Density and Temperature Inhomogeneities in Planetary Nebulae

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The carbon, nitrogen and oxygen abundances in the Planetary Nebulae (PN) derived from the optical recombination lines are usually much larger than those determined from collisional excited UV, IR and optical lines. This discordance is the bright evidence for PN to be strongly inhomogeneous. Starting with consideration by Peimbert (1967) we have been working out the code for calculation the nebular line intensities taking into account both temperature and density fluctuations.

We check all possible causes of the discordance and found that the main are the small-scale temperature fluctuations and the overestimation of the weak line intensities with low S/N values (e.g., Rola & Pelat 1994). The intensities of forbidden [OIII] lines, CII, CIII and CIV recombination lines and CIII] λ1909 UV intercombination doublet for the different values of mean electron temperature T_0 in PN and the *rms* temperature variation t^2 have been calculated. These calculations were used to find the values T_0 and t^2 which allows to provide the best fit of observed and calculated line intensities having regard to the observational errors. In the most cases the obtained values of T_0 appeared to be significantly smaller than ordinarily used for abundance determinations T([OIII]) while the value of $t^2 < 0.2$. The newly determined carbon and oxygen abundances for numerous PNs have been presented. Results of fitting for lines NIII λ4640 and NIV] λ1486 are also given.

The next conclusions can be drawn as a result of our analysis:

1. Observed intensities of the recombination and collision excited lines of the CII, CIII, CIV, NIII, NIV and OIII ions can be successfully fitted in the framework of the simple model of the PN nebula with a single values of mean electron temperature T_0 and mean electron number density n_e^0 as well as the value of the temperature fluctuations t^2. Both the temperature fluctuations and observational errors have to be taken into account in determination of the nebular parameters.
2. Parameters of the PNs obtained as a result of the line intensities fitting depend on the type of the probability distribution function for observed line intensities. Assumption that for low signal/noise ratios the probability distribution function follow by log-normal distribution, described by Rola & Pelat (1994) can change significantly the result of the fitting.

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