A review of astrophysically motivated atomic recombination and ionization measurements in ion storage rings

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Our understanding of the Cosmos rests, in part, on knowledge of the underlying processes that drive the Universe. Of particular importance for many astrophysical objects are those atomic processes which control the charge state distribution (CSD) of the observed plasmas. The CSD is intimately tied in to the observed spectral features and can also affect the thermal structure of the gas. Accurate atomic data are required in order to generate the CSD calculations necessary to reliably model and interpret astrophysical spectral observations (e.g., [1]).

Cosmic atomic plasmas can be divided into two broad classes: photoionized and electron ionized. Photoionized plasmas are formed in objects such as planetary nebulae, H II regions, X-ray binaries, and active galactic nuclei [2,3]. Electron-ionized plasmas are formed in objects such as the Sun and other stars, supernova remnants, galaxies, and the intercluster medium in clusters of galaxies [4]. In photoionized gas, the CSD is determined from ionization by both photons and the resulting photo-electrons balanced with recombination primarily via low temperature dielectronic recombination (DR). In electron-ionized gas the CSD results from the balance between electron impact ionization (EII) and recombination primarily via high temperature DR.

Here we present some of the various astrophysical motivations behind this research, review examples of relevant DR and EII studies which have been performed on ion storage rings [5,6,7], and discuss some of the implications of the results for both astrophysics and atomic physics.

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