

# Collisional Ionization Equilibrium for Optically Thin Plasmas

P. Bryans\*    N.R. Badnell†    T.W. Gorczyca‡    J.M. Laming§  
W. Mitthumsiri\*    D.W. Savin\*

February 3, 2006

## Abstract

Reliably interpreting spectra from electron-ionized cosmic plasmas requires accurate ionization balance calculations for the plasma in question. However, much of the atomic data needed for these calculations have not been generated using modern theoretical methods and their reliability are often highly suspect. We have carried out state-of-the-art calculations of dielectronic recombination (DR) rate coefficients for the hydrogenic through Na-like ions of all elements from He to Zn. We have also carried out state-of-the-art radiative recombination (RR) rate coefficient calculations for the bare through Na-like ions of all elements from H to Zn. Using our data and the recommended electron impact ionization data of Mazzotta et al. (1998), we present improved collisional ionization equilibrium calculations. We compare our calculated fractional ionic abundances using these data with those presented by Mazzotta et al. (1998) for all elements from H to Ni, and with the fractional abundances derived from the modern DR and RR calculations of Gu (2003a,b, 2004) for Mg, Si, S, Ar, Ca, Fe, and Ni.

This work is supported in part by the NASA APRA program.

---

\*Columbia Astrophysics Laboratory, New York, NY, USA

†University of Strathclyde, Glasgow, UK

‡Western Michigan University, Kalamazoo, MI, USA

§US Naval Research Laboratory, Washington, DC, USA