

Disclosing the morphology of compact Galactic planetary nebulae

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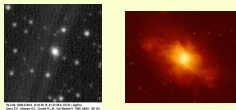
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We present preliminary results of a 200-orbit *HST*/WFC3 survey of compact Galactic planetary nebulae, aimed at filling the blanks in the morphological studies, and in particular to study the early onset of morphology. Planetary nebulae smaller than 4'' are usually younger than ~5000 yr, thus the early stages of their evolution is conveniently studied therein. Both broad- and narrow-band imagery has been employed to disclose both nebular and central star characteristics. We found that early morphology is represented by the known main types, including bipolar and quadrupolar PNe. Statistics, images, and correlations with dust properties of the nebulae analyzed via *Spitzer* spectra are presented in this paper.

Disclosing the morphology of compact Galactic PNe

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Ground-based vs. HST images of compact PNe



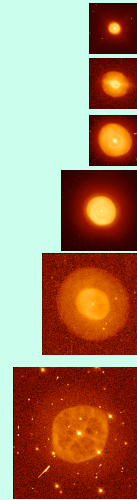
• All HST images in the poster are to scale (apparent)
 • All PNe were unresolved or barely resolved in ground-based images

- WFC3 (λ 5007, F200LP, F350LP, and F814W), 48 targets (so far), which allows an unambiguous identification of the CS
- We found 3 targets that were misclassified as PNe
- Macro-morphology:
 - ~ 10% R PNe
 - > 50% E PNe, confirming it to be the most populated morphological class in any given PN subgroup
 - ~ 30% B, Q, P
 - Very few BC PNe would suggest BC is a late stage morphological characteristic, rather than an ab initio shape

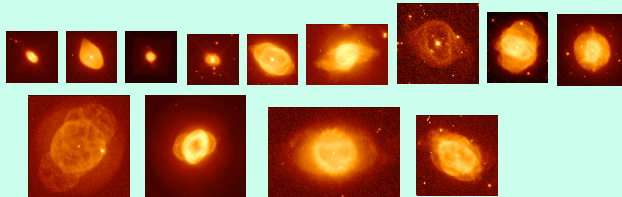
Abstract

We present preliminary results of a 130-target HST Snapshot survey of compact ($<5''$) Galactic planetary nebulae, to explore the early onset of morphology. Planetary nebulae smaller than $5''$ are usually younger than ~ 5000 yr. Both broad and narrow band imagery has been employed to reveal nebular and central star characteristics. We find that early morphology is largely represented by known types, including bipolar and quadrupolar PNe, but some types stand out. Images and statistics are presented here in preliminary form. Peculiarities and differences between this and the general Galactic PN samples are underlined.

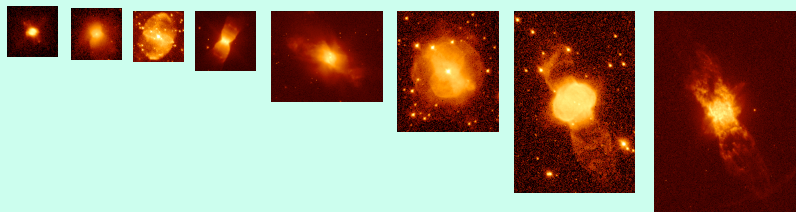
Round or moderately elliptical PNe, low asymmetry, some have halos and structures



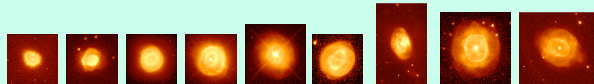
Very elliptical PNe, ansae, flyers, asymmetries



Extremely asymmetric PNe, Bipolar PNe, Quadrupolar, Point-Symmetric



Prominent among compact PNe are multiple excited shells, attached, show post-AGB wind structure. Most of these would be lost in evolved/expanded PNe. Most are round or elliptical.



Central stars are visible in $>90\%$ of PNe, which is a much larger fraction than in ground-based images of Galactic PNe, and is a result of higher angular resolution and UV sensitivity. The central stars are still very bright in young PNe, and most of our PNe are younger than a few thousand years from ejection.

A PN image catalog with morphology, sizes, and peculiarities is in preparation. We are also working on the morphology-central star- dust connection (Spitzer/IRS spectra are available for most targets)

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