



Detailed studies of IPHAS sources – II. Sab 19, a true planetary nebula and its mimic crossing the Perseus Arm

M. A. Guerrero¹,^{*} R. Ortiz²,^{*} L. Sabin³,^{*} G. Ramos-Larios⁴ and E. J. Alfaro¹

¹*Instituto de Astrofísica de Andalucía, IAA-CSIC, Glorieta de la Astronomía, s/n, E-18008 Granada, Spain*

²*Escola de Artes, Ciências e Humanidades, USP, Av. Arlindo Bettio 1000, 03828-000 São Paulo, Brazil*

³*Instituto de Astronomía, UNAM, Apdo. Postal 877, Ensenada 22860, B.C., Mexico*

⁴*Instituto de Astronomía y Meteorología, CUCEI, Universidad de Guadalajara, Av. Vallarta 2602, Arcos Vallarta, 44130 Guadalajara, Mexico*

Accepted 2020 September 28. Received 2020 September 28; in original form 2020 July 8

ABSTRACT

The INT Photometric H α Survey (IPHAS) has provided us with a number of new emission-line sources, among which planetary nebulae (PNe) constitute an important fraction. Here we present a detailed analysis of the IPHAS nebula Sab 19 (IPHASX J055242.8+262116) based on radio, infrared, and optical images and intermediate- and high-dispersion long-slit spectra. Sab 19 consists of a roundish 0.10 pc in radius double-shell nebula surrounded by a much larger 2.8 pc in radius external shell with a prominent H-shaped filament. We confirm the nature of the main nebula as a PN whose sub-solar N/O ratio abundances, low ionized mass, peculiar radial velocity, and low-mass central star allow us to catalogue it as a Type III PN. Apparently, the progenitor star of Sab 19 became a PN when crossing the Perseus Arm during a brief visit of a few Myr. The higher N/O ratio and velocity shift $\simeq 40$ km s $^{-1}$ of the external shell with respect to the main nebula and its large ionized mass suggest that it is not truly associated with Sab 19, but it is rather dominated by a Strömgren zone in the interstellar medium ionized by the PN central star.

Key words: planetary nebulae: general – planetary nebulae: individual: Sab 19 – stars: AGB and post-AGB.

1 INTRODUCTION

The INT Photometric H α Survey (IPHAS; Drew et al. 2005; Barentsen et al. 2014) has mapped the Northern Galactic Plane within the latitude range $b \leq |5^\circ|$, discovering hundreds of new emission-line sources. Among those, many can be expected to be planetary nebulae (PNe), and indeed follow-up spectroscopic observations have unveiled a large sample of new PNe. The first release of extended PNe based on the IPHAS catalogue identified 159 true, likely, and possible PNe (Sabin et al. 2014).

We have started a series of detailed analyses of individual IPHAS objects. Sabin et al. (2020) and Rodríguez-González et al. (in preparation) described an evolved bipolar PN and a highly extinguished bipolar PN, respectively. These two sources at an advanced evolutionary stage and found at large distances and affected by large amounts of extinction can be typically expected among IPHAS PNe. Here we have focused our attention on IPHASX J055242.8+262116, the source number #19 in Sabin et al.'s (2014) list, which will be referred to hereafter as Sab 19. This source, classified originally as a likely PN, is located on the Galactic plane along the Galactic anticentre ($l = 183^\circ 02' 19''$, $b = +0^\circ 01' 76''$) and presents an intriguing triple-shell morphology.

We have obtained new images and spectroscopic information for this source and combined this information with archival radio and infrared (IR) observations. Sab 19 is confirmed to be a true small-size PN surrounded by a much larger Strömgren zone in the interstellar medium (ISM), which mimics a PN halo. The article is organized as follows. The imaging and spectroscopic observations are listed in Section 2. The morphokinematics as well as the nebular and stellar properties of Sab 19 are discussed in Section 3. Finally, our discussion on the properties of the PN and its central star and our conclusions are presented in Sections 4 and 5, respectively.

2 OBSERVATIONS

2.1 Optical narrow-band imaging

Narrow-band optical images of Sab 19 in the H α , [N II] $\lambda 6584$ Å, and [O III] $\lambda 5007$ Å emission lines were obtained with the ALhambra Faint Object Spectrograph and Camera (ALFOSC) on the 2.5-m Nordic Optical Telescope (NOT) at the Roque de los Muchachos Observatory (ORM, La Palma, Spain) on 2020 January 26. The detector was an E2V 231-42 2k \times 2k CCD with pixel size 15 μ m, providing a plate scale of 0.211 arcsec pixel $^{-1}$ and a field of view (FoV) of 6.3 \times 6.3 arcmin 2 . The images were obtained using the Observatorio de Sierra Nevada (OSN) H01 H α [$\lambda_c = 6565$ Å, full width at half-maximum (FWHM) = 13 Å] and E16 [N II] ($\lambda_c = 6583$ Å, FWHM = 13 Å) filters, and the NOT #90 [O III] ($\lambda_c = 5007$ Å, FWHM = 30 Å) filter.

* E-mail: mar@iaa.es (MAG); rortiz@usp.br (RO); lsabin@astro.unam.mx (LS)