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Central stars of planetary nebulae: New spectral classifications and catalogue★

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ABSTRACT

Context. There are more than 3000 confirmed and probable known Galactic planetary nebulae (PNe), but central star spectroscopic information is available for only 13% of them.
Aims. We undertook a spectroscopic survey of central stars of PNe at low resolution and compiled a large list of central stars for which information was dispersed in the literature.
Methods. We observed 45 PNs using the 2.15 m telescope at Casleo, Argentina.
Results. We present a catalogue of 492 confirmed and probable CSPN and provide a preliminary spectral classification for 45 central star of PNe. This revises previous values of the proportion of CSPN with atmospheres poor in hydrogen in at least 30% of cases and provide statistical information that allows us to infer the origin of H-poor stars.

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

1. Introduction

A planetary nebula is the most luminous transitory phase in the life of low and intermediate mass stars ($0.6\ M_\odot < M < 8\ M_\odot$) on their evolution from the asymptotic giant branch (AGB) to their final destiny, white dwarfs (WD). The PN phase begins once the central star reaches an effective temperature of 30 000 K and ionises the shell of material ejected during its evolution in the AGB. After about about 2×10^4 years, it ends when the nuclear burning in a thin shell of the star stops, and the nebula finally disperses.

PNe were discovered more than two centuries ago, and their number has increased every year, but there are still unsolved questions about them. Some of these, and perhaps the most important ones, are related to aspects of the central stars of the planetary nebulae (CSPN). Planetary nebulae nuclei are not located in a confined region of the HR diagram, and their optical spectra encompass all varieties known for hot stars, i.e. ranging from pure emission to emission-absorption mixtures and from near-continuous to pure strong absorption. The appearance of the spectrum depends upon temperature, luminosity, and chemical composition, or more fundamentally, upon core mass and state of evolution. Méndez (1991) suggested that the majority of CSPN can be classified in two distinct categories: those for which stellar H features can be identified in their spectra (hydrogen-rich) and those for which they cannot (hydrogen-poor).

At present, there are about 3000 confirmed and probable PNe known in our Milky Way, listed in Acker et al. (1992, 1996) (SECGPN[1]), (Parker et al. 2006; and Miszalski et al. 2002) (MASH[2]), and Drew et al. (2005) (IPHAS, INT Photometric H-Alpha Survey). However, spectroscopic information on their central stars is known only in a very small fraction of objects (about 13%, see Sect. 3).

Spectroscopy of CSPN is difficult to obtain because of their apparent low brightness, low apparent magnitudes (60% of the CSPN listed in the SECGPN have $V > 15.5$), and the surrounding gaseous shell whose emission lines often mask the stellar lines. In addition, the position of the CSPN is not always clear.

The determination of spectral types of CSPN should help significantly to improve our knowlege of their general evolutionary scheme, making it possible to consider CSPN as physical objects with individual parameters and peculiarities and not just as sources of ionizing radiation.

One of the first lists of CSPN was compiled by Aller (1948), then another was produced by Acker et al. (1982) (Catalogue of CSPN, Strasbourg Observatory). Information on CSPN can be found in the SECGPN and the MASH CDS-catalogues. Several authors have added contributions, although often for particular spectral types, e.g. WR+wels (Acker & Neiner 2003), B[e] (Lamers et al. 1998), evolved CSPN (Napiwotzki 1999), and PG 1159 (Werner & Herwig 2006).

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[1] Strasbourg-ESO Catalogue of Galactic PN (SECGPN) http://vizier.u-strasbg.fr/viz-bin/VizieRPlanetary_NebulaeV/84/cstar.
[2] Macquarie/AAO/Strasbourg Hα Planetary Galactic Catalog http://vizier.u-strasbg.fr/vizier/MASH

Table 1. Summary of the spectral types of CSPN compiled in our catalogue, grouped by their atmospheric hydrogen abundance.

H-rich				H-poor	
Sp.Type	Sample	Sp. Type	Sample	Sp. type	Sample
O3-9+B_{early}	64	sdB	1	[WC4-11]	57
Of	20	Hybrid	3	[WO1-4]	33
Later that B5	38	Symbiotic star?	7	[WR]	11
B[e]	6	Blue	50	[WN]	5
DA+WD	12	Emission-line	25	PG 1159	15
DAO	14			[WC]-PG1159	2
sdO	3			O(He)	3
hgO(H)	16			O(c)+Of(c)	2
Cont.	16			H-poor	1
H-rich	3			DO	4
				wels	72
Total	192	Total	86	Total	205

Notes. Here, we have discarded 9 objects without any specific spectral type.

To contribute to the knowledge of the final stellar evolution stages, we undertook a spectroscopic survey of CSPN and compiled a large list of CSPN. The motivation of the present work lies in a series of astronomical concerns: the complicated puzzle of different types of CSPN observed (see Table 1), few stars with spectral information, a lack of consensus in the evolutionary sequence of the CSPN, and the surprising bimodality in their hydrogen abundance.

This paper is organized as follows. The sample and observations are described in Sect. 2.1; in Sect. 2.2, we comment on the spectral classification; in Sect. 3, we present the catalogue of CSPN and we give a brief discussion. Finally, in Sect. 4 we present our conclusions.

2. New spectral classification

2.1. Observations

We observed 45 southern CSPN selected from SECGPN and Boumis et al. (2003), the coordinates of which were taken from Kerber et al. (2003).

The observations were carried out during a three-year campaign between 2005 November and 2008 December that included a total of 31 nights of observations. For this survey, we used the REOSC spectrograph attached to the 2.15-m telescope at CASLEO, Argentina.

A 300 line mm^{-1} grating was used, which yielded a dispersion of 3.4 Å $pixel^{-1}$. During some nights, a grating of 600 line mm^{-1} was used (1.6 Å $pixel^{-1}$). The gratings provide a typical wavelength range of 3500−7000 Å (3875−5530 Å for the highest resolution). The slit was opened to 3″ to be consistent with the seeing at the site.

2.2. Results

In this first work, we present a very preliminary classification of the observed CSPN. We distinguish between CSPN with absorption and emission lines. In the former group, we basically identified absorption lines of He I and He II, these CSPN then being classified as OB. The latter group contained CSPN with identified emission lines, mainly of CIII (4650 Å and 5696 Å) and C IV (5806 Å), which are typical of [WC] stars. This CSPN were classified as "emission-line". We obtained some spectra whose stellar continuum had a reasonable signal-to-noise ratio (S/N), but displayed, neither absorption nor emission lines. In these cases, although classified as "continuous" type, these objects are expected to be H-rich (Kudritzki et al. 1981). Result are shown in Table 3. In a forthcoming paper, we perform a detailed spectroscopic analysis.

Table 2. Summary of results of KS test applied to the sample of Galactic latitude.

Compared groups	*D*	*P*
H-rich vs. H-poor	0.26	<0.1%
H-rich vs. wels	0.25	0.3%
H-poor vs. wels	0.11	64.1%

Notes. Where *D* indicates the differences between the cumulative number distributions and *P* the probability that the compared samples are equal.

3. The catalogue of CSPN

3.1. Content

Taking into account that the information about CSPN spectral types is scattered among many publications, we carried out an extensive bibliographic compilation of the CSPN data with the goal of producing an updated list of those stars that have spectroscopic information. This list includes 492 stars of both confirmed and possible PN with spectral-type determinations, 45 of them from our own new data. Transition objects, such as post-AGB, PPN, or young-PN (Ej. V 348 Sgr, CRL 618, He 1-5, BD+33 2642, LS IV-12 111 and He 3-1475) were not included.

The information included in the catalogue, discriminated between being confirmed and possible PN (Table 4), is:

- Col. 1 the PN G designation, taken from SECGPN;
- Col. 2 the common name of the object;
- Cols. 3–4 the equatorial coordinates (J2000.0) of the nebula, since in most cases there is no information on the position of the CSPN. Though in many cases this is evident, in others it is not;
- Col. 5 the spectral classification of the CSPN. If there are more than one, they are separated by a semi-colon (idem in the references column). However, we use only two spectral classifications if is it necessary, for example when the spectral classifications are very different. When the authors observed Balmer series absorption, we labeled these objects as H-rich. In some cases, the authors do not give the spectral type of the CS, but describe the identified lines. We also include the CSPN classified by Miszalski et al. (2002) in the MASHII catalogue: blue, [WR] or wels. Note that the blue characteristics of the CSPN images in MASHII is not based on any spectroscopic study;
- Col. 6 the reference where the spectral type was found (t.w. means this work);
- Col. 7 the reference that indicates whether the star is part of a binary system (nothing if not). Although some CSPN are of a late MK spectral type, it is accepted that the excitation source of the PN (if star and nebulae are physically associated) is a hitherto undetected hot star (Lutz 1977). In those cases, we include the label bc-CSPN, corresponding to binarity for the cool CSPN.

