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Low dispersion spectroscopy of point-symmetric planetary nebulae

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Abstract. We present an observational study of three oint-ymmetric lanetary ebulae (PS-PNe): PC 19, He 2-429, and He 1-1, whose kinematics has been previously reported in the literature. The study includes an analysis of physical conditions and chemical abundances. We found that the abundances of He 2-429 and He 1-1 correspond to a Peimbert Type I PNe while those of PC 19 are in good agreement with a Type IV PN. Kinematic evidence derived from proper motion measurement support PC 19 classification and suggest that the progenitor star was a low-mass low-metallicity member of the galactic halo population.

Keywords. ISM: abundances, planetary nebulae: individual (PC19, He 2-429, H 1-1)

1. Introduction

PS-PNe show pairs of condensations located on opposite sides of the central star. The term PS was introduced by Stangellini, Corradi & Schwarz (1993) in order to identify a new morphological class of PNe. Later, Guerrero, Vázquez & López (1999), GVL99 hereafter, based on a kinematic study suggested to reconsider this definition as they found the existence of PS in different morphological classes of PNe. Although several PS-PNe has been detected, only a few studies have been dedicated to analyze their physical and chemical properties (e.g. Balick *et al.* 1993, GVL99; Vázquez *et al.* 1998; Gonçalvez *et al.* 2009). In this work we present an analysis of chemical abundances and physical conditions of objects in a sample of PS-PNe that was kinematically studied by GVL99.

2. Observations, data reduction and the sample

Long-slit low-dispersion spectroscopy was obtained at 2.1m telescope of the Observatorio Astronómico Nacional at San Pedro Mártir (OAN-SPM), Mexico. The instrumental setup is the same as that used by Contreras *et al.* (2010). Observations were made on 2002 July 14 and 15. The planetary nebulae studied are shown in Fig. 1 and were selected from GVL99 paper. The images shown were taken from Manchado *et al.* 1996. The data were processed and calibrated using XVISTA and standard techniques of long-slit spectroscopy. The physical parameters were derived using the NEBULAR package in IRAF (Shaw & Dufour 1994), as well as our own script ANNEB for error analysis and iterative calculation of physical parameters and abundances (Olguín *et al.* 2011). Resulting physical parameters and chemical abundances are summarized in Table 1.

Table 1. Physical conditions and chemical abundances.

Object	T_e([N II]) (K)	T_e([O III]) (K)	N_e([S II]) (cm^{-3})	He/H	O/H $\times 10^4$	N/H $\times 10^4$	Ar/H $\times 10^6$	S/H $\times 10^5$
PC 19	10570	13472	14542	0.103	4.292	0.378	1.279	0.461
σ	1278	211	5383	0.000	0.269	0.042	0.281	0.028
He 2-429	9082	...	6952	0.127	4.036	2.124	5.391	1.093
σ	222	...	930	0.001	0.573	0.722	1.245	0.160
He 1-1	10152	...	1731	0.123	8.980	3.938	6.844	2.312
σ	283	...	261	0.003	1.311	1.432	0.517	0.383

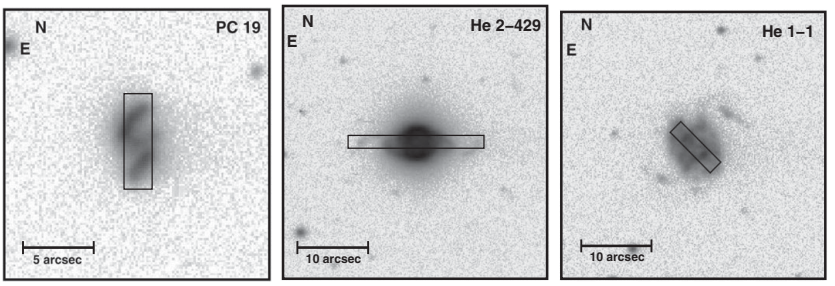

Figure 1. Images above show PC 19, He 2-429 and He 1-1 in the light of Hα and were obtained from Manchado *et al.* (1996). The rectangular regions indicate the position of the spectra.

3. Results

PC 19. Chemical abundances in PC 19 are low with respect to both Type I PNe and the whole PNe population. In particular, N/H and He/H abundances are low, which lead us to classify PC 19 as a Type IV nebula (Peimbert 1978) with a halo population progenitor star. We estimated a kinematical age of 1330 yr. Using the radial velocity found by GVL99 and the velocity on the plane of the sky derived from the proper motions compiled by Kerber (2008), we obtained a total velocity $v = 610$ km s^{-1}. This high velocity value supports the idea of a halo progenitor star. **He 2-429**. A high N_e and low T_e PN. Derived abundances show a He/H value closer to a Type I nebula while O/H and N/H are consistent with the average value of PNe. We have estimated a kinematical age of 1200 yrs for the nebula. **He 1-1**. This nebula shows typical N_e and T_e. Derived chemical abundances show that this nebula is rich in all the analyzed elements. We estimated a kinematical age of 1120 yr. All distances used are from Phillips (2004).

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