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TITLE: The abundance discrepancy in ionized nebulae: which are the correct abundances?

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ABSTRACT:

Ionized nebulae exhibit a wealth of emission lines that are the fundamental basis for estimating the chemical composition of the Universe. Heavy element abundances are particularly important because they are essential to the understanding of nucleosynthesis, star formation and chemical evolution. For more than 80 years, however, a discrepancy between heavy-element abundances derived with collisional excited lines (CELs) and recombination lines (RLs) has thrown our absolute abundance determinations into doubt. Which of the lines (if any) gives the correct heavy-element abundances? Recent results have shown observational evidence that there are temperature inhomogeneities concentrated within the highly ionized gas of the HII regions, causing the reported abundance discrepancy. This work implies that most metallicity determinations of these objects, those based on CELs, must be revised as they may be severely underestimated. However, planetary nebulae do not follow the same trends as the HII regions, suggesting a different origin for the abundance discrepancy.

Although the idea of temperature inhomogeneities is more than 50 years old, in the case of HII regions, it was necessary to consider that these were not concentrated in the entire gas, but in a specific region. What modifications to the already known hypotheses could we explore for planetary nebulae? What are the observational predictions of all these ideas? Can we at least rule out some theories?