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Electron-Ion Recombination for Photoionized and Collisionally Ionized Plasmas

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Abstract : Astrophysical plasma environments can be classified into collisionally ionized (CP) and photoionizedplasmas (PP). In the PP, ionization is caused by an external radiation field, while it is caused by electron collision in the CP. Accurate and reliable laboratory astrophysical data for electron-ion recombination is needed for plasma modeling for low and high-temperatures. Dielectronic recombination (DR) is the dominant recombination process for the CP for most of the ions. When a free electron is captured by an ion with simultaneous excitation of its core, a doubly-exited intermediate state may be formed. The doubly excited state relaxes either by electron emission (autoionization) or by radiative decay (photon emission). DR process takes place when the relaxation occurs to a bound state by a photon emission. DR calculations at low-temperatures are problematic and challenging since small uncertaintiesin the low-energy DR resonance positions can produce huge uncertainties in DR rate coefficients.DR rate coefficients for N^{2+} and O^{3+} ions are calculated using state-of-the-art multi-configurationBreit-Pauli atomic structure AUTOSTRUCTURE collisional package within the generalized collisional-radiative framework. Level-resolved calculations for RR and DR rate coefficients from the ground and metastable initial states are produced in an intermediate coupling scheme associated with□n = 0 and □n = 1 core-excitations. DR cross sections for these ions are convoluted with the experimental electron-cooler temperatures to produce DR rate coefficients. Good agreements are foundbetween these rate coefficients and theexperimental measurements performed at CRYRING heavy-ionstorage ring for both ions.

Keywords : atomic data, atomic process, electron-ion collision, plasmas
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