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Influence of metastable levels on the charge-state distribution of highly charged ions in EBIT plasma

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In an electron beam ion trap (EBIT) the ion plasma is confined in a spatially narrow region centered around the electron beam compressed to about 10^{10}-10^{12} cm^{-3} densities. The ion cloud in its equilibrium generally consists of a narrow distribution of charge states. This can be finely tuned by adjusting the electron beam energy and current, the axial magnetic field, and the amount of neutral atoms in the trap region. The almost mono-energetic electrons are responsible for electron impact ionization and recombination processes and contribute to the confinement of the ions.

In the EBIT of the National Institute of Standards and Technology (NIST) the non-Maxwellian plasma has been modeled by collisional-radiative calculations [1] to reliably predict the spectral emission of the ion cloud [2-3]. In recent experiments we have found that in some cases, the charge state distribution of the ions is strongly affected by metastable energy levels that accumulate considerable ion population. Ag-like and Ni-like heavy ions are examples of such systems, where the lowest excited states are highly metastable. The effect strongly depends on the density of the electrons; therefore, it can serve as a sensitive diagnostic of plasmas where metastable ions are present. Measured spectral features and details of model calculations will be presented.

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Presenting Author

Endre Takacs

Presenting Author Affiliation

Clemson University, Department of Physics and Astronomy

Presenting Author Gender

Male

Country

USA

Presenting Author Email Address

etakacs@clemson.edu

Primary author: Prof. TAKACS, Endre (Clemson University, Department of Physics and Astronomy)

Co-authors: DIPTI (IAEA); Mr HOSIER, Adam (Clemson University, Department of Physics and Astronomy); Mr BURKE, Timothy (Clemson University, Department of Physics and Astronomy); Dr O'NEIL, Galen C. (National Institute of Standards and Technology); Prof. MARLER, Joan P. (Clemson University, Department of Physics and Astronomy); RALCHENKO, Yuri (NIST)

Presenter: Prof. TAKACS, Endre (Clemson University, Department of Physics and Astronomy)

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