Medium- to large-sized True and Likely planetary nebulae from the DSH sample

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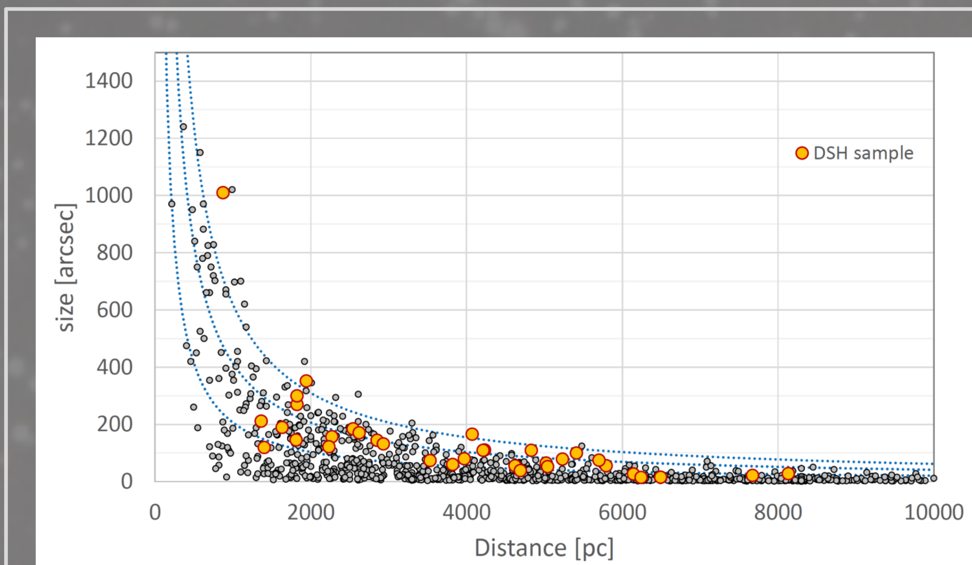
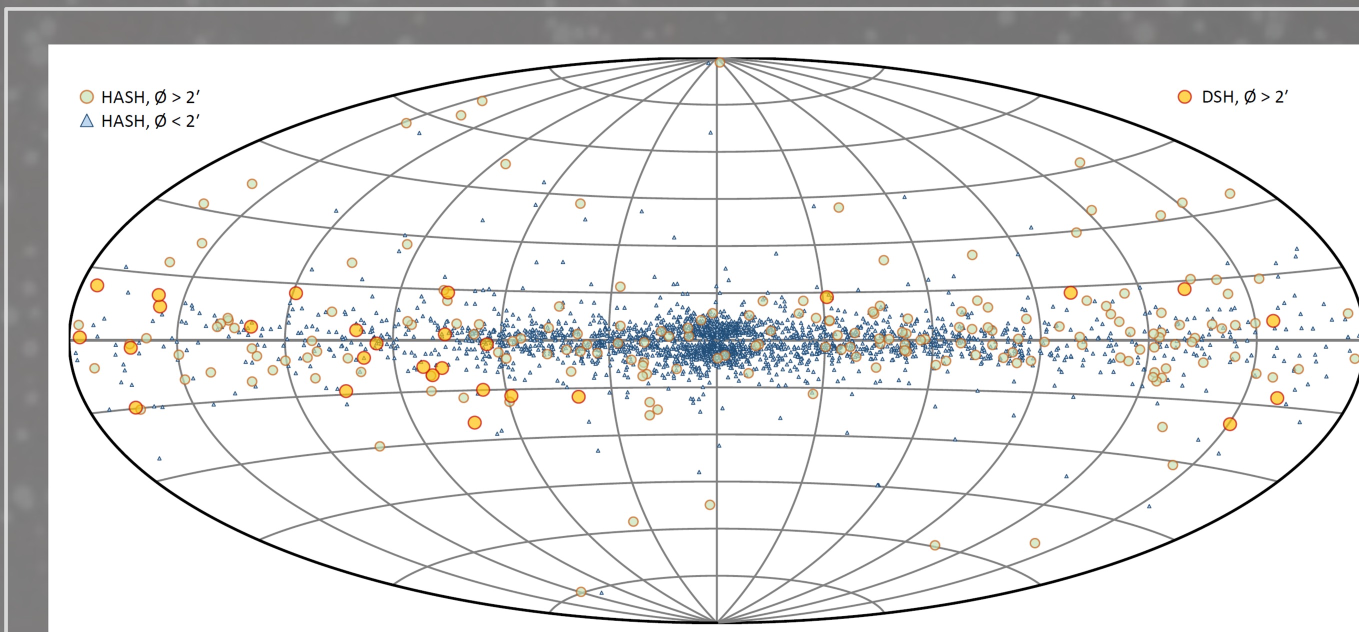
Introduction

