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Research Note

Accurate positions of candidate planetary nebulae in M 33

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Abstract. We present new determinations of the positions of the planetary nebulae candidates found in Messier 33 by Magrini et al. (2000). The new coordinates have an accuracy of ±0.3 arcsec, making them suitable for future studies of the individual objects by means of, for instance, multi-object fiber or slit spectroscopy.

Key words. planetary nebulae – galaxies: M 33

1. Introduction

Extragalactic planetary nebulae (PNe) are known in many galaxies up to the distance of the Virgo Cluster. They are particulary important in determining the extragalactic distance scale, for studies of the dynamics of galaxian subsystems in all type of galaxies, as tracers of intergalactic space (cf. Jacoby 1997; Arnaboldi et al. 2000) and to study chemical abundances in disk population extragalactic stars.

We have recently discovered 134 candidate PNe in the nearby galaxy M 33 (Magrini et al. 2000, hereafter M00), as well as 63 star-like emission-line objects of uncertain classification. Because of the favorable inclination to the line of sight, M 33 offers probably the best opportunity to investigate such factors as, for example, chemical gradients across spiral galaxies. In view of future studies of the individual PNe in M 33, it is important to have very precise coordinates. Since in our previous work the astrometric precision was limited to several arcseconds, we present here new astrometrical determinations of the PNe coordinates.

2. New positions

An astrometric solution was computed for each frame of the field of M 33 covered by the mosaic CCD camera (WFC) of the 2.5 m INT telescope of the ORM (Observatorio del Roque de los Muchachos) at La Palma, using the positions of bright stars in M 33 given by APM (`http://www.ast.cam.ac.uk/apmcat/`). M00 used instead as reference coordinates those given by the National Geographic Society-Palomar Observatory Sky survey (`http://www.ira.bo.cnr.it/skyeye/gb/`). The new astrometric solution provided an accuracy of the PNe positions better than ±0.3 arcsec. Contrary to the estimates in M00, we found that the coordinates in their Tables 1 and 2 are accurate to better than 5 arcsec for most of the candidate PNe, but in some cases there are larger errors.

The new coordinates are reported here in Table 1, together with the fluxes in Hα and [O III], simply taken from Table 1 of M00. Table 2 contains the star-like objects having emission lines and a non-negligible continuum. We give here the new positions with their fluxes in Hα, [O III] and continuum, as from M00. Except for positions, the errors in Tables 1 and 2 of the present paper are the same as reported in M00. Due the mentioned astrometric errors in M00, 3 objects in their Tables 1 and 2 appeared to have been listed twice. As a consequence, the new Tables 1 and 2 contain 131 and 62 entries instead than 134 and 63, respectively. We have, however, maintained for the new PNe the same numbering as in M00.

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Table 1. PN candidates in M 33. Fluxes in Hα+[N II] and in [O III] are in units of 10^{-15} erg cm^{-2} s^{-1}. This table is also available in electronic form at the CDS via anonymous ftp to `cdsarc.u-strasbg.fr (130.79.128.5)` or via `http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/367/498`

