Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: **Ohmic H-Modes**		
OP-XP-1039	Revision: **3**	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: S. Kubota	Date
ATI – ET Group Leader: Howard Yuh	Date
RLM - Run Coordinator: Eric Fredrickson	Date
Responsible Division: Experimental Research Operations	

RESTRICTIONS or MINOR MODIFICATIONS

(Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: **Ohmic H-Modes** No. **OP-XP-1039**

AUTHORS: **S. Kubota, K.C. Lee, R. Maingi, S.J. Zweben, R.J. Maqueda, R.E. Bell, B.P. LeBlanc, S.M. Kaye, T.S. Hahm, R. Raman**

DATE: **October 6, 2010**

1. Overview of planned experiment

This experiment revisits Ohmic H-modes (similar to XP-506) with new and upgraded turbulence diagnostics. The purpose is to study turbulence in the L-mode phase, H-mode phase, and at the L-H transition, with the goal of correlating both local (edge) and non-local (core) turbulence behavior with the ETB formation. Comparisons will be made with existing L-H transition theories, including K.C. Lee's gyrocenter shift theory.

2. Theoretical/ empirical justification

Ohmic H-modes offer a good template for studying the L-H transition: 1) peaked density profiles provide good targets for the reflectometers, 2) there are no fast-ion driven fluctuations to complicate turbulence measurements, and 3) we avoid complicating physics due to external momentum input and hot fueling. In addition, several upgraded and new turbulence diagnostics are available for 2010.

3. Experimental run plan

(1) Re-establish Ohmic H-mode shot similar to 129693. Adjust fueling gas puff/Li to reach higher target electron density (~1.5x). Goal is to create reproducible L-H transition during the initial phase of the I_p flattop (~100 ms) with edge densities in the range ~1.0-1.5x10^{13} cm^{-3}. Target shape and densities are close to those in a more recent Ohmic H-mode shot, 138118. If L-H transition cannot be achieved with reproducible timing, use slight I_p rampdown at beginning of flattop. Shot development phase to be done without GPI. (6 shots)

(2) If reproducible L-H transition conditions are realized, set target and take data. (6 shots)

Settings for the poloidal correlation reflectometer will be adjusted. At least 2 good shots are required at each setting (one shot with GPI, one without).

a. Reflection layer ~ETB radius. (2 shots)

b. Reflection layer outside ETB radius. (2 shots)

c. Reflection layer inside ETB radius. (2 shots)

(3) If adequate time remains continue on to DND configuration. Create symmetric DN (by copying PF2L into PF3L, PF3L to PF3U). As in (1), establish stable target with appropriate density and reproducible L-H transition. Poloidal correlation reflectometer starts at best position from (2). Complete as much of scan in (2) as time permits. (8 shots)

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

A well conditioned chamber with low recycling is necessary. The lead diagnostics are the reflectometers (FMCW, correlation, and fixed-frequency) and GPI. Other required diagnostics are the ERD, MPTS, CHERS (passive), and the FIReTIP edge channel. Additional requested diagnostics are the ORNL SOL reflectometer (dwell mode), high-k, USXR, edge probes, divertor calibrated Dα camera (edge neutral density diagnostic), and ME-SXR.

Note that some reflectometer modes of operation have not been commissioned. Additional XMP time may be requested for the reflectometers, pending analysis of the data.

5. Planned analysis

EFIT, LRDFIT, TRANSP, edge and core gyro-kinetic codes. Analysis of reflectometry data will require the use of 1D and 2D UCLA full-wave codes. Analysis of passive CHERS measurements and estimates of the edge neutral density from calibrated Dα measurements are also necessary.

6. Planned publication of results

This XP combines several new and unique diagnostic capabilities for looking at turbulence, which should yield several publications: PRL, PPCF, PoP, RSI.

PHYSICS OPERATIONS REQUEST

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(use additional sheets and attach waveform diagrams if necessary)

Brief description of the most important operational plasma conditions required:

Reproducible L-H transition times during current flattop and at appropriate edge densities (~1.0-1.5x10^{13} cm^{-3}).

Previous shot(s) which can be repeated: 129693

Previous shot(s) which can be modified: 129693

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

I_{TF} (kA): **53** Flattop start/stop (s): **0.0/0.6**

I_P (MA): **0.9** Flattop start/stop (s): 0.2/0.6

Configuration: **DN / LSN**

Equilibrium Control: **Outer gap / Isoflux** (rtEFIT) **/ Strike-point control** (rtEFIT)

Outer gap (m): Inner gap (m): Z position (m): **0.0**

Elongation: **~2** Triangularity (U/L): **0.4** OSP radius (m):

Gas Species: **D** Injector(s): **Centerstack**

NBI Species: **D** Voltage (kV) **A: 0** **B: 0** **C: 0** Duration (s):

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

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

LITERs: Off / On Total deposition rate (mg/min):

LLD: Temperature (°C):

EFC coils: Off/On Configuration: **Odd / Even / Other** *(attach detailed sheet)*

DIAGNOSTIC CHECKLIST

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Note special diagnostic requirements in Sec. 4

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

Note special diagnostic requirements in Sec. 4

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