The IAC Morphological Catalog of Northern Galactic Planetary Nebulae

A. Manchado[1], M. A. Guerrero[1], L. Stanghellini[2] and M. Serra-Ricart[1]

Instituto de Astrofísica de Canarias Osservatorio Astronomico di Bologna 1; 2

Introduction

Planetary Nebulae (PNs) are highly representative of the late stages of intermediate mass stellar evolution. However, there are still many unresolved questions in their evolutionary scheme. Mass loss processes during the Asymptotic Giant Branch (AGB) are not fully understood. Binarity, rotation and magnetic fields may play an important role in PNs formation. The morphological study of PNs will help us to address those questions, and therefore a meaningful homogeneous database is needed.

In recent years, an ESO catalog of images of more than 250 Southern PNs, observed through narrow-band filters, has been published (Schwarz, Corradi, & Melnick 1992). On the other hand, a complete morphological survey of the Northern sky PNs does not exist to date, and only limited samples of narrow–band PN imagery exist (Balick 1987; Chu, Jacoby, & Arendt 1987). We aim at filling the gap, carring out a complete catalog of extended Northern PNs.

The catalog

The sample was selected according to the following criteria:

1. We observe only those PNs that are spectroscopically confirmed by Acker et al (1992).
2. We include in our observing list PNs larger than 4″. Objects larger than 12″ were observed using the 0.8m IAC-80 telescope, while smaller objects were observed with the 2.5m NOT telescope.
3. Our PN sample suitably covers the Northern sky: PNs with $-10° < \delta < +80°$ and diameters larger than 4″ were all included in the observing list.
4. We did not observe objects that had already been observed by Balick (1987) and Schwarz et al. (1992), to avoid obvious duplications.

In order to obtain sharp images of the different ionized regions, we acquired the data through a choice of narrow–band filters: Hα+[N II] (FWHM=50 Å), Hα and [N II] λ 6584 Å(FWHM=10 Å), and [O III] λ 5007 Å(FWHM=30 Å).

The catalog contains 243 Northern PNs, for a total of 589 gray-scale frames. For thirty-two PNs we have produced a color picture, obtained combining the frames obtained through different narrow-band filters.

The Morphological Classification

We use the catalog images to improve previous morphological classifications (the most recent from Schwarz, Corradi, & Stanghellini 1992). Excluding the non-extended PNs,

https://doi.org/10.1017/S0074180900129730 Published online by Cambridge University Press

there are five main morphological classes, which take into account the apparent morphology and the formation mechanisms. These main classes are:

- **Round (R)**: The PN shape does not show a clear deviation from symmetry.
- **Elliptical (E)**: They have two axis of symmetry, but do not show a waist.
- **Bipolar (B)**: They have two axis of symmetry, with lobes and a waist.
- **Quadrupolar (Q)**: With two pairs of lobes, oriented at different directions.
- **Point-Symmetric (P)**: Their morphological components are symmetrical with respect to reflection through the center.

In addition to this main classes, there are some additional structures and morphological features whose presence we denote with suffixes: inner structures (**s**), ansae (**a**), rings (**r**), multiple shell structures (**m**), and outer structures (**o**). Some of these finer classification (and the relative suffixes) only can be applied to a particular morphological classes (as **r** to **B**, or **s** and **a** to **R** and **E**). For example, a structured elliptical PN with a halo would be **Esm**, a bipolar PN with ring would be **Br**, etc.

The statistics of this sample is summarized in the following table, where $|b|$ is the average galactic altitude and N is the number of objects in the sample.

Morph. Class	Rate	$\|b\|$	N
R	23%	12.9	54
E	49%	6.9	113
B	14%	2.7	32
Q	3%	1.7	6
P	4%	4.3	8
m	17%	10.9	40

For the first time, a complete and homogeneous set of 250 northern galactic PNs have been observed through narrow-band filters to explicitly address their morphologies. We have analyzed these PNs on the basis of a renewed morphological scheme, and found that their main shape is described by five morphological classes. We plan to study these PNs from many other viewpoints, starting from their shapes, to determine their evolutionary stage and their formation mechanisms.

REFERENCES

Acker, A., Ochsenbein, F., Stenholm, B., Tylenda, R., Marcout, J., & Schohn, C., 1992, Strasbourg-ESO catalog of galactic planetary nebulae (Garching: ESO).
Balick, B. 1987, AJ, 94, 671.
Chu, Y.-H., Jacoby, G. H., & Arendt, R. 1987, ApJS, 64, 529.
Schwarz, H., Corradi, R. L M., & Melnick, J., 1992, A&AS, 96, 23.
Schwarz, H., Corradi, R. L M., & Stanghellini, L. 1993, in IAU 155, Planetary Nebulae, eds. R. Weinberger and A. Acker (Dordrecht: Kluwer), 214.

https://doi.org/10.1017/S0074180900129730 Published online by Cambridge University Press