Radiative Cooling in Collisionally- and Photo-Ionized Plasmas

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Abstract. We discuss recent improvements in the calculation of the radiative cooling in both collisionally and photo ionized plasmas. We are extending the spectral simulation code Cloudy so that as much as possible of the underlying atomic data is taken from external databases, some created by others, some developed by the Cloudy team. This work focuses on recent changes in the treatment of many stages of ionization of iron, and discusses its extensions to other elements. The H-like and He-like ions are treated in the iso-electronic approach described previously. Fe II is a special case treated with a large model atom. Here we focus on Fe III through Fe XXIV, ions which are important contributors to the radiative cooling of hot (10^5 - 10^7 K) plasmas and for X-ray spectroscopy. We use the Chianti atomic database to greatly expand the number of transitions in the cooling function. Chianti only includes lines that have atomic data computed by sophisticated methods. This limits the line list to lower excitation, longer wavelength transitions. We had previously included lines from the Opacity Project database, which tends to include higher energy, shorter wavelength, transitions. These were combined with various forms of the "g-bar" approximation, a highly approximate method of estimating collision rates. For several iron ions the two databases are almost entirely complementary. We adopt a hybrid approach in which we use Chianti where possible, supplemented by lines from the Opacity Project for shorter wavelength transitions. The total cooling differs from some previous calculations by significant amounts.

Supported by NSF (0908877; 1108928; and 1109061), NASA (07-ATFP07-0124, 10-ATP10-0053, and 10-ADAP10-0073), JPL (RSA No 1430426), and STScI (HST-AR-12125.01, GO-12560, and HST-GO-12309).