CHEMICAL COMPOSITION OF A SOUTHERN PLANETARY NEBULAE SAMPLE

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Abstract. We report the results of our analysis of a well observed sample of southern planetary nebulae. The average $\frac{S}{O}$ and $\frac{Ar}{O}$ ratios are comparable to the solar value and to those observed in galactic H II regions. The He abundance correlates with the $\frac{N}{O}$ ratio, confirming the trend found by previous studies, indicating the surface contamination of the progenitors by dredge-up episodes.

Key words: Planetary nebulae - Chemical abundances

1. Introduction

Planetary nebulae are the end of the evolutionary path of intermediate mass stars ($1 < \frac{M}{M_\odot} < 9$). Planetaries with low mass progenitors ($M < 3M_\odot$) or type II nebulae have their envelopes contaminated by products of CN cycle. They are nitrogen enriched due to carbon convertion. These objects may contribute significantly to the nitrogen enrichment of our galaxy. Type I nebulae are associated with massive progenitors ($3 < \frac{M}{M_\odot} < 9$). During their AGB phase, several mixing episodes occur following each He-shell flash, dredging-up helium and carbon as well as some s-process elements. Type I planetaries may be another secondary source of the carbon in the galaxy. Therefore the study of the abundances of these objects is quite relevant for comparison with theoretical calculations of advanced stages of intermediate mass stars. In this work, we report the results of the analysis of a southern sample of planetary nebulae. The observations were performed at the National Laboratory for Astrophysics (Brazopolis - Brazil). The data were already partially published in a series of papers and will not be discussed here.

2. Physical conditions

The interstellar extinction was estimated from Balmer decrement. The ionic concentrations to be determinated require a previous knowledge of the electron temperature and density. From optical spectra these parameters can be estimated from the line intensity ratios

$$R(OIII) = \frac{\lambda 4363}{\lambda 5007} \ ; \ R(NII) = \frac{\lambda 5754}{\lambda 6584} \ ; \ R(SII) = \frac{\lambda 6717}{\lambda 6730}$$

In our computations we considered a three-level atom model, including collisional excitation and de-excitation and radiative transitions in the statistical equilibrium equations. The relevant atomic data used in our calculations are those compiled by Mendoza (1983). Collisional effects in the He^{+2} concentration were taking into account using the formulae by Clegg (1987).

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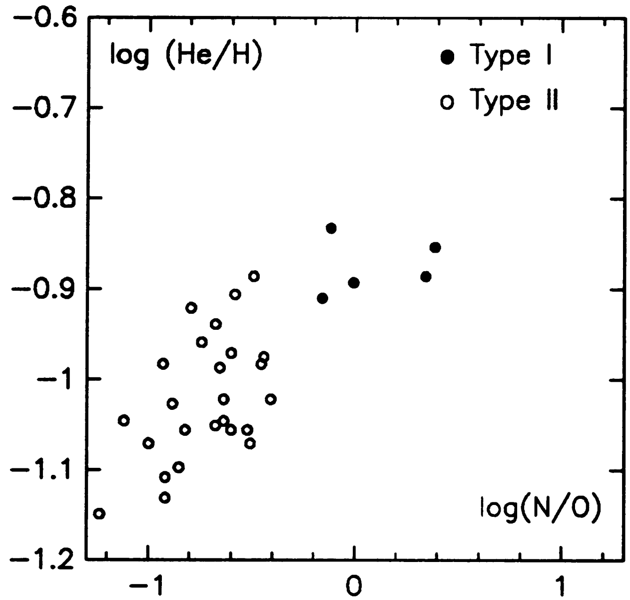

Fig. 1. $\frac{He}{H}$ versus $\frac{N}{O}$ for our sample of southern planetary nebulae. The correlation observed, in the sense that nebulae with high helium content have higher $\frac{N}{O}$ ratio, confirms some earlier results and theoretical expectations.

3. Conclusions

The $\frac{Ne}{O}$, $\frac{S}{O}$ and $\frac{Ar}{O}$ ratios are not expected to be affected by dredge-up episodes. In fact, the average values for our sample are

$$\frac{Ne}{O} = 0.23 \; ; \; \frac{S}{O} = 0.017 \; ; \; \frac{Ar}{O} = 0.0050$$

which are comparable to the solar values and to those observed in galactic H II regions.

The average helium abundance of type II planetaries (25 objects) present in our sample is $\frac{He}{H} = 0.097$, while that of type I (5 objects) is $\frac{He}{H} = 0.133$, indicating the effects of the third dredge-up. Moreover a correlation between the $\frac{He}{H}$ and $\frac{N}{O}$ ratios are expected. Figure 1 shows such a data. In spite of the observed scatter in the data points, a clear trend is observed in sense that nebulae with high helium content also have high $\frac{N}{O}$ ratio. This confirms some earlier results and theoretical expectations (Renzini and Voli 1981).

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