

EDITORIAL

Spectroscopy of highly charged ions

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Editorial

Spectroscopy of highly charged ions

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The transition from neutral or near-neutral atoms to highly-charged ions (HCIs) represents more than a mere shift to shorter wavelengths in light emission. It is the physics of electron–electron and electron–nucleus interaction that undergoes significant modifications and this effect is profoundly exhibited through the spectra of HCIs. Today, multiply-charged ions are routinely produced in electron beam ion traps, storage rings, fusion devices, powerful light sources and other facilities, and their emission plays a dominant role in research and industrial applications. In recent decades, innovative experimental techniques, significant developments in fundamental physics of HCIs and impressive progress in spectra modeling have brought our understanding of HCIs and their spectra to a new level.

This special issue aims to deliver an overview of the present developments in HCI spectroscopy, from analysis of relativistic and quantum electrodynamic effects to hot plasma diagnostics to precise instrumentation to nuclear physics manifestations in HCI spectra. In addition, this collection attempts at providing insight into future directions in HCI research and the emerging opportunities. More than thirty papers written by the leading experts in this field cover diverse and prominent subjects. Among the discussed fundamental topics are studies of relativistic effects in dielectronic recombination, analysis and evaluation of precision spectra, quantum dynamics, photoionization and polarization effects for HCIs, to name a few. Extreme ultraviolet lithography has been an active user of HCI spectra and there are papers that provide a comprehensive view on the recent developments. Several papers discuss importance and peculiarities of HCI spectra in plasmas of tokamaks and stellarators, in particular their rich diagnostic potential. The issue also presents a number of experimental and theoretical papers on collisions between HCIs and electrons or other heavy particles. The interplay between nuclear and atomic effects is a subject of papers on hyperfine splitting and radioactive decays of HCIs.

We hope that this special issue gives both a timely and extensive snapshot of the many exciting developments in the spectroscopy of HCIs and stimulates new experimental and theoretical efforts on better understanding of their structure, interactions and applications.