PRELIMINARY IMPLEMENTATION OF HIBP FOR HSX BASED UPON ELECTRIC FIELD EFFECTS

by

Michael A. Bingham

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

MASTER OF SCIENCE

Major Subject: Electrical Engineering

The original of the complete thesis is on file
In the Rensselaer Polytechnic Institute Library

Approved:

K. A. Connor, Thesis Adviser

Rensselaer Polytechnic Institute
Troy, New York

May, 2008
(For Graduation May 2008)

ABSTRACT

Completion of a design study on the reconstruction of the electric field $\vec{E}$ in a magnetically confined plasma by means of the deflection of a non-confined heavy ion beam has proven concept viability and prompted specific application of heavy ion beam probe technology (HIBP) to the Helically Symmetric eXperiment (HSX). Significant work was undertaken in the deconstruction of the Rensselaer Plasma Dynamics Laboratory (RPDL) HIBP and its preparation for application to HSX. The measurement is based upon the path integral effects the electric field $\vec{E}$ acting on a particle passing through a plasma where the magnetic field $\vec{B}$ is well known. As with standard HIBP technology it is feasible to alter the beam energy and injection angle allowing for the sampling of various regions within the plasma under study. It is possible to measure the deflection in the trajectory of the particle by means of a detection grid and obtain information about the plasma allowing for the reconstruction of the electric field $\vec{E}$. Previous study has demonstrated that reconstruction based on this technique is reasonable so long as $\vec{E}$ is sufficiently strong, being on the order of 1 percent of $\vec{v} \times \vec{B}$, where $\vec{v}$ is the velocity of the subject ion and $\vec{B}$ is the confining magnetic field. Major simplification is realized in the application of this diagnostic via the substantially lower ion accelerator voltages as compared to standard HIBP technology.