Planetary Nebulae: An Eye to the Future
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Gaia future contribution to the study of PNe

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Abstract. Gaia, the forthcoming astrometric ESA survey, is expected to substantially improve our knowledge about the distances to galactic planetary nebulae (PNe). We present an overview of Gaia mission and focus in some aspects which are relevant for the study of PNe. In particular, we present our simulations on Gaia spectrophotometric observations obtained by means of GOG (Gaia Object Generator) for a catalogue of proto-PNe and PNe (Suárez *et al.* 2006) which can be used as templates to classify and study the suitability of Gaia spectrophotometry to infer physical properties of the sources.

Keywords. Planetary nebulae: general, astrometry, surveys

1. Overview of Gaia

Gaia is the forthcoming astrometric mission of ESA, expected to be launched by Spring 2013. It will chart the Galaxy from $6^{\rm m}$ to $20^{\rm m}$ at optical wavelengths both in the spatial and kinematical space, measuring during the 5 years of mission lifetime every astronomical source 70 times on average. The satellite scientific payload is composed by a unique device that includes two telescopes and shares a common focal plane, incorporating the three types of astronomical observations that Gaia will perform: astrometry (parallaxes and proper motions), multiband photometry and spectroscopy (RVS spectrograph, $R = 11\,500$, Ca II IR triplet region). The photometric instrument is composed by two spectrophotometers, BP and RP, that observe in the 338-1082 nm spectral range with a variable dispersion. (see Ordoñez-Blanco *et al.* 2010 and references therein).

2. Astrometry with Gaia

Gaia astrometric accuracy is expected to be of the order of 5, 14 and 26 μas for a B1 star with $V = 6^{\rm m}$, $12^{\rm m}$ and $15^{\rm m}$, respectively. This will allow to measure the distance to a $V = 15^{\rm m}$ star located at 1, 5 or 10 kpc with an accuracy of 3%, 13% and 26% respectively, which will drastically change our knowledge of the luminosity and evolutionary status of central stars of PNe. In addition, the precise knowledge of the galactic PNe luminosity function will us allow to calibrate PNe as primary extragalactic standard candles.

3. Simulations of Gaia spectrophotometry of PNe

Gaia catalogue will be available to the general public from the beginning and is being conceived to include not only the astrometric and kinematical information of the sources

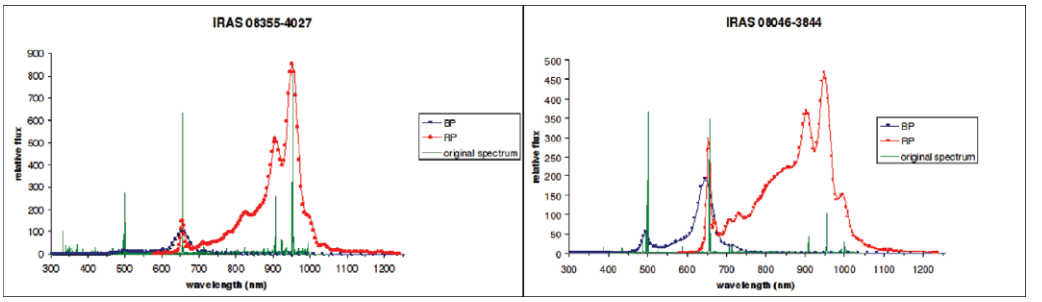

Figure 1. Simulation of the Spectral Energy Distribution for two planetary nebulae obtained with Gaia Object Generator (GOG), Isasi *et al.* 2010.

but also an outline of the object classification and main parameters. It is expected that Gaia will increase significantly the census of stars at any evolutionary stage, including the discovery of new galactic PNe. Gaia final catalogue is responsibility of Gaia DPAC (Data Analysis and Processing Consortium) which is developing tools to classify and parameterize the different astronomical object classes. These software tools make use of the Gaia Object Generator (GOG) (Isasi *et al.* 2010) to simulate catalog data (including mission final data) for all the Gaia instruments.

Figure 1 shows two examples of our GOG simulation of BP/RP spectra for two PNe from Suárez *et al.* (2006) catalogue. The task to identify and separate emission line stars in BP/RP spectra during mission operation will be indeed challenging because it strongly depends on the shape of the instrumental response and line spread function of Gaia spectrophotometers. Work to obtain a representative sample to train the classification algorithms is on-going. Depending on the excitation class of the nebulae, BP/RP spectra will allow to identify emission from Hβ, [OIII], Hα + [NII], [ArIII], [SII], [OII], [SIII] and Paschen emission lines. BP/RP spectral energy distributions present a variety of morphologies that could be used to identify and classify these objects.

4. Image reconstruction of extended sources with Gaia

Gaia will observe many objects with structure (objects with a size $\geqslant$180 mas will be considered extended objects) which are essentially galaxies but may also be PNe. On board algorithm of windowing will cut profiles larger than 700 mas, limiting the size of objects that could be retrieved. The morphologic information of the structure of these objects is present in Gaia observations and will be retrieved by 2D image reconstruction algorithms (Christine Ducourant *et al.*, Obs. Bordeaux, private communication).
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References

Isasi, Y., Figueras, F., Luri, X., & Robin, A. C. 2010, *Highlights of Spanish Astrophysics V. Astrophysics and Space Science Proceedings*, 8, 415

Ordoñez-Blanco, D., Arcay, B., Dafonte, D., Manteiga, M., & Ulla, A 2010, *Lecture Notes and Essays in Astrophysics*, 4, 97

Suárez, O., Garía-Lario, P., Manchado, A., Manteiga, M., Ulla, A., & Pottasch, S. R. 2006, *A&A*, 458, 173

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