1 | 07 02 49.6 | –31 35 41.3 | O(H) + ? | t.w. | | | | JB2019 |
| 243.3–01.0 | | NGC 2452 | 07 47 26.3 | –27 20 06.6 | [WO 1] | AN2003 | | | | JB2019 |
| 243.8–37.1 | | PRTM 1 | 05 03 01.7 | –39 45 44.5 | O(H)3–4 + ? | t.w. | | | | AN2003 PS1998 SK1995 |
| 245.0+02.2 | | BMP J0803–2706 | 08 03 54.2 | –27 06 02.0 | Blue | MASH-II | | | | BM2012a |
| 245.1–05.5 | | BMP J0733–3108 | 07 33 24.1 | –31 08 05.0 | Blue | MASH-II | | | | BM2012a |
| 245.4+01.6 | | M 3–5 | 08 02 28.9 | –27 41 55.4 | O7 | SEC GPN | | | | – |
| 248.7+29.5 | | A 34 | 09 45 35.4 | –13 10 15.8 | hgO(H) | SEC GPN | | | | – |
| 248.8–08.5 | | M 4–2 | 07 28 55.2 | –35 45 15.4 | wels | WG2011b | | | | BA2016 |

Continued on next page

¹⁹ HII region?²⁰ Unknown absorption at 5758 Å²¹ The CSPN is not the bright star near the center, but the fainter one at the center of the nebula (Öttl et al. 2014).

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|-----------------|----------------|---------------------|----------------------|--------------|---------|-------|--------|---------|---------------|
| 249.8+07.1 | | PHR J0834–2819 | 08 34 18.1 | −28 19 03.0 | DAO | WG2018 | | | | WG2018 |
| 250.3−05.4 | | PHR J0745–3535 | 07 45 41.1 | −35 35 04.0 | cont. | WG2018 | | | | WG2018 |
| 250.5+01.9 | | BMP J0816–3150 | 08 16 20.8 | −31 51 00.0 | Blue | MASH-II | | | | - |
| 250.6+09.3 | | BMP J0844–2737 | 08 44 37.9 | −27 37 15.0 | Blue | MASH-II | | | | - |
| 252.6+04.4 | | K 1–1 | 08 31 52.6 | −32 06 08.7 | G-K + ? | SECVPN | | | bc-CSPN | - |
| 253.5+10.7 | | K 1–2 | 08 57 46.0 | −28 57 36.8 | O(H) + K2 V | t.w. | | | EP2003 | RK1999 |
| 253.9+05.7 | | M 3–6 | 08 40 40.2 | −32 22 33.6 | O(H)3I(f*) | AD2016 | | | | AD2016 MA2003 |
| 254.6+00.2 | * ²² | Ns 238 | 08 20 56.7 | −36 13 46.7 | OB | WG2011a | | | | W2009 |
| 255.3−59.6 | | Lo 1 | 02 56 58.4 | −44 10 17.8 | hgO(H) | SECVPN | | | | MK1985 |
| 257.5+00.6 | | VBRC 1 | 08 30 54.2 | −38 18 07.0 | FV: + ? | RK1999 | | | bc-CSPN | RK1999 |
| 258.0−03.2 | | BMP J0815–4053 | 08 15 56.9 | −40 53 08.0 | Blue | MASH-II | | | | - |
| 258.0−15.7 | | wray 17–1 | 07 14 49.4 | −46 57 39.1 | PG 1159 | WH2006 | | | | MK1985 |
| 258.1−00.3 | | Hen 2–9 | 08 28 28.0 | −39 23 40.3 | wels | TA1993 | | | | - |
| 258.5−01.3 | | RCW 24 | 08 25 47.5 | −40 13 10.3 | DA | WG2018 | | | | WG2018 |
| 259.1+00.9 | | Hen 2–11 | 08 37 08.1 | −39 25 07.0 | O + ? | JB2014 | | | JB2014 | JB2014 |
| 261.0+32.0 | | NGC 3242 | 10 24 46.1 | −18 38 32.6 | O(H) + ? | SECVPN | sdO | HA1987 | MM2019 | MK1988 |
| 261.9+08.5 | | NGC 2818 | 09 16 01.7 | −36 37 38.8 | cont. | LS2007 | | | | - |
| 261.9−05.3 | | BMP J0818–4517 | 08 18 16.8 | −45 17 57.0 | Blue | MASH-II | | | | - |
| 263.0−05.5 | | PB 2 | 08 20 39.8 | −46 20 13.2 | wels? | WG2011b | | | | WG2011b |
| 263.1+04.3 | | FPM 0904–4023 | 09 04 02.3 | −40 22 20.0 | Blue | MASH-II | | | | - |
| 263.2+00.4 | * ²³ | K 2–15 | 08 48 47.7 | −42 54 24.0 | B0 V | PC2010 | | | | PC2010 |
| 264.4−12.7 | | Hen 2–5 | 07 47 20.0 | −51 15 03.4 | O(H)f | M1991 | | | | - |
| 264.5+05.0 | | FPM 0911–4051 | 09 11 45.6 | −40 51 59.0 | Blue | MASH-II | | | | - |
| 264.6+03.8 | | BMP J0907–4146 | 09 07 24.3 | −41 46 14.0 | Blue | MASH-II | | | | - |
| 268.4+02.4 | | PB 5 | 09 16 09.6 | −45 28 42.8 | wels | G2014 | | | | G2014 |
| 268.9−00.4 | | PHR J0905–4753 | 09 05 39.6 | −47 53 38.0 | A8? | MASH-I | pec. | Fd2008 | | - |
| 270.1−02.9 | | WRAY 17–23 | 08 59 03.0 | −50 23 39.8 | [WC 5–6] | DP2011 | | | | DP2011 |
| 272.1+12.3 | | NGC 3132 | 10 07 01.8 | −40 26 11.1 | A2 V + ? | SECVPN | | | CB1999 | SH2014 |
| 272.8+01.0 | | PMR 1 | 09 28 40.6 | −49 36 44.0 | [WC 9–10] | AN2003 | | | | MP2001 PM2003 |
| 273.6+06.1 | | HbDs 1 | 09 52 44.5 | −46 13 51.0 | O(H)3 Vz | WG2018 | sdO | HW1988 | | WG2018 |
| 274.3+09.1 | | Lo 4 | 10 05 45.8 | −44 21 33.3 | PG 1159 | WH2006 | | | | MK1985 |
| 274.6+02.1 | | Hen 2–35 | 09 41 37.5 | −49 57 58.6 | wels | TA1993 | | | | - |
| 275.0−04.1 | | PB 4 | 09 15 07.6 | −54 52 38.5 | wels? | WG2011b | | | | WG2011b |
| 275.2−03.7 | * | Hen 2–25 | 09 18 01.3 | −54 39 29.2 | SySt | C1995 | cont. | LS2007 | | LS2007 |
| 276.1−11.9 | | MPA J0835–6039 | 08 35 07.3 | −60 39 43.0 | Blue | MASH-II | | | | - |
| 276.2−06.6 | | PHR J0907–5722 | 09 07 51.0 | −57 22 52.7 | DAO | AW2019 | | | | AW2019 |
| 277.1−03.8 | | NGC 2899 | 09 27 03.0 | −56 06 21.1 | F V: + ? | RK1999 | | | bc-CSPN | RK1999 |
| 277.7−3.5 | | VBRC 2 | 09 31 20.5 | −56 17 39.4 | DAO | PR1997 | | | | - |
| 278.1−05.9 | | NGC 2867 | 09 21 25.3 | −58 18 40.7 | [WO 2] + ? | AN2003 | | | AL2019a | D2014 PS1998 |
| 278.8+04.9 | | PB 6 | 10 13 15.9 | −50 19 59.3 | [WO 1] | AN2003 | | | | AN2003 PS1998 |
| 279.6−03.1 | | Hen 2–36 | 09 43 25.6 | −57 16 55.6 | A2 III + sdO | SECVPN | | | FK2001 | LS2007 SH2014 |
| 280.1−05.1 | | BMP J0936–5905 | 09 36 43.6 | −59 05 17.0 | Blue? | MASH-II | | | | - |
| 281.0−05.6 | | IC 2501 | 09 38 47.5 | −60 05 27.9 | O3-6 | WG2018 | | | | WG2018 |
| 283.6+25.3 | | K 1–22 | 11 26 43.8 | −34 22 11.4 | O(H) + F | RK1999 | | | CB1999 | RK1999 |
| 283.8+02.2 | | My 60 | 10 31 33.4 | −55 20 50.8 | EL | t.w. | | | | BA2016 G2014 |

Continued on next page

²² Compact HII region?²³ HII region?

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|--------------------------|----|----------------|---------------------|----------------------|-------------------------|---------|-----------|---------|---------|---------------|
| 283.8–04.2 | | Hen 2–39 | 10 03 49.2 | –60 43 48.3 | C-star +? ²⁴ | MB2013b | | | MB2013b | MB2013b |
| 283.9+09.7 | | DS 1 | 10 54 40.6 | –48 47 03.0 | sdO + ? | D1983 | M5 V + ? | SEC-GPN | D1985 | - |
| 284.2–05.3 | | PM 12 | 10 01 18.9 | –61 52 01.0 | [WO 3] | DP2011 | | | | DP2011 |
| 285.4+01.5 | | Pe 1–1 | 10 38 27.6 | –56 47 06.5 | [WC 5] | G2014 | | | | G2014 D2014 |
| 285.4–05.3 | | IC 2553 | 10 09 21.7 | –62 36 40.9 | EL | t.w. | | | | - |
| 285.6–02.7 | | Hen 2–47 | 10 23 09.0 | –60 32 34.3 | O(H)7–9 I | WG2018 | | | | WG2018 |
| 285.7–14.9 | | IC 2448 | 09 07 06.3 | –69 56 30.7 | O(H)3 III–V | WG2018 | | | | WG2018 |
| 286.3+02.8 | | Hen 2–55 | 10 48 43.2 | –56 03 10.2 | [WO 3] | AN2003 | | | | AN2003 PS1998 |
| 286.3–04.8 | | NGC 3211 | 10 17 50.5 | –62 40 12.1 | EL | t.w. | | | | BA2016 |
| 286.8–29.5 | | K 1–27 | 05 57 02.2 | –75 40 22.7 | O(He) + ? | RD1998 | | | CB1999 | RK1996 RK1994 |
| 288.7+08.1 | | ESO 216–2 | 11 18 09.7 | –52 10 02.7 | O(H)4–5 V | WG2018 | | | | WG2018 |
| 289.6–01.6 | * | Hen 2–57 | 10 56 03.0 | –61 28 07.4 | SySt | KB1994 | | | | - |
| 289.8+07.7 | | Hen 2–63 | 11 24 01.0 | –52 51 19.4 | wels | AN2003 | | | | - |
| 290.5+07.9 | | Fg 1 | 11 28 36.2 | –52 56 04.1 | O(H)3–4 + ? | t.w. | | | BM2012 | BM2012 |
| 291.3+08.4 | | PMR 2 | 11 34 38.6 | –52 43 33.0 | [WO 4]–[WC 4] | AN2003 | | | | MP2001 PM2003 |
| 291.3–26.2 | | Vo 1 | 06 59 26.4 | –79 38 47.0 | [WC 10] | AN2003 | | | | AN2003 MW1990 |
| 291.4+19.2 | | LoTr 4 | 11 52 29.2 | –42 17 38.7 | O(He) | GT2000 | | | | RK1996 |
| 291.6–04.8 | | IC 2621 | 11 00 19.5 | –65 14 54.2 | wels | WG2011b | | | | WG2011b |
| 291.7+03.7 | | Hen 2–64 | 11 27 24.3 | –57 17 58.9 | O(He) | LS2007 | | | | LS2007 |
| 292.4+04.1 | | PB 8 | 11 33 17.7 | –57 06 14.0 | [WN/C] | TP2010 | [WC5–6] | AN2003 | | TP2010 |
| 292.8+01.1 | | Hen 2–67 | 11 28 47.4 | –60 06 36.7 | [WC 4] | G2014 | | | | G2014 |
| 293.2–09.5 | | MPA J1054–7013 | 10 54 27.3 | –70 13 12.0 | Blue | MASH-II | | | | - |
| 293.6+10.9 | | BIDz 1 | 11 53 06.6 | –50 50 59.2 | O(H) | RK1999 | | | | RK1999 |
| 294.1+14.4 | | Lo 6 | 12 00 43.5 | –47 33 12.0 | cont. | WG2011a | | | | - |
| 294.1+43.6 | | NGC 4361 | 12 24 30.8 | –18 47 05.4 | O(H)6 | P1983 | sdO | HA1987 | | MK1988 |
| 294.6+04.7 | | NGC 3918 | 11 50 17.8 | –57 10 57.0 | O(H)? | Fd2008 | | | | - |
| 296.0–06.2 | | MPA J1137–6806 | 11 37 15.6 | –68 06 45.0 | Blue | MASH-II | | | | - |
| 297.0+06.5 | | BMP J1209–5553 | 12 09 29.1 | –55 53 34.0 | [WO 2]: | DP2011 | | | | DP2011 |
| 298.7–07.5 | | PHR J1202–7000 | 12 02 55.5 | –70 00 56.9 | WD?(H) | AW2019 | | | | AW2019 |
| 300.1+04.1 | | BMP J1229–5839 | 12 29 57.6 | –58 39 06.0 | Blue | MASH-II | | | | - |
| 300.7–02.0 | | Hen 2–86 | 12 30 30.5 | –64 52 05.7 | [WC 5–6] | G2014 | | | | G2014 |
| 301.9–02.1 | | MPA J1242–6459 | 12 42 24.2 | –64 59 25.0 | wels? | MASH-II | | | | - |
| 302.0–01.6 | | MPA J1243–6428 | 12 43 19.4 | –64 28 01.0 | [WC 9] | MASH-II | | | | DP2011 |
| 302.1+00.3 | | RCW 69 | 12 44 27.5 | –62 31 18.9 | WD?(H) | AW2019 | | | | AW2019 |
| 302.2–03.1 | | PHR J1244–6601 | 12 44 59.5 | –66 01 02.0 | H-rich | WG2018 | | | | WG2018 |
| 303.6+40.0 | | A 35 | 12 53 32.8 | –22 52 22.6 | DAO + ? | ZRW2012 | | | bc-CSPN | ZRW2012 |
| 305.1+01.4 | | Hen 2–90 | 13 09 36.2 | –61 19 36.0 | B[e] | KB2005 | | | | CZ2001 |
| 306.4–00.6 | | Th 2–A | 13 22 33.8 | –63 21 01.3 | [WO 3]pec | WG2008 | | | | WG2008 |
| 307.2–03.4 | | NGC 5189 | 13 33 32.9 | –65 58 27.1 | [WO 1] + ? | AN2003 | | | MM2015 | MM2015 SK1995 |
| 307.2–05.3 | | MPA J1337–6751 | 13 37 22.4 | –67 51 07.0 | Blue | MASH-II | | | | - |
| 307.2–09.0 | | Hen 2–97 | 13 45 24.0 | –71 28 48.8 | Of-WR(H) | WM2015 | | | | WM2015 |
| 307.5–04.9 | | MyCn 18 | 13 39 35.1 | –67 22 51.9 | O(H)f + ? | MM2018 | O(C)f + ? | LS2007 | MM2018 | LS2007 |
| 308.2+07.7 | | MeWe 1–3 | 13 28 04.9 | –54 41 58.4 | DAO | SW1997 | | | | SW1997 |
| 308.4+00.4 | | WeKg 2 | 13 38 41.7 | –61 55 51.0 | H-rich | WK1997 | | | | - |
| 308.5+02.5 ²⁵ | | PMR 6 | 13 36 23.0 | –59 53 31.0 | [WC 4] | PM2003 | | | | PM2003 |
| 308.6–12.2 | | Hen 2–105 | 14 15 25.7 | –74 12 49.8 | O | WG2011b | | | | WG2011b |
| 309.0–04.2 | | Hen 2–99 | 13 52 30.7 | –66 23 26.8 | [WC 9] | AN2003 | | | | MH1991 |

