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IONIZATION CORRECTION FACTORS IN PLANETARY NEBULAE: NITROGEN

G. Delgado-Inglada[1], C. Morisset[1], and G. Stasińska[2]

We have recently derived a set of new ionization correction factors (ICFs) to be used in planetary nebulae. Here we present the results for nitrogen. Significant differences are found between the N/O values derived from our ICF and the ones calculated through the usual method: N/O = N^+/O^+.

Ionization correction factors (ICFs) are essential to estimate total abundances in PNe. Using a large grid of photoionization models, computed with Cloudy c10.00 (Ferland et al. 1998), we derived analytical expressions for the ICFs (and for the error bars associated with the ICFs) of He, O, N, Ne, S, Ar, Cl, and C. The whole analysis will be presented elsewhere (Delgado-Inglada, Morisset, & Stasinska, 2014, in prep.)

The upper panel of Figure 1 shows the values of $\mathrm{ICF_m}(N^+/O^+) = x(O^+)/x(N^+)$ as a function of $O^{++}/(O^+{+}O^{++})$ for the models. We see from the figure that the N/O values calculated as N/O = N^+/O^+ (dashed line) will be overestimated (underestimated) in PNe with high (low) values of $He^{++}/(He^+{+}He^{++})$. We suggest a new $\mathrm{ICF_f}(N^+/O^+)$ based on $O^{++}/(O^+{+}O^{++})$ and $He^{++}/(He^+{+}He^{++})$. Each of the four solid lines in the plot represents our ICF for one specific value of $He^{++}/(He^+{+}He^{++})$.

In the lower panel of this figure we show the uncertainties associated with our ICF (solid lines) and with the usual correction scheme for nitrogen, N/O = N^+/O^+, proposed by Kingsburgh & Barlow (1994). The relative differences between $\mathrm{ICF_m}(N^+/O^+)$ and $\mathrm{ICF_f}(N^+/O^+)$ are displayed as a function of $O^{++}/(O^+{+}O^{++})$. The uncertainties associated with our ICF are significantly lower than those associated with the one adopted in Kingsburgh & Barlow (1994). The differences are more evident in the models with low $He^{++}/(He^+{+}He^{++})$ values (corresponding to low effective temperature central stars), where N/O could be underestimated by up to 0.4 dex when calculated simply as N^+/O^+. The uncertainties in log(N/O) associated with our ICF are in general lower than ±0.2 dex.

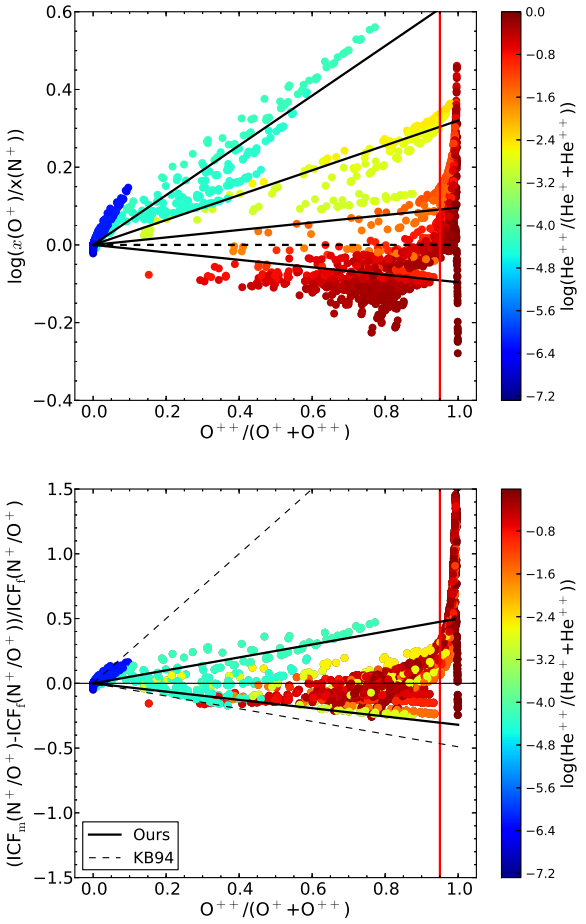

Fig. 1. *Upper panel*: Values of $\mathrm{ICF_m}(N^+/O^+)$ as a function of $O^{++}/(O^+{+}O^{++})$. *Lower panel*: Values of ($\mathrm{ICF_m}(N^+/O^+)$-$\mathrm{ICF_f}(N^+/O^+)$)/$\mathrm{ICF_f}(N^+/O^+)$ as a function of $O^{++}/(O^+{+}O^{++})$.

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[1]Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70264, Méx. D.F., 04510 México (gloria.delgado.inglada@gmail.com, chris.morisset@gmail.com).

[2]LUTH, Observatoire de Paris, CNRS, Université Paris Diderot; Place Jules Janssen 92190 Meudon, France (grazyna.stasinska@obspm.fr)