PN. Considering the presence of spatial temperature fluctuations we determine the abundance of some of the most important elements in Type I PN. The He^+/H^+ values derived from different He I lines come into agreement without the need of invoking an unknown process depopulating the 2^3S He I level. We find He, C and N overabundances; alternatively we find that the O/H ratio is similar to that of stars recently formed; moreover, we also find that the Ar/O value is similar to that of H II regions of the solar vicinity (Orion and M17). These results imply that there is no evidence in favor of a decrease of the O abundance in the nebular shells due to nuclear reactions in the central stars.

THE EFFECT OF TEMPERATURE FLUCTUATIONS ON THE DETERMINATION OF THE CARBON ABUNDANCES OF PLANETARY NEBULAE

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By combining the C III $\lambda\lambda1906 + 1909$ with the C II $\lambda4267$ line intensities it is possible to determine $T(C^{++})$; this temperature is, in general, considerably smaller than $T(O^{++})$, the temperature derived from the O III $\lambda4363$ to $\lambda5007$ intensity ratio. We show that in the presence of spatial temperature fluctuations $T(C^{++}) < T(O^{++})$. We ascribe the large observed values of $T(O^{++}) - T(C^{++})$ to the presence of large spatial temperature fluctuations. We argue that these fluctuations are due to the deposition of mechanical energy by the stellar winds of PNe. The $N(C^{++})/N(H^+)$ and $N(O^{++})/N(H^+)$ values derived from the ratios of collisionally excited lines to Hβ should be based on $T(C^{++})$ instead of $T(O^{++})$; alternatively the abundance ratios derived from recombination line intensity ratios are almost independent of the adopted temperature and consequently are more reliable than those derived from collisionally excited lines.

GRAIN SIZE DISTRIBUTIONS AND THE ABUNDANCES OF HEAVY ELEMENTS IN THE DIFFUSE INTERSTELLAR MEDIUM

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We have calculated grain size distributions for a model of the diffuse interstellar medium in order to account simultaneously for both the interstellar extinction law and also the gas phase abundances of refractory elements. We consider two phases: cold clouds ($n_H = 40$ cm^{-3}, $T = 80$ K) and a warm neutral medium ($n_H = 0.4$ cm^{-3}, $T = 8000$ K). Grains are shattered by shocks in the warm medium. In clouds they either coagulate together or shatter one another through turbulent grain-grain collisions. Our calculations account for variations in the mass fractions of the two phases, turbulent velocities in clouds, grain-grain sticking efficiencies, circulation times between warm gas and clouds, the frequency of shocks, and grain-grain shattering. In calculating a size distribution we neglect grain destruction by thermal sputtering.

We calculate gas-phase abundances for Fe, assuming that atoms accrete onto grains in clouds, where every atom hitting a grain sticks to it. Even with the very conservative assumption that the grain sputtering rate is 10% of theoretical estimates, we find that the abundance of gas phase atoms is much higher than observed values. Mixing diffuse gas into the molecular clouds, where accretion times onto grains are short, would lower our calculated abundances.