FAST BEAM-FOIL SPECTROSCOPY OF SEXTET TRANSITIONS IN DOUBLY EXCITED O IV AND MCHDF THEORY ALONG THE ISOELECTRONIC SEQUENCE

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by

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Abstract

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This work presents observations of VUV transitions between doubly excited sextet states of O IV, and triplet states of O V. Spectra were produced by collisions of an accelerated O^+ beam with a thin solid carbon target. Some observed lines were assigned to $1s2s2p^23l\ ^6L$-$1s2p^33l\ ^6L'$, l=s, p, d, and $1s^22p3l\ ^3L$-$1s^22p4l'\ ^3L'$, l=p, d, l'=d, f, electric-dipole transitions and are in good agreement with our accurate Multi-Configuration Hartree-Fock (MCHF) (with QED and higher-order corrections) and the Multi-Configuration Dirac-Fock (MCDF) calculations. 260 new lines have been identified.

The following theoretical methods have been developed: (1) QED effects including self-energy and vacuum polarization energy, and (2) higher-order corrections, and appended to the MCHF approach. We performed the above methods to calculate the transition energies, transition probabilities, lifetimes and wave functions of doubly excited quintet states of beryllium-like C III, N IV, O V, F VI and Ne VII. The agreements between our calculations and experiments are excellent.

The above and other existing relativistic many-body methods have been applied to calculate the energies, transition probabilities, lifetimes and wave functions of doubly excited sextet states of boron-like O IV, F V and Ne VI, and doubly excited triplet states

of beryllium-like C III, N IV, O V, F VI and Ne VII. The predicted transition wavelengths agree with the experiments in the wavelength range of 380 - 800 Å. The higher-order corrections, fine structures and spectra with high wavelength resolution are found to be critically important in these comparisons.