Charge Exchange Spectra of H-like and He-like Iron

B.J. Wargelin* P. Beiersdorfer† G.V. Brown† H. Chen†
P.A. Neill‡ R.E. Olson§ J.H. Scofield†

05 January 2006

Abstract

In our experiments, bare iron (Fe^{26+}) and hydrogen-like iron (Fe^{25+}) ions are produced in the Livermore electron beam ion trap, and a neutral target gas (either N_2, He, or H_2) is injected into the trap. The ions then undergo charge exchange reactions at a collision energy of ∼10 eV/amu and produce Fe XXV and Fe XXVI emission. These spectra are recorded with a solid-state Ge detector and/or the X-Ray Spectrometer (XRS) microcalorimeter provided by the Goddard Space Flight Center, which has an energy resolution of better than 10 eV. As expected, strong enhancement of emission from the Fe XXV forbidden and intercombination lines is observed, compared with the dominance of the resonance line in electron-impact-excitation spectra. Surprisingly, however, the Fe XXVI high-n Lyman lines have a summed intensity that in most instances is greater than that of Lyα; this is substantially stronger than predicted from theoretical calculations of charge exchange with atomic H. We conclude that the angular momentum distribution resulting from electron capture using a multi-electron target gas is significantly different from that obtained with H, resulting in the observed high-n enhancement.

*Harvard-Smithsonian Center for Astrophysics
†Physics, LLNL
‡UNR
§Physics, University of Missouri