Princeton Plasma Physics Laboratory
NSTX Experimental Proposal

Title: **Application of early error field correction to advanced scenarios**

OP-XP-1004	Revision:	Effective Date: **3/22/2010** *(Approval date unless otherwise stipulated)* Expiration Date: **3/22/2012** *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: J. Menard Jonathan Menard Digitally signed by Jonathan Menard DN: cn=Jonathan Menard, o=PPPL, ou=NSTX, email=jmenard@pppl.gov, c=US Date: 2010.03.22 10:06:26 -04'00'	Date **3/22/2010**
ATI – ET Group Leader: S. Gerhardt	Date
RLM - Run Coordinator: E. Fredrickson	Date

Responsible Division: Experimental Research Operations

RESTRICTIONS or MINOR MODIFICATIONS
(Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

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AUTHORS: **J.E. Menard** DATE: **3/22/1010**

1. Overview of planned experiment

The goal of the proposed experiment is to further optimize early n=1 error-field correction for range of plasma density and flat-top current values. Scans of the time, amplitude, and toroidal phase of the applied early error field correction will be performed to minimize the plasma rotation damping and reduce and/or eliminate the early onset of tearing modes and mode locking.

2. Theoretical/ empirical justification

Previous operation with LITER has shown that low plasma density early in the discharge (first 200ms) can lead to locked tearing modes and disruptions. In 2009, reduction of the OH×TF error field early in the current ramp-up resulted in increased plasma rotation and reduced duration of early tearing modes. Additional optimization of correction is needed to maximize plasma rotation and reduce mode locking. Such correction could be important for reduced density advanced scenarios expected with the LLD.

3. Experimental run plan

A. Reproduce increased rotation w/ n=1 early EFC using fiducial or 700kA shot 135779 (4 shots)

B. Scan EFC turn-on time, amplitude, phase to optimize EFC

  a. Timing scan: -30, -20, -10, 0, +20, +40ms (5-7 shots)

  b. Amplitude scan: ×0.6, 0.8, 1, 1.2, 1.4 (4-6 shots)

  c. Phasing scan: -30, -15, 0, 15, 30° (4-6 shots)

C. Assess stability at low density with and without optimized n=1 EFC

  a. Reduce density in 20% steps until LM disruption with n=1 EFC (8 shots)

D. Increase flat-top I_P and assess/optimize n=1 EFC

  a. Scan EFC amplitude: ×0.8, 1.2, etc. for 0.9MA, 1.1MA (6 shots)

E. Assess impact of early EFC on breakdown by turning on EFC during OH pre-charge (2 shots)

4. Required machine, NBI, RF, CHI and diagnostic capabilities

See Physics Operations Request

5. Planned analysis

MSE LRDFIT + TRANSP + IPEC analysis to understand EF penetration, locking, rotation damping.

6. Planned publication of results

Results will be published in Physics of Plasmas or Nuclear Fusion or similar within 1 year.

PHYSICS OPERATIONS REQUEST

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Brief description of the most important operational plasma conditions required:

Reproducible 700kA NBI discharge (or best available fiducial) with early H-mode.

Previous shot(s) which can be repeated: 135779 or 135774 or fiducial

Previous shot(s) which can be modified: (see above)

Machine conditions *(specify ranges as appropriate, strike out inapplicable cases)*

I_{TF} (kA): **45kA** Flattop start/stop (s): **-0.040/1.75s**

I_P (MA): **0.7MA** Flattop start/stop (s): **0.15-1.5s**

Configuration: **LSN/DND**

Equilibrium Control: **Isoflux** (rtEFIT)

Outer gap (m): **see reference** Inner gap (m): Z position (m):

Elongation: Triangularity (U/L): OSP radius (m):

Gas Species: **D** Injector(s): **see reference shot**

NBI Species: **D** Voltage (kV) **A: 90** **B: 90** **C:** 70 Duration (s): **1.5s**

ICRF Power (MW): **0** Phase between straps (°): Duration (s):

CHI: **Off** Bank capacitance (mF):

LITERs: On Total deposition rate (mg/min): **20mg/min**

LLD: Temperature (°C): **warm (if warm LLD provides reproducible pumping)**

EFC coils: On Configuration: **Odd**

DIAGNOSTIC CHECKLIST

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Note special diagnostic requirements in Sec. 4

Diagnostic	Need	Want
Beam Emission Spectroscopy		X
Bolometer – divertor		X
Bolometer – midplane array		X
CHERS – poloidal		X
CHERS – toroidal	X	
Dust detector		X
Edge deposition monitors		X
Edge neutral density diag.		X
Edge pressure gauges		X
Edge rotation diagnostic		X
Fast cameras – divertor/LLD	X	
Fast ion D_alpha - FIDA		X
Fast lost ion probes - IFLIP		X
Fast lost ion probes - SFLIP		X
Filterscopes	X	
FIReTIP		X
Gas puff imaging – divertor		X
Gas puff imaging – midplane		X
Hα camera - 1D		X
High-k scattering		X
Infrared cameras		X
Interferometer - 1 mm		X
Langmuir probes – divertor		X
Langmuir probes – LLD		X
Langmuir probes – bias tile		X
Langmuir probes – RF ant.		X
Magnetics – B coils	X	
Magnetics – Diamagnetism		X
Magnetics – Flux loops	X	
Magnetics – Locked modes	X	
Magnetics – Rogowski coils	X	
Magnetics – Halo currents		X
Magnetics – RWM sensors	X	
Mirnov coils – high f.		X
Mirnov coils – poloidal array		X
Mirnov coils – toroidal array	X	
Mirnov coils – 3-axis proto.		X

Note special diagnostic requirements in Sec. 4

Diagnostic	Need	Want
MSE		X
NPA – E‖B scanning		X
NPA – solid state		X
Neutron detectors	X	
Plasma TV	X	
Reflectometer – 65GHz		X
Reflectometer – correlation		X
Reflectometer – FM/CW		X
Reflectometer – fixed f		X
Reflectometer – SOL		X
RF edge probes		X
Spectrometer – divertor		X
Spectrometer – SPRED		X
Spectrometer – VIPS		X
Spectrometer – LOWEUS		X
Spectrometer – XEUS		X
SWIFT – 2D flow		X
Thomson scattering	X	
Ultrasoft X-ray – pol. arrays		X
Ultrasoft X-rays – bicolor		X
Ultrasoft X-rays – TG spectr.		X
Visible bremsstrahlung det.		X
X-ray crystal spectrom. - H		X
X-ray crystal spectrom. - V		X
X-ray tang. pinhole camera		X