Measurements of Electron Impact Excitation Cross Sections at the Harvard-Smithsonian Center for Astrophysics

Larry D. Gardner* John L. Kohl*

6 January 2006

Abstract

The analysis of absolute spectral line intensities and intensity ratios with spectroscopic diagnostic techniques provides empirical determinations of chemical abundances, electron densities and temperatures in astrophysical objects. Since spectral line intensities and their ratios are controlled by the excitation rate coefficients for the electron temperature of the observed astrophysical structure, it is imperative that one have accurate values for the relevant rate coefficients. Here at the Harvard-Smithsonian Center for Astrophysics, we have been carrying out measurements of electron impact excitation (EIE) for more than 25 years. We will illustrate our experimental approach and apparatus by discussing a measurement of EIE in C^{2+} ($2s2p\ ^3P^o \rightarrow 2p^2\ ^3P$). The technique employed utilizes a modulated beam of a single ion species which is crossed at 45 degrees with a similarly modulated electron beam. Photons from the decay of ions excited by collisions with the electrons are collected synchronously with the beams' modulation pattern by an absolutely calibrated optical system comprised of a mirror with an appropriate reflective coating, suitable filters, and a microchannel plate based photon counting detector. The experiment is being modified to enable measurements where the decay photon has a wavelength shortward of the cutoff wavelength of commonly available transmitting materials (e.g., MgF_2), which we have traditionally used as windows to limit the optical bandpass and isolate the photon detector system.

This work has been supported by NASA Supporting Research and Technology grants NAG5-9516 and NAG5-12863 in Solar and Heliospheric Physics and by the Smithsonian Astrophysical Observatory.

*Harvard-Smithsonian Center for Astrophysics