Continued on next page

²⁴ Carbon star, subtype C-R3 C₂₄²⁵ Another designation is PN G308.5+02.4

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----|----------------|---------------------|----------------------|------------------|---------|---------|---------|---------|---------------|
| 309.1–04.3 | | NGC 5315 | 13 53 57.0 | –66 30 50.7 | [WO 4] | AN2003 | | | | dM2002 |
| 309.6–04.8 | | MPA J1400–6647 | 14 00 37.1 | –66 47 58.0 | Blue | MASH-II | | | | - |
| 309.8–01.6 | | MPA J1354–6337 | 13 54 22.3 | –63 37 18.0 | [WC 4]: | DP2011 | | | | DP2011 |
| 310.3+24.7 | | Lo 8 | 13 25 37.5 | –37 36 14.8 | O(H)3 Vz | WG2018 | | | | WG2018 |
| 311.0+02.4 | | SuWt 2 | 13 55 43.2 | –59 22 39.9 | A + A + ? | d2009 | | | BO2002 | - |
| 312.3+10.5 | | NGC 5307 | 13 51 03.3 | –51 12 15.9 | O(H)3.5 V | WM2015 | | | | WM2015 |
| 312.6–01.8 | | Hen 2–107 | 14 18 42.5 | –63 07 10.7 | O(H)4 Ifc | WG2018 | | | | WG2018 |
| 313.4+06.2 | | MPA J1405–5507 | 14 05 32.2 | –55 07 44.0 | wels | DP2011 | [WC4-6] | MASH-II | | DP2011 |
| 313.8–05.7 | | BMP J1442–6615 | 14 42 46.6 | –66 15 02.0 | Blue | MASH-II | | | | - |
| 313.9+02.8 | | PM 9 | 14 16 37.6 | –58 09 30.0 | [WC 9] | WG2011b | | | | DP2011 |
| 314.5–01.0 | | PHR J1432–6138 | 14 32 09.6 | –61 38 41.7 | cont. | AW2019 | | | | - |
| 315.1–13.0 | | Hen 2–131 | 15 37 11.2 | –71 54 52.9 | O(H) | t.w. | wels | TA1993 | | G2014 H1977 |
| 315.4–08.4 | | PHR J1510–6754 | 15 10 26.1 | –67 54 54.0 | O(H)e + ? | WG2018 | | | HM2013 | WG2018 |
| 315.7+05.5 | | LoTr 8 | 14 22 00.0 | –55 02 17.0 | [WR] | WG2018 | | | | WG2018 |
| 316.1+08.4 | | Hen 2–108 | 14 18 08.9 | –52 10 39.5 | O(H) | t.w. | wels | TA1993 | | G2014 MA2003 |
| 316.7–05.8 | | MPA J1508–6455 | 15 08 06.4 | –64 55 49.0 | Blue + ? | MASH-II | | | WJ2018 | - |
| 317.2+08.6 | | PHR J1424–5138 | 14 24 32.3 | –51 38 39.0 | O(H)3 I | WG2018 | | | | WG2018 |
| 318.4+41.4 | | A 36 | 13 40 41.3 | –19 52 55.3 | sdO | AM2015 | | | | AM2015 |
| 319.6+15.7 | | IC 4406 | 14 22 26.3 | –44 09 04.4 | [WR] | SECSPN | | | | - |
| 320.1–09.6 | | Hen 2–138 | 15 56 01.7 | –66 09 09.2 | O(H)7-9 f | t.w. | | | | MK1988 |
| 320.3–28.8 | | Hen 2–434 | 19 33 50.7 | –74 32 58.7 | O | WG2011b | | | | WG2011b |
| 320.7+04.2 | | BMP J1457–5413 | 14 57 02.3 | –54 13 58.0 | Blue? | MASH-II | | | | - |
| 320.9+02.0 | | Hen 2–117 | 15 05 59.2 | –55 59 16.6 | [WC 5-6] | G2014 | | | | G2014 |
| 321.0+03.9 | | Hen 2–113 | 14 59 53.5 | –54 18 07.5 | [WC 10] | AN2003 | | | | dM2002 SH2014 |
| 321.3+02.8 | | Hen 2–115 | 15 05 16.8 | –55 11 10.5 | wels | G2014 | | | | G2014 |
| 322.4–00.1 | | Pe 2–8 | 15 23 42.9 | –57 09 25.2 | wels | DP2011 | | | | DP2011 |
| 322.5–05.2 | | NGC 5979 | 15 47 40.6 | –61 13 02.7 | O(H)3-4 | t.w. | | | | BA2016 |
| 323.6–04.5 | | WKK 136–337 | 15 50 28.9 | –59 58 50.0 | O(H)3 III-V | WG2018 | | | | WG2018 |
| 323.9+02.4 | | Hen 2–123 | 15 22 19.4 | –54 08 12.8 | O3-4 | WG2018 | | | | WG2018 |
| 324.0+03.5 | | PM 1–89 | 15 19 08.8 | –53 09 49.8 | [WO 4]pec | AN2003 | | | | AN2003 |
| 324.1+09.0 | | ESO 223–10 | 15 01 40.7 | –48 21 02.0 | O ? | SECSPN | | | | - |
| 324.2+02.5 | | Hen 2–125 | 15 23 36.4 | –53 51 28.1 | VL | G2014 | | | | G2014 |
| 325.3–02.9 | | PHR J1553–5738 | 15 53 09.9 | –57 38 06.1 | DAO | AW2019 | | | | AW2019 |
| 325.8+04.5 | | Hen 2–128 | 15 25 07.9 | –51 19 40.9 | wels? | WG2011b | | | | WG2011b |
| 325.8–12.8 | | Hen 2–182 | 16 54 35.1 | –64 14 28.5 | O(H)4-8 III-V | WG2018 | | | | WG2018 |
| 326.0–06.5 | | Hen 2–151 | 16 15 42.3 | –59 54 01.0 | B0 | WG2018 | | | | WG2018 |
| 326.4+07.0 | | NeVe 3–2 | 15 19 43.9 | –48 59 54.9 | O(H)4 Vz | WG2018 | | | | WG2018 |
| 326.6+05.7 | | BMP J1525–4957 | 15 25 14.1 | –49 57 41.0 | Blue | MASH-II | | | | - |
| 326.9+08.2 | | MPA J1518–4738 | 15 18 18.2 | –47 38 28.0 | [WR]? | MASH-II | | | | DP2011 |
| 327.1–02.2 | | Hen 2–142 | 15 59 57.6 | –55 55 32.9 | [WC 9] | AN2003 | | | | D2014 dM2002 |
| 327.5–02.2 | | MPA J1602–5543 | 16 02 11.2 | –55 43 30.0 | [WR] | MASH-II | | | | DP2011 |
| 327.8+10.0 | | NGC 5882 | 15 16 49.9 | –45 38 58.5 | O(H) f | SECSPN | | | | MK1988 |
| 328.8–01.1 | | PM 15 | 16 03 41.4 | –54 02 04.0 | [WR]? | MASH-I | | | | - |
| 328.9–02.4 | | Hen 2–146 | 16 10 41.2 | –54 57 32.9 | K-M + ? | JE1969 | | | | - |
| 329.0+01.9 | | Sp 1 | 15 51 41.0 | –51 31 28.6 | O(H)3-5 (fc) + ? | WG2018 | | | bc-CSPN | - |
| 329.5+01.7 | | VBRC 7 | 15 54 51.0 | –51 22 34.0 | H-rich | WG2018 | | | HJ2016 | HJ2016 |
| 329.5–02.2 | | WRAY 17–75 | 16 12 34.4 | –54 23 35.3 | O(H) | WG2011b | | | | WG2018 |
| 329.8–02.1 | | BMP J1613–5406 | 16 13 02.0 | –54 06 32.0 | Blue? | MASH-II | | | | WG2011b |
| 329.9+03.7 | | BMP J1548–4936 | 15 48 52.1 | –49 36 48.0 | wels | MASH-II | | | | - |

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Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|-------------|----|----------------|---------------------|----------------------|----------------------|---------|--------------|--------|---------|---------------|
| 330.2+12.3 | | BMP J1521–4228 | 15 21 26.0 | -42 28 08.0 | Blue | MASH-II | | | | - |
| 330.7+04.1 | * | Cn 1–1 | 15 51 15.9 | -48 44 58.5 | F5 III + ? | L1984 | SySt? | AC2007 | | - |
| 331.1–05.7 | | PC 11 | 16 37 42.7 | -55 42 26.4 | A3–4II + WD | PB2010 | | | PB2010 | PB2010 |
| 331.3+16.8 | | NGC 5873 | 15 12 51.1 | -38 07 33.7 | wels | TA1993 | | | | MA2003 |
| 331.3–12.1 | | Hen 3–1357 | 17 16 21.1 | -59 29 23.3 | H-rich | RR2017 | sdO | RR2014 | | PG1995 |
| 331.4–03.5 | | Hen 2–162 | 16 27 50.9 | -54 01 28.4 | B0 I–III | WG2018 | | | | WG2018 |
| 331.5–02.7 | | Hen 2–161 | 16 24 37.8 | -53 22 34.1 | O(H)3–4 + ? | t.w. | | | JB2015 | JB2015 |
| 331.7–01.0 | * | Mz 3 | 16 17 13.4 | -51 59 10.6 | SySt | KB2003 | B0 | LZ1998 | | ZL2002 |
| 331.8–02.3 | | MPA J1624–5250 | 16 24 02.9 | -52 50 06.0 | wels | DP2011 | | | | DP2011 |
| 332.4–01.4 | | BMP J1622–5144 | 16 22 34.0 | -51 44 56.0 | Blue | MASH-II | | | | - |
| 332.5–16.9 | | HaTr 7 | 17 54 09.6 | -60 49 58.0 | DAO + ? | SW1997 | | | HF2017 | HF2017 SW1997 |
| 332.8–16.4 | | HaTr 6 | 17 51 52.8 | -60 23 21.9 | H-rich | WG2018 | | | | WG2018 |
| 332.9–09.9 | | Hen 3–1333 | 17 09 00.9 | -56 54 48.0 | [WC 10] | AN2003 | | | | D2014 dM2002 |
| 333.4–04.3 | | PMR 3 | 16 41 04.4 | -53 02 24.0 | wels | AN2003 | | | | PM2003 |
| 333.9+00.6 | | PMR 5 | 16 19 40.2 | -49 13 59.0 | wels | AN2003 | [WN]? | MP2013 | | MP2013 |
| 333.9–08.5 | | PM 6 | 13 36 23.0 | -59 53 24.4 | [WC 4] | PM2003 | | | | PM2003 |
| 334.3–09.3 | | IC 4642 | 17 11 45.0 | -55 24 01.5 | absorption lines | | SECVPN | | | - |
| 334.8–07.4 | | Hen 3–1312 | 17 03 02.9 | -53 55 54.0 | F6–7 I + ? | P2004 | B[e]? | LZ1998 | bc-CSPN | P2004 |
| 335.5+12.4 | | DS 2 | 15 43 05.0 | -39 18 14.6 | O(H) | SECVPN | sdO | D1983 | | MK1988 |
| 336.2–06.9 | | PC 14 | 17 06 14.8 | -52 30 00.5 | [WO 4] | AN2003 | | | | AN2003 |
| 336.3–05.6 | | Hen 2–186 | 16 59 36.1 | -51 42 06.5 | cont. | LS2007 | | | | - |
| 336.5+05.5 | | MPA J1611–4356 | 16 11 12.9 | -43 56 22.0 | [WO 4] | DP2011 | | | | DP2011 |
| 337.0+08.4 | | ESO 330–9 | 16 02 18.0 | -41 26 50.0 | O(H)3–4 + ? | t.w. | | | HF2017 | HF2017 |
| 337.4+01.6 | | Pe 1–7 | 16 30 25.9 | -46 02 50.8 | [WC 9] | AN2003 | | | | AN2003 |
| 337.5–05.1 | * | Hen 2–187 | 17 01 37.4 | -50 22 56.6 | O(H)7–9 ((f)) | WG2011b | | | | WG2011b |
| 338.1–08.3 | | NGC 6326 | 17 20 46.2 | -51 45 15.2 | O(H)5–8 ((fc)) + ? | WG2018 | | | | WG2018 |
| 338.8+05.6 | | Hen 2–155 | 16 19 23.2 | -42 15 36.7 | O(H)3–5 + ? | t.w. | | | | JB2015 |
| 339.9+88.4 | | LoTr 5 | 12 55 33.7 | +25 53 30.6 | G5 III + sdO | JT1996 | | | | VH2014 |
| 341.5+12.1 | | Sand 3 | 16 06 28.4 | -35 45 13.0 | [WO 1] | Cd1998 | | | | FK1983 |
| 341.6+13.7 | | NGC 6026 | 16 01 21.1 | -34 32 36.6 | O(H)7 V + ? | t.w. | WD/sdO | d2009 | HB2010 | HB2010 WD2011 |
| 341.8+05.4 | | NGC 6153 | 16 31 30.8 | -40 15 14.2 | wels | LS2000 | | | | LS2000 |
| 342.5–14.3 | | Sp 3 | 18 07 15.8 | -51 01 10.1 | O3 + ? | GP2001 | | | | - |
| 343.5–07.8 | | PC 17 | 17 35 41.1 | -46 59 51.3 | wels | WG2011b | | | | WG2011b |
| 343.6+03.7a | | MPA J1644–4002 | 16 44 20.4 | -40 02 13.0 | Blue | MASH-II | | | | - |
| 343.9–05.8 | | SB 30 | 17 27 02.3 | -45 32 38.5 | wels | GS2004 | | | | - |
| 344.6–04.5 | | MPA J1723–4419 | 17 23 06.1 | -44 19 16.0 | Blue | MASH-II | | | | - |
| 344.9+03.0 | | BMP J1651–3930 | 16 51 41.3 | -39 30 27.0 | Blue | MASH-II | | | | - |
| 345.0–04.9 | | Cn 1–3 | 17 26 11.8 | -44 11 29.1 | wels? | WG2011b | | | | WG2011b |
| 345.2–08.8 | | Tc 1 | 17 45 35.3 | -46 05 23.7 | O(H)5–9 f | t.w. | | | | MK1988 |
| 345.4+00.1 | | IC 4637 | 17 05 10.5 | -40 53 08.4 | O(H) + ? | SECVPN | | | | MK1988 |
| 345.5+15.1 | | Lo 13 | 16 09 45.9 | -30 55 07.6 | O(H) | SECVPN | | | | MK1985 |
| 346.2–08.2 | | IC 4663 | 17 45 28.5 | -44 54 11.5 | [WN 3] | M2012 | | | | M2012 |
| 347.4+05.8 | | H 1–2 | 16 48 54.1 | -35 47 09.1 | wels | GS2004 | | | | - |
| 348.0–13.8 | | IC 4699 | 18 18 31.2 | -45 59 03.2 | O(H)3 V((f)) | WM2015 | | | | WM2015 |
| 348.4+04.9 | | MPA J1655–3535 | 16 55 22.0 | -35 35 24.0 | [WC 10] | DP2011 | | | | DP2011 |
| 349.3–01.1 | | NGC 6337 | 17 22 15.7 | -38 29 03.5 | wels + ? | WG2011b | M4 V | d2006 | HB2006 | HJ2016 |
| 349.3–04.2 | | Lo 16 | 17 35 41.9 | -40 11 26.5 | O(H)3–4 Vz((fc)) + ? | WG2018 | | | | HF2017a |
| 349.5+01.0 | | NGC 6302 | 17 13 44.4 | -37 06 12.9 | G V + ? | d2006 | G V + H-poor | WB2011 | bc-CSPN | WG2018 |
| 349.7+04.0 | | PPA J1702–3509 | 17 02 46.1 | -35 09 02.0 | [WR]? | MASH-I | | | | - |

