SOFT X-RAY TOMOGRAPHY
ON THE ALCATOR C TOKAMAK

by

JOSEPH FRANK CAMACHO

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ABSTRACT

A soft x-ray tomography experiment has been performed on the Alcator C tokamak. An 80-chord array of detectors consisting of miniature PIN photodiodes was used to obtain tomographic reconstructions of the soft x-ray emissivity function's poloidal cross-section. The detectors are located around the periphery of the plasma at one toroidal location (top and bottom ports) and are capable of yielding useful information over a wide range of plasma operating parameters and conditions. The reconstruction algorithm employed makes no assumptions whatsoever about plasma rotation, position, or symmetry. Its performance was tested, and it was found to work well and to be fairly insensitive to estimated levels of random and systematic errors in the data.

The reconstructions of the soft x-ray emissivity can be used to study plasma position and shape under equilibrium conditions (i.e., Shafranov shift and non-circularity). MHD phenomena (e.g., disruptions and sawtooth oscillations), impurity effects, and several other aspects of plasma behavior. Of particular interest is the MHD activity which takes place in pellet-fueled discharges. Under these conditions, the reconstructions appear to indicate the presence of the $m = 1$ magnetic island structure associated with sawtooth oscillations. The behavior of the emissivity enhancement factor in this type of discharge is also presented. In addition to this rotating instability which accompanies sawtooth oscillations, the occurrence of an unexplained instability not associated with sawteeth and not exhibiting rotation is observed in other pellet-fueled plasmas.

A study was done of what further information could be obtained by installing an additional array of detectors on a side port in order to have more views of the plasma. Recommendations for future work along these lines are given.

Thesis Supervisor: Dr. Ronald R. Parker
Titles: Professor of Electrical Engineering
Associate Director, MIT Plasma Fusion Center