Laboratory X-ray Spectroscopy Experiments in Support of NASA's X-ray Satellite Missions

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The power of moderate-to-high resolution x-ray spectroscopy to probe physical processes and conditions occurring in cosmic high temperature plasmas has become widely recognized by the astrophysical community following the launch of the *ASCA* Observatory. Moreover, it was realized that simple spectral models, which had been invoked in the past to analyze low-resolution, low-statistics data, do no longer fit the data. The new observations require more sophisticated astrophysical models that include a correct treatment of the atomic processes underlying the X-ray spectra. Not only simple atomic parameters such as oscillator and collision strenghts must be known correctly but the balance of all excitation and deexcitation processes that feed and deplete relevant quantum levels. The problems encountered in modelling of *ASCA* data will increase considerably when we begin to analyze the spectra acquired by the next series of X-ray observatories: *AXAF, XMM*, and *ASTRO E*.

In order to gain a quantitative understanding of which processes are important, we have established a state-of-the-art laboratory spectroscopy research program devoted to the measurement of key atomic processes central to the interpretation of high resolution X-ray spectroscopic observations of cosmic sources. Using an integrated set of spectroscopic equipment at the LLNL Electron Beam Ion Trap facility we have studied a broad range of processes peculiar to equilibrium and non-equilibrium plasmas, including electron-impact excitation, dielectronic recombination, resonance excitation, and innershell ionization. Measurements were carried out, for example, for the diagnostically relevant K-shell ions Ne VIII through Fe XXIV. Presently, we are focussing on definitve measurements of line emissivities for iron L-shell ions in optically thin, thermal plasmas in equilibrium to address systematic discrepancies between *ASCA* spectra and spectral synthesis codes in the vicinity of the iron L-shell complexes and to aid the development of spectral modeling codes for the upcoming high-resolution x-ray missions.

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