Progress Towards Charge Exchange with Highly Charged Ions

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Keywords: Charge exchange, Ions, Cross-sections

Abstract: Highly charged ions (HCIs) are an integral component of atomic and molecular physics, in part because their compressed size and strong electric fields make them relevant to various areas of study, including quantum electrodynamics (QED). In addition, HCIs are often formed in conditions of extreme temperature or pressure, such as those found in astrophysics. These characteristics of HCIs increase the difficulty of HCI production in a laboratory setting compared to singly charged ions or neutral atoms, making HCIs less explored than other phenomena. Using HCIs created at the Clemson University Electron Beam Ion Trap (CUEBIT), we will study interactions between highly charged ions and neutral particles. A gas cell has been constructed in order to measure charge exchange cross-sections of these interactions. During the course of our work we confirmed that the gas cell was effective for analyzing singly charged ions (SCIs) by comparing our cross-section measurements to known literature values. These resulting measurements made with the gas cell will be presented along with ideas for further development of the system. In particular, plans to use the gas cell to perform these cross-section measurements for HCIs created by CUEBIT will be described. These studies on HCIs will assist in studies pertaining to QED and astrophysics, and will also result in additional understanding of the structure and nature of HCIs themselves.