The Hong Kong/AAO/Strasbourg Hα planetary nebula database (HASH) [1] incorporates almost 300 true, probable and possible planetary nebulae (PNe) that have been identified since 2003 within the framework of the Deep Sky Hunters (DSH) project, and other amateur-based efforts [2-4]. Our sample covers all types of different PN morphologies, spectral properties, and evolutionary states. Estimated distances range from below 1kpc to extragalactic. This contribution focuses on all currently known medium- to large-sized PNe and candidates (optical diam > 2′) in our sample.



Relation between angular diameters and distances for all PNe listed in [5]. The overplotted lines correspond to diameters of 1pc, 2pc and 3pc, respectively. Objects belonging to the DSH sample are highlighted. The plot shows that the sizes of DSH PNe are above 1pc in the majority of cases, translating into a size limit of 2′ for possible Extended Local Volume members (d < 2kpc) in our sample.

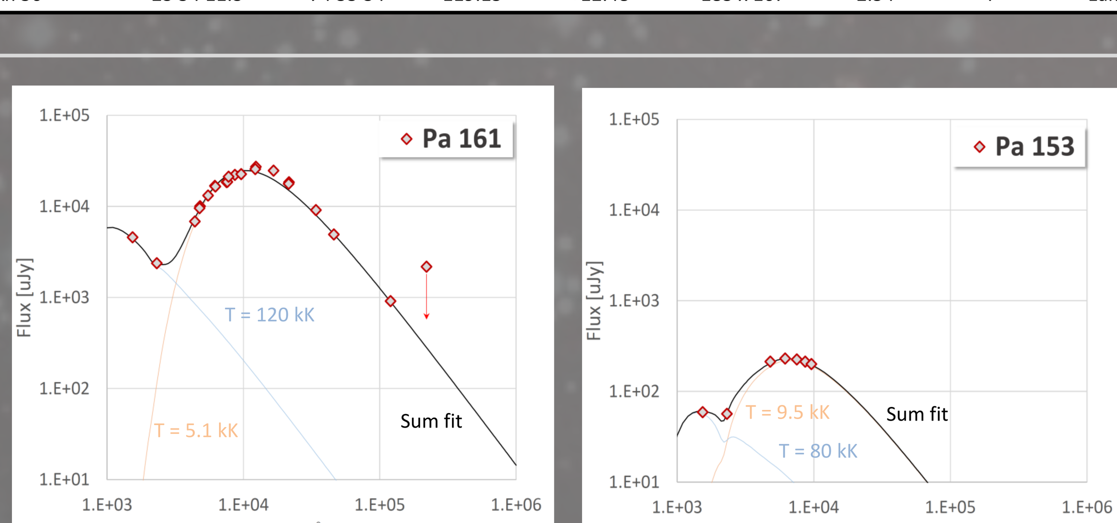


Distribution of True and Likely PNe from the DSH sample with Ø > 2′ in an Aitoff–Hammer projection of the Galactic Plane. Other True and Likely PNe listed in the HASH database are shown for comparison. The average scale heights of the DSH and HASH samples with Ø > 2′ are 10.0° and 11.4°, with RMS dispersions of 11.8° and 18.8°, respectively.

