ON THE STRENGTH OF THE CIV 155 nm RESONANCE LINES IN PLANETARY NEBULAE

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Ionization models for NGC 6210, 7009, 3242 and II 2003 have been constructed from optical and IUE spectroscopic data. The CIV 155 nm resonance line is predicted about ten times stronger than observed. Radiative transfer calculations of the CIV lines in a spherical nebula, assuming partial frequency redistribution, were made to investigate the effects of dust absorption and an additional depopulation of the upper level.

The results of our calculations can be approximated by analytical formulae; the total flux F emitted in the line is decreased by dust absorption (optical depth τ_D) as $F(\tau_D)/F(\tau_D=0) = 1/(1 + \tau_D\sqrt{10})$, independent of the line optical depth ($\tau_\ell = 10^2 \ldots 10^4$). If the upper level is depopulated at a rate of δ times the spontaneous emission rate A of the CIV line, the emergent flux is roughly $F(\delta)/F(\delta=0) = 1/(1 + \delta\tau_\ell)$.

To weaken the CIV line by a factor of 10 in our models, we either need a dust optical depth of the C^{+3} zone of $\tau_D \sim 1$ or a de-excitation rate of $\delta A \approx 10^6\ s^{-1}$. We cannot find a process as fast as this rate. With respect to dust, we estimate from the 10 μm IR excess dust optical depths of less than 10^{-2} (cf. Köppen, 1977, Astron. Astrophys. 56, 189), which seem too small to explain the discrepancy in the CIV lines in these nebulae.

Shifts in the ionization balance due to e.g. dielectronic recombination do not appreciably alter CIV, as this line is a dominant coolant.

In these four objects, the CIV lines can be sufficiently weakened by assuming a thin shell model for the nebula with a relative thickness $\Delta R/R(\text{nebula}) \approx 0.3$. This is in accord with monochromatic images, and also brings NeIV 242 nm/NeIII 387 nm and NIV 149 nm/NIII 175 nm in agreement with observed line ratios.

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