Planetary nebulae discovered and confirmed by amateur astronomers

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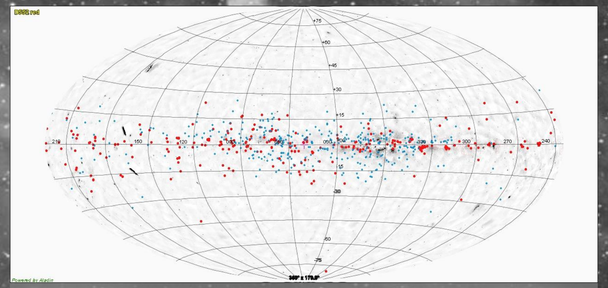
Context

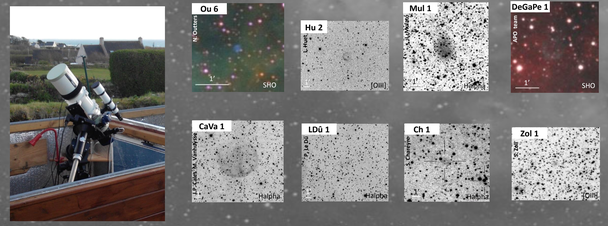
Unreferenced objects from the sky are regularly discovered by amateur astronomers from their own images or from professional images. Like the DSH list, thanks to the initiative of Agnès Acker and Pascal Le Dû [1][5], a list of planetary nebulae candidates is maintained in France and regularly published in the SAF magazine and then in VizieR. Recently, amateur astronomers specializing in spectroscopy have managed to observe the spectra of some of these candidates to confirm their nature.



PN Candidates from DSH* list (blue) and French list (red)

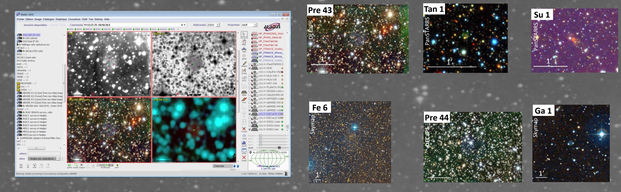
Planetary nebulae detections

Discovery from amateur images



The detections are mainly made from instruments of small diameters with low F/D ratio, using efficient cameras with large, sensitive detectors, equipped with Halpha, [OIII] and [SII] narrow-band filters [1].

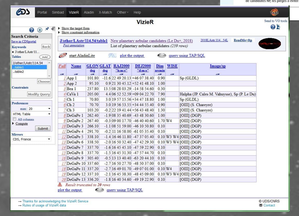
Discovery from professional images



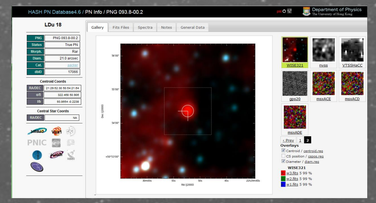
Professional surveys at different wavelengths are easily accessible from advanced tools like Aladin from the CDS. Objects are searched in the visible (DSS, DECaPS ...) but also in the medium infrared (WISE ...) [2][3][4].

Publications and dissemination of works

The articles published in the SAF magazine report on new discoveries of planetary nebulae candidates [5] [6] [7] [8] [9]. The techniques used by the discoverers are described and advice is given to avoid confusing PN candidates with other objects that may resemble them



PN candidate tables are easily searchable using the VizieR tool of the Strasbourg Astronomical Data Center (CDS) [10]

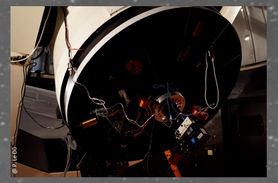


Hong Kong / AAO / Strasbourg Halpha planetary nebula database (HASH) [11] is a database of all known planetary nebulae, whether candidate or confirmed. Each object is associated with images at different wavelengths and spectra, if available. This SQL database and research platform is the result of a collaboration between the University of Hong Kong, the Astronomical Observatory of Australia and the Astronomical Observatory of Strasbourg. It is maintained by Quentin Parker and Ivan Bojičić in Hong Kong and is open to the public recently. The table of candidates discovered by amateur astronomers is regularly transmitted to Hong Kong.

Spectroscopics confirmations

Instruments and teams

The spectra of some candidates were acquired with modest instruments from 0.09 m to 0.2 m diameter. Specific missions have allowed amateur teams like the PNST to use larger telescopes from 0.5 m (AstroQueyras) to 1 m (Calern) diameter. The spectrographs used are at low resolution at F/D = 5.



