NEW CALCULATIONS OF INNER SHELL X-RAY LINES IN Ti, Cr, AND Ni AS DENSITY DIAGNOSTICS

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We present new calculations for 1s-2p transitions in C-, N-, and O-like Ti, Cr, and Ni for application to tokamak X-ray spectra. This extends our earlier work for the corresponding iron ions (Phillips *et al.* 1983, Ap.J. 265, 1120) in which a density dependence of line intensities was pointed out. These lines are principally formed by dielectronic recombination; the density effect arises due to the density-dependent populations of the fine structure levels in the ground configuration of the recombining ion. In the present work the calculations of the Ti, Cr, and Ni lines have been made for the wavelengths and the dielectronic recombination rates using a Hartree-Fock technique with statistical exchange. The density dependence of the collisionally excited transitions was also included. Density-dependent populations of the fine structure levels of the ground configuration were obtained from Feldman *et al.* (1980 J. Appl. Phys. 51, 190) and Bhatia *et al.* (1980, J. Appl. Phys. 51, 1464). In calculating the ionization fractions we have assumed coronal equilibrium; new ionization rate coefficients were calculated using the formalism given by Burgess and Chidichimo (1983). The spectra were synthesized with Voigt line profiles and typical tokamak radius-dependent temperature and density profiles were assumed. The N-like lines in particular show a strong dependence over the range: $<10^{11}$-3.10^{13} cm^{-3} (Ti XVI) $<10^{11}$-3.10^{14} cm^{-3} (Cr XVIII), 10^{12}-10^{15} cm^{-3} (Ni XXII). If a density profile across the torus is available from Thomson-scattered laser radiation, observations of these lines may serve to show where the N-like ions are formed in the tokamak plasma.

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