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Spectroscopy of Highly Charged Ions for Astrophysics, Plasma Science, and Fundamental Science[1]

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The need for accurate atomic data of highly charged ions is spread across many branches of physics. The discovery of x-ray emission from various astrophysical objects produced by charge exchange of neutral species with highly charged ions has brought awareness that the atomic data underlying line formation is seriously inadequate, and laboratory spectroscopy is needed to advance the field. Similarly, the excitation cross sections for various L-shell emission lines of iron do not yet match the quality of the astrophysical data, thus limiting the diagnostic information that can be derived from orbiting observatories. Diagnosing the high-temperature plasmas expected to be produced by the ITER tokamak will require the development of diagnostics based on the spectroscopic emission of highly charged tungsten ions. Detailed spectroscopic studies of highly charged tungsten are now underway. Highly charged ions also provide a means for testing fundamental physics. Spectroscopic studies of U^{89+} provided tests of the two-loop QED terms on par with those provided by laser spectroscopy of atomic hydrogen, while measurements of the 1s hyperfine splitting of various isotopes up to Bi^{80+} have yielded data that until now have not been fully explained. This talk will point out current areas of research on highly charged ions performed on electron beam ion traps, synchrotron and free-electron x-ray lasers, and the Chandra X-ray Observatory, placing emphasis on unresolved issues and novel results.

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