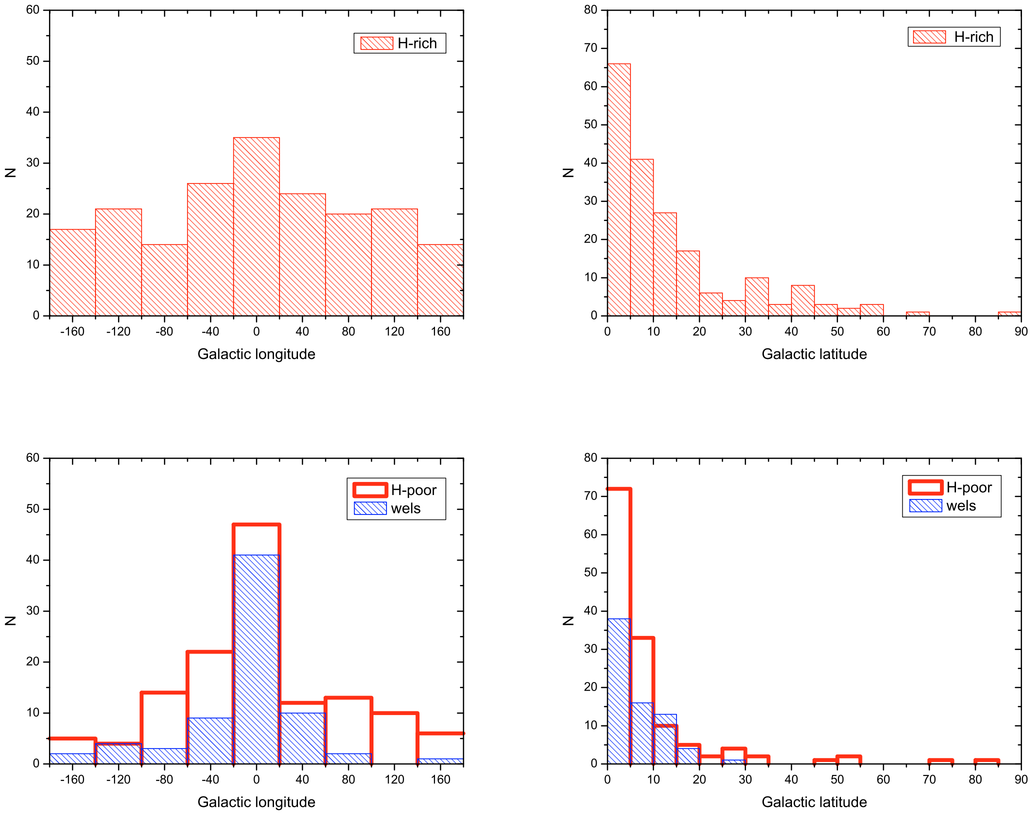

Fig. 1. Distributions in Galactic longitude and latitude of CSPN (of true and possible PN) that belong to H-rich, H-poor, and wels star groups. Note that H-poor PN are more concentrated towards the Galactic center than H-rich ones. The similarity between the wels and H-poor distributions is also noticeable.

The catalogue of Acker et al. (1992) and AN03 provided spectroscopic information for 240 CSPN; with this new collated list, the number of CSPN with spectral classification has doubled. We hope that this new list will be useful for future investigations. In addition, we note that Parker et al. (2006) estimated that ~30% of the MASH entries have candidate CSPN, with about half of these being high quality candidates suitable for immediate follow-up, so the list of CSPN with spectral classification will be increased quickly.

3.2. Discussion

The larger sample of CSPN with spectral types allows us to discuss the dichotomy between H rich and poor stars.

We grouped the H-rich and H-poor CSPN in Table 1[3], It is clear that the former group is more numerous than the H-poor one, the ratio being 1.4. In an earlier study, Méndez (1991) reported a ratio of 3. It is evident that stars with strong emission lines are easier to detect than those with absorption lines, thus favouring the detection of H-poor stars. However, is this effect strong enough to explain the ratio of stars observed between both groups?

We have found above that 30% of the whole CSPNe population appears to be hydrogen deficient (without counting the "blue" stars). It is difficult to obtain a theoretical prediction of this ratio of stellar types because the mechanism for generating H-poor CSPNe is not well known. The more accepted hypothesis for explaining the lack of hydrogen in the atmospheres of CSPN is the born-again phenomenon (Iben et al. 1983). In this framework, it is estimated that roughly 15% (Lawlor & MacDonald 2001) of post-AGB stars suffer a born-again event. Blöcker et al. (2001), based on their improved born-again models (thermal pulses plus overshooting), found that 20−25% of stars can be expected to become H-poor. These theoretical values are substantially lower than our observational value. According to this catalogue, it is difficult to imagine how a selection effect could be as efficient as to produce this high fraction of H-poor stars, so perhaps the born-again phenomenon is not the unique mechanism for obtaining an atmosphere free of hydrogen. We recall other ways to form H-poor CSPN, such as the binary channel (Tylenda & Górny 1993) or the continuous stripping of the outer H-rich layers by intense stellar winds (Górny & Tylenda 2000).

Only 71 close binary CSPN have been found (de Marco 2009; Miszalski et al. 2009b, and 2010), almost all of which have a H-rich spectra. The first [WR] star, in a close binary system, has been discovered in 2010 (Hajduk et al. 2010). We note that nearly 14% of the compiled CSPN are probably binary systems, in good agreement with the 10−15 value obtained by Bond et al. (1989).

We analyzed the distribution in Galactic coordinates of the CSPN sample that belongs to the H-rich and H-poor groups.

[3] Although we have included the wels in the H-poor group (since we found evidence that wels and H-poor are in the same group), we prefer to be cautious and define and use the three groups H-rich, H-poor, and wels in the following discussion.

Table 3. Spectral types from our observations.

Name	PN G	AR(2000)	Dec(2000)	Sp. Type	E.T.[s] (grating)
H 1-62	000.0–06.8	18 13 17.9	–32 19 43.0	emission-line	3600 (300)
PC 12	000.1+17.2	16 43 49.3	–18 56 33.0	OB	2 × 1200 (300)
IC 4634	000.3+12.2	17 01 33.5	–21 49 33.1	emission-line	3 × 1000 (300)
H 1-63	002.2–06.3	18 16 18.5	–30 07 35.8	OB?	3600 (300)
M 1-38	002.4–03.7	18 06 05.8	–28 40 34.3	cont.	3600 (300)
M 1-53	015.4–04.5	18 35 48.2	–17 36 08.4	emission-line?	3600 (300)
Sa 1-8	020.7–05.9	18 50 44.2	–13 31 02.4	OB	3600 (300)
IRAS 19021+0209	036.4-01.9	19 04 38.5	02 14 23.0	cont.	3600 (300)
M 1-6	211.2–03.5	06 35 44.6	–00 05 41.1	emission-line	3600 (300)
SaSt 2-3	232.0+05.7	07 48 03.5	–14 07 42.6	OB	3600 (300)
M 1-11	232.8–04.7	07 11 16.6	–19 51 03.0	emission-line	3600 (300)
M 1-14	234.9–01.4	07 27 56.5	–20 13 23.4	OB	2 × 3600 (300)
M 1-12	235.3–03.9	07 19 21.4	–21 43 55.3	emission-line	3600 (300)
Y-C 2-5	240.3+07.0	08 10 41.7	–20 31 32.9	emission-line	3600 (300)
KLSS 1-9	240.8–19.6	06 24 36.4	–33 04 49.0	OB	3600 (300)
M 3-4	241.0+02.3	07 55 11.2	–23 37 45.6	cont.	3600 (300)
M 3-1	242.6–11.6	07 02 49.6	–31 35 41.3	cont.	3600 (300)
M 4-2	248.8–08.5	07 28 55.2	–35 45 15.4	emission-line	3600 (300)
Ns 238	254.6+00.2	08 20 56.7	–36 13 46.7	OB	2 × 3600 (300)
PB 2	263.0–05.5	08 20 39.8	–46 20 13.2	emission-line?	2 × 1200 (300)
PB 4	275.0–04.1	09 15 07.6	–54 52 38.5	emission-line?	3600 (300)
IC 2501	281.0–05.6	09 38 47.5	–60 05 27.9	emission-line	2 × 3600 (300)
IC 2553	285.4–05.3	10 09 21.7	–62 36 40.9	emission-line	4 × 300 (300)
He 2-47	285.6–02.7	10 23 09.0	–60 32 34.3	emission-line	2 × 2700 (300)
IC 2621	291.6–04.8	11 00 19.5	–65 14 54.2	emission-line	2 × 3600 (300)
Lo 6	294.1+14.4	12 00 43.5	–47 33 12.0	cont.	3600 (300)
Th 2-A	306.4–00.6	13 22 34.8	–63 20 55.2	emission-line	3600 (300)[a]
He 2-97	307.2–09.0	13 45 24.0	–71 28 48.8	emission-line	3600 (300)
He 2-105	308.6–12.2	14 15 25.7	–74 12 49.8	OB	3600 (300)
NGC 5307	312.3+10.5	13 51 03.3	–51 12 15.9	emission-line	3600 (300)
He 2-107	312.6–01.8	14 18 42.5	–63 07 10.7	emission-line	2 × 3600 (300)
He 2-434	320.3–28.8	19 33 50.7	–74 32 58.7	OB	3600 (300)
NGC 5979	322.5–05.2	15 47 40.6	–61 13 02.7	emission-line	2 × 1500 (300)
He 2-128	325.8+04.5	15 25 07.9	–51 19 40.9	emission-line?	3600 (600)
WRAY 17-75	329.5–02.2	16 12 34.4	–54 23 35.3	OB	3600 (300)
He 2-187	337.5–05.1	17 01 37.4	–50 22 56.6	OB	3600 (300)
NGC 6026	341.6+13.7	16 01 20.8	–34 32 38.0	OB	3600 (300)
PC 17	343.5–07.8	17 35 41.1	–46 59 51.3	emission-line	3600 (600)
Cn 1-3	345.0–04.9	17 26 11.8	–44 11 29.1	emission-line?	4 × 700 (300)
IC 4663	346.2–08.2	17 45 28.5	–44 54 11.5	emission-line?	4 × 700 (600)
IC 4699	348.0–13.8	18 18 31.2	–45 59 03.2	emission-line	3600 (600)
NGC 6337	349.3–01.1	17 22 16.0	–38 28 57.6	emission line	3600 (300)
Fg 3	352.9–07.5	18 00 11.9	–38 49 51.7	cont.	3600 (300)
H 1-35	355.7–03.5	17 49 13.9	–34 22 53.3	emission-line?	2 × 1700 (300)
Te 2022	358.8–00.0	17 42 42.4	–29 51 35.4	OB	3600 (300)

