Accurate Calculations of Energy Structures and radiation rates for L-shell ions of astrophysics interest

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Level energies, wavelengths, electric dipole, magnetic dipole, electric quadrupole, and magnetic quadrupole transition rates, oscillator strengths, and line strengths from combined relativistic configuration interaction and many-body perturbation calculations are reported for the $n \leq 6$ states in a number of L-shell ions of astrophysics interest[1−5]. Extensive comparisons with experiments from the NIST and CHIANTI databases[6−7], and other recent benchmark calculations, show that the present results are highly accurate: for level energies, uncertainties are less than 0.1% for most states; for transition rates, accuracies are better than 10% for a majority of transitions.

The excellent description of the energy separations along the isoelectronic sequences makes it possible to point out a number of lines for which the experimental identifications were be questioned. A complete dataset should be helpful in analyzing new observations from the solar and other astrophysical sources, and is also likely to be useful for modeling and diagnosing a variety of plasmas including astronomical and fusion plasma.

References

[1] K. Wang et al, The Astrophysical Journal Supplement 215, 26 (2014).

[2] K. Wang et al, The Astrophysical Journal Supplement 218, 16 (2015).

[3] K. Wang et al, The Astrophysical Journal Supplement 223, 3 (2016).

[4] K. Wang et al, The Astrophysical Journal Supplement (submitted).

[5] R. Si et al, The Astrophysical Journal Supplement (to be submitted).

[6] A. Kramida, Yu. Ralchenko , J. Reader, and NIST ASD Team, NIST. Atomic Spectra Database (ver. 5.3), [Online]. Available: `http://physics.nist.gov/asd` [2015, December 24].

[7] P. R. Yong et al, Journal of Physics B Atomic Molecular Physics 49, 74009 (2016).