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Electron-impact ionization measurements for use in astrophysics MARK E. BANNISTER, Oak Ridge National Laboratory

Spectroscopic data produced by an array of past, present, and future satellite and space observatories are being used to address many fundamental questions in astrophysics. Analyzing the collected spectra from electron-ionized plasmas, however, requires accurate ionization balance calculations for plasmas in collisional ionization equilibrium (CIE) as well as plasmas under conditions of non-equilibrium ionization (NEI). Therefore accurate electron-impact ionization (EII) data are needed for ions found in many cosmic plasmas where EII is the dominant ionization mechanism, such as supernova remnants, stellar coronae, the interstellar medium (ISM), the intracluster medium in clusters of galaxies, and elliptical galaxies. Here we report on a program of laboratory measurements of EII for ions in the berylliumlike isoelectronic sequence at the ORNL Multicharged Ion Research Facility. These results are compared with state-of-the-art non-perturbative calculations. Our studies also focus on measurements of EII for heliumlike and oxygenlike ions. For these three isoelectronic sequences there appear to be significant errors and uncertainties in the EII data used in astrophysics, primarily due to uncertainty in the fraction of metastable ions encountered in prior measurements. By determining the metastable ion fractions independently of the ionization experiments, our measurements will provide new EII data with total uncertainties of 15% or less.

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