AN EXPERIMENTAL STUDY OF VISIBLE AND ULTRAVIOLET IMPURITY EMISSION FROM THE ALCATOR C TOKAMAK

by

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Abstract

Densities of carbon, oxygen, and silicon in Alcator C tokamak plasmas have been computed from spectroscopic measurements of the absolute brightnesses of visible and ultraviolet emission lines in combination with a one dimensional numerical calculation which models the charge state and emissivity profiles. Profiles of all the charge states of a particular impurity were calculated by utilizing independent measurements of plasma density and temperature and solving the coupled system of transport and rate equations connecting the ionization states. These profiles were then used to calculate emissivity and brightness profiles by solving the matrix equation relating the level populations through atomic processes such as electron impact excitation, de-excitation, spontaneous emission and cascades from upper levels. Good agreement was found between predicted impurity line brightnesses and experimentally measured brightnesses of different charge states.

Three different types of limiter materials, molybdenum, graphite and SiC coated graphite have been used on Alcator C. It was determined that the principal impurities in the plasma, under most conditions, depends upon the type of limiter being used. However, the sources of the impurities are both the wall and the limiters, since it was observed that the wall becomes coated with limiter material due to plasma discharges.

A significant influx of impurities directly from the limiters, causing an increase in the effective ion charge, was often seen during the application of lower hybrid RF power to the plasma. This RF induced influx of impurities exhibited a toroidal asymmetry for the low ionization states. Numerical simulations of toroidal transport of impurities were consistent with these observations.

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