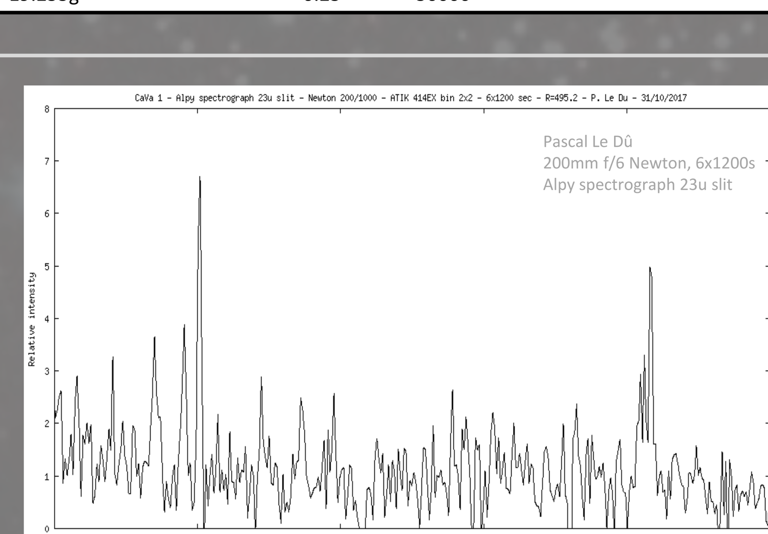
Results

The table below summarizes all 28 True (T) and Likely (L) PNe from the DSH sample with optical diameters > 2′ and lists the fundamental properties of the nebular shells and the CSPNe. Previously unpublished objects are highlighted in blue. Statistically derived distances were taken from [5]. The listed CSPN magnitudes were extracted from PanStarrs photometry. For 15 objects with available UV, optical and IR photometry, we determined E(B-V) and T by fitting the spectral distributions of the CSPNe with distribution functions of blackbody emitters corrected for the effects of interstellar extinction using the formalism in [6] and assuming $R_V = 3.1$. The GALEX UV fluxes were corrected by applying the revised photometric calibration from [7]. Effective wavelengths and zero points were taken from various resources. We note that two CSPNe (Pa 161 and Pa 153) have composite distribution functions with a hotter and a cooler component.