id	RA (2000.0)	Dec.	$F_{H\alpha}$	$F_{[OIII]}$
1	1 32 26.55	30 25 49.8	0.0	0.7
2	1 32 37.98	30 24 00.9	4.2	5.9
3	1 32 39.80	30 37 40.6	2.4	4.1
4	1 32 42.65	30 12 24.2	1.1	2.8
5	1 32 44.04	30 22 04.5	9.1	6.3
6	1 32 44.29	30 43 26.1	0.3	0.7
7	1 32 49.14	30 51 08.6	2.2	7.7
8	1 32 48.66	30 25 53.2	11.4	10.1
9	1 32 52.91	30 41 58.5	1.0	3.0
10	1 32 54.20	30 37 29.7	3.2	0.0
11	1 33 05.74	30 14 23.3	1.5	3.4
12	1 32 53.68	30 32 26.1	2.0	0.5
13	1 32 55.03	30 09 52.8	2.9	8.6
14	1 32 58.82	30 27 38.5	0.2	3.8
15	1 32 59.40	30 10 23.9	2.8	2.4
16	1 33 01.26	30 15 31.2	1.0	1.0
17	1 33 07.31	30 54 23.5	3.1	10.4
18	1 33 06.11	30 31 04.5	3.0	14.2
19	1 33 08.98	30 13 58.5	1.1	0.9
20	1 33 09.61	30 29 13.6	5.8	0.6
21	1 33 08.43	30 21 07.2	1.7	0.5
22	1 33 14.08	30 40 42.9	1.4	6.1
23	1 33 13.58	30 22 36.3	14.2	3.3
24	1 33 12.25	30 30 49.1	1.8	2.7
25	1 33 15.48	30 17 53.8	0.4	0.4
26	1 33 16.90	30 29 59.9	2.0	1.8
27	1 33 18.47	30 12 39.0	0.7	1.6
28	1 33 19.25	30 29 40.4	2.9	13.9
29	1 33 17.07	30 30 00.5	6.4	2.8
30	1 33 21.13	31 06 43.9	0.7	2.4
31	1 33 21.16	30 41 14.7	3.5	5.6
32	1 33 21.61	30 36 57.2	1.2	1.4
33	1 33 22.83	30 13 41.0	1.1	2.9
34	1 33 24.96	30 38 48.7	1.2	1.5
35	1 33 19.66	30 43 05.5	3.6	3.3
36	1 33 24.23	30 16 14.5	0.9	1.3
37	1 33 27.29	30 40 51.3	4.7	2.1
38	1 33 26.59	30 35 50.1	2.1	1.6
39	1 33 28.52	30 37 45.7	0.6	4.2
40	1 33 27.81	30 34 28.8	1.7	4.2
41	1 33 26.39	30 41 47.5	0.7	1.7
42	1 33 32.31	30 28 21.0	4.7	12.7
43	1 33 32.69	30 26 42.1	3.0	3.2
44	1 33 33.59	30 39 24.0	4.0	0.7
45	1 33 31.88	30 30 32.5	3.5	3.2
46	1 33 36.99	30 26 33.0	4.0	9.2
47	1 34 25.55	30 40 10.7	2.3	0.3
48	1 33 36.78	30 31 40.2	6.0	1.7
49	1 33 32.32	30 42 40.3	2.4	5.1
50	1 33 39.53	30 55 47.1	0.9	0.8
51	1 33 38.54	30 33 01.9	0.7	3.5
52	1 33 37.39	30 40 54.7	0.0	0.6
53	1 33 41.73	30 37 24.1	11.1	1.2
54	1 33 42.32	30 37 39.5	2.5	7.0
55	1 33 41.88	30 08 31.3	5.5	0.0
56	1 33 42.80	30 54 04.3	1.3	3.5
57	1 33 43.44	30 59 41.0	1.9	0.9
58	1 33 42.73	30 49 05.5	1.5	2.2
59	1 33 44.42	30 20 23.7	3.3	10.2
60	1 33 46.42	30 26 55.3	1.4	3.4
61	1 33 46.78	30 17 33.3	2.8	10.1
62	1 33 48.58	30 35 47.5	1.6	6.5
63	1 33 49.95	30 14 25.2	2.9	9.2
64	1 33 50.84	30 18 44.5	1.7	0.3
65	1 33 49.37	30 32 06.3	10.1	5.6
