CHEMICAL ABUNDANCES OF NEWLY DISCOVERED PLANETARY NEBULAE IN THE GALACTIC BULGE

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1. Introduction

The galactic bulge is a structure whose properties have been deeply studied recently. Its connection with other spheroidal structures as globular clusters or elliptical galaxies has been also examined under many aspects. However, many questions concerning its chemical and dynamical evolution, as well as the kinematics of their components, are still open. In particular, the study of bulge Planetary Nebulae (PNe) brings important information on the evolution of light element abundances (He,O,N,Ne,Ar,S), which are associated to the evolution of intermediate mass stars.

While a strong effort has been made in the last years to identify new PNe in the bulge (Acker *et al.*, 1992; Kohoutek, 1994), the determination of their chemical abundances is mostly to be made. Extensive works like those of Webster (1988), Acker *et al.* (1991) and Cuisinier *et al.* (1998) cover only a fraction of the known PNe of the bulge. We present here the first results of a long term project aimed to derive chemical abundances of recently discovered PNe in the galactic bulge, in order to enlarge the database of chemical abundances needed to study the chemical evolution of this structure. Object names on the table refer to Kohoutek (1994).

2. Observations and Data Reduction

All the objects were observed (at least twice) at the Pico dos Dias Observatory (LNA/CNPq) in Brazil, using a Cassegrain spectrograph attached to the 1.60 m telescope. Data reduction followed the standard procedure of bias, dark and faltfield corrections, extraction of the spectrum, wavelength calibration, and flux calibration through spectrophotometric standard stars observed each night. The table below summarizes our results.

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TABLE I
Chemical abundances of Bulge PNe

Object	He/H	ε(O)	ε(N)	ε(S)	ε(Ar)	log(N/O)
K5-3	0.144	8.25	7.57	6.80	6.06	−0.678
K5-4	0.130	8.61	7.88	7.35	6.33	−0.737
K5-8	0.234	8.00	6.80	7.09	5.77	−1.195
K5-11	0.213	8.36	8.00	6.49	6.58	−0.362
K5-13	0.211	8.43	8.40	6.73	5.73	−0.031
K5-16	0.178	8.34	8.47	7.00	6.23	0.121

3. Discussion

Our data were combined with those derived by Cuisinier *et al.* (1998) (CMAK), and with a sample of planetary nebulae from the galactic disk. Results show that the CMAK sample points to bulge PNe more abundant in Ar, S, O than their disk counterparts. Our sample, that covers weaker objects, indicates however that small abundances can also be found in bulge objects. As these elements are not produced by nucleosynthesis in the progenitor stars, their abundances reflect the composition of the interstellar medium at the epoch of the progenitor formation, so, the spread in abundances is consistent with the scenario of star formation in the bulge beginning in early phases of the Galactic history and spanning over a wide range of metallicities.

On the other hand, He and N abundances are an indication of the progenitor mass once these elements are mainly produced by stellar nucleosynthesis. In this case, behavior of bulge and disk objects are about the same, since progenitors have the same spread in mass and then in evolution time. Helium abundances are, on the average, higher for bulge than for disk objects, which was already noted by Ratag (1992).

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References

Acker, A., Raytchev, B., Köppen, J. and Stenholm, B.: 1991, *Astron. Astrophys. Suppl.* **89**, 237.
Acker, A., Cuisinier, F., Stenholm, B. and Terzan, A.: 1992, *Astron. Astrophys.* **264**, 217.
Cuisinier, F., Maciel, W.J., Acker, A. and Köppen, J.: 1998 in: B. Barbuy *et al.* (eds.), *Science with Gemini*, IAG-USP/UFSC, p. 220.

Kohoutek, L.: 1994, *Ast. Nach.* **315**, 235.
Ratag, M.A., Pottasch, S.R., Dennefeld, M. and Menzies, J.W.: 1992, *Astron. Astrophys.* **255**, 255.
Webster, L.: 1988, *Mon. Not. R. Astron. Soc.* **230**, 377.