Notes. The PNe are denoted by their common name and by their PN G designation. Fifth column lists the preliminary spectral type that we have adopted for each CSPN. The last column indicates the exposure time and grating used (300 or 600 line mm^{-1}).
[(a)] GEMINI observation, see Weidmann et al. (2008).

From Fig. 1, it is evident that there is a strong concentration of H-poor and wels stars toward the Galactic center. This effect was observed by Górny et al. (2004) and attributed to a possible selection effect. However, it might be caused by the influence of metallicity in the mechanism that leads to an unleashing of the total hydrogen loss from the stellar atmosphere of those objects.

On the other hand, the average height above the Galactic plane of H-rich, H-poor and wels stars was found to be 13.9° ± 15.2, 9.0° ± 12.6, and 6.7° ± 5.3, respectively. As these errors are too large, we performed a Kolmogorov-Smirnov (KS) statistical analysis. The significance of the trends in KS test is assessed on the basis of differences, D, between their cumulative number distributions. This is used to define a probability coefficient P, such that low values of P imply significant differences. The results of the KS test are shown in Table 2. It is clear that the distribution of Galactic latitudes of H-rich and H-poor stars are very different. In addition, the sample of wels stars are, apparently, more similar to the H-poor stars than the other group, supporting the hypothesis that wels stars belong to the H-poor group and enhancing the ratio of H-poor to the whole CSPN population.

4. Conclusions

We have carried out a spectroscopic survey of PNe, during which we have performed a very preliminary determination of the spectral types of 45 of their central stars, all of them previously unclassified. In addition, we have performed an extensive bibliographic compilation of CSPN with determined spectral types. We have presented the list of 492 CSPN with spectral classification (together with their respective references), and included a tag indicating those that are either binary systems or candidates. We hope that this list will be useful for future investigations.

From our catalogue, we grouped CSPN whose atmospheres are hydrogen rich or poor; conservatively we ruled out the wels (nevertheless we found evidence supporting the hypothesis that wels belong to the H-poor group). We found that the ratio of stars in both groups is lower than previous estimates. According to our statistical analysis, we have found that PN with H-poor central star are more concentrated toward the Galactic center and Galactic plane than the H-rich group. This suggests that H-poor stars may have a more massive progenitor and in addition, the metallicity could play an important role in the mechanism responsible for generating hydrogen-free atmospheres. In addition, we have found that the frequency of occurrence of known close binaries among CSPNe is ~14%.

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Table 4. Catalogue of CSPN (true PN).

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
000.0-06.8	H 1-62	18 13 17.9	–32 19 43.0	emission-line	t.w.	
000.1+17.2	PC 12	16 43 49.3	–18 56 33.0	OB	t.w.	
000.3+12.2	IC 4634	17 01 33.6	–21 49 32.8	emission-line	t.w.	
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	[WC5-6]	AN2003	
000.7+08.0	MPA 1717-2356	17 17 09.0	–23 56 29.0	Blue	MASH-II	
000.7+04.7	H 2-11	17 29 25.9	–25 49 06.6	wels	GS2004	
000.7-02.7	M 2-21	17 58 09.6	–29 44 20.1	wels	GC2009	
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	[WC11]?	GS2004	
001.5-06.7	SwSt 1	18 16 12.3	–30 52 08.1	[WC9]pec	AN2003	
001.7-04.4	H 1-55	18 07 14.6	–29 41 24.5	[WC11]	GC2009	
001.7-04.6	H 1-56	18 07 53.9	–29 44 34.3	wels	GC2009	
002.0-06.2	M 2-33	18 15 06.6	–30 15 33.3	O5f(H);	HP2007;	
				wels	AN2003	
002.0-13.4	IC 4776	18 45 50.6	–33 20 32.0	wels	TA1993	
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	OB?	t.w.	
002.2-09.4	Cn 1-5	18 29 11.7	–31 29 59.2	[WO4]pec	AN2003	
002.4+05.8	NGC 6369	17 29 20.5	–23 45 34.8	[WO3]	AN2003	
002.4-03.7	M 1-38	18 06 05.8	–28 40 29.3	O;	HP2007	
				[WC11]	GC2009	
002.6+05.5	K 5-3	17 30 41.2	–23 45 00.4	[WC4]	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	[WC11]?;	GZ2006;	
				peculiar	HP2007	
002.7-52.4	IC 5148	21 59 35.2	–39 23 08.0	hgO(H)	SECGPN	
003.1+02.9	Hb 4	17 41 52.8	–24 42 08.1	[WO3]	AN2003	
003.2-04.4	KFL 12	18 10 30.8	–28 19 22.9	wels	GC2009	
003.3-04.6	Ap 1-12	18 11 35.1	–28 22 36.6	[WC11]?	GC2009	
003.4-04.8	H 2-43	18 12 48.0	–28 19 59.7	symbiotic star?;	BM2000;	
				wels?	GC2009	
003.6+03.1	M 2-14	17 41 57.3	–24 11 16.1	wels	GS2004	
003.7-04.6	M 2-30	18 12 34.4	–27 58 11.6	wels	GC2009	
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	H-poor	PT1992	
004.2-04.3	H 1-60	18 12 25.2	–27 29 12.8	wels	TA1993	
004.6+06.0	He 2-244	17 33 37.6	–21 46 25.0	wels	AN2003	
004.8-22.7	He 2-436	19 32 06.7	–34 12 57.5	[WC4]	AN2003	
004.9+04.9	M 1-25	17 38 30.3	–22 08 38.8	[WC5-6]	AN2003	
004.9-04.9	M 1-44	18 16 17.4	–27 04 32.5	symbiotic star?;	BM2000;	bc-CSPN
				K2III	SECGPN	
005.9-02.6	MaC 1-10	18 09 12.9	–25 04 33.3	[WC8]	GS2003	
006.0-03.6	M 2-31	18 13 16.1	–25 30 05.3	[WC4]	AN2003	
006.0-41.9	PaRu 1-1	21 05 53.6	–37 08 40.3	O(H)	PT1992	
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) ?	SECGPN	
006.8+04.1	M 3-15	17 45 31.7	–20 58 01.8	[WC4]	AN2003	
006.8-19.8	WRAY 16-423	19 22 10.6	–31 30 38.7	[WC4-6]/wels	GZ2003	
006.9-05.1	MPA 1820-2524	18 20 57.7	–25 24 22	Blue	MASH-II	
007.0-06.8	Vy 2-1	18 27 59.6	–26 06 48.3	wels	TA1993	
007.5-05.0	BMP 1822-2449	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]	SECGPN	
007.8-04.4	H 1-65	18 20 08.9	–24 15 05.0	[WC11];	GC2009;	
				wels	AN2003	
008.0+03.9	NGC 6445	17 49 15.2	–20 00 34.5	cont.	SECGPN	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
008.1-04.7	M 2-39	18 22 01.1	–24 10 40.2	wels	GS2004	
008.2+06.8	He 2-260	17 38 57.1	–18 17 35.0	O	HP2007	
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	
009.4-05.0	NGC 6629	18 25 42.4	–23 12 10.6	[WC4]?; wels	AN2003; TA1993	
009.6+10.5	A 41	17 29 02.0	–15 13 04.4	sdB	WO1994	GB1983
009.6+14.8	NGC 6309	17 14 04.3	–12 54 37.7	wels	GS2004	
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	[WO2]	GS2004	
009.8-07.5	IRAS 18333-2357	18 36 22.8	–23 55 18.3	sdO?; O(C)	HP1993; PT1992	
010.4+04.4	SAKURAIÂt'S	17 52 32.7	–17 41 08.0	born-again	DB1996	
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	
010.8-01.8	NGC 6578	18 16 16.5	–20 27 02.7	wels	TA1993	
011.4+17.9	DHW 1-2	17 06 55.0	–09 46 59.0	DAO	SW1997	
011.7-00.6	NGC 6567	18 13 45.2	–19 04 34.2	wels	TA1993	
011.7-06.6	M 1-55	18 36 42.5	–21 48 59.4	O?	SECGPN	
011.9+04.2	M 1-32	17 56 20.0	–16 29 04.0	[WO4]pec	AN2003	
012.2+04.9	PM 1-188	17 54 21.1	–15 55 52.0	[WC10]	AN2003	
012.5-09.8	M 1-62	18 50 26.1	–22 34 22.8	wels	TA1993	
012.9+06.6	BMP 1749-1429	17 49 39.7	–14 29 18.0	Blue?	MASH-II	
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	SECGPN	bc-CSPN
014.2+03.8	PMR 4	18 02 38.3	–14 42 02.8	wels	AN2003	
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.?	SECGPN	
015.4-04.5	M 1-53	18 35 48.2	–17 36 08.4	emission-line?	t.w.	
015.5+02.8	BMP 1808-1406	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	
016.4-01.9	M 1-46	18 27 56.3	–15 32 54.6	wels; Of(H)	TA1993; H2003	
016.8-01.7	BMP 1827-1504	18 27 50.8	–15 04 24.0	[WC4]	MASH-II	
017.3-21.9	A 65	19 46 34.2	–23 08 12.9	Op k	SECGPN	WW1996
017.6-10.2	A 51	19 01 01.4	–18 12 15.3	O(H)	SECGPN	
017.9-04.8	M 3-30	18 41 14.9	–15 33 43.6	[WO2]	AN2003	
019.4-05.3	M 1-61	18 45 55.1	–14 27 37.9	wels	AN2003	
019.7-04.5	M 1-60	18 43 38.1	–13 44 48.9	[WC4]	AN2003	
019.7-10.7	MPA 1906-1634	19 06 32.8	–16 34 00.0	Blue	MASH-II	
020.4-07.0	MPA 1854-1420	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	OB	t.w.	
020.7-08.0	MPA 1858-1430	18 58 19.3	–14 30 26.0	Blue	MASH-II	
020.9-01.1	M 1-51	18 33 28.9	–11 07 26.4	[WO4]pec	AN2003	
021.0-04.1	PMR 7	18 44 07.7	–12 26 51.0	[WC4]	PM2003	
023.8-06.2	BMP 1857-1054	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	O7; O5f(H)	BD1993; SECGPN	
025.4-04.7	IC 1295	18 54 37.2	–08 49 39.1	hgO(H)	NS1995	
025.8-17.9	NGC 6818	19 43 57.8	–14 09 11.9	wels	TA1993	BC2003
025.9-10.9	NA 2	19 18 19.5	–11 06 15.4	wels	MA2003	
027.6+04.2	M 2-43	18 26 40.1	–02 42 57.3	[WC7-8]	AN2003	
027.6+16.9	DeHt 2	17 41 40.9	+03 06 57.3	O	SECGPN	
027.6-09.6	IC 4846	19 16 28.2	–09 02 36.5	Of	SECGPN	
028.0+10.2	WeSb 3	18 06 00.8	+00 22 38.6	PG 1159?	NS1995	
029.2-05.9	NGC 6751	19 05 55.6	–05 59 32.9	[WO4]	AN2003	
030.6+06.2	Sh 2-68	18 24 58.4	+00 51 35.9	hybrid; DAO	WH2006; P1996	
033.2-01.9	Sa 3-151	18 58 51.7	–00 32 54.3	A	SECGPN	bc-CSPN
034.1-10.5	HDW 11	19 31 07.2	–03 42 31.5	hgO(H)	NS1995	
034.5-06.7	NGC 6778	19 18 24.9	–01 35 47.4	cont.	F1994	MC2010