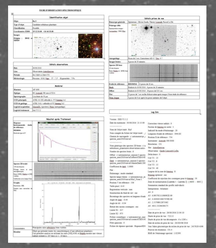
Some observed candidates

Name	AD (J2000)	DEC (J2000)	Region	Instrument	Confirmed PN
Hu 2	00:33:57.40	+74:18:40.00	Ponspoder (29)	0.2 m / ALPY*	Yes
Pre 8	01:26:36.00	+18:51:19.80	AstroQueyras (05)	0.5 m / LISA*	Yes
Fe 8	02:10:10.64	+65:25:15.30	Ponspoder (29)	0.2 m / ALPY*	
LDû 14	03:04:21.70	+62:18:01.30	AstroQueyras (05)	0.5 m / LHIRES3*	Yes
Pre 24	04:25:53.60	+39:49:10.40	CALERN (06)	1 m / LISA*	
DeGaPe 32	05:17:57.10	+07:26:24.70	CALERN (06)	1 m / LISA*	
Ga 1	05:25:56.63	+07:48:21.70	Ponspoder (29)	0.2 m / ALPY*	Yes
LDû 31	06:13:51.03	+19:37:09.00	Ponspoder (29)	0.2 m / ALPY*	
CaVa 1	06:52:52.59	+09:04:22.70	Ponspoder (29)	0.2 m / ALPY*	Yes
Ou 4	09:50:48.00	-28:01:51.60	OHP (04)	0.09 m / LISA*	
Pre 35	18:20:14.30	-22:30:14.10	Armidale, Australia	0.31 m / LISA*	
Ra 11	18:25:15.00	+00:02:03.00	CALERN (06)	1 m / LISA*	Yes
Ra 1	18:54:45.77	+36:30:12.00	OHP (04)	0.13 m / LISA*	Yes
LDûPa 1	19:11:56.23	+15:25:25.20	AstroQueyras (05)	0.5 m / LISA*	Yes
Ra 3	19:12:10.00	+16:46:33.00	AstroQueyras (05)	0.5 m / LISA*	Yes
Mul-Ir 14	19:16:21.40	+16:56:36.00	AstroQueyras (05)	0.5 m / LISA*	Yes
Ra 24	19:37:40.00	+20:35:47.00	CALERN (06)	1 m / LISA*	Yes
Mul 5	19:49:53.70	+18:40:15.10	Cantanet (31)	0.2 m / ALPY*	Yes
Ch 1	19:57:15.56	+34:47:18.80	CALERN (06)	1 m / LISA*	Yes
Ou 6	20:03:53.54	+35:22:50.40	AstroQueyras (05)	0.5 m / LHIRES3*	Yes
Mul 4	20:10:17.90	+36:13:09.00	AstroQueyras (05)	0.5 m / LHIRES3*	
LDû 2	20:24:50.63	+46:22:24.40	AstroQueyras (05)	0.5 m / LISA*	
Mul-Ir 19	20:34:26.20	+31:18:33.12	AstroQueyras (05)	0.5 m / LISA*	Yes
Ra 67	20:36:07.20	+46:01:53.00	Ponspoder (29)	0.2 m / ALPY*	Yes
KnFe 1	20:38:09.15	+61:55:05.00	Ponspoder (29)	0.2 m / ALPY*	Yes
Ra 4	20:44:13.00	+36:07:38.00	AstroQueyras (05)	0.5 m / LISA*	Yes
Ra 10	20:50:13.00	+46:55:18.00	AstroQueyras (05)	0.5 m / LHIRES3*	
Zol 1	20:53:49.60	+46:46:47.00	Pirra (Espagne)	0.5 m / ESPETEC	Yes
Hu 1	20:54:14.00	+58:51:20.40	Ponspoder (29)	0.2 m / ALPY*	Yes
Ra 5	21:02:38.00	+44:46:42.00	OHP (04)	0.31 m / LISA*	Yes
Ou 5	21:14:20.00	+43:41:35.00	Cantanet (31)	0.2 m / ALPY*	Yes
LDû 18	21:29:52.51	+50:54:19.18	AstroQueyras (05)	0.5 m / LISA*	Yes
LDû 1	21:36:06.35	+50:54:04.80	AstroQueyras (05)	0.5 m / LISA*	Yes
St 8	22:07:59.14	+66:45:13.30	Ponspoder (29)	0.2 m / ALPY*	
Ra 50	22:10:45.27	+56:23:13.10	CALERN (06)	1 m / LISA*	Yes
App 2	22:19:41.44	+56:43:48.40	OHP (04)	0.31 mm / LISA*	Yes
App 1	22:49:20.13	+46:07:38.40	CALERN (06)	1 m / LISA*	
Ra 21	23:02:57.00	+63:13:07.00	AstroQueyras (05)	0.5 m / LISA*	
LDû 13	23:38:40.43	+61:41:40.90	AstroQueyras (05)	0.5 m / LISA*	Yes

* Shelyak Instruments (www.shelyak.com)

Spectrum

The instrumental response of each spectrum is determined using an observation made on a naturally non-reddened type A or B reference star (E (b-v) ~ = 0) that is located near the target. Calibration is performed with Argon-Neon lamps.



Slit on targets	2D spectrum	1D spectrum
KnFe 1		
LDûPa 1		
Ra 3		
Ra 50		

The treatment software generally used is ISIS. The spectral data are recorded with observation sheets and are transmitted to Quentin Parker.

[1] Acker, A. et al., Rev. Mex. A&A 48,223 (2012)
[2] Jacoby, G. H. et al. Pub. Ast. Soc. Aus. 27,156 (2010)
[3] Parker, Q. A. et al. Mon. Not. Roy. Ast. Soc. 427, 3016 (2012)
[4] Kronberger, M. et al. APN-VI conf. (2013)
[5] Acker, A. Le Dû, P. LAst. 128, 68 (2014)
[6] Acker, A. Le Dû, P. LAst. 129, 80 (2015)
[7] Acker, A. Le Dû, P. L'Ast. 130, 91 (2016)
[8] Le Dû, P. LAst. 131, 102 (2017)
[9] Le Dû, P. LAst. 132-114 (2018)
[10] Le Dû, P. VizieR. Onl. Dat. Cat. J/other/Lastr/114.54 (2018)
[11] Parker, Q. A. et al. JPhCS 728, 3, 2008 (2016)