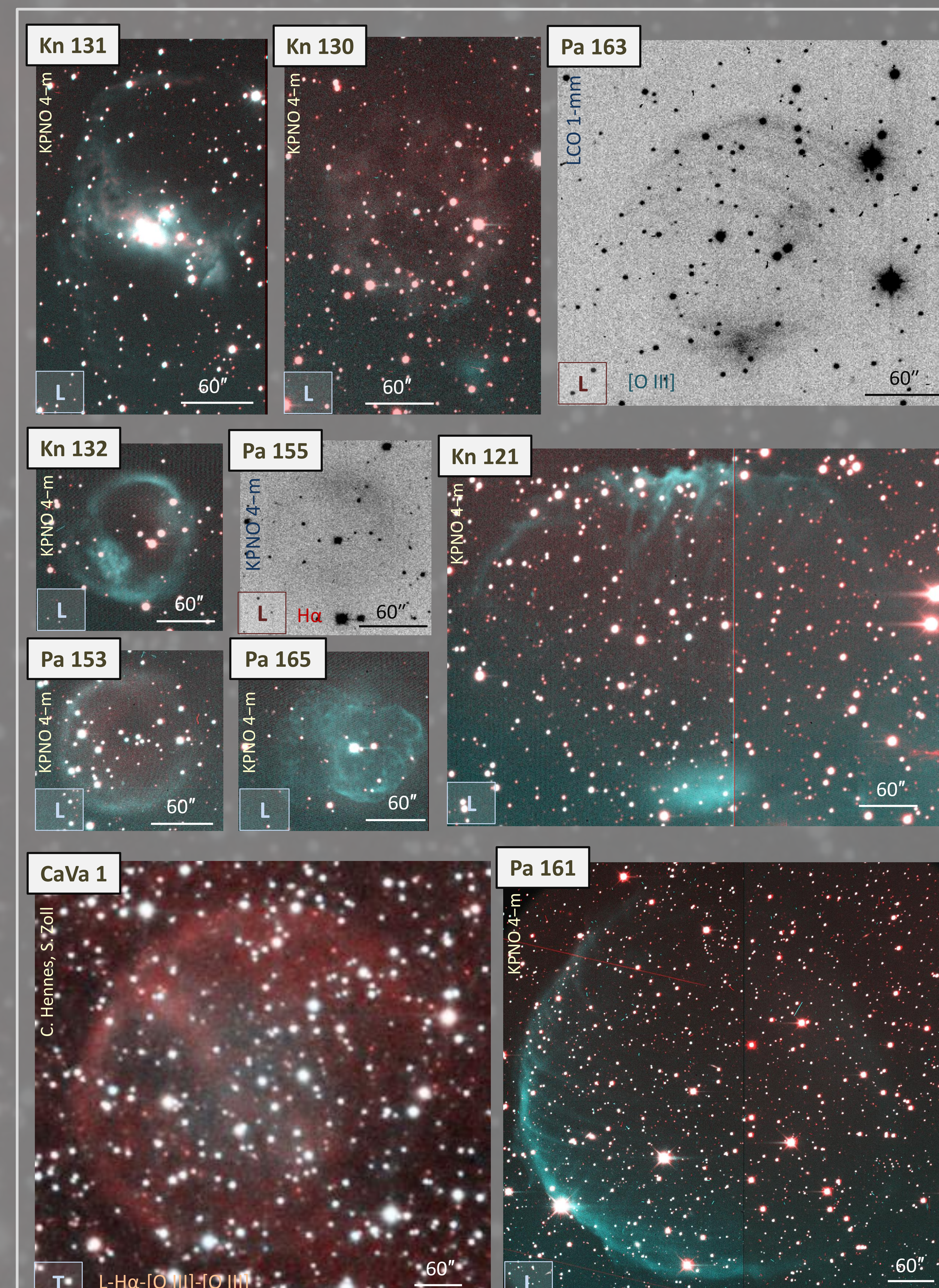
Object ID	RA [2000.0]	DE [2000.0]	l [°]	b [°]	Diam. [″]	D [kpc]	Status	Class	CSPN [mag]	Spectral Type	E (B-V) [mag]	T [K]	Notes
Fe 6	01 56 25.1	+65 28 30	129.61	+03.45	212 x 198		T	Rar	19.014g				= IPHASX J015624.9+652830 [1]
Kn 132	**04 14 21.2**	**+30 23 31**	**166.61**	**-14.78**	**158 x 152**		**L**	**Eaprs**	**-**				
Kn 131	**04 50 17.7**	**+41 54 53**	**162.94**	**-01.68**	**266 x 192**		**L**	**Bas**	**19.739g**				**misclassified as GX (Wein 92)**
Pa 153	05 09 07.5	+53 10 28	156.00	+07.75	156 x 154		L	Ra	18.081g		0.15	9500 + 80000	Composite
Hu 4	**05 28 21.0**	**+53 31 20**	**157.33**	**+10.32**	**150 x 150**		**L**	**?**	**-**				**Unclear CSPN identification**
Te 2	05 40 44.8	+31 44 31	177.06	+00.59	122 x 117	2.23	T	Ras	21.169g				
Kn 63	05 42 06.7	+04 43 03	200.56	-13.10	388 x 358	1.94	T	Rams	17.454g				
Pa 155	05 45 23.9	-11 45 49	209.59	-19.90	128 x 120		L	Ra	15.345g		0.14	100000	
Kn 62	06 23 55.4	+38 15 15	175.63	+11.46	126 x 126		T	Baps	18.421g		0.12	55000	
CaVa 1	**06 52 51.4**	**+09 03 34**	**205.01**	**+04.44**	**480 x 435**		**T**	**Eas**	**18.093g**				
KnAlv 1	08 04 04.4	-06 30 57	227.32	+12.94	1100 x 1060	0.87	T	Ear	15.963g		0.01	120000	= Fr 2-25 [1]
Pa 163	**09 24 55.2**	**-31 45 03**	**259.69**	**+13.29**	**220 x 216**		**L**	**Eas**	**18.315i**		**0.10**	**75000**	
Pa 33	15 11 13.2	-42 10 23	328.82	+13.56	175 x 165	4.07	L	Eas					
Pa 5	19 19 30.5	+44 45 43	076.32	+14.11	157 x 154	2.27	T	Eamrs	15.525g	PG1159? [8]	0.07	140000	
Pa 161	19 43 28.6	-13 44 59	039.66	-17.65	536 x 484		L	As	13.897g		0.05	5100 120000	Composite
Te 1	19 57 22.3	+26 39 08	063.93	-01.22	146 x 140	1.81	T	Bamps	20.473g				
Ju 1	20 15 21.4	+38 02 44	075.57	+01.72	240 x 240	2.09	T	Rr	19.413g				
Kn 121	20 42 01.9	+13 51 15	058.88	-16.97	486 x 371		L	As	15.428g	sdO [9]	0.04	75000	
Kn 45	20 53 03.9	+21 00 11	066.51	-14.90	145 x 138	2.85	T	Ears	18.270g		0.10	60000	
Pa 28	20 58 11.0	+33 08 33	076.89	-08.18	133 x 123		L	Eas	18.709g		0.17	45000	
Kn 24	21 13 37.7	+37 15 38	082.12	-07.81	190 x 190	1.63	T	Bams	19.189g				
Alv 1	21 15 06.6	+33 58 18	079.89	-10.27	270 x 270	1.82	T	Es	18.153g		0.10	100000	
LDu 1	21 36 05.8	+50 54 09	094.58	-00.89	132 x 120	2.93	T	Rar	21.358g				
Pa 165	**21 38 52.8**	**+18 40 15**	**072.02**	**-24.63**	**188 x 162**		**L**	**Ims**	**12.637g**	**sdO [9]**	**0.14**	**80000**	
Cr 1	21 49 11.7	+57 27 20	100.31	+02.82	120 x 106	1.40	T	Es	18.180g				
Pa 41	22 10 13.6	+50 04 33	098.31	-04.93	154 x 136		L	Ias	17.269g		0.15	50000	
Kn 130	**23 13 05.2**	**+45 26 18**	**105.42**	**-14.06**	**277 x 173**		**L**	**Ias**	**16.424g**		**0.13**	**80000**	
Kn 50	23 54 11.3	+74 55 34	119.15	+12.48	185 x 167	2.54	T	Eams	19.255g		0.25	50000	