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
034.6+11.8	NGC 6572	18 12 06.4	+06 51 13.0	wels	TA1993	
035.9-01.1	Sh 2-71	19 01 59.3	+02 09 18.0	A7 V - F0 V	F1999	F1999
036.0+17.6	A 43	17 53 32.3	+10 37 24.2	hybrid	WH2006	
036.1-57.1	NGC 7293	22 29 38.6	–20 50 13.6	DAO	NS1995	
036.4-01.9	IRAS 19021+0209	19 04 38.5	+02 14 23.0	cont.	t.w.	
037.5-05.1	A 58	19 18 20.5	+01 46 59.6	[WCE]	SECGPN	
037.7-06.0	MPA 1921+0132	19 21 44.5	+01 32 40.0	[WO3-4]	MASH-II	
037.7-34.5	NGC 7009	21 04 10.9	–11 21 48.3	O(H)	SECGPN	
037.8-06.3	NGC 6790	19 22 57.0	+01 30 46.6	WN?	SECGPN	
038.2+12.0	Cn 3-1	18 17 34.1	+10 09 03.3	wels	TA1993	
042.5-14.5	NGC 6852	20 00 39.2	+01 43 40.1	PG 1159	WH2006	
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	O6;	SECGPN	
				CIII and HeII emission	K1994	
043.1+37.7	NGC 6210	16 44 29.5	+23 47 59.7	O6	SECGPN	
043.3+11.6	M 3-27	18 27 48.3	+14 29 06.1	Hα emission	MV1997	
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	SECGPN	
046.4-04.1	NGC 6803	19 31 16.5	+10 03 21.7	wels	TA1993	
046.8+03.8	Sh 2-78	19 03 10.1	+14 06 58.9	PG 1159	WH2006	
047.0+42.4	A 39	16 27 33.7	+27 54 33.5	hgO(H)	NS1995	
048.7+01.9	He 2-429	19 13 38.4	+14 59 19.1	[WC4]	AN2003	
049.4+02.4	He 2-428	19 13 05.2	+15 46 39.8	O5	RC2001	SG2010
051.0+02.8	IRAS 19127+1717	19 14 59.7	+17 22 46.0	? + B9 V	SECGPN	bc-CSPN
051.9-03.8	M 1-73	19 41 09.3	+14 56 58.8	wels	TA1993	
052.2-04.0	M 1-74	19 42 18.9	+15 09 08.2	WN b?	SECGPN	
052.5-02.9	Me 1-1	19 39 09.8	+15 56 48.2	K(1-2) II	PM2008	bc-CSPN
053.8-03.0	A 63	19 42 10.4	+17 05 14.5	M4 V	SECGPN	A1966
054.1-12.1	NGC 6891	20 15 08.8	+12 42 15.6	wels	TA1993	
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	M6 V;	MO2007;	MO2007
				O9k	SECGPN	
055.5-00.5	M 1-71	19 36 26.9	+19 42 24.1	wels	TA1993	
057.2-08.9	NGC 6879	20 10 26.7	+16 55 21.4	wels	AN2003	
058.3-10.9	IC 4997	20 20 08.8	+16 43 53.6	wels	TA1993	
060.1-07.7	NGC 6886	20 12 42.8	+19 59 22.6	cont.	CP1985	
060.4+01.5	PM 1-310	19 38 52.1	+25 05 32.6	[WC11]	SECGPN	
060.8-03.6	NGC 6853	19 59 36.3	+22 43 16.1	DAO	NS1995	
061.0+08.0	K 3-27	19 14 30.0	+28 40 45.5	G0:	L1977	bc-CSPN
061.4-09.5	NGC 6905	20 22 22.9	+20 06 16.8	[WO2]	AN2003	
061.8+02.1	He 2-442	19 39 43.4	+26 29 33.1	symbiotic star?	BM2000	
061.9+41.3	DDDM 1	16 40 18.2	+38 42 20.0	O(H)	PT1992	
062.4+09.5	NGC 6765	19 11 06.5	+30 32 42.5	PG 1159	WH2006	
063.1+13.9	NGC 6720	18 53 35.1	+33 01 45.0	DA(O?)	NS1995	
064.6+48.2	NGC 6058	16 04 26.6	+40 40 56.1	O9	P1983	
064.7+05.0	BD+30 3639	19 34 45.2	+30 30 58.9	[WC9]	AN2003	
065.0-27.3	Ps 1	21 29 59.4	+12 10 27.5	sdO;	RH2002;	
				O(H)-C	PT1992	
066.7-28.2	NGC 7094	21 36 53.0	+12 47 19.0	hybrid	WH2006	
068.3-02.7	He 2-459	20 13 57.9	+29 33 55.9	[WC9]	AN2003	
068.7+14.8	SP 4-1	19 00 26.6	+38 21 07.3	wels	TA1993	
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	
075.7+35.8	Sa 4- 1	17 13 50.4	+49 16 11.0	O(H)	SECGPN	
077.6+14.7	A 61	19 19 10.2	+46 14 52.0	hgO(H)	NS1995	
080.3-10.4	RX J2117.1+3412	21 17 08.3	+34 12 27.5	PG 1159	WH2006	
081.2-14.9	A 78	21 35 29.4	+31 41 45.3	[WC]-PG1159	GT2000	
082.1+07.0	NGC 6884	20 10 23.7	+46 27 39.8	WN b?	SECGPN	
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	O3f(H)	SECGPN	LR1983
089.0+00.3	NGC 7026	21 06 18.2	+47 51 05.4	[WO3]	AN2003	
089.3-02.2	M 1-77	21 19 07.4	+46 18 47.2	OB ?	SECGPN	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
089.8-05.1	IC 5117	21 32 31.0	+44 35 48.5	[WR]	SECGPN	
093.4+05.4	NGC 7008	21 00 32.5	+54 32 36.2	O7	SECGPN	CB1999
093.9-00.1	IRAS 21282+5050	21 29 58.4	+51 03 59.8	O7(f)-[WC11]	CJ1987	
094.0+27.4	K 1-16	18 21 52.2	+64 21 54.3	PG 1159 (lg E); [WO]	WH2006; SK1994	
095.2+00.7	K 3-62	21 31 50.2	+52 33 51.6	cont.	SECGPN	
096.3+02.3	K 3-61	21 30 00.7	+54 27 27.5	[WC4-6]	TA1993	
096.4+29.9	NGC 6543	17 58 33.4	+66 37 59.5	wels	TA1993	
096.9+32.0	RE 1738+665	17 37 59.1	+66 53 46.3	DA	TK1996	
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	[WC8-9]?; wels	AN2003; TA1993	
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	
104.4-01.6	M 2-53	22 32 17.7	+56 10 26.1	WN a?	SECGPN	
104.8-06.7	M 2-54	22 51 38.9	+51 50 42.4	B	SECGPN	bc-CSPN
106.5-17.6	NGC 7662	23 25 53.6	+42 32 06.0	UV emission lines	F1994	
107.7+07.8	IsWe 2	22 13 22.5	+65 53 55.5	DA	NS1995	
107.7-02.2	M 1-80	22 56 19.8	+57 09 20.7	cont.	SECGPN	
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	
111.8-02.8	Hb 12	23 26 14.8	+58 10 54.7	B[e]?; WN7?	LZ1998; SECGPN	HI2006
114.0-04.6	A 82	23 45 47.8	+57 03 58.5	K0 IV	CB1999	bc-CSPN
118.0-08.6	Vy 1-1	00 18 42.2	+53 52 20.0	O(H); [WC]	N1999; AK1985	
118.8-74.7	NGC 246	00 47 03.3	–11 52 18.9	PG 1159 (lg E)	WH2006	BC1999
119.6-06.7	Hu 1-1	00 28 15.6	+55 57 54.7	A?	SECGPN	bc-CSPN
120.0+09.8	NGC 40	00 13 01.0	+72 31 19.1	[WC8]	AN2003	
120.2-05.3	Sh 2-176	00 31 53.3	+57 22 49.0	DA	NS1995	
120.3+18.3	Sh 2-174	23 45 02.3	+80 56 59.6	DAO	NS1995	
123.6+34.5	IC 3568	12 33 06.9	+82 33 49.0	O3(H); O5f	SECGPN; P1983	
124.0+10.7	EGB 1	01 07 07.6	+73 33 23.1	DA	NS1995	
126.6+01.3	PRINCIPES DE ASTURIAS	01 25 08.0	+63 56 52.7	Hα and CaII emission	MC2006	MC2006
128.0-04.1	Sh 2-188	01 30 33.1	+58 24 50.7	DAO	NS1995	
130.2+01.3	IC 1747	01 57 35.9	+63 19 19.4	[WO4]	AN2003	
130.9-10.5	NGC 650-1	01 42 19.9	+51 34 31.2	PG 1159 (E)	WH2006	
135.6+01.0	WeBo 1	02 40 14.4	+61 09 16.8	K0 III	SB2007	BP2003
135.9+55.9	TS 01	11 53 24.7	+59 39 56.9	WD/NS	TN2004	NT2005
136.3+05.5	HFG 1	03 03 47.0	+64 54 35.7	F9 V	EP2005	GB1987
138.1+04.1	HDW 2	03 11 01.3	+62 47 45.1	A	SECGPN	bc-CSPN
138.8+02.8	IC 289	03 10 19.3	+61 19 01.0	O(H); WD?	N1999; CG2009	
143.6+23.8	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	[WO4]	AN2003	
144.8+65.8	BE Uma	11 57 44.8	+48 56 18.7	M3 V	MD1981	FM1981
146.7+07.6	M 4-18	04 25 50.9	+60 07 12.8	[WC11]	AN2003	
147.4-02.3	M 1-4	03 41 43.4	+52 17 00.3	Of	AK1987	
148.4+57.0	NGC 3587	11 14 47.7	+55 01 08.5	hgO(H)	NS1995	
149.4-09.2	HDW 3	03 27 15.4	+45 24 20.5	DAO	NS1995	
149.7-03.3	IsWe 1	03 49 05.9	+50 00 14.8	PG 1159 (A)	GT2000	
156.3+12.5	HDW 4	05 37 56.2	+55 32 16.0	DA	NS1995	
156.9-13.3	HaWe 5	03 45 26.6	+37 48 51.8	DA	NS1995	
158.6+00.7	Sh 2-216	04 43 21.3	+46 42 05.8	DAO	NS1995	
158.9+17.8	PuWe 1	06 19 34.3	+55 36 42.3	DAO	NS1995	
159.0-15.1	IC 351	03 47 33.1	+35 02 48.5	wels	dS2003	
161.2-14.8	IC 2003	03 56 22.0	+33 52 30.6	[WC3]?; [WC7-8]	TA1993; SECGPN	
164.8+31.1	VV 47	07 57 51.6	+53 25 17.0	PG 1159 (E:)	WH2006	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
165.5-06.5	K 3-67	04 39 47.9	+36 45 42.6	O(C);	SECGPN	
				CIV+HeII emission	TS1987	
165.5-15.2	NGC 1514	04 09 17.0	+30 46 33.5	sdO + A0 III	SECGPN	bc-CSPN
