Physical properties of PNe: what IFU spectrographs can do?

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Rationale

Structure, kinematics and physical parameters of planetary nebulae are related to their progenitor stars. A better understanding of these properties is essential to improve the knowledge of the late stages of evolution of intermediate-mass stars, as well as to better understand the chemical enrichment mechanisms that feed the interstellar medium with the nucleosynthesis yields from such stars.

Integral Field Unit (IFU) spectrographs can provide valuable information for PNe, mapping properties point-to-point over the projected nebulae. In this communication we present the results of a survey of physical properties for southern PNe.

We have used **IFU spectroscopy** in order to derive the angular distribution of electron densities and ionic abundances, and also to map the ionization profiles. The aim is to characterize their physical properties and structures, showing therefore the capabilities of IFU spectroscopy in the diagnostics of extended nebulae.

Observations

- A sample of southern PNe (see panel at right) was selected based on their angular size and surface brightness.
- Observations were carried on at Pico dos Dias Observatory in Brazil, between 2009 and 2010, using the 1.60m telescope.
- The ***Eucalyptus* IFU spectrograph** was used to derive the angular profiles of flux, density and ionization.
- *Eucalyptus* is a fiber-fed IFU unit of 30 × 15 optical fibers, covering nearly 30" × 15". It was designed and built as a functional **prototype for the SIFS spectrograph**, an instrument of the **SOAR telescope**, installed in Chile.

Discussion

- Results show clearly the **flux distribution and the density stratification** for all nebulae, as well as their ionization profiles.
- They demonstrate that **IFU spectroscopy is a very useful tool in the diagnostics of extended nebulae**, producing results that can be used for morpho-kinematical modeling (e.g. using SHAPE) or for photoionization modeling (e.g. using CLOUDY or MOCASSIN) to describe in detail the 3D structure and evolution of such objects.
- New IFUs typically have **higher angular resolution, although smaller coverage**, and could be used to extend this sample to more distant targets, or smaller such as pPNe.

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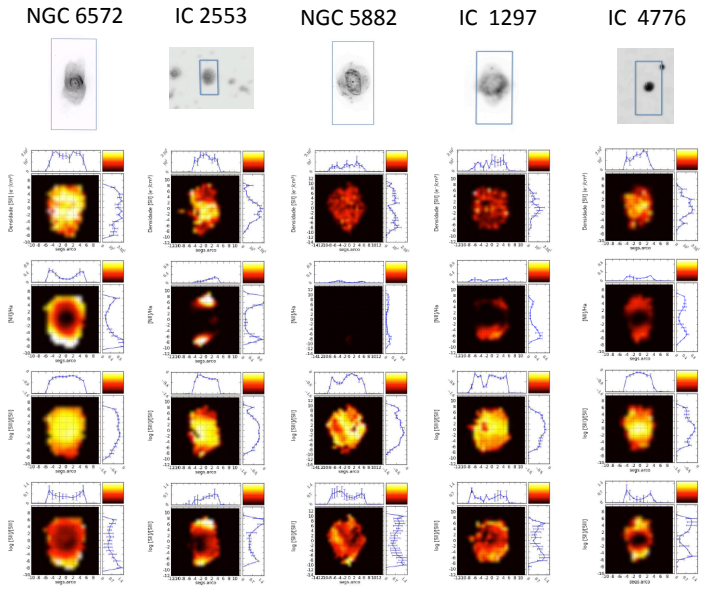
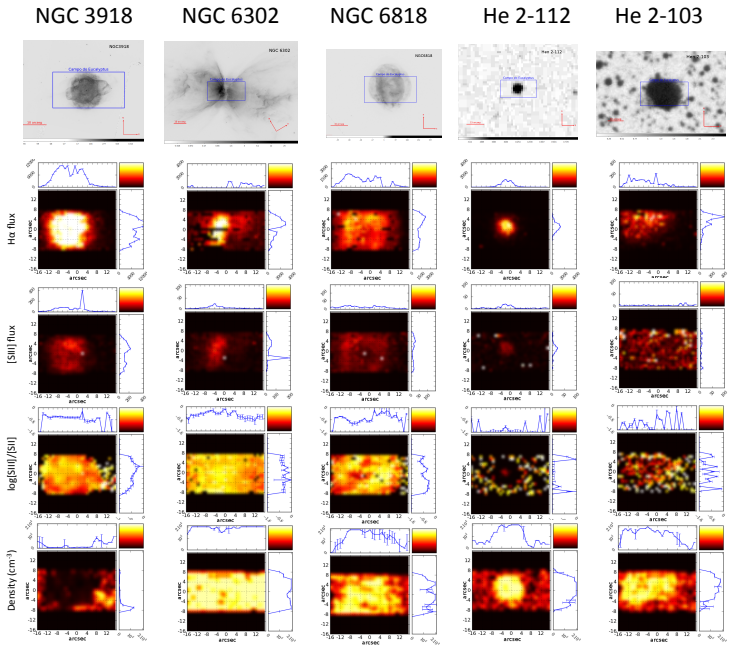
Sample and results



For each nebula the size of the IFU box is shown in blue over its target's image. Then, from top to bottom: density from the [SII] lines, [NII]/Hα, and ionization profile seen both top-down and bottom-up from [SIII]/[SII] and [SII]/[SIII] line ratios. In all figures, blue lines at top and right represent cuts at the center of the image in both axes and bars represent the dispersion derived from different measures.



For each nebula the size of the IFU box is shown in blue over its target's image. Then, from top to bottom: Hα flux, [SIII] flux, ionization profile from [SIII]/[SII] and density from [SIII] line ratio. In all figures, blue lines at top and right represent cuts at the center of the image in both axes and bars represent the dispersion derived from different measures.