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A Search for New Emission Nebulae from the SHASSA and VTSS Surveys

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Abstract. As an adjunct to the planetary nebula (PN) search from the AAO/UKST Hα survey, a visual search was conducted for new emission nebulae from the SHASSA and VTSS surveys, outside a Galactic latitude of $|b| = 10^\circ$. Fifteen new objects were found from SHASSA and three from the available fields of VTSS. With one exception, all objects are $>5'$ across, as smaller nebulae are confused with large numbers of artifacts and compact emitters on these surveys. All previously known PNe larger than this size in the search area, as well as Hewett 1, PG 0108, and PG 0109 were recovered in this blind search. Candidates were selected as discrete, morphologically symmetric Hα enhancements, to differentiate them from the ubiquitous diffuse emission structure of the ISM. These criteria were relaxed for the VTSS survey due to its poorer inherent resolution. Most of the new discoveries are probable Stromgren spheres in the ISM. Some show unusual line ratios (e.g. strong [O III] or [N II] emission) based on slit spectroscopy and WHAM data (see Madsen *et al.* 2006, this volume), suggesting these are ionised by a hot subdwarf or white dwarf star, and may be possible PNe. Our most interesting discovery is a rare bowshock nebula around a bright, previously unnoticed, nova-like cataclysmic variable.

Keywords. (ISM:) planetary nebulae: general, (ISM:) HII regions

1. Introduction

Large evolved planetary nebulae (PNe) dominate any volume-limited PN census. Numerous highly evolved PN candidates have been discovered from the AAO/UKST Hα Survey (see Parker *et al.* 2005), a high resolution Hα+[N II] survey of the southern Galactic plane using the 1.2-m UKST. This survey has led to the discovery of ∼900 new Galactic PNe, presented as the Macquarie/AAO/Strasbourg/Hα (MASH) Catalogue (Parker *et al.* 2006).

As an adjunct to this survey, the first author has utilised the Southern Hα Sky Survey Atlas (SHASSA; Gaustad *et al.* 2001) and the Virginia Tech Spectral line Survey (VTSS; Dennison, Simonetti & Topasna 1998) to search for emission enhancements outside the zone covered by the AAO/UKST Hα survey, i.e. above $|b| = 10^\circ$. Both of these CCD surveys used fast short-focus lenses, so have modest angular resolution; $48''$pixel^{-1} for SHASSA and $96''$pixel^{-1} for VTSS. Despite this poor resolution, both surveys are very deep (down to ∼1 Rayleigh at Hα) and are a useful tool to search for any *large* evolved high-latitude PNe that may have been missed previously.

2. Method and Results

Both surveys, but especially SHASSA, contain large numbers of artifacts, compact emitters and variable stars. This precludes the use of an automated search technique for new PN candidates. Hence a visual search was conducted of all SHASSA fields plus the VTSS fields that are currently available online. Nebula candidates were selected

Table 1. Hα nebulae discovered from SHASSA and VTSS surveys. The positions are for J2000. Column 7 gives the field number (SHASSA fields have the 3 digit code), while columns 8 and 9 give the ID and V magnitude of the suggested ionizing star candidate. The last column gives alternative identifications for the nebulae, including objects from the WHAM Point Source Catalogue (WPS; Reynolds *et al.* 2005).

Name	R.A.	Dec.	l	b	Dimensions (arcmin)	Field	Star	V	Type	Other ID
Fr 2-1	01 02 00	−61 18 00	300.9	−55.8	100 × 100	025	LB 3174	12.34	HII?	...
Fr 2-2	02 40 46	+10 21 16	161.9	−44.1	15 × 15	238	...	...	?	WPS 53
Fr 2-3	04 56 20	−28 07 48	229.3	−36.2	20 × 15	238	RE 0457-28	13.95	HII?	...
Fr 2-4	07 11 52	−82 03 03	294.1	−26.1	90 × 60	004	...	...	HII?	...
Fr 2-5	08 10 14	−67 27 22	280.7	−17.8	80 × 45	015	...	...	HII?	...
Fr 2-6	08 40 23	−57 54 49	274.3	−9.8	8.2 × 6.3	031	...	...	PN?	FP 0840-5754
Fr 2-7	10 54 10	−70 11 45	293.2	−9.6	8.0 × 7.5	016	...	...	PN?	FP 1054-7011
Fr 2-8	14 00 43	−51 02 12	313.9	+10.4	2.0 × 1.9	057	...	...	PN	AM 1357-504
Fr 2-9	14 23 31	−09 18 48	337.6	+47.3	80 × 60	184	G124-26	15.48	HII?	WPS 82
Fr 2-10	15 09 19	−05 20 54	353.9	+43.5	30 × 30	720	PG 1506-052	14.0	HII?	...
Fr 2-11	16 57 48	−63 12 00	327.5	−12.5	8.0 × 6.0	037	V341 Ara	10.7_v	CV	...
Fr 2-12	17 21 09	−56 54 25	333.9	−11.3	7.3 × 6.0	038	...	...	PN	FP 1721-5654
Fr 2-13	17 59 00	+34 29 36	60.5	+25.1	15 × 12	Her13	...	...	HII?	...
Fr 2-14	20 26 00	+76 37 00	109.8	+21.1	90 × 80	Cep08	...	...	HII?	WPS 31
Fr 2-15	20 27 16	+11 49 20	55.1	−15.1	25 × 20	265	...	...	HII?	WPS 16
Fr 2-16	21 18 30	+12 01 36	62.9	−25.1	30 × 15	266	HS2115+1148	16.5	HII?	...
Fr 2-17	21 19 45	−56 23 45	339.7	−42.7	80 × 30	041	...	...	HII?	...
Fr 2-18	23 11 41	+29 27 54	98.2	−28.6	30 × 25	Peg13	...	...	HII?	...

as discrete, symmetric Hα enhancements, to differentiate them from the diffuse ISM background. Fifteen nebulae were found from SHASSA and three from VTSS. With one exception, all objects are $>5'$ across. All previously known PNe larger than this size, as well as PHL 932, Hewett 1, PG 0108+101 and PG 0109+111 were recovered in this blind search. Table 1 summarizes the main properties of the new nebulae.

Most of the new discoveries are probable Strömgren spheres in the ISM. However, some show unusual line ratios (e.g. strong [O III] or [N II] emission) based on long-slit spectroscopy or observations with the Wisconsin Hα Mapper (WHAM; Haffner *et al.* 2003), which suggest these nebulae are ionized by a very hot subdwarf or white dwarf star, and may be possible PNe. The ability of WHAM to provide velocity information has allowed us to determine the true nature of several of these objects (Madsen *et al.* 2006, this conference). A follow-up program of imagery and spectroscopy is underway to determine the nature of the nebulae too far south for WHAM. Our most interesting discovery is a rare bowshock nebula around a bright, previously unnoticed, nova-like cataclysmic variable, V341 Ara.

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