166.1+10.4	IC 2149	05 56 23.9	+46 06 17.3	O4f	SECGPN	
167.4-09.1	K 3-66	04 36 37.2	+33 39 30.0	cont.	SECGPN	
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	
189.1+19.8	NGC 2371-72	07 25 34.7	+29 29 26.4	[WO1]	AN2003	
189.8+07.7	M 1-7	06 37 21.0	+24 00 35.4	[WO]-[WC8]	SECGPN	
190.3-17.7	J 320	05 05 34.3	+10 42 22.7	wels	TA1993	
191.4+33.1	Ton 320	08 27 05.5	+31 30 08.6	DAO	N1999	
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	
197.8+17.3	NGC 2392	07 29 10.8	+20 54 42.5	O6f	SECGPN	CB1999
197.8-03.3	A 14	06 11 08.7	+11 46 43.8	B5 III-V	LK1987	bc-CSPN
204.1+04.7	K 2-2	06 52 23.2	+09 57 55.7	hgO(H)	NS1995	
205.1+14.2	A 21	07 29 02.7	+13 14 48.4	PG 1159 (E)	WH2006	
206.4-40.5	NGC 1535	04 14 15.8	–12 44 22.0	O5	SECGPN	CB1999
208.5+33.2	A 30	08 46 53.5	+17 52 45.5	[WC]-PG1159	GT2000	CB1999
211.2-03.5	M 1-6	06 35 45.1	–00 05 37.4	emission-line	t.w.	
211.4+18.4	HDW 7	07 55 11.3	+09 33 09.3	hgO(H)	SECGPN	
211.9+22.6	EGB 5	08 11 12.8	+10 57 17.1	hgO(H)	SECGPN	
214.9+07.8	A 20	07 22 57.7	+01 45 32.8	O(H)	SECGPN	
215.2-24.2	IC 418	05 27 28.2	–12 41 50.3	Of(H)	SECGPN	
215.5-30.8	A 7	05 03 07.5	–15 36 22.7	DAO	NS1995	CB1999
215.6+03.6	NGC 2346	07 09 22.5	–00 48 23.6	A5 V	SECGPN	MN1981
215.7-03.9	BMP 0642-0417	06 42 18.4	–04 17 49.0	Blue	MASH-II	
216.0+07.4	PHR 0723+0036	07 23 48.1	+00 36 48.0	[WR]	MASH-I	
218.9-10.7	HDW 5	06 23 37.2	–10 13 23.7	hgO(H);	SECGPN	
				unknown absorption at 5758Å.	LS2007	
219.1+31.2	A 31	08 54 13.2	+08 53 53.1	hgO(H)	NS1995	CB1999
219.5+02.8	BMP 0713-0432	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);	SECGPN;	MN1977
				WD/MS	d2006	
221.0-01.4	PHR 0701-0749	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	hgO(H)	SECGPN	BM1993
222.1+03.9	PFP 1	07 22 17.7	–06 21 46.0	pre-WD?	PF2004	
222.5+07.6	BMP 0736-0500	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	[WC7]	SG2006	HZ2010
224.9+01.0	We 1-6	07 17 26.0	–10 10 37.7	hgO(H)	SECGPN	
225.5-02.5	MPA 0705-1224	07 05 37.2	–12 24 52.0	Blue	MASH-II	
228.0-00.4	MPA 0717-1334	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	K V	d2006	bc-CSPN
231.1+03.9	BMP 0739-1418	07 39 50.6	–14 18 26.0	Blue	MASH-II	
231.8+04.1	NGC 2438	07 41 50.5	–14 44 07.7	M3 V;	d2009;	BC2008
				O(H)	N1999	
232.0+05.7	SaSt 2-3	07 48 03.5	–14 07 42.6	OB	t.w.	
232.8-04.7	M 1-11	07 11 16.7	–19 51 02.9	emission-line	t.w.	
233.5-16.3	A 15	06 27 01.9	–25 22 49.6	O(H)	SECGPN	
234.3-07.2	MPA 0704-2221	07 04 23.0	–22 21 52.0	Blue	MASH-II	
234.9-01.4	M 1-14	07 27 56.5	–20 13 23.4	OB	t.w.	
234.9-09.7	MPA 0656-2356	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	emission-line	t.w.	
237.3-08.4	BMP 0705-2528	07 05 45.5	–25 28 50.0	Blue	MASH-II	
237.4-09.6	BMP 0700-2607	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	O(H)	SECGPN	CB1999
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	emission-line	t.w.	
240.8-19.6	KLSS 1-9	06 24 36.4	–33 04 49.0	OB	t.w.	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
241.0+02.3	M 3-4	07 55 11.2	–23 37 45.6	cont.	t.w.	
242.6-11.6	M 3-1	07 02 49.6	–31 35 41.3	cont.	t.w.	
243.3-01.0	NGC 2452	07 47 26.3	–27 20 06.6	[WO1]	AN2003	
243.8-37.1	PRTM 1	05 03 01.7	–39 45 44.5	O(H)	SECGPN	
245.0+02.2	BMP 0803-2706	08 03 54.2	–27 06 02.0	Blue	MASH-II	
245.1-05.5	BMP 0733-3108	07 33 24.1	–31 08 05.0	Blue	MASH-II	
245.4+01.6	M 3-5	08 02 28.9	–27 41 55.4	O7	SECGPN	
248.7+29.5	A 34	09 45 35.4	–13 10 15.8	hgO(H)	SECGPN	
248.8-08.5	M 4-2	07 28 55.2	–35 45 15.4	emission-line	t.w.	
250.5+01.9	BMP 0816-3150	08 16 20.8	–31 51 00.0	Blue	MASH-II	
250.6+09.3	BMP 0844-2737	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	SECGPN	bc-CSPN
253.5+10.7	K 1-2	08 57 46.0	–28 57 36.8	K2 V (earlier than)	d2009	BG1987
253.9+05.7	M 3-6	08 40 40.2	–32 22 33.6	wels	AN2003	
254.6+00.2	Ns 238	08 20 56.7	–36 13 46.7	OB	t.w.	
255.3-59.6	Lo 1	02 56 58.4	–44 10 17.8	hgO(H)	SECGPN	
257.5+00.6	VBRC 1	08 30 54.2	–38 18 07.0	F V:	RK1999	bc-CSPN
258.0-03.2	BMP 0815-4053	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	
258.1-00.3	He 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	absorption lines	FP2006	
261.0+32.0	NGC 3242	10 24 46.1	–18 38 32.6	O(H)	SECGPN	
261.9+08.5	NGC 2818	09 16 01.7	–36 37 38.8	cont.	LS2007	
261.9-05.3	BMP 0818-4517	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	emission-line?	t.w.	
263.1+04.3	FPM 0904-4023	09 04 02.3	–40 22 20.0	Blue	MASH-II	
263.2+00.4	K 2-15	08 48 47.7	–42 54 24.0	O(H)	SECGPN	
264.4-12.7	He 2-5	07 47 20.0	–51 15 03.4	wels	AN2003	
264.5+05.0	FPM 0911-4051	09 11 45.6	–40 51 59.0	Blue	MASH-II	
264.6+03.8	BMP 0907-4146	09 07 24.3	–41 46 14.0	Blue	MASH-II	
272.1+12.3	NGC 3132	10 07 01.8	–40 26 11.1	A2 V	SECGPN	CB1999
272.8+01.0	PMR 1	09 28 40.6	–49 36 44.0	[WC9-10]	AN2003	
273.6+06.1	HBDS 1	09 52 44.5	–46 13 51.0	O(H)	SECGPN	
274.3+09.1	Lo 4	10 05 45.8	–44 21 33.3	PG 1159	WH2006	
274.6+02.1	He 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	emission-line?	t.w.	
275.2-03.7	He 2-25	09 18 01.3	–54 39 29.2	symbiotic star?; cont.	C1995; LS2007	
276.1-11.9	MPA 0835-6039	08 35 07.3	–60 39 43.0	Blue	MASH-II	
277.1-03.8	NGC 2899	09 27 03.0	–56 06 21.1	F V:	RK1999	bc-CSPN
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	[WO2]	AN2003	
278.8+04.9	PB 6	10 13 15.9	–50 19 59.3	[WO1]	AN2003	
279.6-03.1	He 2-36	09 43 25.6	–57 16 55.6	A2 III; sdO + A2 III	LS2007; SECGPN	bc-CSPN
280.1-05.1	BMP 0936-5905	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	emission-line	t.w.	
283.6+25.3	K 1-22	11 26 43.8	–34 22 11.4	F V	RK1999	CB1999
283.9+09.7	DS 1	10 54 40.6	–48 47 03.0	M5 V	SECGPN	D1985
284.2-05.3	PM 12	10 01 18.9	–61 52 01.0	[WR]	MASH-I	
285.4+01.5	Pe 1-1	10 38 27.6	–56 47 06.5	[WO4]	AN2003	
285.4-05.3	IC 2553	10 09 21.7	–62 36 40.9	emission-line	t.w.	
285.6-02.7	He 2-47	10 23 09.0	–60 32 34.3	emission-line	t.w.	
285.7-14.9	IC 2448	09 07 06.3	–69 56 30.7	O(H)	SECGPN	
286.3+02.8	He 2-55	10 48 43.2	–56 03 10.2	[WO3]	AN2003	
286.8-29.5	K 1-27	05 57 02.2	–75 40 22.7	O(He)	RD1998	CB1999
289.6-01.6	He 2-57	10 56 03.0	–61 28 07.4	symbiotic star?	KB1994	
289.8+07.7	He 2-63	11 24 01.0	–52 51 19.4	wels	AN2003	
291.3+08.4	PMR 2	11 34 38.6	–52 43 33.0	[WO4]-[WC4]	AN2003	
291.3-26.2	Vo 1	06 59 26.4	–79 38 47.0	[WC10]	AN2003	
291.4+19.2	LoTr 4	11 52 29.2	–42 17 38.7	O(He)	GT2000	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
291.6-04.8	IC 2621	11 00 19.5	–65 14 54.2	emission-line	t.w.	
291.7+03.7	He 2-64	11 27 24.3	–57 17 58.9	O(He)	LS2007	
292.4+04.1	PB 8	11 33 17.7	–57 06 14.0	[WC5-6]	AN2003	
293.2-09.5	MPA 1054-7013	10 54 27.3	–70 13 12.0	Blue	MASH-II	