Continued on next page

Table 1 – continued from previous page

| PNG | f_ | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----|------------------------------|---------------------|----------------------|----------------|---------|--------|---------|--------|---------------------|
| 350.1–03.9 | | H 1–26 | 17 36 29.7 | −39 21 57.0 | [WC 4–5] | GS2003 | | | | GS2004 |
| 350.9+04.4 | | H 2–1 | 17 04 36.3 | −33 59 18.8 | O(H)5–9 | t.w. | | | | MK1988 |
| 351.1+04.8 | | M 1–19 | 17 03 46.8 | −33 29 43.8 | wels? | AN2003 | | | | – |
| 351.5–06.5 | | SB 34 | 17 52 09.4 | −39 32 14.5 | [WO 2] | GS2004 | | | | GS2004 |
| 351.7–06.6 | | SB 35 | 17 53 02.9 | −39 24 08.9 | wels | GS2004 | | | | – |
| 352.1+05.1 | | M 2–8 | 17 05 30.7 | −32 32 08.1 | [WO 3] | GS2004 | | | | GS2004 |
| 352.1–02.6 | | PHR J1736–3659 | 17 36 17.3 | −36 59 47.2 | O(H)8 If | WG2018 | | | | WG2018 |
| 352.9+11.4 | | K 2–16 | 16 44 49.1 | −28 04 04.7 | [WC 11] | AN2003 | | | | LH1998 dM2002 D2014 |
| 352.9–07.5 | | Fg 3 | 18 00 11.9 | −38 49 51.7 | cont. | WG2011a | | | | – |
| 353.7+06.3 | | M 2–7 | 17 05 13.9 | −30 32 19.7 | O | WG2018 | | | | WG2018 |
| 354.5–03.9 | | SAB 41 | 17 48 16.3 | −35 38 31.0 | H-rich + ? | WG2018 | | | MA2009 | WG2018 |
| 354.7–03.9 | | MPA J1748–3530 | 17 48 48.6 | −35 30 30.0 | Blue? | MASH-II | | | | – |
| 355.2–02.5 | | H 1–29 | 17 44 13.8 | −34 17 33.1 | [WC 4] | AN2003 | | | | – |
| 355.3+03.8 | | MPA J1719–3043 | 17 19 20.1 | −30 43 40.0 | Blue | MASH-II | | | | – |
| 355.3–03.2 | | PPA J1747–3435 | 17 47 08.3 | −34 35 43.0 | O(H) + ? | WG2018 | | | MA2009 | WG2018 |
| 355.4–04.0 | | Hf 2–1 | 17 51 12.1 | −34 55 24.3 | [WO 2] | DP2011 | | | | DP2011 |
| 355.5–02.8 | | MPA J1746–3412 | 17 46 18.5 | −34 12 37.0 | [WC 10–11] | MM2013 | | | | – |
| 355.6–02.3 | | PHR J1744–3355 | 17 44 27.9 | −33 55 20.3 | H-rich | WG2018 | | | | WG2018 |
| 355.7–03.5 | | H 1–35 | 17 49 13.9 | −34 22 53.3 | wels? | WG2011b | | | | WG2011b |
| 355.9+03.6 | | H 1–9 | 17 21 31.9 | −30 20 48.9 | [WC 11] | GC2009 | wels | PR2013 | | GC2009 |
| 355.9–04.2 | | M 1–30 | 17 52 58.9 | −34 38 23.0 | wels | AN2003 | [WC 7] | GT2000 | | AN2003 |
| 355.9–04.4 | | K 6–32 | 17 53 40.3 | −34 43 41.0 | [WO 3]: | DP2011 | | | | DP2011 |
| 356.0–04.2 | | PHR J1753–3428 | 17 53 04.9 | −34 28 39.0 | [WO 2–3] | DP2011 | | | | DP2011 |
| 356.1+02.7 | | Th 3–13 | 17 25 19.4 | −30 40 42.0 | [WC 5–6] | DP2011 | | | | DP2011 |
| 356.2–04.4 | | Cn 2–1 | 17 54 33.0 | −34 22 21.2 | Of | AK1987 | | | | MA2003 |
| 356.2–04.4 | | Cn 2–2 | 17 54 33.0 | −34 22 21.2 | wels | TA1993 | | | | – |
| 356.5–02.3 | * | M 1–27 | 17 46 45.5 | −33 08 35.1 | [WC 11]? | GZ2006 | pec. | WG2011b | | WG2011b |
| 356.5–03.9 | | H 1–39 | 17 53 21.0 | −33 55 58.5 | [WC 11]? | GS2004 | | | | – |
| 356.7–04.8 | | H 1–41 | 17 57 19.1 | −34 09 49.1 | wels | TA1993 | | | | MA2003 |
| 356.8–03.6 | | PHR J1752–3330 | 17 52 29.2 | −33 30 04.2 | [WC 11] | DP2011 | | | | DP2011 |
| 356.9+04.4 | | M 3–38 | 17 21 04.5 | −29 02 59.7 | wels | DP2011 | | | | DP2011 |
| 356.9+04.5 | | M 2–11 | 17 20 33.3 | −29 00 39.1 | wels? | GC2009 | | | | GC2009 |
| 357.0–04.4 | | PHR J1756–3342 | 17 56 39.5 | −33 42 31.0 | O(H)3–4 Vz + ? | WG2018 | | | MA2009 | WG2018 |
| 357.1+03.6 | | M 3–7 | 17 24 34.4 | −29 24 19.5 | wels | TA1993 | | | | – |
| 357.1–04.7 | | H 1–43 | 17 58 14.4 | −33 47 37.5 | [WC 11] | GS2004 | | | | GS2004 |
| 357.1–05.3 | | BMP J1800–3408 ²⁶ | 18 00 26.5 | −34 07 49.0 | O(H)4–5 Vz + ? | WG2018 | | | MA2009 | WG2018 |
| 357.2–04.5 | | H 1–42 | 17 57 25.2 | −33 35 42.9 | wels | GC2009 | | | | GC2009 |
| 357.3+03.3 | | M 3–41 | 17 25 59.8 | −29 21 50.4 | [WC 11] | GC2009 | | | | GC2009 |
| 357.4–03.2 | | M 2–16 | 17 52 34.4 | −32 45 51.4 | [WO 2–3] | DP2011 | | | | DP2011 |
| 357.6+01.7 | | H 1–23 | 17 32 46.9 | −30 00 15.1 | Of? | AK1987 | | | | – |
| 357.6–03.3 | | H 2–29 | 17 53 16.8 | −32 40 38.5 | O(H) + ? | WG2018 | | | MA2009 | WG2018 |
| 357.7–04.8 | | BMP J1759–3321 | 17 59 45.2 | −33 21 13.0 | Blue | MASH-II | | | | – |
| 358.0–04.6 | | Sa 3–107 | 17 59 55.0 | −32 59 11.8 | wels | DP2011 | | | | DP2011 |
| 358.3–21.6 | | IC 1297 | 19 17 23.5 | −39 36 46.4 | [WO 3] | AN2003 | | | | D2014 SK1994 |
| 358.7–03.0 | | K 6–34 | 17 54 41.1 | −31 31 43.2 | O(H)4–6 + ? | WG2018 | | | MA2009 | WG2018 |
| 358.8+00.0 | | Te 2022 | 17 42 42.4 | −29 51 35.4 | B early | WG2011b | | | | WG2011b |
| 358.9+03.3 | | H 1–19 | 17 30 02.6 | −27 59 17.5 | wels | DP2011 | | | | DP2011 |
| 358.9–00.7 | | M 1–26 | 17 45 57.7 | −30 12 00.6 | O(H) f | SEC-GPN | B[e]? | LZ1998 | | MK1988 |

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Table 1 – continued from previous page

| PNG | f _— | Name | RA _{J2000} | DEC _{J2000} | SpT | Ref. | SpT2 | Ref. | RB | Ref. spectra |
|------------|----------------|----------------|---------------------|----------------------|-------------------|---------|------|------|--------|--------------|
| 359.1–02.3 | | M 3–16 | 17 52 46.1 | –30 49 35.5 | O(H)4–6 III–V + ? | WG2018 | | | MA2009 | WG2018 |
| 359.2+01.2 | * | 19w32 | 17 39 03.0 | –28 56 37.0 | SySt | BM2000 | | | | C1995 |
| 359.2–33.5 | | CRBB 1 | 20 19 28.7 | –41 31 27.6 | B0 III | t.w. | | | | MR1991 |
| 359.3–00.9 | | Hb 5 | 17 47 56.2 | –29 59 39.6 | cont. | AK1985 | | | | - |
| 359.3–01.8 | | M 3–44 | 17 51 18.9 | –30 23 53.0 | [WC 11] | GS2004 | | | | GS2004 |
| 359.3–03.1 | | M 3–17 | 17 56 25.6 | –31 04 16.8 | [WC 11]? | GS2004 | | | | - |
| 359.4–05.6 | | BMP J1807–3215 | 18 07 07.0 | –32 15 22.0 | Blue? | MASH-II | | | | - |
| 359.7+06.0 | | BMP J1721–2554 | 17 21 58.1 | –25 54 24.0 | Blue | MASH-II | | | | - |
| 359.8+03.5 | | PHR J1731–2709 | 17 31 47.8 | –27 09 19.0 | [WC 4]: | DP2011 | | | | DP2011 |
| 359.8+05.6 | | M 2–12 | 17 24 01.5 | –25 59 23.3 | O7–8 | t.w. | | | | HP2007 |
| 359.9–04.5 | | M 2–27 | 18 03 52.6 | –31 17 46.7 | [WC 4]: | DP2011 | | | | DP2011 |

Table 2. Physical parameters of CSPNe. Description of the columns is in Section 4.2.

| PN G | $\log g$ | ref. | met. | $\log T$ | ref. | $\log(L_*/L_\odot)$ | ref. | mag. | ref. |
|------------|-----------|--------|--------|-------------------|---------|---------------------|---------|-------------------|--------|
| # 1 | 7.00 | N1999 | eff | 5.079 | N1999 | 3.700 | WW2010 | v 12.99 | WW2010 |
| # 2 | 7.50 | N1999 | eff | 4.978 | N1999 | 1.000 | R1987 | v 15.60 | R1987 |
| # 3 | 8.00 | N1999 | eff | 5.041 | N1999 | - | - | v 15.40±0.05 | ZF2012 |
| # 4 | 7.50 | N1999 | eff | 5.000 | N1999 | - | - | v 13.21 | HD2007 |
| # 5 | - | - | - | - | - | - | - | - | - |
| # 6 | - | - | - | - | - | - | - | - | - |
| # 7 | 8.30 | dO2015 | eff | 5.079 | dO2015 | - | - | r 18.48±0.01 | GD2014 |
| # 8 | - | - | - | - | - | - | - | - | - |
| # 9 | 6.52±0.05 | LF2015 | eff | 4.910±0.007 | LF2015 | - | - | v 10.58 | LF2015 |
| 000.0–06.8 | - | - | - | - | - | - | - | v 14.92 | TA1991 |
| 000.1+17.2 | 4.50 | RP1997 | eff | 4.574 | RP1997 | 3.748 | M1997 | v 16.30 | TA1991 |
| 000.2–01.9 | - | - | - | - | - | - | - | v 17.30 | TA1991 |
| 000.3+12.2 | 4.10 | ZK1993 | * | 4.623 | HA1999b | 3.040 | HA1999b | v 13.90 | TA1991 |
| 000.4+04.4 | - | - | - | - | - | - | - | - | - |
| 000.4–01.9 | - | - | - | 4.660 | AN2003 | - | - | v 16.10 | TA1991 |
| 000.7+04.7 | - | - | - | 5.146±0.093 | JB2014 | 3.800 | JB2014 | i 16.80 | JB2014 |
| 000.7+08.0 | - | - | - | - | - | - | - | - | - |
| 000.7–02.7 | - | - | bT | 4.997 | PA1989 | - | - | v 14.70 | TA1991 |
| 000.9–02.0 | - | - | - | - | - | - | - | v 19.20 | LF2010 |
| 001.2–03.0 | 4.50 | RP1997 | eff | 4.477 | RP1997 | 3.699 | ZK1993 | v 16.20 | TA1991 |
| 001.2–05.6 | - | - | - | - | - | - | - | ks 12.28 | DP2011 |
| 001.5–06.7 | 4.00 | dC2001 | eff | 4.602 | Gd2013 | 4.300 | GZ2007 | v 11.76 | TA1991 |
| 001.7–04.4 | 3.64 | M1997 | bb | 4.530 | GZ2014 | 3.643 | M1997 | v 16.70 | LF2010 |
| 001.7–04.6 | 4.75 | RP1997 | eff | 4.813 | RP1997 | 3.000 | GZ2007 | v 17.00 | TA1991 |
| 001.8–02.0 | - | - | - | - | - | - | - | v 19.69 | SB2019 |
| 001.8–03.7 | - | - | - | - | - | - | - | - | - |
| 002.0–06.2 | 3.65±0.14 | HP2007 | eff | 4.591±0.022 | HP2007 | 3.920±0.17 | HP2007 | v 14.40±0.5 | HP2007 |
| 002.0–13.4 | 5.10 | Gd2013 | eff | 4.813 | Gd2013 | 3.600 | GZ2007 | v 14.00 | TA1991 |
| 002.1–02.2 | 5.50 | t.w. | bb | 4.880 | GZ2007 | 3.200 | GZ2007 | - | - |
| 002.2–02.7 | 4.00 | RP1997 | eff | 4.760 | RP1997 | 4.199 | ZK1993 | b 16.70 | TA1991 |
| 002.2–06.3 | - | - | - | - | - | - | - | v 14.70 | TA1991 |
| 002.2–09.4 | 5.20 | RP1997 | - | 5.040 | AN2003 | 3.613 | M1997 | v 15.20 | WL2007 |
| 002.4+05.8 | 5.10 | SP2015 | eff | 4.792±0.070 | SP2015 | 3.700 | Ko2001 | v 15.94 | GT2000 |
| 002.4–03.7 | 3.08±0.09 | HP2007 | eff | 4.491±0.021 | HP2007 | 4.170±0.14 | HP2007 | v 14.45±0.25 | HP2007 |
| 002.6+05.5 | - | - | - | - | - | - | - | - | - |
| 002.6+08.1 | 4.70 | RP1997 | eff | 4.903 | RP1997 | 3.400 | GZ2007 | - | - |
| 002.6–03.4 | 3.45±0.27 | HP2007 | eff | 4.491+0.021-0.028 | HP2007 | 3.680+0.29 -0.30 | HP2007 | v 14.99±0.25 | HP2007 |
| 002.7–04.8 | 5.30 | PB2007 | - | 4.929 | PB2007 | 3.544 | PB2007 | v 17.40 | PB2007 |
| 002.7–52.4 | 7.05 | BK2018 | eff | 5.114 | BK2018 | 2.360 | GM2019b | v 16.14±0.03 | BK2018 |
| 003.1+02.9 | 5.00 | ZK1993 | * | 4.934 | PM2003b | 3.600 | GZ2007 | v 17.00 | CM2000 |
| 003.2–04.4 | - | - | - | - | - | - | - | - | - |
| 003.3+66.1 | 6.11 | KP2016 | - | 5.079 | KP2016 | - | - | r 18.66 | KP2016 |
| 003.3–04.6 | 3.40 | RP1997 | eff | 4.462 | RP1997 | - | - | v 13.29 | TA1991 |
| 003.4–04.8 | 4.50 | RP1997 | eff | 4.889 | RP1997 | - | - | v 16.20 | LF2010 |
| 003.5–02.4 | 5.50 | ZK1993 | - | 5.010 | ZK1993 | 3.732 | ZK1993 | v 17.58+0.62-0.42 | SK1989 |
| 003.6+03.1 | 4.70 | t.w. | bb | 4.630 | GZ2014 | 3.000 | GZ2007 | - | - |
| 003.7–04.6 | 4.30 | ZK1993 | bb | 5.040 | GZ2007 | 3.500 | GZ2007 | v 15.70 | LF2010 |
| 003.9–02.3 | 4.60 | ZK1993 | - | 4.828 | ZK1993 | 3.898 | ZK1993 | v 15.10 | DP2011 |
| 003.9–14.9 | - | - | eff | 4.699 | Gd2013 | 4.070 | AG1985 | v 13.97 | TA1991 |
| 004.0–03.0 | 4.00±0.3 | MM2011 | eff | 4.699±0.087 | MM2011 | 3.300 | GZ2007 | v 15.54 | TA1991 |
| 004.2–04.3 | 5.80 | t.w. | bb | 4.900 | GZ2007 | 3.000 | GZ2007 | v 18.10 | LF2010 |
| 004.6+06.0 | - | - | eff | 4.610 | PL2016 | 3.780 | PL2016 | - | - |
| 004.9+04.9 | 4.20 | RP1997 | - | 4.750 | AN2003 | 3.800 | GZ2007 | b 17.90 | TA1991 |
| 004.9–04.9 | - | - | z(HeI) | 4.196 | P2003 | - | - | v 12.50 | BM2000 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_\star/L_\odot) | ref. | mag. | ref. |
|------------|-----------|---------|---------|-------------|---------|---------------------------|---------|--------------------|---------------|
| 005.0+03.0 | - | - | - | - | - | - | - | v 19.17 | SB2019 |
| 005.1–08.9 | - | - | - | 4.792±0.042 | HB2016 | 2.778 | HB2016 | v 17.76 | HB2016 |
| 005.8–06.1 | 7.47 | M1997 | - | 5.132 | M1997 | 2.255 | M1997 | v 19.60 | SECGPN |
| 005.9–02.6 | - | - | - | - | - | - | - | - | - |
| 006.0–03.6 | 4.70 | RP1997 | eff | 4.778 | RP1997 | 3.700 | GZ2007 | - | - |
| 006.0–41.9 | 5.20 | PR1989 | eff | 4.840 | PL2016 | 3.020 | PL2016 | v 17.50 | SECGPN |
| 006.1+08.3 | 5.00 | OK2013 | - | 4.724 | OK2013 | 3.919 | OK2013 | v 17.10 | WL2007 |
| 006.3+04.4 | 5.00 | RP1997 | eff | 4.916 | RP1997 | - | - | - | - |
| 006.4+02.0 | 5.30 | ZK1993 | bb | 4.680 | GZ2014 | 3.800 | GZ2007 | b 19.00 | TA1991 |
| 006.5–03.1 | - | - | - | - | - | - | - | - | - |
| 006.7–02.2 | 7.20 | B2008 | - | 5.260 | B2008 | 3.079 | B2008 | - | - |
| 006.8+04.1 | 4.70 | RP1997 | - | 4.740 | AN2003 | 3.600 | GZ2007 | - | - |
| 006.9–05.1 | - | - | - | - | - | - | - | - | - |
| 007.0–06.8 | 5.00 | RP1997 | eff | 4.778 | RP1997 | 3.924 | ZK1993 | v 15.10 | LF2010 |
| 007.5+04.3 | - | - | - | - | - | - | - | v 18.20 | TA1991 |
| 007.5–05.0 | - | - | - | - | - | - | - | - | - |
| 007.8–03.7 | - | - | - | - | - | - | - | v 17.60 | LF2010 |
| 007.8–04.4 | 3.80 | RP1997 | eff | 4.439 | RP1997 | 3.716 | ZK1993 | v 14.67 | TA1991 |
| 008.0+03.9 | 7.29 | M1997 | eff | 5.194 | M1997 | 2.690 | M1997 | v 19.00 | TS1994 |
| 008.1–04.7 | - | - | - | - | - | - | - | v 15.80 | WL2007 |
| 008.2+06.8 | 2.95±0.09 | HP2007 | eff | 4.447±0.023 | HP2007 | 4.090±0.15–0.14 | HP2007 | v 14.20±0.1 | HP2007 |
| 008.2–04.8 | 4.90 | ZK1993 | - | 4.874 | ZK1993 | 3.763 | ZK1993 | b 18.20 | SECGPN |
| 008.3–01.1 | 5.50 | ZK1993 | - | 5.066 | ZK1993 | 3.300 | GZ2007 | v 18.30 | CM2000 |
| 008.3–07.3 | 6.75 | RP1997 | eff | 5.097 | RP1997 | 3.663 | HK2010 | v 15.60±0.4 | SK1989 |
| 009.4–05.0 | 3.90 | MK1992 | eff | 4.672 | MK1992 | 3.820 | GM2019b | v 12.96 | TA1991 |
| 009.6+10.5 | 4.80±0.3 | SB2008 | - | 4.544±0.012 | SK1989 | <2.602 | SK1989 | v 16.42±0.24 | SK1989 |
| 009.6+14.8 | 4.70 | ZK1993 | - | 4.822 | ZK1993 | 3.799 | ZK1993 | v 13.74 | CM2000 |
| 009.6–10.6 | 4.75 | RP1997 | eff | 4.916 | RP1997 | 3.300 | GZ2007 | v 15.90 | WL2007 |
| 009.8–04.6 | - | - | - | - | - | - | - | - | - |
| 009.8–07.5 | 4.60±0.24 | MP2013b | eff | 4.690 | PL2016 | 3.340 | PL2016 | - | - |
| 010.4+04.4 | - | - | eff | 4.690 | P1999 | 3.680 | TE2002 | v 24.00 | TE2002 |
| 010.7–06.4 | 4.90 | t.w. | z(HeII) | 4.796±0.024 | P2003 | 3.600 | GZ2007 | b 17.20 | TA1991 |
| 010.8+18.0 | 3.90 | ZK1993 | eff | 4.176 | LC2011 | 3.447 | ZK1993 | v 15.65±0.19 | SK1989 |
| 010.8–01.8 | 4.20 | ZK1993 | * | 4.813 | PM2003b | 3.799 | ZK1993 | v 15.74 | TA1991 |
| 011.1–07.9 | <2.70 | JH2019 | - | 4.322 | JH2019 | 0.568 | Ko2001 | v 14 ²⁷ | BDI982 JH2019 |
| 011.3–09.4 | - | - | - | - | - | - | - | v 13.41 | TA1991 |
| 011.4+17.9 | 5.00 | SW1997 | eff | 4.954 | SW1997 | - | - | - | - |
| 011.7–00.6 | 4.40 | ZK1993 | z(HeII) | 4.797 | Ph2005 | 3.620 | GS1997 | v 14.36 | WL2007 |
| 011.7–06.6 | - | - | - | - | - | - | - | v 13.94 | TA1991 |
| 011.9+04.2 | - | - | * | 4.820 | PM2003b | - | - | v 17.00 | TA1991 |
| 012.1–11.2 | - | - | - | - | - | - | - | - | - |
| 012.2+04.9 | 3.70 | HW2006 | * | 4.544 | Ko2001 | 3.700 | Ko2001 | v 14.90 | GT2000 |
| 012.5–09.8 | - | - | - | 4.914 | PA1989 | - | - | v 17.40 | TA1991 |
| 012.9+06.6 | - | - | - | - | - | - | - | - | - |
| 013.1+05.0 | - | - | - | - | - | - | - | - | - |
| 013.7–10.6 | - | - | - | 4.833 | MP2006 | - | - | v 16.70 | TA1991 |
| 014.0–05.5 | - | - | z(HeII) | 4.920±0.143 | MV2016 | 2.880±0.28 | MV2016 | v 13.27 | TA1991 |
| 014.2+03.8 | - | - | - | - | - | - | - | v 16.50 | PM2003 |
| 014.3–05.5 | - | - | - | 4.920±0.014 | MV2016 | 2.880±0.28 | MV2016 | - | - |
| 014.4–06.1 | - | - | - | - | - | - | - | - | - |
| 014.6–04.3 | 5.25 | RP1997 | eff | 5.000 | RP1997 | - | - | - | - |
| 014.8–08.4 | - | - | - | - | - | - | - | - | - |
| 015.4–04.5 | 4.70 | RP1997 | eff | 4.889 | RP1997 | 3.756 | M1997 | v 14.30 | TA1991 |

