ON THE O III/O II PROBLEM IN MEDIUM AND HIGH EXCITATION PLANETARY NEBULAE

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Numerical models have been constructed for twelve ionization bounded, medium to high excitation planetary nebulae. In most objects the excitation sensitive line ratio [O III] λ 500.9 nm / [O II] λ 372.7 nm is predicted to be too low as compared to observations. A similar systematic discrepancy is observed for [S III] λ 953.2 nm / [S II] λ 672.0 nm. We investigated the following effects on the ionization structure of the nebulae: $O^{++} + H^{o} \rightarrow O^{+} + H^{+}$ charge exchange reaction, energy distribution of ionizing radiation and density distribution of gas in the nebular shell. The results show that density distribution is the most important factor determining the O III/O II and S III/S II line intensity ratios. While a factor of ten decrease in the charge exchange coefficient is required to explain the systematic discrepancy, a reduction of nebular radius by a few percent - truncated nebula (quasi density bounded model, but nebula still optically thick to Lyman photons) - suffices to produce the correct O III/O II ratio. Also, a density gradient of $n \sim r^{-1}$ to r^{-2} yields much better agreement with observations. Realistic variations in stellar spectrum hardly affects the O III/O II line intensity ratio.

NUSSBAUMER: The newly calculated dielectronic recombination rates of Nussbaumer and Storey (this volume) lead to increased recombination $O^{2+} \rightarrow O^{+}$ as well as $O^{3+} \rightarrow O^{2+}$. It seems likely that the increased rate of $O^{2+} \rightarrow O^{+}$ recombination will worsen your problem, as there is probably insufficient O^{3+} to be turned into O^{2+} by its enhanced rate of recombination.

CHE: That is possible as the recombination and charge exchange rates are of the same order of magnitude.

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