293.6+10.9	BlDz 1	11 53 06.6	–50 50 59.2	H-rich	RK1999	
294.1+14.4	Lo 6	12 00 43.5	–47 33 12.0	cont.	t.w.	
294.1+43.6	NGC 4361	12 24 30.8	–18 47 05.4	O6	P1983	
296.0-06.2	MPA 1137-6806	11 37 15.6	–68 06 45.0	Blue	MASH-II	
297.0+06.5	BMP 1209-5553	12 09 29.1	–55 53 34.0	[WO1-2]	MASH-II	
300.1+04.1	BMP 1229-5839	12 29 57.6	–58 39 06.0	Blue	MASH-II	
300.7-02.0	He 2-86	12 30 30.5	–64 52 05.7	[WC4]	AN2003	
301.9-02.1	MPA 1242-6459	12 42 24.2	–64 59 25.0	wels?	MASH-II	
302.0-01.6	MPA 1243-6428	12 43 19.4	–64 28 01.0	[WC9]	MASH-II	
303.6+40.0	A 35	12 53 32.8	–22 52 22.6	? + G8 IV	SECGPN	bc-CSPN
305.1+01.4	He 2-90	13 09 36.2	–61 19 36.0	B[e]	KB2005	
306.4-00.6	Th 2-A	13 22 33.8	–63 21 01.3	[WO3]pec	WG2008	
307.2-03.4	NGC 5189	13 33 32.9	–65 58 27.1	[WO1]	AN2003	
307.2-05.3	MPA 1337-6751	13 37 22.4	–67 51 07.0	Blue	MASH-II	
307.2-09.0	He 2-97	13 45 24.0	–71 28 48.8	emission-line	t.w.	
307.5-04.9	MyCn 18	13 39 35.1	–67 22 51.9	Of(C)	LS2007	
308.2+07.7	MeWe 1-3	13 28 04.9	–54 41 58.4	DAO	SW1997	
308.4+00.4	WeKg 2	13 38 41.7	–61 55 51.0	H-rich	WK1997	
308.5+02.5	PMR 6	13 36 23.0	–59 53 31.0	[WC4]	PM2003	
308.6-12.2	He 2-105	14 15 25.7	–74 12 49.8	OB	t.w.	
309.0-04.2	He 2-99	13 52 30.7	–66 23 26.8	[WC9]	AN2003	
309.1-04.3	NGC 5315	13 53 57.0	–66 30 50.7	[WO4]	AN2003	
309.6-04.8	MPA 1400-6647	14 00 37.1	–66 47 58.0	Blue	MASH-II	
309.8-01.6	MPA 1354-6337	13 54 22.3	–63 37 18.0	[WO4]?	MASH-II	
310.3+24.7	Lo 8	13 25 37.5	–37 36 14.8	O(H)	SECGPN	
311.0+02.4	SuWt 2	13 55 43.2	–59 22 39.9	B9 V	MO2007	BO2002
312.3+10.5	NGC 5307	13 51 03.3	–51 12 15.9	emission-line	t.w.	
312.6-01.8	He 2-107	14 18 42.5	–63 07 10.7	emission-line	t.w.	
313.4+06.2	MPA 1405-5507	14 05 32.2	–55 07 44.0	[WC4-6]	MASH-II	
313.8-05.7	BMP 1442-6615	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	[WR]	MASH-II	
315.1-13.0	He 2-131	15 37 11.2	–71 54 52.9	wels	TA1993	
316.1+08.4	He 2-108	14 18 08.9	–52 10 39.5	wels	TA1993	
316.7-05.8	MPA 1508-6455	15 08 06.4	–64 55 49.0	Blue	MASH-II	M2010
318.4+41.4	A 36	13 40 41.3	–19 52 55.3	O(H)	SECGPN	
319.6+15.7	IC 4406	14 22 26.3	–44 09 04.4	[WR]	SECGPN	
320.1-09.6	He 2-138	15 56 01.7	–66 09 09.2	Of(H); O(H)	MK1988; SECGPN	
320.3-28.8	He 2-434	19 33 50.7	–74 32 58.7	OB	t.w.	
320.7+04.2	BMP 1457-5413	14 57 02.3	–54 13 58.0	Blue?	MASH-II	
321.0+03.9	He 2-113	14 59 53.5	–54 18 07.5	[WC10]	AN2003	
322.5-05.2	NGC 5979	15 47 40.6	–61 13 02.7	emission-line	t.w.	
323.9+02.4	He 2-123	15 22 19.4	–54 08 12.8	wels?	LS2007	
324.0+03.5	PM 1-89	15 19 08.8	–53 09 49.8	[WO4]pec	AN2003	
324.1+09.0	ESO 223-10	15 01 40.7	–48 21 02.0	O ?	SECGPN	
325.8+04.5	He 2-128	15 25 07.9	–51 19 40.9	emission-line?	t.w.	
325.8-12.8	He 2-182	16 54 35.1	–64 14 28.5	O(H)	SECGPN	
326.0-06.5	He 2-151	16 15 42.3	–59 54 01.0	O(H)	SECGPN	
326.6+05.7	BMP 1525-4957	15 25 14.1	–49 57 41.0	Blue	MASH-II	
326.9+08.2	MPA 1518-4738	15 18 18.2	–47 38 28.0	[WR]?	MASH-II	
327.1-02.2	He 2-142	15 59 57.6	–55 55 32.9	[WC9]	AN2003	
327.5-02.2	MPA 1602-5543	16 02 11.2	–55 43 30.0	[WR]	MASH-II	
327.8+10.0	NGC 5882	15 16 49.9	–45 38 58.5	Of(H)	SECGPN	
328.8-01.1	PM 15	16 03 41.4	–54 02 04.0	[WR]?	MASH-I	
328.9-02.4	He 2-146	16 10 41.2	–54 57 32.9	LST	JE1969	bc-CSPN
329.0+01.9	Sp 1	15 51 41.0	–51 31 28.6	O(H)	SECGPN	BL1990
329.5-02.2	WRAY 17-75	16 12 34.4	–54 23 35.3	OB	t.w.	
329.8-02.1	BMP 1613-5406	16 13 02.0	–54 06 32.0	Blue?	MASH-II	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
329.9+03.7	BMP 1548-4936	15 48 52.1	–49 36 48.0	wels	MASH-II	
330.2+12.3	BMP 1521-4228	15 21 26.0	–42 28 08.0	Blue	MASH-II	
331.3+16.8	NGC 5873	15 12 51.1	–38 07 33.7	wels	TA1993	
331.4-03.5	He 2-162	16 27 50.9	–54 01 28.4	O(H)	SECGPN	
331.7-01.0	Mz 3	16 17 13.4	–51 59 10.6	B0	LZ1998	
331.8-02.3	MPA 1624-5250	16 24 02.9	–52 50 06.0	wels?	MASH-II	
332.4-01.4	BMP 1622-5144	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	
332.9-09.9	He 3-1333	17 09 00.9	–56 54 48.0	[WC10]	AN2003	
333.4-04.3	PMR 3	16 41 04.4	–53 02 24.0	wels	AN2003	
333.9+00.6	PMR 5	16 19 40.2	–49 13 59.0	wels	AN2003	
334.3-09.3	IC 4642	17 11 45.0	–55 24 01.5	absorption lines	SECGPN	
334.8-07.4	He 3-1312	17 03 02.9	–53 55 54.0	F(6-7) I; B[e]?	P2004; LZ1998	bc-CSPN
335.5+12.4	DS 2	15 43 05.0	–39 18 14.6	O(H)	SECGPN	
336.2-06.9	PC 14	17 06 14.8	–52 30 00.5	[WO4]	AN2003	
336.3-05.6	He 2-186	16 59 36.1	–51 42 06.5	cont.	LS2007	
336.5+05.5	MPA 1611-4356	16 11 12.9	–43 56 22.0	[WO3]	MASH-II	
337.4+01.6	Pe 1-7	16 30 25.9	–46 02 50.8	[WC9]	AN2003	
337.5-05.1	He 2-187	17 01 37.4	–50 22 56.6	OB	t.w.	
339.9+88.4	LoTr 5	12 55 33.7	+25 53 30.6	G5 III	d2006	FK1983
341.5+12.1	Sand 3	16 06 28.4	–35 45 13.0	[WC3]	MN1982	
341.6+13.7	NGC 6026	16 01 21.1	–34 32 36.6	OB; WD/sdO	t.w.; d2009	HB2006
341.8+05.4	NGC 6153	16 31 30.8	–40 15 14.2	wels	LS2000	
342.5-14.3	Sp 3	18 07 15.8	–51 01 10.1	O3	GP2001	CB1999
343.5-07.8	PC 17	17 35 41.1	–46 59 51.3	emission-line	t.w.	
343.6+03.7a	MPA 1644-4002	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 1723-4419	17 23 06.1	–44 19 16.0	Blue	MASH-II	
344.9+03.0	BMP 1651-3930	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	emission-line	t.w.	
345.2-08.8	Tc 1	17 45 35.3	–46 05 23.7	Of(H)	SECGPN	
345.4+00.1	IC 4637	17 05 10.5	–40 53 08.4	O(H)	SECGPN	CB1999
345.5+15.1	Lo 13	16 09 45.9	–30 55 07.6	O(H)	SECGPN	
346.2-08.2	IC 4663	17 45 28.5	–44 54 11.5	emission-line?	t.w.	
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	emission-line	t.w.	
348.4+04.9	MPA 1655-3535	16 55 22.0	–35 35 24.0	[WC]	MASH-II	
349.3-01.1	NGC 6337	17 22 15.7	–38 29 03.5	emission-line; M4 V	t.w.; d2006	HB2006
349.5+01.0	NGC 6302	17 13 44.2	–37 06 15.9	G V	d2006	bc-CSPN
349.7+04.0	PPA 1702-3509	17 02 46.1	–35 09 02.0	[WR]?	MASH-I	
350.1-03.9	H 1-26	17 36 29.7	–39 21 57.0	[WC4-5]	GS2003	
350.9+04.4	H 2-1	17 04 36.3	–33 59 18.8	[WC11]; O(H)	GC2009; SECGPN	
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	[WO2]	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	[WO3]	GS2004	
352.9+11.4	K 2-16	16 44 49.1	–28 04 04.7	[WC11]	AN2003	
352.9-07.5	Fg 3	18 00 11.9	–38 49 51.7	cont.	t.w.	
354.7-03.9	MPA 1748-3530	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	[WC4]	AN2003	
355.3+03.8	MPA 1719-3043	17 19 20.1	–30 43 40.0	Blue	MASH-II	
355.4-04.0	Hf 2-1	17 51 12.1	–34 55 24.3	[WO]	MA2009	
355.7-03.5	H 1-35	17 49 13.9	–34 22 53.3	emission-line?	t.w.	
355.9+03.6	H 1-9	17 21 31.9	–30 20 48.9	[WC11]	GC2009	
355.9-04.2	M 1-30	17 52 58.9	–34 38 23.0	wels	AN2003	
355.9-04.4	K 6-32	17 53 40.3	–34 43 41.0	[WR]?	MASH-I	
356.0-04.2	PHR 1753-3428	17 53 04.9	–34 28 39.0	[WR]	MASH-I	
356.1+02.7	Th 3-13	17 25 19.4	–30 40 42.0	wels	GS2004	