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²⁷ Irregular variable.

Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_\star/L_\odot) | ref. | mag. | ref. |
|------------|-----------|---------|---------|-------------|---------|---------------------------|---------|--------------|---------|
| 015.5+02.8 | - | - | - | >4.813 | Fd2008 | - | - | v 19.00 | Fd2008 |
| 015.9+03.3 | - | - | - | - | - | - | - | - | - |
| 016.2-03.7 | - | - | - | - | - | - | - | v 16.50 | PM2003 |
| 016.4-01.9 | 4.20 | ZK1993 | - | 4.699 | ZK1993 | 3.763 | ZK1993 | v 12.83 | TA1991 |
| 016.8-01.7 | - | - | - | - | - | - | - | i 15.41 | DP2011 |
| 017.3-21.9 | 6.70±0.2 | HF2015 | - | 5.041±0.039 | HF2015 | 2.610 | HF2015 | v 15.40 | HF2015 |
| 017.6-10.2 | - | - | * | >4.903 | Fd2008 | 1.750 | GS1997 | v 15.42 | TS1994 |
| 017.9-04.8 | 4.60 | ZK1993 | * | 4.987 | PM2003b | 3.929 | ZK1993 | v 17.90 | GT2000 |
| 019.4-05.3 | 4.70 | ZK1993 | - | 4.860 | ZK1993 | 4.000 | ZK1993 | b 17.10 | TA1991 |
| 019.7-04.5 | 4.80 | ZK1993 | - | 4.870 | AN2003 | 3.929 | ZK1993 | - | - |
| 019.7-10.7 | - | - | - | - | - | - | - | - | - |
| 019.7-10.7 | 7.00 | AW2019 | - | 4.919 | AW2019 | - | - | g 18.45 | AW2019 |
| 020.4-07.0 | - | - | - | - | - | - | - | - | - |
| 020.7-05.9 | 4.60 | ZK1993 | - | 4.803 | ZK1993 | 3.740 | ZK1993 | v 14.16 | TA1991 |
| 020.7-08.0 | - | - | - | - | - | - | - | - | - |
| 020.9-01.1 | - | - | - | 4.980 | AN2003 | - | - | v >18.00 | AN2003 |
| 021.0-04.1 | - | - | - | - | - | - | - | - | - |
| 023.8-06.2 | - | - | - | - | - | - | - | - | - |
| 025.3+40.8 | 3.70±0.2 | HB2011 | * | 4.682 | HB2011 | 3.740 | GM2019b | v 11.33 | GM2019b |
| 025.4-04.7 | 6.66±0.30 | N1999 | eff | 4.955±0.030 | N1999 | 1.817±0.301 | SV2002 | v 16.90±0.2 | NS1995 |
| 025.8-17.9 | 6.78 | PB2005 | * | 5.161 | PB2005 | 3.037 | PB2005 | b 16.97±0.15 | GP1988 |
| 025.9-10.9 | - | - | - | - | - | - | - | - | - |
| 027.6+04.2 | 4.10 | ZK1993 | * | 4.813 | PM2003b | 3.600 | GZ2007 | v 15.70 | GG2006 |
| 027.6+16.9 | 5.60 | Gd2013 | eff | 5.068 | Gd2013 | 1.831 | SV2002 | v 15.10±0.2 | NS1995 |
| 027.6-09.6 | 4.60 | HA2001b | - | 4.845 | HA2001b | 3.591 | HA2001b | v 15.19 | WL2007 |
| 028.0+10.2 | - | - | eff | 4.599±0.248 | SV2002 | 1.344±4.05 | SV2002 | v 18.40±0.2 | NS1995 |
| 029.0+00.4 | 4.90 | FB2014 | - | 4.851 | FB2014 | 3.740 | FB2014 | v 17.80±0.01 | FB2014 |
| 029.2-05.9 | 4.60 | ZK1993 | * | 5.130 | PM2003b | 3.000 | GZ2007 | v 15.45 | TA1991 |
| 030.6+06.2 | 7.24 | GB2010 | eff | 4.927 | GB2010 | - | - | v 16.60±0.2 | NS1995 |
| 032.0-03.0 | 3.60 | ZK1993 | - | 4.576 | ZK1993 | 3.898 | ZK1993 | - | - |
| 033.2-01.9 | - | - | - | - | - | - | - | - | - |
| 034.1-10.5 | 6.38±0.31 | N1999 | eff | 4.833±0.060 | N1999 | 1.950 | Fd2008 | v 16.90±0.2 | NS1995 |
| 034.3+06.2 | - | - | eff | 5.375±0.301 | SV2002 | 2.644±0.302 | SV2002 | - | - |
| 034.5-06.7 | 4.30 | ZK1993 | eff | 5.030±0.070 | SV2002 | 2.605±0.199 | SV2002 | v 18.10 | TA1991 |
| 034.6+11.8 | 4.20 | Gd2013 | eff | 4.778 | Gd2013 | 3.170 | SP2015 | v 12.00 | TA1991 |
| 035.9-01.1 | 6.80 | B2008 | - | 5.196 | GM2019b | 3.110 | GM2019b | v 19.00 | GM2019b |
| 036.0+17.6 | 5.70 | Gd2013 | eff | 5.041 | Gd2013 | 3.630 | GM2019b | v 14.80±0.3 | NS1995 |
| 036.1-57.1 | 7.00 | Gd2013 | eff | 5.041 | GM2019b | 1.830 | GM2019b | v 13.40±0.4 | NS1995 |
| 036.4-01.9 | - | - | - | - | - | - | - | - | - |
| 037.5-05.1 | - | - | - | 4.978 | CK2006 | 3.763 | KK2001 | - | - |
| 037.7-06.0 | - | - | - | - | - | - | - | v 16.60 | DP2011 |
| 037.7-34.5 | 4.90 | MK1992 | eff | 4.940 | Gd2013 | 3.970 | MK1992 | v 12.54 | TA1991 |
| 037.8-06.3 | 5.50 | SP2015 | eff | 4.985±0.045 | SP2015 | 3.763 | SP2015 | v 15.50 | KJ1991 |
| 038.1-25.4 | 7.55 | M1997 | eff | 5.242±0.302 | SV2002 | 1.160±0.306 | SV2002 | v 17.82 | MB2012 |
| 038.2+12.0 | 3.50 | ZK1993 | eff | 4.809±0.070 | SV2002 | 3.893±0.281 | SV2002 | v 12.40 | TA1991 |
| 038.4-03.3 | - | - | - | - | - | - | - | v 14.72 | TA1991 |
| 039.0-04.0 | - | - | - | - | - | - | - | - | - |
| 039.5-02.7 | - | - | - | - | - | - | - | v 17.30 | TA1991 |
| 041.8+04.1 | - | - | - | - | - | - | - | - | - |
| 041.8-02.9 | 7.47 | M1997 | eff | 4.982±0.027 | SB2019b | 1.130±0.134 | SB2019b | v 16.88 | Fd2008 |
| 042.0+05.4 | 3.10 | ZK1993 | - | 4.433 | ZK1993 | 3.799 | ZK1993 | v 16.20 | TA1991 |
| 042.5-14.5 | - | - | bT | 4.770 | HD2013 | 2.446 | SV2002 | v 18.20±0.2 | NS1995 |
| 042.9-06.9 | 4.18 | M1997 | z(HeII) | 4.711±0.010 | MV2016 | 3.690±0.27 | MV2016 | v 15.14±0.13 | MV2016 |
| 043.1+03.8 | - | - | z(HeI) | 4.447±0.155 | P2003 | 3.810 | GS1997 | v 14.74 | TA1991 |
| 043.1+37.7 | 4.80±0.2 | HB2011 | * | 4.946 | HB2011 | 3.870 | HB2011 | v 12.70 | dB2004 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|------------|-----------|--------|---------|-------------|---------|-----------------------|---------|--------------|---------|
| 043.3+11.6 | - | - | z(HeI) | 4.618±0.023 | P2003 | 4.390 | P2003 | v 15.50 | TA1991 |
| 044.1+05.8 | - | - | z(HI) | 4.365±0.032 | MV2016 | 1.910±0.33 | MV2016 | v 16.86±0.01 | MV2016 |
| 044.3-05.6 | - | - | eff | 4.890±0.025 | SV2002 | 3.229±0.12 | SV2002 | v 17.30 | TA1991 |
| 045.4-02.7 | 3.50 | cH1989 | z(HeII) | 4.771 | KJ1991 | 3.544 | cH1989 | v 15.10 | TA1991 |
| 045.7-04.5 | 5.37 | BC2012 | eff | 4.954 | BC2012 | 3.210 | GM2019b | v 14.37 | TA1991 |
| 046.4-04.1 | 4.50 | ZK1993 | | 4.954 | LH2013 | 3.650 | GS1997 | v 15.20 | TS1994 |
| 046.8+03.8 | 7.50 | FP2016 | | 5.079 | FP2016 | 1.830 | GM2019b | v 17.66 | FP2016 |
| 047.0+42.4 | 6.30 | Gd2013 | eff | 5.068 | Gd2013 | 2.470 | GM2019b | v 15.60±0.2 | NS1995 |
| 047.1+04.1 | - | - | eff | 4.392±0.049 | SV2002 | 2.760±0.159 | SV2002 | v 16.90 | TA1991 |
| 048.7+01.9 | - | - | eff | 4.362±0.205 | SV2002 | 3.771±3.418 | SV2002 | v >17.00 | AN2003 |
| 049.4+02.4 | 4.60 | ZK1993 | eff | 4.550 | GS2016 | 3.150 | GS2016 | b 12.00 | GS2016 |
| 051.0+02.8 | - | - | | - | - | - | - | v 13.40 | dB2004 |
| 051.3+01.8 | - | - | | - | - | - | - | v 15.10 | SECVPN |
| 051.4+09.6 | 2.80 | ZK1993 | | 4.580 | M1997 | 3.820 | M1997 | v 13.09 | TA1991 |
| 051.9-03.8 | - | - | eff | 4.744±0.010 | SV2002 | 3.988±0.077 | SV2002 | v 14.54 | TA1991 |
| 052.2+07.6 | - | - | | - | - | - | - | - | - |
| 052.2-04.0 | 4.80 | ZK1993 | z(HeII) | 4.763 | KJ1991 | 4.100 | ZK1993 | v 18.10 | TA1991 |
| 052.5-02.9 | 4.36 | M1997 | eff | 4.806±0.030 | SV2002 | 3.969±0.164 | SV2002 | v 14.12 | TA1991 |
| 052.7+50.7 | 2.90 | NH1994 | | 4.305 | NH1994 | - | - | v 10.73 | HF2000 |
| 053.3+24.0 | - | - | eff | 5.075±0.084 | SV2002 | 3.275±0.285 | SV2002 | v 17.60 | SECVPN |
| 053.8-03.0 | 8.00 | SG2003 | eff | 4.623 | SV2002 | 1.922 | SV2002 | v 18.04 | WW1993 |
| 054.1-12.1 | 4.00 | MK1992 | eff | 4.699 | MK1992 | 4.020 | MK1992 | v 12.43 | TA1991 |
| 054.2-03.4 | - | - | | - | - | - | - | i 17.25 | CS2011 |
| 054.4-02.5 | 3.80 | ZK1993 | | 4.679 | ZK1993 | 4.149 | ZK1993 | v 17.70 | TA1991 |
| 055.1-01.8 | - | - | | - | - | - | - | - | - |
| 055.4+16.0 | 5.67±0.05 | HF2017 | | 4.695±0.039 | HF2017 | 3.180 | GM2019b | v 14.80 | GM2019b |
| 055.5-00.5 | - | - | | - | - | - | - | - | - |
| 055.6+02.1 | - | - | eff | 4.475±0.038 | SV2002 | 3.867±0.097 | SV2002 | v 16.70 | TA1991 |
| 057.2-08.9 | 4.34 | M1997 | eff | 4.835±0.026 | SV2002 | 3.617±0.13 | SV2002 | v 14.80 | TA1991 |
| 058.3-10.9 | 4.20 | ZK1993 | eff | 4.740 | HA1994 | 3.314 | HA1994 | v 14.40 | Ph2005 |
| 058.6+06.1 | 5.00 | dP2013 | eff | 4.667±0.022 | SV2002 | 1.666±0.022 | SV2002 | v 17.73 | dP2013 |
| 059.7-18.7 | - | - | eff | 5.029±0.016 | SB2019b | 2.517±0.044 | SV2002 | v 16.01 | dP2013 |
| 060.0-04.3 | - | - | | - | - | - | - | v 13.26 | SECVPN |
| 060.1-07.7 | 7.00 | SP2015 | eff | 5.216±0.053 | SP2015 | 2.892 | SP2015 | v 18.00 | TS1994 |
| 060.4+01.5 | - | - | | - | - | - | - | v 18.60 | GT2000 |
| 060.5+01.8 | - | - | | - | - | - | - | - | - |
| 060.8-03.6 | 7.36 | GB2010 | eff | 5.130 | GM2019b | 2.440 | GM2019b | v 14.20±0.2 | NS1995 |
| 061.0+08.0 | 4.00 | ZK1993 | z(HeII) | 5.057 | P2003 | 2.499±0.303 | SV2002 | v 17.20 | SECVPN |
| 061.3+03.6 | - | - | | - | - | - | - | - | - |
| 061.4-09.5 | 4.70 | ZK1993 | eff | 5.117±0.042 | SB2019b | 4.010 | GM2019b | v 15.70 | SB2019b |
| 061.8+02.1 | - | - | | - | - | - | - | v 16.17±0.02 | AE1985 |
| 061.9+41.3 | 3.40 | N1999 | eff | 4.568 | N1999 | 3.500 | PL2016 | v 15.30 | TA1991 |
| 062.4+09.5 | - | - | z(HeII) | 4.968 | P2003 | 2.150 | GS1997 | v 17.80±0.2 | NS1995 |
| 063.1+13.9 | 6.90 | Gd2013 | | 5.170 | GM2019b | 2.620 | GM2019b | v 16.20±0.3 | NS1995 |
| 064.6+48.2 | 4.80 | HB2011 | * | 4.961 | HB2011 | 3.920 | HB2011 | v 13.94 | TA1991 |
| 064.7+05.0 | 4.20 | Gd2013 | | 4.550 | AN2003 | 4.100 | GZ2007 | v 12.50 | GT2000 |
| 065.0-27.3 | 3.90 | Gd2013 | eff | 4.591 | Gd2013 | 3.480 | PL2016 | v 12.86 | TA1991 |
| 066.7-28.2 | 5.70 | Gd2013 | eff | 5.041 | Gd2013 | 3.088±0.204 | SB2019b | v 13.60±0.2 | NS1995 |
| 066.8+02.9 | - | - | | - | - | - | - | - | - |
| 068.1+11.0 | - | - | | - | - | - | - | - | - |
| 068.3-02.7 | 4.40 | HW2006 | * | 4.886 | AN2003 | 4.370 | Ko2001 | v 17.30 | AN2003 |
| 068.7+01.9 | - | - | | - | - | - | - | - | - |
| 068.7+14.8 | - | - | z(HeII) | 4.772±0.003 | MV2016 | 4.120±0.26 | MV2016 | v 16.10±0.04 | MV2016 |
| 069.4-02.6 | 7.46 | M1997 | eff | 5.000 | GM2019b | 2.100 | GM2019b | v 18.32 | GM2019b |
| 072.7-17.1 | 6.82±0.27 | N1999 | eff | 5.033±0.060 | N1999 | 1.490 | GM2019b | v 17.05 | HD2007 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|--------------------------|-----------|--------|---------|-------------|---------|-----------------------|---------|----------------------|---------|
| 075.7+35.8 | - | - | eff | 4.315±0.009 | SV2002 | 3.113±0.044 | SV2002 | v 14.31 | TA1991 |
| 075.9+11.6 | - | - | - | - | - | - | - | - | - |
| 076.3+14.1 | 6.70 | dO2015 | - | 5.161 | dO2015 | - | - | v 15.67 | dO2015 |
| 077.6+14.7 | 7.10±0.37 | N1999 | eff | 4.945±0.039 | N1999 | 1.880 | GM2019b | v 17.39 | dO2015 |
| 078.5+18.7 | - | - | eff | 5.178±0.301 | SV2002 | 2.027±0.301 | SV2002 | b 20.00 | SECGPN |
| 079.9+06.4 | - | - | z(HI) | 4.755±0.064 | MV2016 | - | - | - | - |
| 080.3–10.4 ²⁸ | 6.61 | FP2016 | eff | 5.230 | Cd2014 | 3.260 | GM2019b | v 13.13 | FP2016 |
| 081.2–14.9 | 5.70 | Gd2013 | - | 5.053 | Gd2013 | 3.750 | GM2019b | v 13.26 | GM2019b |
| 082.1+07.0 | 5.70 | SP2015 | eff | 5.057±0.038 | SP2015 | 3.903 | M1997 | v 15.50 | TA1991 |
| 082.5+11.3 | 3.58 | M1997 | z(HeII) | 4.799 | Ph2005 | 3.886 | M1997 | v 14.60 | TA1991 |
| 083.5+12.7 | 5.00 | SP2015 | eff | 4.700±0.043 | SP2015 | 4.093 | SP2015 | v 10.68 | GM2019b |
| 084.7–08.0 | - | - | - | 4.845 | GM2013 | - | - | - | - |
| 084.9–03.4 | 6.00 | SP2015 | eff | 5.211±0.053 | SP2015 | 3.467 | SP2015 | v 16.20 | HH1994 |
| 085.4+52.3 | 7.50±0.5 | WR2016 | - | 5.176±0.022 | WR2016 | 2.380 | Fd2008 | v 15.52 | FP2016 |
| 086.9–03.4 | - | - | - | - | - | - | - | i 18.0 ²⁹ | CR2014 |
| 089.0+00.3 | 4.40 | ZK1993 | eff | 4.965±0.029 | SV2002 | 2.913±0.108 | SV2002 | v 14.20 | GT2000 |
| 089.3–02.2 | - | - | eff | 4.320±0.006 | SV2002 | 4.430±0.03 | SV2002 | v 12.10 | TA1991 |
| 089.8–05.1 | 8.00 | SP2015 | eff | 5.098±0.035 | SP2015 | 3.417 | SP2015 | v 16.40 | TA1991 |
| 093.4+05.4 | - | - | eff | 4.990±0.254 | HS2018 | 3.063±0.301 | SV2002 | v 13.88 | TA1991 |
| 093.9–00.1 | 3.20 | FB2014 | - | 4.447 | LH1998 | <3.750 | LH1998 | v 14.40 | HZ2019 |
| 094.0+27.4 | 6.40 | Gd2013 | eff | 5.146 | Gd2013 | 3.530 | GM2019b | v 15.08 | GT2000 |
| 095.2+00.7 | - | - | eff | 4.653 | OK2014 | - | - | - | - |
| 096.3+02.3 | - | - | eff | 4.299±0.188 | SV2002 | 3.537±3.126 | SV2002 | v >14.80 | GT2000 |
| 096.4+29.9 | 4.70±0.3 | HB2011 | * | 4.781 | HB2011 | 3.580 | GM2019b | v 11.29 | GM2019b |
| 096.9+32.0 | 7.86 | N1999 | eff | 4.979 | N1999 | - | - | v 14.58 | HD2007 |
| 100.0–08.7 | 3.50 | ZK1993 | z(H) | 4.771 | KJ1991 | 4.061 | ZK1993 | v 16.10 | TS1994 |
| 100.6–05.4 | 5.50 | HA2001 | eff | 4.978 | Gd2013 | 3.820 | ZK1993 | v 16.30 | TA1991 |
| 102.9–02.3 | 7.30 | B2008 | eff | 4.389±0.212 | SV2002 | 2.404±3.527 | SV2002 | v 16.97 | dP2013 |
| 103.7+00.4 | 7.10 | B2008 | - | 5.279 | B2008 | 2.970 | SV2002 | - | - |
| 104.2–29.6 | 6.50 | HW2006 | eff | 5.176 | HW2006 | 1.844 | SV2002 | v 16.10±0.3 | NS1995 |
| 104.4–01.6 | 7.10 | B2008 | eff | 5.035±0.007 | SV2002 | 2.521±0.023 | SV2002 | b 21.20 | KS1990 |
| 104.8–06.7 | - | - | - | 4.477 | H2003 | - | - | v 12.05 | TA1991 |
| 106.5–17.6 | 5.70 | HB2011 | eff | 5.102±0.034 | SP2015 | 3.780 | HB2011 | v 13.30 | HA1997 |
| 107.4–00.6 | - | - | - | - | - | - | - | - | - |
| 107.6–13.3 | 3.70 | ZK1993 | eff | 4.531 | Gd2013 | 4.153 | SV2002 | v 14.55 | TA1991 |
| 107.7+07.8 | 7.50 | P1996 | - | 5.100 | GM2019b | 2.150 | GM2019b | v 17.71 | GM2019b |
| 107.7–02.2 | 7.66 | M1997 | eff | 5.226±0.301 | SV2002 | 2.748±0.302 | SV2002 | - | - |
| 107.8+02.3 | 4.60 | ZK1993 | eff | 4.989±0.301 | SV2002 | 4.140±0.301 | GM2019b | v 16.20 | GM2019b |
| 111.0+11.6 | 6.65±0.19 | N1999 | eff | 4.884±0.033 | N1999 | 1.176 | BC2012 | v 15.47 | HD2007 |
| 111.8–02.8 | 3.10 | ZK1993 | z(H) | 4.681 | KJ1991 | 4.199 | ZK1993 | v 13.60 | TA1991 |
| 114.0–04.6 | - | - | eff | 4.863±0.031 | SV2002 | 3.071±0.135 | SV2002 | v 14.92±0.1 | Pi2005 |
| 118.0–08.6 | 4.20 | N1999 | eff | 4.778 | N1999 | 3.687±0.041 | SV2002 | v 13.93 | TA1991 |
| 118.8–74.7 | 5.70 | Gd2013 | eff | 5.176 | Gd2013 | 2.954±0.109 | SB2019b | v 11.78 | BC2012 |
| 119.6–06.7 | 5.98 | M1997 | eff | 5.055±0.066 | SV2002 | 2.686±0.176 | SV2002 | v 19.50 | TS1994 |
| 120.0+09.8 | 4.80 | Gd2013 | eff | 4.851 | Gd2013 | 3.300 | GZ2007 | v 11.58 | GT2000 |
| 120.2–05.3 | 7.50 | P1996 | eff | 4.813 | P1996 | 1.730 | Fd2008 | v 18.70±0.4 | NS1995 |
| 120.3+18.3 | 6.70 | Gd2013 | eff | 4.839 | Gd2013 | - | - | v 14.70±0.3 | NS1995 |
| 123.6+34.5 | 4.05 | MK1992 | eff | 4.699 | MK1992 | 3.960 | MK1992 | v 13.72 | TA1991 |
| 124.0+10.7 | 7.34±0.31 | N1999 | eff | 5.167±0.074 | N1999 | 1.680 | GM2019b | v 16.30±0.4 | NS1995 |
| 125.9–47.0 | 5.93±0.12 | N1999 | eff | 4.544±0.011 | N1999 | - | - | v 12.11 | HD2007 |
| 126.6+01.3 | - | - | - | - | - | - | - | r' 18.12±0.02 | MC2006 |
| 128.0–04.1 | 7.41 | GB2010 | - | 5.199 | GM2019b | 2.400 | GM2019b | v 17.70±0.3 | NS1995 |

