PHOTOIONIZATION AND RECOMBINATION OF Ne IV AND EXCITATION OF NeV IN NEBULAR PLASMAS

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The inverse processes of photoionization and electron-ion recombination are dominant in photoionized astrophysical plasmas. They determine the ionization fractions in photoionization equilibrium, physical conditions, and chemical abundances. We employ the unified theory of electron-ion recombination to study photoionization of Ne IV in photoionized nebulae. That leads to the production of Ne V and spectral emission of forbidden optical and mid-infrared [Ne V] lines via collisional excitation. These lines are prominent in the observations made by infrared space observatories SPITZER, SOFIA, and HERSCHEL. The unified method for electronic recombination provides self-consistent data for photoionization and recombination that is necessary to eliminate uncertainties in the determination of ionization fractions. To wit: Precise abundance of neon in the Sun is unknown owing to lack of accurate atomic data. A 20-level wave function expansion is used for the calculations of photoionization, recombination, and collisional excitation employing the relativistic Breit-Pauli R-matrix method in the close coupling approximation. We find and delineate extensive resonance structures at low energies that considerably enhance the effective cross sections and rates in astrophysical sources.
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[a] Acknowledgement: Partially supported by DOE and NSF. Computational work was carried out at the Ohio Supercomputer Center