Chemical Abundance of PN based on Recombination lines - Comparison with derivation from collisional line

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The spectrum of Planetary Nebulae, IC 4997, NGC 7009, and NGC 6543, etc.. is characterized by a large number of permitted lines of C II, C III, N II, N III, O I, & O II. The wealth of data on permitted lines of ions such as those of O II should be enable us to decide whether the permitted line spectrum arises from recombination or from ''fluorescence'', or from some combination of the two. Some of the O I lines, most spectacularly 8446 A, are excited by fluorescence (see e.g. Aller, 1984) but most of the ionic lines are probably largely recombination features. To the extent that they arise from recombination and cascades, a transition of ion X_i of element X is of interest in that it can be readily related to ionic chemical abundance provided the appropriate atomic parameters are known. Thus, for example, O II recombination lines will depend on the number of O III lines, and we get an independent insight on the O^{++} concentration inferred from the [O III] lines.

We analyze spectroscopic data and interpret the permitted lines of CII, CIV, NI, NII, NIII, OII, OIII, etc. via the recombination theory by Storey et al. (1999) and Pequinot et al. (1991). Some recombination lines show a Doppler displacement very different from lines of known nebular origin. By analysing the line profiles of the recombination lines, we try to find the temperature of these lines. This provides independent check on T_ε fluctuations, a point emphasized by Peimbert et al. (1993). We confirm that recombination theory gives an excessively high abundance in the gas.