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TEMPERATURE GRADIENTS AND CHEMICAL ABUNDANCES IN H II REGIONS

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We have collected a sample of 112 H II regions with measurements of T_e[N II] and T_e[O III] to study the effect of using relations between these two temperatures in the determination of oxygen abundances. The results confirm that the temperature relation depends on the degree of ionization of the H II regions. We propose new temperature relations that consider this dependence and lead to better estimates of electron temperatures and oxygen abundances.

When the observed spectra of H II regions allow the measurement of the line intensity ratios used to estimate electron temperatures, their chemical abundances can be calculated with the direct method. A two-zone ionization structure is commonly assumed, with T_e[N II] associated to the emission of the low ionization ions, like O^+ or N^+, and T_e[O III] to the high ionization ions, like O^{++}. When only one of these temperatures is measured, a value for the other one can be derived using a temperature relation. In order to study the effect of temperature relations on the derived metallicities, we have compiled a sample of 112 H II regions with measurements of both T_e[N II] and T_e[O III].

We find that the T_e[N II]–T_e[O III] relation depends on the degree of ionization, confirming a previous result reported by Pilyugin (2007) for a smaller sample of H II regions. Hence, we divided our sample in two groups according to their value of the line intensity ratio $P = I([\mathrm{O\,III}]\ \lambda\lambda 4959,5007)/(I([\mathrm{O\,III}]\ \lambda\lambda 4959,5007) + I([\mathrm{O\,II}]\ \lambda 3727))$, which is related to the hardness of the ionizing radiation. Robust fits provide new temperature relations for the two groups. For $P < 0.65$ we find:

$$T_e[\mathrm{N\,II}] = 0.5\,T_e[\mathrm{O\,III}] + 4400\ \mathrm{K}$$

$$T_e[\mathrm{O\,III}] = 0.8\,T_e[\mathrm{N\,II}] + 1300\ \mathrm{K},$$

and for $P > 0.65$:

$$T_e[\mathrm{N\,II}] = 0.6\,T_e[\mathrm{O\,III}] + 4600\ \mathrm{K}$$

$$T_e[\mathrm{O\,III}] = 1.1\,T_e[\mathrm{N\,II}] - 1700\ \mathrm{K}.$$

We have calculated the differences between the oxygen abundances derived using both electron temperatures and the abundances implied by either T_e[N II] or T_e[O III] with the corresponding temperature relation. We compare the results with those obtained with one of the most used temperature relations, that of Campbell et al. (1986). The mean and standard deviation of the logarithmic abundances are 0.03 ± 0.10 and 0.01 ± 0.12 when the relation of Campbell et al. (1986) is used to derive T_e[N II] and T_e[O III], respectively. Our new relations lead to small but consistent improvements on the differences: 0.02 ± 0.09 and -0.01 ± 0.10. The fact that the improvements are not larger can be due to intrinsic dispersion in the dependence of the temperature relation with P or to errors in the line ratios used to derive electron temperatures. The complete analysis will be presented in Arellano-Córdova et al. (in prep.).

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REFERENCES

Campbell A., Terlevich R., Melnick J., 1986, MNRAS, 223, 811

Pilyugin L. S., 2007, MNRAS, 375, 685

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