Table 4. continued.

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
356.2-04.4	Cn 2-1	17 54 33.0	–34 22 21.2	Of	AK1987	
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	[WC11]?	GZ2006	
356.5-03.9	H 1-39	17 53 21.0	–33 55 58.5	[WC11]?	GS2004	
356.7-04.8	H 1-41	17 57 19.1	–34 09 49.1	wels	TA1993	
356.9+04.5	M 2-11	17 20 33.3	–29 00 39.1	wels?	GC2009	
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	[WC11]	GS2004	
357.2-04.5	H 1-42	17 57 25.2	–33 35 42.9	wels	GC2009	
357.3+03.3	M 3-41	17 25 59.8	–29 21 50.4	[WC11]	GC2009	
357.6+01.7	H 1-23	17 32 46.9	–30 00 15.1	Of?	AK1987	
357.7-04.8	BMP 1759-3321	17 59 45.2	–33 21 13.0	Blue	MASH-II	
358.3-21.6	IC 1297	19 17 23.5	–39 36 46.4	[WO3]	AN2003	
358.8-00.0	Te 2022	17 42 42.4	–29 51 35.4	OB	t.w.	
358.9-00.7	M 1-26	17 45 57.7	–30 12 00.6	B[e]?;	LZ1998;	
				Of(H)	SECGPN	
359.2+01.2	19w32	17 39 03.0	–28 56 37.0	symbiotic star?	BM2000	
359.2-33.5	CRBB 1	20 19 28.7	–41 31 27.6	O(H)	SECGPN	
359.3-01.8	M 3-44	17 51 18.9	–30 23 53.0	[WC11]	GS2004	
359.3-03.1	M 3-17	17 56 25.6	–31 04 16.8	[WC11]?	GS2004	
359.4-05.6	BMP 1807-3215	18 07 07.0	–32 15 22.0	Blue?	MASH-II	
359.7+06.0	BMP 1721-2554	17 21 58.1	–25 54 24.0	Blue	MASH-II	
359.8+05.6	M 2-12	17 24 01.5	–25 59 23.3	O;	HP2007;	
				[WC11]	GS2004	

