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High Velocity Flow Suggested by Wing Components of the Hα Line Profiles in the Selected Planetary Nebulae

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This is a short report on the study of internal motions of selected Planetary nebulae. We have studied this subject with both high (4 or 8 Å/mm) and intermediate (20 Å/mm) dispersion spectrographs. During the course of this work we noticed the existence of a high velocity gas flow distinct from the well known expanding gas, but with smaller velocities than stellar winds (Yadoumaru & Tamura 1994 on Abell 30; Otsuka & Tamura, 2001 on H 4-1). We present subsequent results obtained with the intermediate dispersion spectrograph about 10 selected planetary nebulae. The analyses were made by multiple Gaussian method on the emission line profiles of Hα. High velocity gas flows were recognized by a weak broad wing component.

Table 1. Ten selected planetary nebulae and the results of our observations. Slit position angles are 90° for all nebulae. *Nebulae with confirmed high velocity gas.

Nebulae	PN G	$2V_{exp}$ main	V_{FWZI} wing	Obs.Date	diameter arcsec	stellar wind
Vy 2-2	045.4-02.7	42	570*	2000/8/7	14	–
M 1-71	055.5-00.5	32	360	2000/8/7	3.8	–
M 1-73	051.9-03.8	31	280	2000/8/7	5.	–
M 1-72	054.4-02.5	37	–	2000/8/7	<10	–
M 1-74	052.2-04.0	37	400	2000/8/7	<5.	–
M 1-75	068.8-00.0	36	?	2000/8/7	14.6	–
NGC 7026	089.0+00.3	58	–	2000/8/3	20	4600
NGC 7027	084.9-03.4	26	620*	2000/8/3	14	–
Vy 2-3	107.6-13.3	37	–	2000/8/3	4.2	–
Hb 12	111.8-02.8	44	570*	2000/8/3	1.	800

Ten planetary nebulae were selected for analysis. Their Hα emission line profiles are given in Table 1. We made observations with the cassegrain spectrograph of 74-inch telescope at the Okayama Astrophysical Observatory in August 2000. The dispersion of 20 Å/mm was provided by using 1800 lines/mm grating. As the detector two dimensional 512 × 512 pixels CCD was used, the wavelength or velocity resolution was 0.4 pixel or 0.16 Å, which corresponds to $7\,\mathrm{km\,s^{-1}}$.

The most prominent feature is the shape of weak broad wing components of Hα of 6 nebulae among 10 selected samples, which were never noticed and reported. In table 1 we also summarize the results of measurements on such weak broad wings in the velocity scale V_{FWZI} as well as the width of main components($2V_{exp}$).

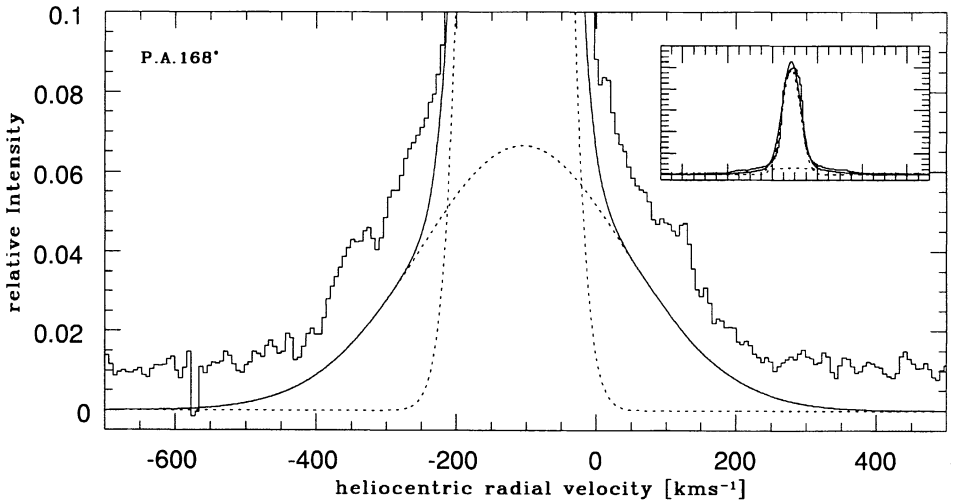

Figure 1. The spectrum of Vy 2-2 with 8 Å/mm resolution.

As to 3 nebulae, Vy 2-2, NGC 7027, and Hb 12, such wing features are also clearly confirmed by another our own higher dispersion observation (8 Å). We show only Vy 2-2 in Fig. 1. High velocity flows indicated by broad wing components are found with higher frequency than 50 % while our sample consist of ten PNe. Several objects among our sample are confirmed as well about such broad wings by another group(Arrieta and Torres-Peimbert 2001). Abell 30 (Yadoumaru and Tamura 1994; Meaburn and López 1996) and H 4-1 (Otsuka and Tamura 2001) might be other samples of this group made by a criterion of broad wing components. In case of Hb 12 its broad wing can be explained by the resultant gas flow interacting with the stellar wind. Further observations of larger samples would be very valuable.

References

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