Calculation of Atomic Data for NASA Missions

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Abstract

The interpretation of cosmic spectra relies on a vast sea of atomic data which are not readily obtainable from analytic expressions or simple calculations. Rather, their evaluation typically requires state-of-the-art atomic physics calculations, with the inclusion of weaker effects (spin-orbit and configuration interactions, relaxation, Auger broadening, etc.), to achieve the level of accuracy needed for use by astrophysicists. Our NASA-supported research program is focused on calculating data for three important atomic processes, 1) dielectronic recombination (DR), 2) inner-shell photoabsorption, and 3) fluorescence and Auger decay of inner-shell vacancy states. Our DR work has produced rate coefficients for all H-like through Na-like ions up to nuclear charge $Z = 30$. We compare some of these to existing experimental measurements. Present work is focused on the more challenging third-row isoelectronic sequences, some of which will be presented. K-shell photoabsorption cross sections for all oxygen and neon ions will be presented and compared to existing experimental measurements (i.e., neutral species only). These newly computed data have already been used to infer elemental abundances in the ISM by Juett, Schulz, and Chakrabarty. We also present new fluorescence yields for all second-row K-shell-vacancy isoelectronic sequences, where the inclusion of higher-order effects frequently give results that differ considerably from the currently recommended data.

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