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²⁸ PN G080.8–10.6²⁹ variable

Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|--------------------------|------------|---------|-------|-------------------|---------|-----------------------|---------|--------------|---------|
| 130.2+01.3 | 4.30 | ZK1993 | * | 5.100 | Ko2001 | 3.700 | Ko2001 | v 15.40 | GT2000 |
| 130.3–11.7 | 5.22 | M1997 | | 4.940 | MP2006 | 3.489 | AG1985 | v 16.20 | TA1991 |
| 130.9–10.5 | 7.31 | FP2016 | | 5.140 | FP2016 | 2.230 | MK2015 | v 17.53 | FP2016 |
| 133.1–08.6 | - | - | eff | 4.736±0.024 | SV2002 | 2.384±0.155 | SV2002 | v 13.44 | TA1991 |
| 135.6+01.0 | - | - | | - | - | - | - | v 14.45 | BP2003 |
| 135.9+55.9 | - | - | eff | 4.760 | PL2016 | 3.140 | PL2016 | - | - |
| 136.3+05.5 | 5.65±0.05 | CB2016 | | 5.000 | PR2013b | 3.330 | PR2013b | v 14.50 | CB2016 |
| 138.1+04.1 | - | - | | - | - | - | - | - | - |
| 138.8+02.8 | 5.60 | GP1988 | eff | 5.000 | GP1988 | 2.760 | AG1985 | v >15.90 | SECVPN |
| 143.6+23.8 | - | - | eff | 4.616±0.023 | SV2002 | 2.278±0.031 | SV2002 | v 12.50±0.4 | NS1995 |
| 144.5+06.5 | 6.00 | HW2006 | eff | 5.127 | HW2006 | 3.800 | GZ2007 | v 14.39 | GT2000 |
| 144.8+65.8 | 6.50 | N1999 | eff | 5.021 | N1999 | 2.550 | GM2019b | v 16.15 | LT1995 |
| 146.7+07.6 | 2.90 | t.w. | bb | 4.400 | GZ2007 | 3.800 | GZ2007 | v 13.96 | GT2000 |
| 147.4–02.3 | 5.06 | M1997 | * | 4.826 | PM2003b | 3.869 | M1997 | v 16.70 | AK1987 |
| 147.8+04.1 | 4.72 | AK1987 | eff | 5.216±0.301 | SV2002 | 3.229±0.302 | SV2002 | - | - |
| 148.4+57.0 | 6.90 | Gd2013 | eff | 4.973 | Gd2013 | 2.010 | GM2019b | v 16.50±0.3 | NS1995 |
| 149.4–09.2 | 7.32 | GB2010 | eff | 5.097 | GM2019b | 2.050 | GM2019b | v 17.20±0.4 | NS1995 |
| 149.7–03.3 | 7.00 | FP2016 | | 5.000 | FP2016 | 1.400 | GM2019b | v 16.56 | FP2016 |
| 156.3+12.5 | 7.90 | Gd2013 | eff | 4.672 | Gd2013 | - | - | v 16.53 | HD2007 |
| 156.9–13.3 | 7.58±0.20 | N1999 | eff | 4.581±0.017 | N1999 | - | - | v 17.50±0.4 | NS1995 |
| 158.6+00.7 ³⁰ | 6.70 | Gd2013 | eff | 4.919 | Gd2013 | 1.670 | GM2019b | v 12.90±0.4 | NS1995 |
| 158.8+37.1 | 7.58±0.051 | KK2013 | eff | 4.795±0.008 | KK2013 | 0.493±0.23 | SB2019b | v 16.56 | dP2013 |
| 158.9+17.8 | 7.10 | Gd2013 | eff | 4.973 | Gd2013 | 1.700 | PR2013b | v 15.53 | HD2007 |
| 159.0–15.1 | 4.50 | ZK1993 | eff | 5.127±0.114 | SV2002 | 3.066±0.218 | SV2002 | v 15.60 | TA1991 |
| 161.2–14.8 | 4.90 | ZK1993 | eff | 4.954±0.028 | SV2002 | 3.445±0.109 | SV2002 | v 15.00 | TA1991 |
| 164.8+31.1 | 7.00 | FP2016 | eff | 5.010±0.010 | SV2002 | 1.840 | GM2019b | v 17.16 | BC2012 |
| 165.5–06.5 | - | - | | - | - | - | b | 17.90 | TA1991 |
| 165.5–15.2 | 5.50±0.1 | AM2015b | | 4.954±0.048 | AM2015b | 3.400±0.2 | AM2015b | v 9.44 | TA1991 |
| 166.1+10.4 | 3.60 | Gd2013 | eff | 4.623 | Gd2013 | 3.014±0.023 | SV2002 | v 11.47 | KJ1991 |
| 167.4–09.1 | - | - | z | 4.470 | P2003 | - | - | v 15.36 | TS1994 |
| 169.6+00.0 | - | - | | 4.623 | AG1985 | 2.851 | AG1985 | - | - |
| 170.3+15.8 | 5.62 | M1997 | eff | 5.025±0.033 | SV2002 | 2.778±0.1 | SV2002 | v 17.60 | SECVPN |
| 171.3–25.8 | - | - | eff | 5.058±0.080 | SV2002 | 2.126±0.025 | SV2002 | b 18.70 | TS1994 |
| 184.0–02.1 | - | - | z(HI) | 4.605±0.002 | MV2016 | 2.620±0.26 | MV2016 | v 16.27±0.01 | MV2016 |
| 189.1+19.8 | 6.30 | Gd2013 | eff | 5.130 | Gd2013 | 3.317±0.251 | SB2019b | v 14.85 | GT2000 |
| 189.8+07.7 | - | - | eff | 5.045±0.302 | SV2002 | 2.353±0.307 | SV2002 | v 19.64 | TS1994 |
| 190.3–17.7 | 4.70 | N1999 | eff | 4.929 | N1999 | 3.700±0.074 | SV2002 | v 14.35 | TA1991 |
| 191.4+33.1 ³¹ | 7.76 | GB2010 | eff | 4.860 | GB2010 | 1.800 | Fd2008 | v 15.70 | HD2007 |
| 193.6–09.5 | - | - | eff | 5.099±0.301 | SV2002 | 1.987±0.301 | SV2002 | v 14.24 | CB1999 |
| 194.2+02.5 | 6.00 | OH2019 | * | 5.113 | OH2019 | 3.745 | OH2019 | v 17.80 | TS1994 |
| 196.6–10.9 | 5.30 | N1999 | eff | 5.000 | N1999 | 2.930 | PB2005 | b 15.92±0.08 | GP1988 |
| 197.4–06.4 | 7.53±0.32 | N1999 | eff | 5.149±0.059 | N1999 | 1.540 | GM2019b | v 17.24 | FP2016 |
| 197.8+17.3 | 4.00±0.2 | HB2011 | * | 4.680 | HB2011 | 4.110 | GM2019b | v 10.63 | GM2019b |
| 197.8–03.3 | 7.00 | AC2016 | | 5.079 | AC2016 | 1.176 | AC2016 | v 15.24 | LK1987 |
| 199.4+14.3 | - | - | | - | - | - | - | - | - |
| 203.1–13.4 | - | - | | 4.114+0.167-0.084 | MW2016 | - | - | r' 18.40 | MW2016 |
| 204.1+04.7 | 6.10 | Gd2013 | eff | 4.826 | Gd2013 | 2.210 | GM2019b | v 14.30±0.3 | NS1995 |
| 205.1+14.2 | 6.50 | BC2012 | eff | 5.146 | BC2012 | 1.980 | GM2019b | v 15.96 | HD2007 |
| 206.4–40.5 | 4.80±0.3 | HB2011 | * | 4.929 | HB2011 | 3.440 | GM2019b | v 12.30 | TA1991 |
| 208.5+33.2 | - | - | eff | 5.061 | Gd2013 | 2.254±0.24 | SB2019b | v 14.38 | GT2000 |
| 211.2–03.5 | 3.50 | OK2014 | eff | 4.780±0.014 | SV2002 | 3.273±0.092 | SV2002 | v 15.84 | TA1991 |
| 211.4+18.4 | - | - | | - | - | - | - | v 18.00 | TA1991 |