Table 5. Catalogue of CSPN (possible PN).

PN G	Name	RA	Dec	Classif.	Ref.	Binary ref.
–	KPD 0005+5106	00 08 18.4	+51 23 19.0	DO	D1999	
–	PG 0108+101	01 11 06.6	+10 21 39.2	DO	D1999	
–	PG 0109+111	01 12 22.9	+11 23 36.6	DO	D1999	
–	RWT 152	07 29 58.4	–02 06 37.5	sdO;	KC1989;	
				O4-5 V	C1980	
–	PG 1034+001	10 37 04.0	–00 08 20.0	DO	HI2004	
–	PG 1520+525	15 21 46.6	+52 22 04.0	PG 1159	WH2006	
–	He 2-139	15 54 44.5	–55 29 34.1	B[e]	LZ1998	
–	PM 1-322	20 14 50.9	+12 03 50.0	symbiotic star?	MV2010	
–	BD+28 4211	21 51 11.0	+28 51 50.4	O(H)	N1999	

References to Tables 4 and 5:

A1966 - Abell (1966);
AK1985 - Aller & Keyes (1985);
AK1987 - Aller & Keyes (1987);
AN2003 - Acker & Neiner (2003);
CB2008 - Bilikova et al. (2008);
BC1999 - Bond & Ciardullo (1999);
BC2003 - Benetti et al. (2003);
B2008 - Bohigas (2008);
BD1993 - Bianchi & Defrancesco (1993);
BG1987 - Bond & Grauer (1987);
BL1990 - Bond & Livio (1990);
BM1993 - Bond et al. (1993);
BM2000 - Belczyski ă et al. (2000);
BO2002 - Bond et al. (2002);
BP2002 - Bond & Pollacco (2002);
BP2003 - Bond et al. (2003);
CB1999 - Ciardullo et al. (1999);
C1980 - Chromey (1980);
C1995 - Corradi (1995);
CB1999 - Ciardullo et al. (1999);
CG2009 - Chu et al. (2009);
CJ1987 - Cohen & Jones (1987);
CP1985 - Cerruti-Sola & Perinotto (1985);
D1983 - Drilling (1983);
D1985 - Drilling (1985);
D1999 - Dreizler (1999);
d2006 - de Marco (2006);
d2009 - de Marco (2009);
DB1996 - Duerbeck & Benetti (1996);
dS2003 - de Marco et al. (2003);
EP2005 - Exter et al. (2005);
F1999 - Feibelman (1999);
F1994 - Feibelman (1994);
FK1983 - Feibelman & Kaler (1983);
FM1981 - Ferguson et al. (1981);
FP2006 - Frew et al. (2006);
FS2010 - Frew et al. (2010);
GB1983 - Grauer & Bond (1983);
GB1987 - Grauer et al. (1987);
GC2009 - Górny et al. (2009);
GP2001 - Gauba et al. (2001);
GS2003 - Górny & Sidmiak (2003);
GS2004 - Górny et al. (2004);
GT2000 - Górny & Tylenda (2000);
GZ2003 - Gesicki & Zijlstra (2003);
GZ2006 - Gesicki et al. (2006);
HB2006 - Hillwig (2006);
HI2006 - Hsia et al. (2006);
HZ2010 - Hajduk et al. (2010);
H2003 - Handler (2003);
HD1984 - Heber & Drilling (1984);
HI2004 - Hewett & Irwin (2004);
HP1993 - Harrington & Paltoglou (1993);
HP2007 - Hultzsch et al. (2007);
JE1969 - Jones et al. (1969);
K1994 - Kondrat'eva (1994);
KB1994 - Kingsburgh & Barlow (1994);
KB2005 - Kraus et al. (2005);
KC1989 - Kwitter et al. (1989);
L1977 - Lutz (1977);
LK1987 - Lutz & Kaler (1987);
LS2000 - Liu et al. (2000);
LS2007 - Lee et al. (2007);
LR1983 - Law & Ritter (2001)
LZ1998 - Lamers et al. (1998);
MA2003 - Marcolino & derajoă (2003);
MA2009 - Miszalski et al. (2009a);
MA2010 - Miszalski (2010);
MASH-I - Parker et al. (2006);
MASH-II - Miszalski et al. (2008);
MC2006 - Mampaso et al. (2006);
MC2010 - Miszalski et al. (2010);
MD1981 - Margon et al. (1981);
MK1988 - Méndez et al. (1988a);
MN1977 - Méndez & Niemela (1977);
MN1982 - Méndez & Niemela (1982);
MN1981 - Méndez & Niemela (1981);
MO2007 - Mitchell et al. (2007a);
MP2001 - Morgan et al. (2001);
MP2007 - Mitchell et al. (2007b);
MV1997 - Miranda et al. (1997);
MV2010 - Miranda et al. (2010);
N1999 - Napiwotzki (1999);
NS1995 - Napiwotzki & Schoenberner (1995);
NT2005 - Napiwotzki et al. (2005);
P1983 - Pottasch (1983);
P1996 - Pottasch (1996);
P2004 - Pereira (2004);
PF2004 - Pierce et al. (2004);
PM2002 - Pea & Medina (2002);
PM2003 - Parker & Morgan (2003);
PM2008 - Pereira et al. (2008);
PR1997 - Pena et al. (1997);
PT1992 - Pena et al. (1992);
RC2001 - Rodrŋguez et al. (2001);
RD1998 - Rauch et al. (1998);
RH2002 - Rauch et al. (2002);
RK1999 - Rauch et al. (1999);
SB2007 - Smith et al. (2007);
SECGPN - Acker et al. (1992);
SF1987 - Sabbadin et al. (1987);
SG2010 - Santander-García (2010);
SK1994 - Stanghellini et al. (1994);
SL2004 - Shen et al. (2004);
SW1997 - Saurer et al. (1997);
SZ1997 - Soker & Zucker (1997);
TA1993 - Tylenda et al. (1993);
TK1996 - Tweedy & Kwitter et al. (1996);
TN2004 - Tovmassian et al. (2004);
TS1987 - Tamura & Shaw (1987);
WG2008 - Weidmann et al. (2008);
WH2006 - Werner & Herwig (2006);
WK1997 - Weinberger et al. (1997);
WW1996 - Walsh & Walton (1996);
WO1994 - Wlodarczyk & Olszewski (1994);
ZP1990 - Zijlstra et al. (1990).