# Detailed Spectra Modeling in Low-Density Plasmas

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The spectral properties of low-density plasmas are generally considered to be much easier to simulate as compared to dense optically-thick plasmas. Indeed, a simple coronal model may often provide accurate description of radiative power losses or spectral emission in strongest electric-dipole lines. However, more subtle spectral features, such as intensities of forbidden lines or spectral patterns under induced electric fields, may require not only a full-scale modeling of all relevant collisional and radiative processes but also development of new methods and tools for spectra calculation and analysis.

This approach will be exemplified by several applications of collisional-radiative (CR) modeling to low-density plasmas of electron beam ion traps (EBITs) and magnetic fusion devices. In particular, we will discuss identification of inner-shell dielectronic resonances from 50+-times ionized tungsten under EBIT conditions [1] and the effect of a magnetic-dipole line on allowed transitions in $Kr^{23+}$ and its potential use for fusion diagnostics [2]. In addition, the results of experimental validation of the recently developed CR parabolic-state model for motional Stark effect using the latest data from the Alcator-C Mod tokamak [3].

Another important subject for modeling applications is single-electron and multielectron charge exchange that is highly important in astrophysics, magnetic fusion, and some other fields of research. Charge exchange is known to provide very distinct spectral features due to electron capture into relatively high shells. While the spectra due to single and double electron transfer can be calculated reasonably well using standard CR models [4], the population kinetics and photon emission following multiple electron capture (MEC) have so far been treated with very approximate qualitative models. Moreover, the number of atomic states to be included increases significantly due to a large number of possible combinations of the electron momenta. We will present a detailed Monte-Carlo stabilization model for MEC that utilizes accurate radiative and autoionization data, can operate with tens of thousands of atomic states, and is orders of magnitude faster than the CR time-dependent simulations.

**References**

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