Proposal and Attendance Form for NSTX Research Forum 2001

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Please write in the boxes below a one-page abstract of your proposal to be presented:

Title: Steady state edge current profile modification using CHI (Thomas R Jarboe and Roger Raman)

Abstract: CHI experiments thus far have succeded in attaining 260kA of CHI generated toroidal current using about 27kA of injector current. CHI discharges have been obtained without relying on the Ohmic solenoid. Methods to safely ramp the CHI produced toroidal current to over 200ms have been developed. Experiments to date have shown that CHI engineering systems can be applied to a large ST for the production of substantial toroidal current. Driven toroidal currents are consistent with our present understanding of current multiplication. Experiments thus far constitute a test of CHI on NSTX.

We are interested in initiating CHI discharges in which CHI will provide some edge current to a pre-formed lower single null Ohmic discharge. The goals are to determine the magnitude of edge current that can be added without confinement degradation. Since CHI current drive is applied to the edge region, it is possible that this current drive method can be used to modify the bootstrap current drive profile by providing current drive in regions where conventional methods cannot provide current drive. In developing this current drive method, several piggy back experiments would be needed.

These are:

1. Improve EFIT to include open field line and private flux current (in collaboration with M. Schaffer, L. Lao of GA and S.M. Kaye of PPPL)
2. Improve TSC to model discharges that contain CHI edge current (in collaboration with S. Jardin, S. Kaye of PPPL).
3. Conduct fast camera measurements to observe edge fluctuations in the CHI current channel to understand mechanisms that transport this current into the edge closed flux region (in collaboration with R. Maqueda of LANL, S. Zweben of PPPL).
4. Conduct edge probing studies to understand current penetration mechanisms (in collaboration with H. Ji and S. Zweben of PPPL and the UC-SD group).
5. Initiate MSE measurements to understand current penetration mechanisms (in collaboration with F.M. Levinton).
6. Conduct divertor heat load studies to learn how to maximize the current that flows the long way around the torus and not in the private flux region. Additionally, these studies may lead to improved divertor tile material selection for the NSTX upgrade extension (in collaboration with R. Maingi of ORNL and H. Kugel of PPPL).
7. Extend feedback control to discharges that contain CHI edge current drive (in collaboration with David Gates of PPPL).

The eventual plan for the NSTX program is to fully drive MA discharges using non-inductive methods. Of this, CHI is expected to provide a fraction of the total current (current magnitude is yet to be determined). This current will be provided in the edge region and used to control the current profile in the edge region to optimize the bootstrap current profile. Additionally, this edge current drive may usefully contribute in other ways. These include: (1) Improvement in confinement due to alteration in edge plasma flows (as seen in PBX-M) and (2) Possibility of providing rotation to the edge plasma through an n=1 mode activity (as observed on the HIT-I, HIT-II, HIST and SPHEX experiments). The acceptable amplitude and frequency of this mode (for the purpose of edge plasma rotation in NSTX) is yet to be determined. The possibility of providing edge rotation could be quite important in a reactor where neutral beams will not be used for plasma heating during steady state operation.
We expect that many of the techniques needed to make this system feasible (edge current drive, confinement improvement, edge rotation) will be developed in the present NSTX machine configuration. Necessary hardware machine modifications will then be implemented during the NSTX center stack machine upgrade to optimize these methods in the upgraded NSTX machine.

Choose only one topical session by inserting X for each proposal (Use separate forms for separate proposals)	**2000 Results** (mbell@pppl.gov) **& 2001 Research Program** (esynakowski@pppl.gov) (Please submit by January 10, 2001) __ET1: Macroscopic Stability __ET2: Transport & Turbulence __ET3: High Harmonic Fast Wave & Electron Bernstein Wave __ET4: Coaxial Helicity Injection __ET5: Boundary Physics **2002-2005 Research Opportunities** (mpeng@pppl.gov) (Please submit by January 11, 2001) __TG1: Noninductive Startup **_X_TG2: Heating, Current Drive & Fueling** __TG3: Macroscopic Stability __TG4: Transport & Turbulence __TG5: Energetic Particle Physics __TG6: Multiphase Interface (Boundary Physics) __TG7: Plasma Science User Research **Fluctuations Measurement** (esynakowski@pppl.gov) (Please submit by January 10, 2001) __Fluctuations Measurement proposals

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