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Research Note

A Search for Planetary Nebulae on the "POSS"

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Summary. Five new possible planetary nebulae were found as a result of a systematic survey on a quarter of the Palomar Sky Survey *E* prints. With one exception, the objects are of considerably low surface brightness.

Key words: new planetary nebulae – systematic search

Introduction

An unexpected high number of hitherto unreported, extended planetary nebulae (PN) still appears to be detectable on the Palomar Observatory Sky Survey (POSS). Arguments for this suspicion, and especially a description of the goals and methods of our search are given in a paper by Dengel et al., 1979. In the present article we report on the results of our 1 1/2 yr lasting survey as to new PN on a quarter of all the POSS *E* (i.e. red) prints. Succeeding papers will also deal with our detections of diverse other objects.

Results and Discussion

The prints examined are about equally scattered over all accessible galactic longitudes and latitudes. The total number of the fields wholly surveyed amounts to 218. In addition to these fields, the region within $l = 33°–213°$, $b = \pm 2°$ has been searched through.

During our survey we detected five objects which are probably new planetary nebulae; they are reproduced in Fig. 1. No. 1 was indepedently discovered by Longmore and Tritton (private communication). These objects had to fulfill at least one of the following two criteria: (i) to be an emission nebulosity of an appearance "typical" for PN. (ii) to show a blue star at the centre or likely centre of the nebular image.

In the area searched through, we also discovered another 3 dozen of generally very faint, more or less roundish unlisted objects. The majority of them are visible on the *E* prints but not on the *O* (i.e. blue) prints and are presumably for the most part plate flaws: Similar objects in overlapping zones ordinarily turn out to be spurious. However, deep direct plates in a narrow spectral range around an emission line should serve as evidence for such a suspicion in every single case. – The remaining objects out of the 3 dozen are also faint, but real. No statement about their nature can be made at present; a few of them might well be new PN too.

In Table 1 data on the five new PN are summarized:

The equatorial coordinates were measured with an accuracy of $\pm 10''$ on enlargements of POSS prints by use of at least 5 SAO reference stars. When no central stars could be identified, the coordinates refer to the centres of the nebular images. l and b are the galactic coordinates. x and y are rectangular coordinates (in mm), measured from the lower left corner of the first POSS field given in the subsequent column. Dimension means the maximum and minimum diameters of the nebular images as visible on the *E* prints; they should be accurate to $\pm 3''$–$5''$, but to ± 0.5 for No. 5. The minimum diameters for Nos. 4, and 5 had to be assumed. Magnitudes of the central stars were determined on the POSS prints by use of the magnitude-diameter relation calculated by Dorschner et al. (1966). A star is considered by us as a central star only if it is at or near the centre or assumed centre of the nebular image and is very blue. The errors in both colours are about $\pm 0^m.8$. The centrally located star in the nebula No. 1 is of about neutral colour and may hide the true central star. No. 3: when illuminated from below, at least the central regions become transparent, but do not show any clear starlike object. In No. 4, the faint star near the possible centre of the nebula is of neutral colour. The red (m_r^s) and blue (m_b^s) surface brightest section of each nebula. m_r^i and m_b^i are the integrated nesses of Abell (1966) planetaries and are expected to be reliable to ± 1.0 mag/arc s^2 at worst. The values listed correspond to the brightest section of each nebula. m_r^i and m_b^i are the integrated nebular magnitudes, computed from the surface brightnesses of the various sections of the respective nebula and their projected areas. From the measured – or sometimes supposed – dimensions of the nebular images angular volumes have been calculated. By that, we assumed Nos. 1, 2, and 5 to be spheres, No. 3 to be an oblate ellipsoid, and No. 4 to be an oblate ellipsoidal shell with a mean extent of $7''$. The distances were calculated by use of Abell's (1966) formula (4) and are uncorrected for possible interstellar extinction. Especially for No. 4 the distance may therefore be strongly overestimated. The maximum distances were estimated taking a maximum linear nebular diameter of $D = 1.2$ pc. Comparisons of the two last columns support the suspicion that our PN are rather extended, implying a late evolutionary state.

The distance of No. 5 reveals this object as one of the nearest known PN. Together with Nos. 2 and 4 it has been photographed with an image tube plus H_α interference filter ($\Delta\lambda = 40$ Å) at the 182 cm telescope of the Osservatorio Astrofisico di Asiago: As Nos. 2 and 4, it too is definitively an emission nebula; a somewhat unexpected result, since No. 5 is scarcely red (see also the "Cata-

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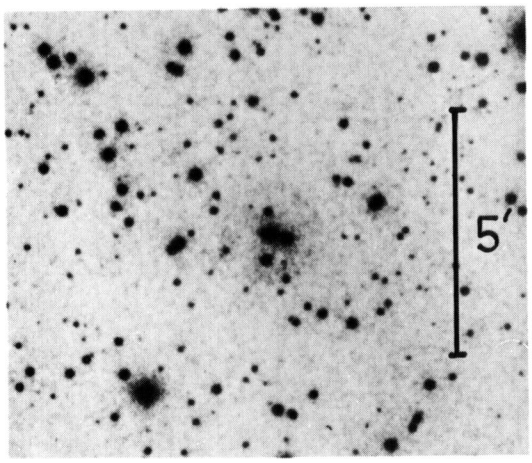