CSPN fluxes and spectral distribution fits. Left: Pa 161; Right: Pa 153.



Broadband spectrum of the confirmed PN CaVa 1.



Compilation of narrowband images of sample objects that were recently confirmed as True (T) or Likely (L) PNe. Unless otherwise noted, R = Hα, G,B = [O III].

Other PN candidates

The table below lists updated observational data of previously published PN candidates that do not meet the selection criteria above. In addition, we present in **yellow** new, yet unpublished PNe and candidates that are expected to be true, likely or possible PNe based on their morphologies, their spectral properties, and their characteristics at optical and infrared wavelengths.

Object ID	RA [2000.0]	DE [2000.0]	l [°]	b [°]	Diam. ["]	Type	Imaging	Spectrum	Notes
Hu 2	00 33 57.4	+74 18 39	121.72	+11.48	100 x 100	L	Huet	Le Dû 0.2-m	
Pa 154	01 01 25.0	+72 45 52	123.68	+09.90	83 x 80	L	KPNO 4-m		
Pa 59	01 14 39.0	+61 19 44	125.71	-01.41	26 x 22	L	KPNO 4-m		
Pre 8	01 26 36.0	+18 51 18	134.38	-43.23	116 x 111	T	KPNO 4-m	PNST 0.5-m DCT	
Kn 67	03 32 15.0	+21 39 43	165.54	-27.60	5.5 x 5.2	T		DCT	
Kn 122	03 53 15.7	+09 56 34	179.20	-32.41	240 x 230	rej.	KPNO 4-m		(1)
Kn 133	**04 54 33.7**	**+28 49 29**	**173.71**	**-09.24**	**31 x 30**	**L**	**KPNO 4-m**		
Kn 135	**05 36 31.1**	**-75 07 04**	**286.45**	**-30.94**	**stellar**	**L**	**LCO 1-m**		**(2)**
PrKn 1	**06 20 02.5**	**-18 37 32**	**199.43**	**-15.11**	**46 x 40**	**L**	**LCO 1-m**		
Kn 134	**06 45 55.0**	**-18 10 22**	**197.21**	**-09.35**	**9 x 9**	**P**	**SHS**		
Kn 71	08 16 42.5	-72 59 36	286.08	-19.96	80 x 80	L	LCO 1-m		
App 2	08 28 03.3	-14 58 55	095.19	+00.99	56 x 45	T		PNST 0.35-m	(3)
DeGaPe 1	08 35 40.7	-43 48 31	262.49	-01.92	60 x 54	L	APO team		
DeGaPe 2	09 00 17.7	-46 40 41	264.44	-00.35	102 x 96	L	APO team		

