

# **Uncertainties in Atomic Data and their Propagation through Spectral Models**

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We present a method for computing uncertainties in spectral models, i.e., level populations, line emissivities, and emission line ratios, based upon the propagation of uncertainties originating from atomic data. We provide analytic expressions, in the form of linear sets of algebraic equations, for the coupled uncertainties among all levels. These equations can be solved efficiently for any set of physical conditions and uncertainties in the atomic data.

Regarding the intrinsic uncertainties in theoretical atomic data, we propose that these uncertainties can be estimated from the dispersion in the results from various independent calculations. We apply our approach to the computation of atomic data for O III and Fe II. For these ions we derive data uncertainties by comparing all previous published data with several new calculations employing a variety of different methods, such as Hartree-Fock, Thomas-Fermi-Dirac potential, and Dirac-Fock, and R-matrix methods. Then, we construct excitation balance spectral models, and compare the predictions from each data set with observed spectra from various astronomical objects. We are thus able to establish benchmarks based on observed astronomical spectra.

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