

Cycle 14 Results from the Chandra Planetary Nebula Survey (ChanPlaNS)

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Abstract

The Chandra Planetary Nebula Survey (ChanPlaNS) is the first comprehensive X-ray survey of PNe in the solar neighborhood (within ~ 1.5 kpc). ChanPlaNS began with a combined Cycle 12 and archive Chandra survey of 35 PNe, resulting in an overall $\sim 70\%$ X-ray detection rate. The survey is yielding such fundamental, new results as the frequency of appearance and range of X-ray spectral characteristics of X-ray-emitting PN central stars and the evolutionary timescales of wind-shock-heated bubbles within PNe. ChanPlaNS is continuing via a Chandra Cycle 14 Large Program targeting all (24) remaining known compact (radius ≤ 0.4 pc), young PNe that lie within ~ 1.5 kpc. We will present preliminary results from Cycle 14 observations performed prior to APN VI, including first-time X-ray detections of hot bubbles within NGC 1501, 6369, and 3918.

New (Cycle 14) ChanPlaNS Detections

Point-like X-ray sources at CSPNe: HbDs 1, NGC 6337, Sp 1 With these detections, the overall ChanPlaNS detection rate of CSPNe now stands at $\sim 40\%$ (i.e., 21 of the 54 surveyed thus far).

Diffuse (hot bubble) X-ray sources: NGC 1501 (Fig 1a), NGC 3918 (Fig 1b), NGC 6369 (Fig 1c), Hubble 5 (Fig 1d) With these detections, the overall ChanPlaNS detection rate of PNe hot bubbles now stands at $\sim 30\%$. (i.e., 15 of the 54 surveyed thus far).