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³⁰ PN G158.5+00.7³¹ PN G191.4+33.0

Table 2 – continued from previous page

| PN G | log <i>g</i> | ref. | met. | log <i>T</i> | ref. | log (<i>L</i> _★ / <i>L</i> _⊙) | ref. | mag. | ref. |
|------------|--------------|---------|---------|--------------|---------|---|---------|-----------------------|---------|
| 211.9+22.6 | 5.80 | N1999 | eff | 4.623 | N1999 | 1.370 | LH2005 | v 14.08 | TA1991 |
| 214.9+07.8 | 6.13 | N1999 | eff | 4.990±0.009 | SB2019b | 2.560 | GM2019b | v 16.47 | dP2013 |
| 215.2–24.2 | 3.70 | Gd2013 | eff | 4.556 | GZ2007 | 3.860 | GM2019b | v 10.09 | KJ1991 |
| 215.5–30.8 | 7.00 | Gd2013 | eff | 4.996 | Gd2013 | 1.720 | GM2019b | v 15.48 | HD2007 |
| 215.6+03.6 | 7.00 | GM2019 | eff | 5.114 | GM2019 | 2.230 | GM2019 | v 11.47 | TA1991 |
| 215.7–03.9 | - | - | - | - | - | - | - | - | - |
| 216.0+07.4 | - | - | - | - | - | - | - | v 13.90 | DP2011 |
| 218.9–10.7 | - | - | eff | 4.657±0.029 | SV2002 | 1.258±0.031 | SV2002 | v 16.29 | TA1991 |
| 219.1+31.2 | 6.60 | Gd2013 | eff | 4.929 | Gd2013 | 1.690 | GM2019b | v 15.52 | HD2007 |
| 219.2+07.5 | 5.60 | TH2005 | - | 5.053 | TH2005 | - | - | v 13.02 | FP2016 |
| 219.5+02.8 | - | - | - | - | - | - | - | - | - |
| 220.3–53.9 | 5.70+0.3-0.2 | MM2018a | eff | 5.021±0.041 | MM2018a | 3.280 | GM2019b | v 11.06 | TA1991 |
| 221.0–01.4 | - | - | - | - | - | - | - | - | - |
| 221.3–12.3 | 6.80 | t.w. | eff | 5.021±0.012 | HB2015 | 3.870±0.1 | HB2015 | v 17.90 | NA2000 |
| 221.5+46.3 | 7.00 | GP1988 | eff | 5.041 | GM2019b | 2.460 | GM2019b | v 16.09 | TA1991 |
| 222.1+03.9 | - | - | - | - | - | - | - | v 15.78 | Fd2008 |
| 222.5+07.6 | - | - | - | - | - | - | - | - | - |
| 222.8–04.2 | - | - | - | - | - | - | - | v 14.10 | DP2011 |
| 224.9+01.0 | - | - | - | - | - | - | - | - | - |
| 225.5–02.5 | - | - | - | - | - | - | - | - | - |
| 228.0–00.4 | - | - | - | - | - | - | - | - | - |
| 228.2–22.1 | - | - | - | 5.090 | TJ2013 | - | - | v 12.44 | TJ2013 |
| 231.1+03.9 | - | - | - | - | - | - | - | - | - |
| 231.8+04.1 | 6.62±0.22 | OK2014b | eff | 5.057±0.038 | OK2014b | 2.756 | OK2014b | v 16.80 | OK2014b |
| 232.0+05.7 | 3.30 | OK2014 | | 4.473 | OK2014 | 2.800 | OK2014 | v 13.26 | SECVPN |
| 232.8–04.7 | 3.50 | OK2013 | - | 4.504 | OK2013 | 3.654 | OK2013 | v 13.83 | TA1991 |
| 233.5–16.3 | 5.70 | N1999 | - | 5.041 | N1999 | 3.398 | ZK1993 | b 16.10±0.06 | GP1988 |
| 234.3–07.2 | - | - | - | - | - | - | - | - | - |
| 234.8+02.4 | 6.70 | SP2015 | eff | 5.275±0.023 | SP2015 | 2.964 | SP2015 | v 14.24+0.28-0.25 | SK1989 |
| 234.9–01.4 | 3.50 | ZK1993 | z(H) | 4.491 | KJ1991 | 3.778 | ZK1993 | v 14.18 | TA1991 |
| 234.9–09.7 | - | - | - | - | - | - | - | - | - |
| 235.3–03.9 | 3.40 | OK2013 | - | 4.519 | OK2013 | 3.940 | OK2013 | v 14.08 | TA1991 |
| 236.9+08.6 | - | - | - | - | - | - | - | - | - |
| 237.0+00.7 | 7.50 | AW2019 | - | 4.813 | AW2019 | - | - | g 18.13 | AW2019 |
| 237.3–08.4 | - | - | - | - | - | - | - | - | - |
| 237.4–09.6 | - | - | - | - | - | - | - | - | - |
| 238.0+34.8 | 6.20 | P1996 | - | 5.000 | GM2019b | 2.040 | GM2019b | v 16.03 | GM2019b |
| 239.6+13.9 | 5.80 | GP1988 | eff | 5.152 | GM2019b | 3.210 | GM2019b | v 15.97 | BC2012 |
| 240.3+07.0 | - | - | - | - | CA1996 | - | - | v 15.65 | TA1991 |
| 240.3–07.6 | 7.58 | M1997 | eff | 5.168 | P2003 | 3.431+0.080-0.097 | SK1989 | v 16.31 ³² | TA1991 |
| 240.8–19.6 | - | - | - | - | - | - | - | v 15.72 | TA1991 |
| 241.0+02.3 | - | - | - | - | - | - | - | - | - |
| 242.6–11.6 | 4.89 | M1997 | z(HeII) | 4.813 | KJ1991 | 3.732 | M1997 | v 15.30 | TA1991 |
| 243.3–01.0 | 5.79 | M1997 | * | 5.149 | Ko2001 | 3.700 | Ko2001 | b 17.70±0.15 | GP1988 |
| 243.8–37.1 | 5.20 | BM2012a | eff | 4.900 | PL2016 | 3.370 | PL2016 | b 15.20 | BM2012a |
| 245.0+02.2 | - | - | - | - | - | - | - | - | - |
| 245.1–05.5 | - | - | - | >4.978 | Fd2008 | - | - | v 18.50 | Fd2008 |
| 245.4+01.6 | 6.20 | B2008 | - | 5.099 | ZK1993 | 3.602 | ZK1993 | v 17.90 | CM2000 |
| 248.7+29.5 | 7.17 | C1984 | - | 4.991 | GM2019b | 2.080 | GM2019b | v 16.40 | GM2019b |
| 248.8–08.5 | 5.40 | ZK1993 | - | 5.130 | BA2016 | 3.440 | BA2016 | v 17.00 | TA1989 |
| 249.8+07.1 | - | - | - | - | - | - | - | - | - |
| 250.3–05.4 | - | - | - | - | - | - | - | - | - |
| 250.5+01.9 | - | - | - | - | - | - | - | - | - |

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³² Probably these data are not of the CSPN.

Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_\star/L_\odot) | ref. | mag. | ref. |
|------------|--------------|--------|---------|-------------|---------|---------------------------|---------|-------------------|---------|
| 250.6+09.3 | - | - | - | - | - | - | - | - | - |
| 252.6+04.4 | - | - | eff | 5.033 | SC1993 | 2.341 | SC1993 | v 13.93 | TA1991 |
| 253.5+10.7 | - | - | - | 4.929 | d2009 | 3.041 | SP2015 | v 16.6 | RK1999 |
| 253.9+05.7 | 4.50 | ZK1993 | - | 4.763 | ZK1993 | 4.000 | GZ2007 | v 13.91 | TA1991 |
| 254.6+00.2 | - | - | - | - | - | - | - | b 10.50 | SECGPN |
| 255.3–59.6 | 6.70+0.3–0.7 | HB2004 | - | 5.079±0.036 | HB2004 | 2.470 | GM2019b | v 15.21 | FP2016 |
| 257.5+00.6 | - | - | - | - | - | - | - | - | - |
| 258.0–03.2 | - | - | - | - | - | - | - | v 20.00 | Fd2008 |
| 258.0–15.7 | 6.30 | W1995 | eff | 5.150 | F1996 | 3.450 | F1996 | - | - |
| 258.1–00.3 | - | - | bb | 4.730 | GZ2007 | 2.900 | GZ2007 | v 16.53 | KJ1991 |
| 258.5–01.3 | - | - | - | 5.121 | Fd2008 | 2.070 | Fd2008 | v 18.21 | FP2006 |
| 259.1+00.9 | 4.50 | JB2014 | - | 5.146 | JB2014 | 3.750 | JB2014 | v 18.92+0.38–0.29 | SK1989 |
| 261.0+32.0 | 4.75 | MK1992 | eff | 4.949 | GM2019b | 3.790 | GM2019b | v 12.10±0.13 | SK1989 |
| 261.9+08.5 | 7.10 | B2008 | - | 5.157 | B2008 | 2.801 | B2008 | v 17.50 | CM2000 |
| 261.9–05.3 | - | - | - | - | - | - | - | - | - |
| 263.0–05.5 | - | - | z(HeII) | 4.827±0.005 | MV2016 | 2.420±0.26 | MV2016 | v 15.96±0.01 | MV2016 |
| 263.1+04.3 | - | - | - | - | - | - | - | - | - |
| 263.2+00.4 | 3.8 | HM1990 | eff | 4.491 | HM1990 | - | - | v 11.30 | SECGPN |
| 264.4–12.7 | 4.40 | ZK1993 | z(H) | 4.643 | KJ1991 | 3.540±0.26 | MV2016 | v 15.47 | KJ1991 |
| 264.5+05.0 | - | - | - | - | - | - | - | - | - |
| 264.6+03.8 | - | - | - | - | - | - | - | - | - |
| 268.4+02.4 | - | - | - | 5.004±0.039 | SK1989 | - | - | v 18.70 | SECGPN |
| 268.9–00.4 | - | - | - | - | - | - | - | v 12.67 | Fd2008 |
| 270.1–02.9 | - | - | - | - | - | - | - | v 16.60 | DP2011 |
| 272.1+12.3 | 7.48 | M1997 | - | 5.000 | GM2019b | 2.190 | GM2019b | v 15.76 | GM2019b |
| 272.8+01.0 | - | - | - | - | - | - | - | v 18.80 | BC2012 |
| 273.6+06.1 | 5.70±0.3 | HB2011 | eff | 5.077 | HB2011 | 3.490 | GM2019b | v 12.53 | FP2016 |
| 274.3+09.1 | 5.50 | Gd2013 | eff | 5.079 | Gd2013 | - | - | v 20.50 | GT2000 |
| 274.6+02.1 | 3.90 | ZK1993 | - | 4.623 | ZK1993 | 3.785 | ZK1993 | v 16.20 | TA1991 |
| 275.0–04.1 | 5.00 | ZK1993 | - | 4.968±0.014 | AD2019 | 3.114±0.13 | AD2019 | v 15.15 | SK1989 |
| 275.2–03.7 | - | - | z(H) | 4.462 | KJ1991 | <4.540 | SK1989 | v 16.96 | KJ1991 |
| 276.1–11.9 | - | - | - | - | - | - | - | - | - |
| 276.2–06.6 | 7.30 | AW2019 | - | 4.903 | AW2019 | - | - | g 18.76 | AW2019 |
| 277.1–03.8 | 5.80 | ZK1993 | z(HeI) | >5.041 | P2003 | 4.250 | GM2019b | v 16.50 | RK1999 |
| 277.7–3.5 | - | - | - | 5.079 | GM2019b | 2.210 | GM2019b | v 17.94 | GM2019b |
| 278.1–05.9 | 6.00 | Gd2013 | eff | 5.149 | Gd2013 | 3.100 | GZ2007 | v 15.00+0.8–0.5 | SK1989 |
| 278.8+04.9 | 6.60 | t.w. | eff | 5.199 | Gd2013 | 3.700 | Ko2001 | v 17.60 | TA1991 |
| 279.6–03.1 | - | - | - | 4.778±0.072 | d2009 | - | - | v 11.48 | CB1999 |
| 280.1–05.1 | - | - | - | - | - | - | - | - | - |
| 281.0–05.6 | 4.75 | OK2014 | - | 4.740±0.024 | AD2019 | 3.476±0.076 | AD2019 | v 14.30 | KJ1991 |
| 283.6+25.3 | 6.73 | N1999 | - | 5.149 | N1999 | 2.512 | BC2012 | v 17.40 | RK1999 |
| 283.8+02.2 | 5.60 | ZK1993 | - | 5.110 | BA2016 | 3.390 | BA2016 | v 16.87+0.29–0.23 | SK1989 |
| 283.8–04.2 | - | - | - | 5.352 | MB2013b | 2.362 | MB2013b | v 22.50 | MB2013b |
| 283.9+09.7 | 5.25 | P1996 | - | 4.886±0.045 | d2009 | 3.470 | GM2019b | v 12.00±0.2 | KS1988 |
| 284.2–05.3 | - | - | - | - | - | - | - | v 16.40 | DP2011 |
| 285.4+01.5 | 5.60 | t.w. | eff | 4.930 | AN2003 | 2.110±0.36 | MV2016 | v 19.38±0.09 | MV2016 |
| 285.4–05.3 | 7.40 | ZK1993 | z(HeII) | 5.000±0.004 | P2003 | 2.602 | ZK1993 | v 15.51±0.35 | SK1989 |
| 285.6–02.7 | - | - | z(HeII) | 4.663 | P2003 | - | - | v 12.98 | Ph2005 |
| 285.7–14.9 | 5.40 | HB2011 | * | 4.993 | HB2011 | 3.680 | HB2011 | v 14.26 | FP2016 |
| 286.3+02.8 | - | - | * | 5.107 | Ko2001 | 3.700 | Ko2001 | v 17.40 | TA1991 |
| 286.3–04.8 | 5.60 | ZK1993 | - | 5.160 | BA2016 | 3.300 | BA2016 | v 15.50 | CM2000 |
| 286.8–29.5 | 6.50 | N1999 | eff | 5.021 | N1999 | 2.680 | Fd2008 | v 16.11 | FP2016 |
| 288.7+08.1 | - | - | - | - | - | - | - | v 15.68 | TA1991 |
| 289.6–01.6 | - | - | - | - | - | - | - | - | - |
| 289.8+07.7 | - | - | z(HeII) | 5.038±0.018 | MV2016 | 3.120±0.29 | MV2016 | v 19.30±0.05 | MV2016 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|--------------------------|-----------|---------|---------|-------------|---------|---------------------|---------|--------------|---------|
| 290.5+07.9 | 5.00±0.25 | BM2012 | | 4.903±0.081 | BM2012 | 3.270 | GM2019b | v 14.50 | GM2019b |
| 291.3+08.4 | - | - | | - | - | - | - | v 13.30 | BC2012 |
| 291.3-26.2 | - | - | eff | 4.342 | S2002 | - | - | v 15.80 | GT2000 |
| 291.4+19.2 | 5.50 | N1999 | eff | 5.079 | N1999 | 4.000 | RK1996 | v 16.65 | FP2016 |
| 291.6-04.8 | 4.30 | CM2000 | z(HeII) | 4.829 | P2003 | 3.919 | ZK1993 | v 15.39±0.35 | SK1989 |
| 291.7+03.7 | - | - | bT | 4.684 | LS2007 | - | - | - | - |
| 292.4+04.1 | 3.60 | ZK1993 | eff | 4.716 | Gd2013 | 3.600 | GZ2007 | v 14.08 | TA1991 |
| 292.8+01.1 | - | - | bT | 4.976 | PA1991 | - | - | - | - |
| 293.2-09.5 | - | - | | - | - | - | - | - | - |
| 293.6+10.9 | 6.85±0.48 | RK1999 | eff | 5.107±0.102 | RK1999 | 2.740 | RK1999 | v 18.40 | Fd2008 |
| 294.1+14.4 | - | - | | - | - | - | - | - | - |
| 294.1+43.6 | 5.50 | MK1992 | eff | 5.100 | GM2019b | 3.540 | GM2019b | v 13.26 | FP2016 |
| 294.6+04.7 | 5.56 | M1997 | | 5.176 | Fd2008 | 3.700 | MK2015 | v 15.49 | Fd2008 |
| 296.0-06.2 | - | - | | - | - | - | - | - | - |
| 297.0+06.5 | - | - | | - | - | - | - | - | - |
| 298.7-07.5 | - | - | | - | - | - | - | g 20.00 | AW2019 |
| 300.1+04.1 | - | - | | - | - | - | - | - | - |
| 300.7-02.0 | 4.70 | ZK1993 | | 4.790 | AN2003 | 3.400 | GZ2007 | v 18.40 | CM2000 |
| 301.9-02.1 | - | - | | - | - | - | - | - | - |
| 302.0-01.6 | - | - | | - | - | - | - | i 16.74 | DP2011 |
| 302.1+00.3 | - | - | | 5.161 | Fd2008 | 2.430 | Fd2008 | v 18.60 | Fd2008 |
| 302.2-03.1 | - | - | | - | - | - | - | - | - |
| 303.6+40.0 | 7.20±0.3 | ZRW2012 | | 4.903±0.054 | ZRW2012 | 1.500+0.35-0.45 | ZRW2012 | v 9.63±0.01 | Pi2005 |
| 305.1+01.4 | - | - | z(H) | 4.708 | KJ1991 | 3.000 | Cd1993 | v 15.88 | KJ1991 |
| 306.4-00.6 | 7.30 | ZK1993 | | 5.196 | ZK1993 | 2.699 | ZK1993 | v 17.08 | CB1999 |
| 307.2-03.4 | 6.62 | Fd2008 | eff | 5.217 | KB2014 | 3.700 | Ko2001 | v 14.53 | Fd2008 |
| 307.2-05.3 | - | - | | - | - | - | - | - | - |
| 307.2-09.0 | 5.10 | t.w. | z(HeII) | 4.748 | KJ1991 | 3.300 | GZ2007 | v 15.48 | KJ1991 |
| 307.5-04.9 | 4.70 | ZK1993 | | 4.699±0.087 | MM2018 | 3.760±0.31 | MM2018 | b 14.50 | LS2007 |
| 308.2+07.7 | 5.50 | SW1997 | eff | 5.000 | SW1997 | - | - | v 17.10 | FP2016 |
| 308.4+00.4 | - | - | | - | - | - | - | - | - |
| 308.5+02.5 ³³ | - | - | | - | - | - | - | r 18.90 | PM2003 |
| 308.6-12.2 | 4.30 | ZK1993 | z(HeII) | 4.785 | KJ1991 | 3.447 | ZK1993 | v 15.17 | KJ1991 |
| 309.0-04.2 | 4.70 | ZK1993 | | 4.530 | AN2003 | 3.720 | Ko2001 | v 13.18 | BC2012 |
| 309.1-04.3 | 5.00 | SP2015 | eff | 4.708±0.060 | SP2015 | 2.996 | SP2015 | v 14.40 | GT2000 |
| 309.6-04.8 | - | - | | - | - | - | - | - | - |
| 309.8-01.6 | - | - | | - | - | - | - | i 17.00 | DP2011 |
| 310.3+24.7 | 5.10 | N1999 | eff | 4.954 | N1999 | 3.280 | GM2019b | v 12.88 | TA1991 |
| 311.0+02.4 | 7.10 | DP2013 | eff | 5.176 | DP2013 | 2.800 | DP2013 | v 11.95 | Fd2008 |
| 312.3+10.5 | 5.29 | M1997 | | 4.934±0.010 | SK1989 | 3.757±0.046 | SK1989 | v 14.74 | TA1991 |
| 312.6-01.8 | 3.80 | ZK1993 | z(HeII) | 4.760 | Ph2005 | 3.681 | ZK1993 | v 15.51 | KJ1991 |
| 313.4+06.2 | - | - | | - | - | - | - | v 15.80 | DP2011 |
| 313.8-05.7 | - | - | | - | - | - | - | - | - |
| 313.9+02.8 | - | - | | - | - | - | - | v 16.20 | DP2011 |
| 314.5-01.0 | - | - | | - | - | - | - | g 18.53 | AW2019 |
| 315.1-13.0 | 3.10 | Gd2013 | z(HeII) | 4.627 | Ph2005 | 3.919 | ZK1993 | v 16.84 | KJ1991 |
| 315.4-08.4 | - | - | | >4.544 | Fd2008 | - | - | v 15.20 | Fd2008 |
| 315.7+05.5 | - | - | | - | - | - | - | - | - |
| 316.1+08.4 | 3.60±0.2 | HP2007 | eff | 4.544±0.062 | HP2007 | 3.760±0.2 | HP2007 | v 12.63±0.1 | HP2007 |
| 316.7-05.8 | - | - | | - | - | - | - | - | - |
| 317.2+08.6 | - | - | | - | - | - | - | - | - |
| 318.4+41.4 | 5.30 | N1999 | eff | 5.053 | GM2019b | 3.360 | GM2019b | v 11.54 | Fd2008 |
| 319.6+15.7 | 7.56 | M1997 | eff | 5.100 | M1997 | 2.041 | M1997 | b 17.52±0.06 | GP1988 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|------------|-----------|--------|---------|-------------|---------|---------------------|---------|-------------------|---------|
| 320.1-09.6 | 3.00 | Gd2013 | eff | 4.462 | Gd2013 | 4.050 | MK1992 | v 10.81 | TA1991 |
| 320.3-28.8 | - | - | z(HI) | 4.538 | P2003 | - | - | v 14.96 | SECVPN |
| 320.7+04.2 | - | - | - | - | - | - | - | - | - |
| 320.9+02.0 | 4.50 | ZK1993 | - | 4.813 | ZK1993 | 3.959 | ZK1993 | v 17.90 | CM2000 |
| 321.0+03.9 | 3.40 | t.w. | eff | 4.491 | SH2014 | 3.720 | SH2014 | v 12.28 | GT2000 |
| 321.3+02.8 | 3.00 | ZK1993 | z(HeII) | 4.769 | Ph2005 | 3.978 | ZK1993 | v 15.87 | KJ1991 |
| 322.4-00.1 | 4.00 | ZK1993 | - | 4.701 | ZK1993 | 4.100 | ZK1993 | v 17.30 | DP2011 |
| 322.5-05.2 | 4.40 | ZK1993 | - | 5.200 | BA2016 | 3.180±0.15 | BA2016 | v 15.29±0.12 | SK1989 |
| 323.6-04.5 | - | - | - | - | - | - | - | - | - |
| 323.9+02.4 | 3.90 | ZK1993 | z(H) | 4.681 | KJ1991 | 3.820 | ZK1993 | v 16.84 | KJ1991 |
| 324.0+03.5 | - | - | - | - | - | - | - | b 16.20 | GT2000 |
| 324.1+09.0 | 6.85±0.48 | RK1999 | - | 5.107±0.102 | RK1999 | - | - | v 17.10 | SECVPN |
| 324.2+02.5 | - | - | - | - | - | - | - | b 17.00 | SECVPN |
| 325.3-02.9 | 6.75 | AW2019 | - | 4.778 | AW2019 | - | - | g 16.69 | AW2019 |
| 325.8+04.5 | 4.70 | t.w. | bb | 4.700 | GZ2007 | 3.300 | GZ2007 | b 15.98 | SECVPN |
| 325.8-12.8 | 3.50 | MK1992 | eff | 4.556 | MK1992 | 3.930 | MK1992 | v 12.63 | TA1991 |
| 326.0-06.5 | 2.80 | MK1992 | eff | 4.398 | MK1992 | 4.010 | MK1992 | v 13.08 | TA1991 |
| 326.4+07.0 | - | - | - | - | - | - | - | - | - |
| 326.6+05.7 | - | - | - | - | - | - | - | - | - |
| 326.9+08.2 | - | - | - | - | - | - | - | - | - |
| 327.1-02.2 | 3.80 | ZK1993 | bb | 4.410 | GZ2007 | 3.700 | GZ2007 | v 15.15 | KJ1991 |
| 327.5-02.2 | - | - | - | - | - | - | - | - | - |
| 327.8+10.0 | 3.80 | Gd2013 | eff | 4.833 | Gd2013 | 3.580 | GM2019b | v 13.42 | KJ1991 |
| 328.8-01.1 | - | - | - | - | - | - | - | - | - |
| 328.9-02.4 | - | - | - | - | - | - | - | - | - |
| 329.0+01.9 | - | - | eff | 4.914±0.011 | SB2019b | 3.014±0.078 | SB2019b | v 13.95 | HJ2016 |
| 329.5+01.7 | - | - | - | - | - | - | - | v 13.57 | TA1991 |
| 329.5-02.2 | - | - | - | - | - | - | - | v 15.79 | TA1991 |
| 329.8-02.1 | - | - | - | - | - | - | - | - | - |
| 329.9+03.7 | - | - | - | - | - | - | - | - | - |
| 330.2+12.3 | - | - | - | - | - | - | - | - | - |
| 330.7+04.1 | 2.40±0.7 | PS2005 | - | 4.881 | L1984 | 1.799 | BM1986 | v 17.00 | L1984 |
| 331.1-05.7 | 2.30±0.4 | PB2010 | - | 5.021 | PB2010 | 3.301 | PB2010 | v 12.67 | KJ1991 |
| 331.3+16.8 | 4.10 | ZK1993 | - | 4.675 | ZK1993 | 3.778 | ZK1993 | v 15.52±0.41-0.34 | SK1989 |
| 331.3-12.1 | 6.00 | RR2014 | - | 4.778 | RR2014 | 2.500 | RR2014 | v 9.50±0.8 | AI2013 |
| 331.4-03.5 | 2.95 | MK1992 | eff | 4.431 | MK1992 | 3.990 | MK1992 | v 13.41 | TA1991 |
| 331.5-02.7 | 3.70 | ZK1993 | - | 4.545 | ZK1993 | 3.623 | ZK1993 | i 15.10 | JB2015 |
| 331.7-01.0 | 5.00 | ZK1993 | - | 4.919 | ZK1993 | 3.462 | ZK1993 | b 17.60 | BC2012 |
| 331.8-02.3 | - | - | - | - | - | - | - | v 16.50 | DP2011 |
| 332.4-01.4 | - | - | - | - | - | - | - | - | - |
| 332.5-16.9 | 6.00 | SW1997 | eff | 5.000 | SW1997 | 3.260 | GM2019b | v 14.66 | GM2019b |
| 332.8-16.4 | - | - | - | - | - | - | - | - | - |
| 332.9-09.9 | - | - | - | 4.505 | Ko2001 | 4.060 | Ko2001 | v 11.50 | GT2000 |
| 333.4-04.3 | - | - | - | - | - | - | - | v 16.80 | PM2003 |
| 333.9+00.6 | - | - | - | - | - | - | - | v 19.00 | Fd2008 |
| 333.9-08.5 | - | - | - | - | - | - | - | b 20.30 | PM2003 |
| 334.3-09.3 | 5.80 | ZK1993 | - | 5.064 | ZK1993 | 3.663 | ZK1993 | v 15.66±0.55-0.36 | SK1989 |
| 334.8-07.4 | - | - | z(HI) | 4.473±0.002 | MV2016 | 3.250±0.26 | MV2016 | v 12.29±0.01 | MV2016 |
| 335.5+12.4 | 5.00±0.2 | MK1988 | eff | 4.954 | GM2019b | 3.530 | GM2019b | v 12.40 | BC2012 |
| 336.2-06.9 | 4.80 | ZK1993 | - | 4.860 | AN2003 | 3.763 | ZK1993 | v 16.51 | KJ1991 |
| 336.3-05.6 | 5.40 | ZK1993 | - | 5.032 | ZK1993 | 3.898 | ZK1993 | v 16.62±0.09 | SK1989 |
| 336.5+05.5 | - | - | - | - | - | - | - | v 17.40 | DP2011 |
| 337.0+08.4 | 6.70 | HF2017 | - | 4.778±0.036 | HF2017 | - | - | v 16.90±0.2 | HF2017 |
| 337.4+01.6 | - | - | - | 4.600 | AN2003 | - | - | v 16.70 | GT2000 |
| 337.5-05.1 | - | - | z(HI) | 4.279 | P2003 | - | - | v 12.74 | TA1991 |