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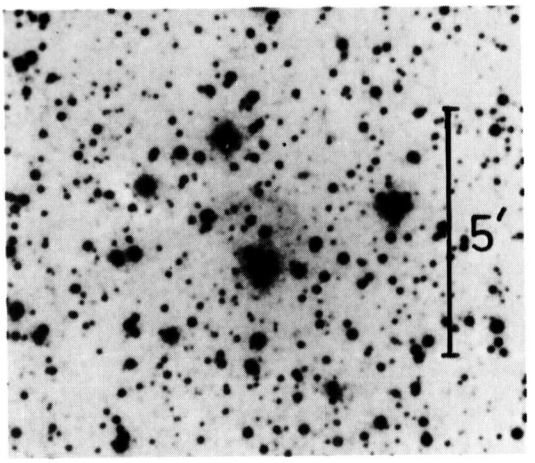

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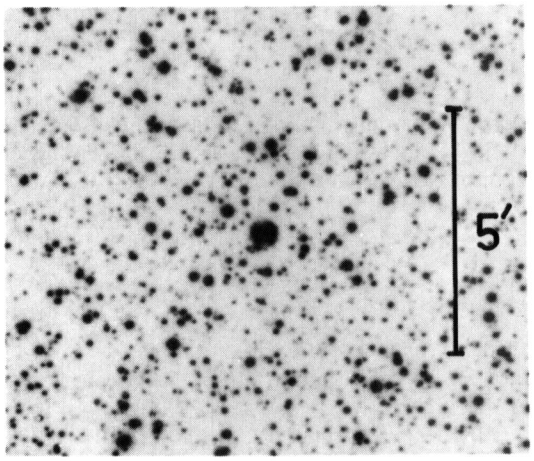

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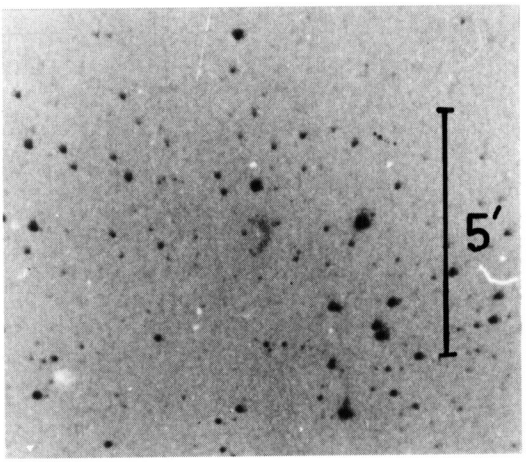

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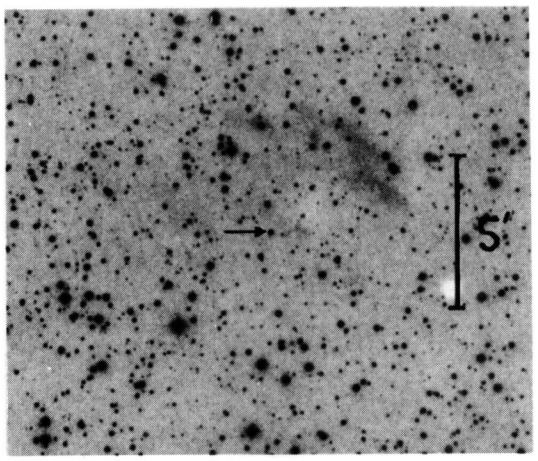

5

Fig. 1. Nos. 1–3, and 5 are reproductions from the POSS (*E* prints). Copyright by the National Geographic Society – Palomar Observatory Sky Survey. Reproduced by permission from the Hale Observatories. No. 4 is a reproduction of a photograph at $\lambda = 6563$ Å ($\Delta\lambda = 40$ Å; exposure time 15 min; image tube VARO 8605 + 103 aD; 182 cm telescope). The arrow in No. 5 marks the central star.
North is at the top, east to the left

Table 1. Some data on the new planetary nebulae

No.	R.A. 1950	Decl. 1950	l	b	x	y	POSS No.	Dimension
1	$05^h53^m00^s.9$	−22°54′27″	228°.21	−22°.14	28	229	888, 655	128″ × 128″
2	17 39 10.5	+03 08 27	27.65	+16.93	190	23	780	94 × 94
3	19 14 10.2	−18 06 59	19.42	−13.63	218	157	157	34 × 29
4	19 24 07.3	+13 13 38	48.76	− 1.53	74	228	506	44 × 34?
5	22 18 21.8	+70 40 55	111.09	+11.64	277	81	559	526 × 526?

No.	Central star		Surface br. (mag/arc s^2)		Integrated neb. magnitude		Volume (arc s^3)	Dist. (pc)	Dist. max. (pc)
	m_r^c	m_b^c	m_r^s	m_b^s	m_r^i	m_b^i			
1			24.5	26.4	14.2	16.9	$1.10\ 10^6$	1500	1900
2	14.2	14.2	23.8	26.4	14.5	16.8	$4.35\ 10^5$	1900	2600
3			20.3	23.0	12.9	15.6	$1.75\ 10^4$	2600	7300
4			22.4	26.3	16.2	19.4	$2.50\ 10^4$	4500	5600
5	15.6	15.1	22.8	25.7	11.4	13.8	$7.62\ 10^7$	400	500

logue of Bright Nebulae" by Linds, 1965, where it is listed; its colour is described as "about equal on both red and blue POSS plates". Therefore it has-up to now-probably rather been taken as a reflection nebula). However, as soon as the visible nebula is considered as a part of a shell or sphere, we find the very blue star of Table 1 at the suspected centre. At a distance of 400 pc, the star's absolute magnitude is $M_b = +7^m$, corresponding to a large linear diameter D of the nebula according to Abell's (1966) Fig. 6; this matches with $D = 1.0$ pc, found from the distance in Table 1.

Clearly, spectroscopic verification is badly needed for this interesting object.

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