Figure 1: New Diffuse X-ray Sources

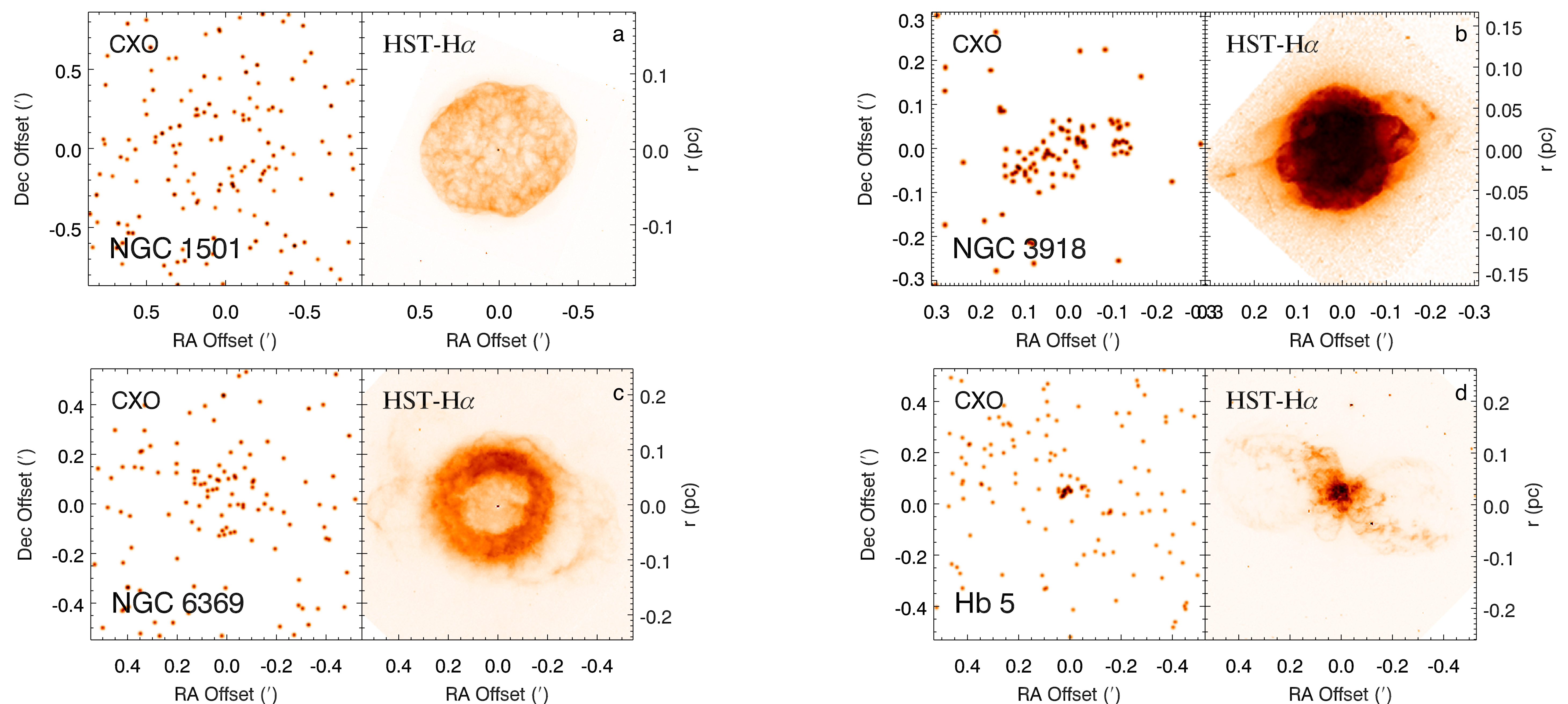


Table 1: Compact ($R \leq 0.4$ pc) Planetary Nebulae Within ~ 1.5 kpc^a Observed by *Chandra* in Cycle 14

Name	PN G	Morph. ^b (F08)	D (kpc)	R (pc)	age (10^3 yr)	T_* (kK)	X-rays ^c
<i>PNe observed in Cycle 14 to date</i>							
Abell 65	017.3–21.9	Eafm:	1.17	0.30	27	>83	N
HaWe 13	034.1–10.5	Efp?	1.01	0.18	...	68	N
Hb 5	359.3–00.9	Bps	1.70	0.13	...	172	D
HbDs 1	273.6+06.1	Er?	0.80	0.29	...	114	P
He 2-11	259.1+00.9	Ebps	1.14	0.24	...	>90	N
IC 1295	025.4–04.7	Efm:	1.23	0.30	11	98	N
IC 2149	166.1+10.4	E	1.52	0.04	2	42	N
IC 5148/50	002.7–52.4	Rm	0.85	0.27	5	110	N
M 1-26	358.9–00.7	R	1.20	0.02	1	33	N
M 1-41	006.7–02.2	Bs/Is	1.47	0.15	...	187	N
NGC 1501	144.5+06.5	Es	0.72	0.09	2	135	D
NGC 2899	277.1–03.8	Baps	1.37	0.37	14	270	N
NGC 3918	294.6+04.7	Ems(h)	1.84	0.08	3	150	D
NGC 6026	341.6+13.7	Ef	1.31	0.16	6	>35	N
NGC 6337	349.3–01.1	Epr	0.86	0.10	12	105	P
NGC 6369	002.4+05.8	Ebpr(h:)	1.55	0.12	3	66	D
NGC 7076	101.8+08.7	Ea	1.52	0.04	2	80	N
Sh 2-71	035.9–01.1	Bs/Is	1.14	0.30	14	157	N
Sp 1	329.0+01.9	Rr	1.13	0.20	6	72	P
<i>PNe to be observed in Cycle 14</i>							
IC 4637	345.4+00.1	Eam	1.30	0.05	2	50	...
NGC 6072	342.1+10.8	Ba	1.39	0.23	23	140	...
NGC 6153	341.8+05.4	Es	1.10	0.07	4	109	...
NGC 6894	069.4–02.6	Emr	1.31	0.17	4	100	...
NGC 7354	107.8+02.3	Emp	1.60	0.09	3	96	...

Table 1. Notes

- PN and central star data compiled from Frew (2008 and references therein)
- Morphologies as listed in Frew (2008, F08): B: bipolar, E: elliptical, R: round, a: asymmetry present, b: bipolar core present, f: filled (amorphous) center, m: multiple shells present, p: point symmetry present, r: ring structure dominant, s: internal structure noted, (h): distinct outer halo.
- X-ray results key: P = point source; D = diffuse source; N = not detected.