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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|-------------|-------|--------|---------|-------------|---------|-----------------------|---------|-------------------|---------|
| 338.1–08.3 | 5.20 | ZK1993 | | 4.958 | ZK1993 | 3.799 | ZK1993 | v 15.53±0.27 | SK1989 |
| 338.8+05.6 | 4.40 | ZK1993 | | 4.954±0.024 | JB2015 | 3.750 | JB2015 | v 16.26+0.43–0.35 | SK1989 |
| 339.9+88.4 | 6.00 | Fd2008 | eff | 5.000 | GM2019b | 1.970 | GM2019b | v 14.70 | FK1983 |
| 341.5+12.1 | 6.00 | Fd2008 | * | 5.146 | Ko2001 | 3.700 | Ko2001 | v 14.20 | KH1997b |
| 341.6+13.7 | 5.00 | ZK1993 | eff | 4.833±0.026 | SB2019b | 3.755±0.263 | SB2019b | v 13.29±0.01 | SK1989 |
| 341.8+05.4 | 5.40 | ZK1993 | eff | 5.037 | GM2019b | 3.750 | GM2019b | v 15.39 | CM2000 |
| 342.5–14.3 | - | - | eff | 4.699 | Gd2013 | - | - | v 12.51 | TA1991 |
| 343.5–07.8 | - | - | eff | - | - | - | - | v 14.61 | TA1991 |
| 343.6+03.7a | - | - | | - | - | - | - | - | - |
| 343.9–05.8 | - | - | | - | - | - | - | - | - |
| 344.6–04.5 | - | - | | - | - | - | - | - | - |
| 344.9+03.0 | - | - | | >4.857 | Fd2008 | - | - | v 19.00 | Fd2008 |
| 345.0–04.9 | 4.20 | t.w. | bb | 4.650 | GZ2007 | 3.600 | GZ2007 | - | - |
| 345.2–08.8 | 3.40 | OK2013 | eff | 4.531 | AL2019 | 3.400 | AL2019 | v 11.85 | TA1991 |
| 345.4+00.1 | 4.05 | MK1992 | eff | 4.699 | MK1992 | 3.550 | GM2019b | v 12.70 | GM2019b |
| 345.5+15.1 | - | - | | - | - | - | - | - | - |
| 346.2–08.2 | 6.10 | M2012 | | 5.146±0.062 | M2012 | 0.556 | M2012 | v 16.90±0.05 | M2012 |
| 347.4+05.8 | 5.10 | t.w. | | 4.959 | GZ2006 | 3.900 | GZ2006 | - | - |
| 348.0–13.8 | 4.80 | ZK1993 | | 4.845 | ZK1993 | 3.763 | ZK1993 | v 15.10 | WL2007 |
| 348.4+04.9 | - | - | | - | - | - | - | v 16.40 | DP2011 |
| 349.3–01.1 | 4.20 | ZK1993 | z(HeII) | 4.643 | Ph2005 | 2.633 | AG1985 | v 16.00±0.04 | HJ2016 |
| 349.3–04.2 | - | - | | >4.914 | Fd2008 | - | - | v 15.42 | Fd2008 |
| 349.5+01.0 | 7.00 | WB2011 | z(HeII) | 5.143±0.034 | P2003 | 4.155 | WB2011 | v 22.10 | SW2009 |
| 349.7+04.0 | - | - | | - | - | - | - | - | - |
| 350.1–03.9 | - | - | | - | - | - | - | - | - |
| 350.9+04.4 | 3.35 | MK1992 | | 4.519 | MK1992 | 3.920 | MK1992 | v 13.25 | TA1991 |
| 351.1+04.8 | 3.60 | ZK1993 | bb | 4.710 | GZ2014 | 3.200 | GZ2007 | b 16.90 | SECVPN |
| 351.5–06.5 | - | - | | - | - | - | - | - | - |
| 351.7–06.6 | - | - | | - | - | - | - | - | - |
| 352.1+05.1 | 4.80 | ZK1993 | bb | 5.110 | GZ2007 | 3.200 | GZ2007 | - | - |
| 352.1–02.6 | - | - | | - | - | - | - | - | - |
| 352.9+11.4 | 3.70 | t.w. | * | 4.477 | Ko2001 | 3.700 | Ko2001 | v 12.75 | TA1991 |
| 352.9–07.5 | 3.90 | t.w. | bb | 4.670 | GZ2007 | 4.000 | GZ2007 | v 14.30 | SECVPN |
| 353.7+06.3 | 3.00 | ZK1993 | | 4.342 | ZK1993 | 3.477 | ZK1993 | v 13.96 | SECVPN |
| 354.5–03.9 | - | - | | - | - | - | - | - | - |
| 354.7–03.9 | - | - | | - | - | - | - | - | - |
| 355.2–02.5 | 4.72 | RP1997 | | 4.890 | AN2003 | - | - | - | - |
| 355.3+03.8 | - | - | | - | - | - | - | - | - |
| 355.3–03.2 | - | - | | - | - | - | - | - | - |
| 355.4–04.0 | 5.90 | ZK1993 | | 5.049 | ZK1993 | 3.505 | ZK1993 | - | - |
| 355.5–02.8 | - | - | | - | - | - | - | - | - |
| 355.6–02.3 | - | - | | - | - | - | - | - | - |
| 355.7–03.5 | 4.70 | RP1997 | eff | 4.677 | RP1997 | 4.000 | GZ2007 | v 15.40 | WL2007 |
| 355.9+03.6 | 3.30 | ZK1993 | bb | 4.550 | GZ2014 | 4.000 | GZ2007 | v 15.80 | SECVPN |
| 355.9–04.2 | 4.75 | RP1997 | eff | 4.813 | RP1997 | 3.800 | GZ2007 | v 16.40 | TA1991 |
| 355.9–04.4 | - | - | | - | - | - | - | v 15.70 | DP2011 |
| 356.0–04.2 | - | - | | - | - | - | - | v 17.80 | DP2011 |
| 356.1+02.7 | 6.10 | t.w. | bb | 5.050 | GZ2007 | 3.300 | GZ2007 | i 16.14 | DP2011 |
| 356.2–04.4 | 3.80 | RP1997 | bb | 4.900 | GZ2007 | 3.600 | GZ2007 | - | - |
| 356.2–04.4 | - | - | | - | - | - | - | - | - |
| 356.5–02.3 | 3.20 | t.w. | bb | 4.410 | GZ2007 | 3.600 | GZ2007 | v 14.53 | KJ1991 |
| 356.5–03.9 | 3.30 | ZK1993 | | 4.493 | ZK1993 | 3.813 | ZK1993 | v 16.30 | SECVPN |
| 356.7–04.8 | 5.30 | ZK1993 | | 4.903 | ZK1993 | 3.505 | ZK1993 | v 16.20 | WL2007 |
| 356.8–03.6 | - | - | | - | - | - | - | v 14.40 | DP2011 |
| 356.9+04.4 | 5.90 | ZK1993 | bb | 5.090 | GZ2014 | 4.100 | ZK1993 | v 17.20 | DP2011 |

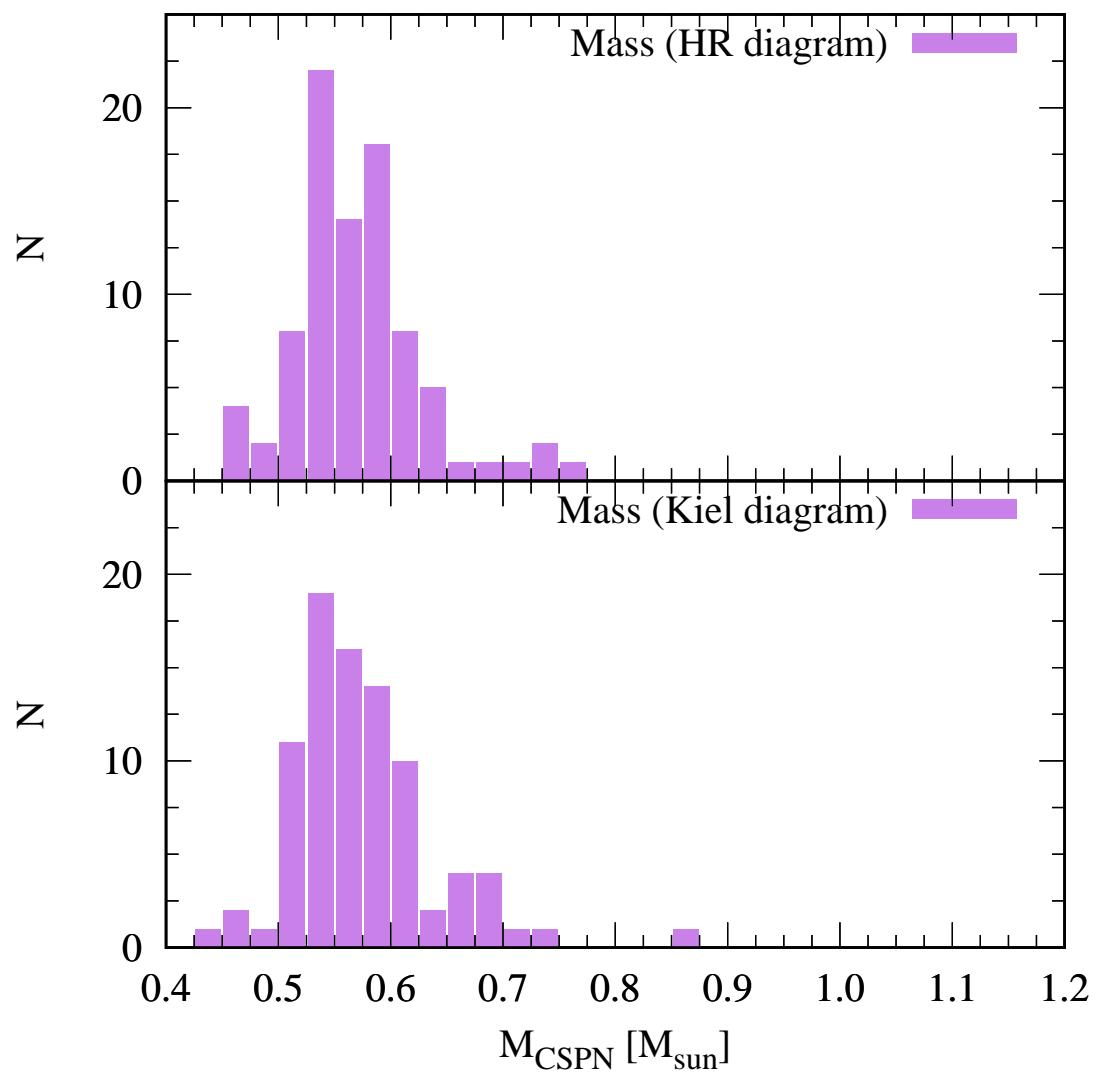
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Table 2 – continued from previous page

| PN G | log g | ref. | met. | log T | ref. | log (L_*/L_\odot) | ref. | mag. | ref. |
|------------|----------------|--------|------|-------------|--------|---------------------|--------|-------------|--------|
| 356.9+04.5 | 5.80 | ZK1993 | eff | 5.146 | RP1997 | 2.700 | GZ2007 | - | - |
| 357.0-04.4 | - | - | - | - | - | - | - | - | - |
| 357.1+03.6 | 4.70 | RP1997 | eff | 4.903 | RP1997 | 3.200 | GZ2007 | v 16.40 | WL2007 |
| 357.1-04.7 | 3.30 | ZK1993 | - | 4.447 | ZK1993 | 3.643 | ZK1993 | v 15.42 | SECGPN |
| 357.1-05.3 | - | - | - | - | - | - | - | v 18.13 | SB2019 |
| 357.2-04.5 | - | - | - | - | - | - | - | b 17.30 | TA1991 |
| 357.3+03.3 | 3.20 | RP1997 | eff | 4.447 | RP1997 | 3.643 | M1997 | v 16.31 | SECGPN |
| 357.4-03.2 | 5.70 | t.w. | bb | 4.950 | GZ2007 | 3.300 | GZ2007 | v 16.50 | DP2011 |
| 357.6+01.7 | 4.00 | RP1997 | eff | 4.720 | RP1997 | - | - | - | - |
| 357.6-03.3 | - | - | - | - | - | 2.496±0.301 | SV2002 | v 19.31 | SB2019 |
| 357.7-04.8 | - | - | - | - | - | - | - | - | - |
| 358.0-04.6 | - | - | - | - | - | - | - | v 16.40 | DP2011 |
| 358.3-21.6 | 5.29 | M1997 | eff | 4.960 | AN2003 | 3.800 | SK1994 | v 16.60 | AN2003 |
| 358.7-03.0 | - | - | - | - | - | - | - | - | - |
| 358.8+00.0 | - | - | - | - | - | - | - | - | - |
| 358.9+03.3 | 4.10 | ZK1993 | - | 4.715 | ZK1993 | 3.968 | ZK1993 | v 17.10 | DP2011 |
| 358.9-00.7 | 3.30 | MK1992 | - | 4.519 | MK1992 | 3.650 | MK2015 | v 12.83 | TA1991 |
| 359.1-02.3 | 4.50 | ZK1993 | bb | 4.570 | GZ2007 | 3.800 | GZ2007 | v 17.20 | SECGPN |
| 359.2+01.2 | - | - | - | - | - | - | - | v 17.20 | TA1991 |
| 359.2-33.5 | 3.10 | Fd2008 | bb | 4.430 | GZ2007 | 3.800 | GZ2007 | v 10.72 | Fd2008 |
| 359.3-00.9 | 5.90 | ZK1993 | bb | 5.080 | GZ2007 | 3.500 | GZ2007 | v 17.40 | CM2000 |
| 359.3-01.8 | 3.20 | ZK1993 | - | 4.420 | ZK1993 | 3.653 | ZK1993 | - | - |
| 359.3-03.1 | 3.30 | ZK1993 | - | 4.446 | ZK1993 | 3.613 | ZK1993 | v 17.10 | SECGPN |
| 359.4-05.6 | - | - | - | - | - | - | - | - | - |
| 359.7+06.0 | - | - | - | - | - | - | - | - | - |
| 359.8+03.5 | - | - | - | - | - | - | - | - | - |
| 359.8+05.6 | 3.05+0.18-0.09 | HP2007 | eff | 4.484±0.021 | HP2007 | 4.180+0.13-0.22 | HP2007 | v 14.74±0.1 | HP2007 |
| 359.9-04.5 | 4.50 | ZK1993 | bb | 4.780 | GZ2007 | 3.700 | GZ2007 | v >14.40 | DP2011 |

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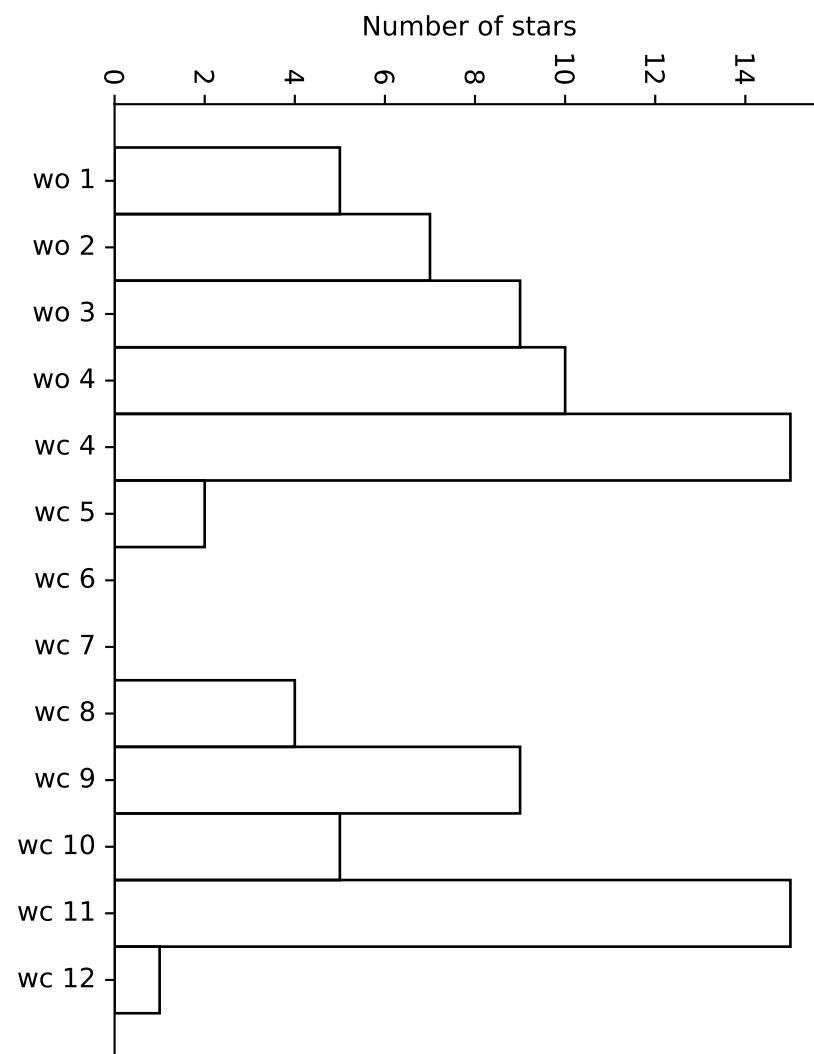


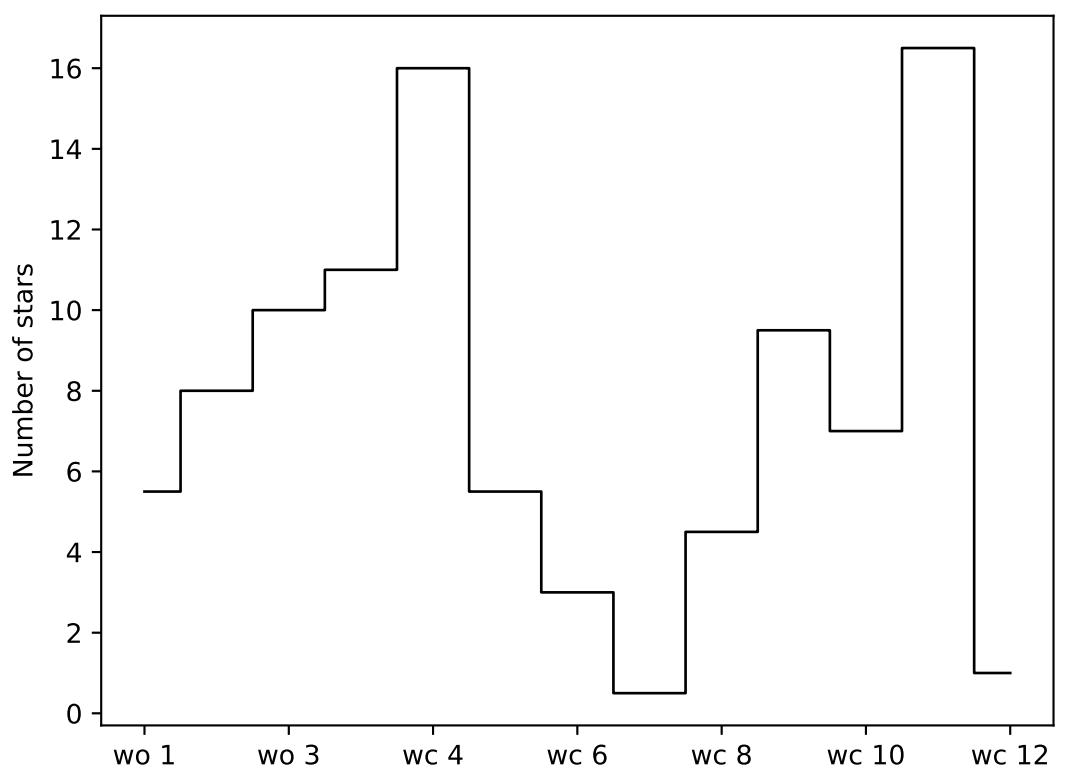
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