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: Non inductive plasma startup using Coaxial Helicity Injection

Abstract: Coaxial Helicity Injection on NSTX (FY 02 to 05 Goals)

Thomas R. Jarboe and Roger Raman

PPPL collaborators: David Gates, Dennis Mueller, Masa Ono, Stan Kaye and others

CHI experiments thus far have succeed 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 durations 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. Toroidal current startup scenarios have been developed. Our next step plans are to conduct a test of plasma startup and to establish plasma startup using CHI.

Our plans for FY 02 to 05 are as follows.

FY 01 to 02 (10/00 to 3/02) [Test plasma startup]

- Extend the CHI produced toroidal current up to the 500kA level.
- Investigate flux closure.
- Initiate experiments on adding CHI to an Ohmic discharge (in collaboration with D. Mueller of PPPL) - The purpose here is to begin to develop understanding of feed back control of discharges that also contain a CHI component. Since these discharges will initially contain a much larger portion of transformer driven current and will be feedback controlled to start with, modifications to the feedback control system can be made in gradual steps as the portion of the CHI current is increased in gradual steps. Eventually, methods developed here will be used on CHI only discharges that are used for plasma startup.
- Drive a high current CHI produced target plasma using OH induction.
- Consider discharges with no TF for FRC formation (in collaboration with F. Perkins of PPPL and Y. Ono of U-Tokyo). This will be a transient experiment and not steady state in nature. This represents an alternate method for plasma startup. After FRC formation, currents in the CHI circuit will be turned off. Once the FRC plasmoid has formed, the TF can be ramped up in current while simultaneously others methods are used to sustain the discharge (HHFW, NBI, Ohmic).

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 CHI discharge evolution (in collaboration with S. Jardin, S. Kaye of

PPPL).

3. Design faster acting PF coils to reduce field in the absorber region (in collaboration with M. Ono, C. Neumeyer of PPPL and others). This means two new PF coils for the absorber region. The primary motivation for these coils is to reduce the stray poloidal fields in the absorber. Therefore these coils will have few turns (low inductance, faster acting) and low current capability (since the stray field magnitudes in the absorber are small).
4. Initiate feedback control studies on discharges in which CHI is added to an Ohmic discharge and identify needed diagnostics (in collaboration with D. Gates of PPPL).
5. Conduct discussion on the feasibility of advanced spheromak merging experiments and related hardware changes (in collaboration with the NSTX Engineering team, Y. Ono, D. Mueller and others)

FY 02 to 03 (4/02 to 9/03) [Establish plasma startup , Non-inductive sustained operation]

- Implement fast PF coils for absorber field reduction.
- Establish plasma start-up without the OH coil.
- Produce reference operating conditions in which CHI provides edge current drive.
- Operate with no external TF for FRC formation test.

1. Conduct fast camera measurements (in collaboration with R. Maqueda of LANL, S. Zweben of PPPL).
2. Conduct edge probing studies (in collaboration with H. Ji and S. Zweben of PPPL).
3. Initiate MSE measurements (in collaboration with F.M. Levinton).
4. Conduct divertor heat load studies (in collaboration with R. Maingi of ORNL and H. Kugel of PPPL).
5. Routine EFIT and TSC for CHI only discharges.

6. Extend feedback control to CHI only discharges and implement needed diagnostics.
7. Initiate work on 3D MHD modeling using existing codes (M3D, Nimrod) through graduate student involvement.

8. Design improved insulator for CS upgrade (in collaboration with PPPL Engineers).
9. Install improved design insulator.
10. Consider and if necessary design and implement hardware modifications for advanced spheromak merging experiments.

FY 04 to 05 (10/03 to 3/06) [Routine plasma startup, Routine operation with new CS, Current drive understanding]

- Initiate experiments with new CS.
- Implement full feedback control of CHI discharges using improved insulator, faster absorber PF coils and previously developed CHI discharges.

1. Detailed measurements using edge probe, MSE, Fast Camera.
2. Understand mechanisms that lead to closed flux generation based on edge probing studies, MSE measurements, EFIT, TSC simulations and other diagnostics.

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) **_X_TG1: Noninductive Startup** __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

Select a presentation option by inserting X:

_X_Oral presentation in person
__Remote presentation via ShowStation and speakerphone
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__No need to present, but include in meeting summaries
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Special Requests for your proposal (projector type, time constraints, etc.):

Please return this document via e-mail attachment to jrobinson@pppl.gov, jsavino@pppl.gov, and the corresponding organizer listed above. Please e-mail questions or comments to the organizers listed above.