The Line Ratios of the Resonance Doublets CIV 1550, NV 1240, OVI 1032, 1038 in Symbiotic Stars

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In many symbiotic stars and planetary nebulae, the resonance doublet emission lines including CIV 1548, 1551, NV1237, 1243, OVI 1032, 1038 are observed to exhibit various line ratios between 1 and 2. In this paper, we argue that the various line ratios can be explained by the collisional de-excitation. In a typical medium photoionized by a hot white dwarf with temperature $T\sim10^5$ K and luminosity $L\sim10^{37}$ erg s^{-1} the line center optical depth of resonance doublet line photons may reach $\tau_0\sim10^5$. Despite the small collision time scale, the probability of collisional de-excitation is significant because of the enhanced life time of 2P state due to a large number of resonance scatterings before escape. The disappearance of line photons is more effective for the short wavelength component ($S_{1/2}\rightarrow P_{3/2}$ transition) than the long component because the oscillator strength is twice larger, which leads to the various flux ratio depending on τ_0 and n_e. We perform Monte Carlo simulations to show that the emergent flux ratios takes various values between 1 and 2 when $n_e\sim10^9-10^{10}$ cm^{-3} and $\tau_0\sim10^5$, which is consistent with the photoionization condition near a hot white dwarf in a symbiotic star. We discuss the importance of this process as an astrophysical diagnostic for various emission nebulae especially in the accretion disk emission model of symbiotic stars.