Object ID	RA [2000.0]	DE [2000.0]	l [°]	b [°]	Diam. ["]	Type	Imaging	Spectrum	Notes
Pre 3	11 35 38.2	-48 21 10	290.15	+12.62	60 x 56	L	LCO 1-m		(4)
Kn 136	**17 25 22.3**	**-26 29 27**	**359.64**	**+05.08**	**7 x 7**	**P**	**SHS**		
Kn 128	**17 36 20.4**	**-25 06 18**	**002.16**	**+03.77**	**10 x 10**	**P**	**SHS**		
Kn 129	**17 39 17.0**	**-25 04 40**	**002.54**	**+03.22**	**11 x 8**	**P**	**SHS**		
Pa 157	17 47 08.6	+11 00 21	035.72	+19.20	38 x 36	T	KPNO 4-m	Le Dû 0.2-m	
Pre 13	18 17 30.9	-55 28 43	338.94	-17.54	34 x 24	L	LCO 1-m		
DeGaPe 28	18 18 20.0	-12 14 48	018.32	+01.64	12 x 10	L	APO team		
DeGaPe 50	**18 29 10.5**	**-16 32 05**	**015.71**	**-02.69**	**104 x 54**	**L**	**APO team**		
Pa 110	18 38 00.7	-12 41 07	020.12	-02.83	25 x 24	P	KPNO 4-m		
Pa 19	19 05 08.7	+16 15 21	048.96	+04.38	35 x 32	T		DCT	
Pa 159	19 15 06.6	-06 10 43	035.76	-08.07	151 x 141	rej.	KPNO 4-m		(1)
Pa 131	19 22 06.0	+11 32 41	046.69	-01.44	9 x 8	L	KPNO 4-m		
Pa J1934	**19 34 33.6**	**+02 17 15**	**039.94**	**-08.53**	**238 x 188**	**rej.**	**KPNO 4-m**		**(1)**
Ch 1	19 57 15.6	+34 47 19	070.86	+03.04	60 x 24	T	Le Dû	PNST 1-m	
Pa 164	**19 57 23.2**	**+23 52 49**	**061.56**	**-02.66**	**105 x 50**	**L**	**KPNO 4-m**		

Object ID	RA [2000.0]	DE [2000.0]	l [°]	b [°]	Diam. ["]	Type	Imaging	Spectrum	Notes
Pa 143	20 04 14.9	+35 51 52	072.53	-02.39	43 x 33	P	DCT		(5)
Pa 144	20 06 31.9	+09 26 21	050.22	-12.00	33 x 27	L	KPNO 4-m		
Pa 146	20 29 09.5	+15 37 00	058.59	-13.41	101 x 89	L	KPNO 4-m		
Pa 147	20 29 23.6	+45 17 56	083.03	+03.70	56 x 50	P	DCT	DCT	(6)
Ra 67	**20 36 07.2**	**+46 01 51**	**084.31**	**+03.19**	**9 x 9**	**L**	**KPNO 4-m**		
Pa 3	20 46 10.5	+52 57 06	090.82	+06.11	72 x 58	rej.		DCT	(1)
Hu 1	20 54 14.0	+58 51 20	096.17	+08.93	99 x 70	L	Huet		
Pa 166	**22 03 05.9**	**+58 39 12**	**102.50**	**+02.62**	**33 x 31**	**P**	**KPNO 2.1-m**		
Pa 162	22 12 15.2	-76 26 03	313.78	-37.14	300 x 300	rej.	LCO 1-m		(7)
Pa 152	22 14 58.0	+66 32 59	108.23	+08.25	34 x 31	L	KPNO 4-m		

Type:
T ... true PN
L ... Likely PN
P ... Possible PN

Notes:
(1) ionized ISM
(2) possible LMC PN?
(3) = KKR 62
(4) "Southern Soccerball"
(5) Dark nebula + CG
(6) Pre-PN?
(7) Plate fault?

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