66	1 33 50.88	30 37 12.3	13.2	1.2
67	1 33 52.68	30 16 54.1	4.3	10.1
68	1 33 52.78	30 37 38.6	11.3	12.8
69	1 33 54.68	30 36 05.4	7.8	6.2
70	1 33 54.93	30 37 44.1	17.3	0.8
71	1 33 55.57	30 16 02.8	1.0	0.7
72	1 33 56.99	30 54 12.3	3.3	9.6
73	1 33 57.18	30 36 47.2	4.4	4.5
74	1 33 59.89	30 40 28.8	0.0	7.1
75	1 34 01.14	30 50 27.1	4.4	12.5
76	1 34 02.07	30 50 41.0	0.6	1.6
77	1 34 02.59	30 23 25.4	0.0	0.8
78	1 34 02.59	30 58 10.2	27.6	10.1
79	1 34 03.55	30 39 15.3	5.4	7.8
80	1 34 03.66	30 52 39.5	1.2	3.0
81	1 34 06.77	31 00 29.1	0.0	1.0
83	1 34 06.58	30 48 23.1	7.4	4.3
84	1 34 02.58	30 40 00.1	8.2	3.7
85	1 34 09.08	30 49 07.7	2.7	1.6
86	1 34 11.72	31 07 31.3	2.9	2.1
87	1 34 12.05	30 39 10.1	17.8	0.2
88	1 33 52.76	30 44 32.4	1.5	1.1
89	1 34 15.71	31 08 12.5	2.2	5.7
90	1 34 12.82	30 47 18.1	2.8	1.9
91	1 34 13.97	30 22 36.4	4.9	16.3
92	1 34 14.47	30 17 02.9	2.4	3.4
93	1 34 15.88	30 24 54.6	3.1	7.4
94	1 34 14.73	30 31 49.7	3.1	8.8
95	1 33 51.05	30 45 38.4	5.5	9.1
96	1 34 15.44	30 32 20.2	3.1	11.9
97	1 34 18.29	30 58 29.3	1.5	4.7
98	1 34 20.21	30 51 25.6	2.8	1.1
99	1 34 20.61	30 16 47.5	0.9	1.8
100	1 34 22.96	30 59 32.9	0.4	0.6
101	1 34 24.25	30 27 54.3	4.1	11.4
102	1 34 25.80	31 07 44.7	1.0	0.6
103	1 34 25.10	30 39 39.4	3.9	2.8
104	1 34 25.55	30 40 10.7	4.8	7.7
105	1 34 16.61	30 41 10.2	0.0	4.5
106	1 34 08.67	30 43 33.3	1.8	0.9
107	1 34 31.50	31 06 51.4	0.8	3.5
108	1 34 31.45	31 05 24.0	2.5	3.2
109	1 34 30.57	30 38 27.1	3.6	4.2
111	1 34 13.35	30 45 00.9	4.5	8.6
113	1 34 03.66	30 45 58.5	2.3	1.1
114	1 34 16.39	30 43 26.5	1.7	2.4
115	1 34 09.84	30 45 07.5	0.6	0.3
116	1 34 23.04	30 42 05.9	1.7	0.0
117	1 34 40.69	30 52 08.5	3.9	1.8
118	1 34 33.42	30 39 23.5	1.2	4.9
119	1 34 11.93	30 45 00.6	1.6	8.4
120	1 34 43.56	31 06 10.7	2.8	2.8
121	1 34 41.96	30 56 49.6	1.4	3.2
122	1 33 37.89	30 39 34.8	6.5	10.7
123	1 34 15.16	30 44 57.1	3.4	3.1
124	1 34 44.71	30 49 36.6	6.9	3.9
125	1 34 32.85	30 41 10.5	7.5	8.2
126	1 34 27.72	30 42 32.3	1.9	3.3
127	1 34 47.13	30 59 36.9	14.4	2.8
128	1 34 48.86	31 05 14.8	4.2	12.4
129	1 34 37.53	30 40 12.6	0.7	0.6
130	1 33 25.04	30 45 06.6	10.0	9.3
131	1 34 51.19	30 59 34.8	2.9	0.2
132	1 34 49.20	30 37 27.7	7.5	3.4
133	1 34 35.30	30 43 56.5	4.7	0.9
134	1 34 23.27	30 46 27.4	6.9	6.4

Table 2. Emission lines objects with non-negligible continuum emission in M 33. Fluxes in Hα+[N II] and in [O III] are in units of 10^{-15} erg cm^{-2} s^{-1}

id	RA	Dec.	$F_{\mathrm{H}\alpha}$	$F_{[\mathrm{OIII}]}$	$\frac{F_{\mathrm{StrY}}}{F_{[\mathrm{OIII}]}}$
1	1 31 56.16	30 28 05.2	0.0	0.9	2.7
2	1 32 09.32	30 26 01.1	4.2	3.7	5.8
3	1 32 16.71	30 09 18.1	20.8	8.1	7.0
4	1 32 21.80	30 21 26.0	62.2	23.6	8.5
5	1 32 26.97	30 24 13.1	6.2	1.3	1.9
6	1 32 27.35	30 25 35.8	56.6	19.1	0.5
7	1 32 29.03	30 28 20.5	2.0	3.0	1.9
8	1 32 34.25	30 22 45.0	6.0	1.0	0.9
9	1 32 37.03	30 20 28.1	24.3	17.1	4.9
10	1 32 43.08	30 25 36.3	2.0	0.3	6.4
11	1 32 43.72	30 13 14.6	6.7	0.7	22.
12	1 32 49.88	30 45 55.4	8.7	0.6	3.1
13	1 32 52.46	30 50 17.9	17.9	4.1	0.5
15	1 32 58.56	30 36 37.6	11.9	1.0	3.1
16	1 33 00.20	30 30 15.1	1.1	3.1	2.2
17	1 33 00.43	30 33 11.4	6.2	1.5	2.3
18	1 33 05.31	30 35 10.1	4.2	0.1	9.6
19	1 33 08.12	30 42 24.6	13.6	3.5	0.1
20	1 33 08.35	30 56 40.5	8.4	1.2	1.2
21	1 33 05.27	30 30 02.9	13.3	3.6	2.5
22	1 33 09.87	30 55 12.5	3.7	0.5	1.0
23	1 33 07.64	30 31 00.7	81.3	36.5	0.3
24	1 33 11.33	30 18 19.1	2.8	1.9	0.8
25	1 33 13.65	30 39 29.2	50.2	7.4	0.1
26	1 33 15.89	30 39 52.4	8.0	0.2	13.
27	1 33 14.06	30 51 25.2	4.4	0.1	22.
29	1 33 22.99	30 23 41.0	3.7	0.5	1.4
30	1 33 23.88	30 29 04.1	3.5	1.1	4.4
31	1 33 23.33	30 49 42.7	4.2	0.3	1.2
32	1 33 24.63	30 23 28.4	17.5	1.6	2.4
33	1 33 27.97	30 37 35.2	1.5	1.8	1.2
34	1 33 33.46	31 01 42.0	3.4	0.3	3.7
35	1 33 35.56	30 25 56.8	89.0	14.7	0.4
36	1 33 34.36	30 31 24.6	13.7	0.6	6.3
37	1 33 38.44	30 23 56.5	9.6	0.4	1.9
38	1 33 45.22	30 27 39.0	0.8	2.2	1.8
39	1 33 44.10	30 48 36.2	39.6	3.8	1.2
40	1 33 43.44	30 59 41.0	2.1	1.1	3.3
41	1 33 54.25	30 57 33.1	2.3	0.3	1.2
42	1 33 55.53	30 56 45.6	0.7	0.0	0.0
43	1 33 57.34	30 32 42.0	8.6	1.4	4.4
44	1 33 57.88	30 47 50.6	10.3	0.8	1.5
45	1 34 05.36	30 59 42.0	14.5	1.1	1.7
46	1 34 12.94	30 19 24.9	4.8	0.6	3.2
47	1 34 17.92	30 52 48.0	11.9	7.1	0.2
48	1 34 18.23	30 22 02.6	5.9	1.7	2.2
49	1 34 24.86	30 52 42.2	0.7	3.2	0.3
50	1 34 26.15	30 34 24.7	13.6	0.7	8.2
51	1 34 29.37	30 59 12.4	2.3	0.2	2.7
52	1 34 29.31	30 59 21.4	7.1	0.1	10.
53	1 34 30.73	30 49 42.8	4.6	0.2	1.2
54	1 34 31.51	30 21 11.4	10.0	1.0	5.9
55	1 34 36.84	31 02 38.8	7.4	0.4	2.9
56	1 34 39.53	30 48 00.2	3.4	0.8	1.8
57	1 34 38.66	30 46 59.9	3.4	0.8	1.8
58	1 34 41.84	30 56 05.9	17.1	3.6	0.8
59	1 34 42.54	30 55 44.5	26.3	3.6	0.3
60	1 34 50.05	31 08 21.6	3.3	0.2	1.7
61	1 34 49.50	30 47 37.8	2.4	0.0	0.0
62	1 34 47.27	30 37 55.8	47.4	19.8	0.3
63	1 34 38.66	30 46 59.9	3.4	0.0	0.0