Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: **Effect of Rotation on the L-H Threshold**		
OP-XP-936	Revision:	Effective Date: **4/20/09** *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: Stanley Kaye	Date
ATI – ET Group Leader: Kevin Tritz	Date
RLM - Run Coordinator: Roger Raman	Date4/20/09
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

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AUTHORS: **S. Kaye** DATE: **4/16/09**

1. Overview of planned experiment

The goal of this experiment is to study the effect of rotation on the L-H threshold power. n=3 braking will be used to vary the rotation.

2. Theoretical/ empirical justification

This XP studies the effect of rotation, and by extension rotational shear at the edge, on the L-H threshold. This has direct bearing on developing an understanding of the effect of this edge rotational shear and how it might impact thresholds in future devices at both low rotation (ITER) and at higher rotation (NHTX, ST-CTF). Results on MAST indicate that the L-H transition is delayed with increasing applied n=3 field, although the real reason for this is not known. Applied n=1 fields on MAST showed no change. This study is an element of an ITPA JEX.

3. Experimental run plan

- Establish L-H threshold power in **high-κ**, δ **LSN** discharge (**132717 baseline**) using one source (use B or B+C as needed, initially); vary voltage in source to achieve threshold. If necessary modulate source to lower power even farther
  - Use optimal n=3 error field correction (-300 A in SPA1) and n=1 mode control
  - Source C will allow lower power (voltage) if necessary
- Vary n=3 SPA coil current to 0 A, 400 A, 800 A (adjust levels as necessary to avoid disruptions)
  - Establish threshold in same manner at each level.
- Use 10-15 mg/min Li evaporation
- No HeGDC between shots.
- Shorten shot to 500-600 ms to reduce shot cycle to 10 minutes if possible

TABULAR SHOT LIST

Condition	**I_p (MA)**	**B_T (T)**	**SPA 1 Current (steady)**
1	0.8	0.45	-300 A (optimum)
2	0.8	0.45	0 A
3	0.8	0.45	400 A
4	0.8	0.45	800 A

Total: 12 good shots

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

Discharge reproducibility, including ability to achieve H-mode.

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5. Planned analysis

EFIT, TRANSP, specialized codes

6. Planned publication of results

TTF, ITPA, IAEA

TTF, ITPA, IAEA PHYSICS OPERATIONS REQUEST

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Describe briefly the most important plasma conditions required for the XP:

Discharge reproducibility achieving the L-H transition.

List any pre-existing shots: 132717

Equilibrium Control: Gap Control / rtEFIT(isoflux control): rtEFIT

Machine conditions *(specify ranges as appropriate, use more than one sheet if necessary)*

I_{TF} (kA): **52 (4.5 kG)** Flattop start/stop (s):

I_P (MA): 0.8 MA Flattop start/stop (s):

Configuration: **LSN**

Outer gap (m): **0.09** Inner gap (m): **0.38** Z position (m): **0.00**

Elongation κ: **~2** lower triangularity δ: ~

Gas Species: **D** Injector(s): as in 132717

NBI Species: **D** Voltages (kV) **A: 90 B: var C:** var Duration (s): on @ 190 ms

ICRF Power (MW): 0 Phasing: Duration (s):

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

LITERs: On Total deposition rate (mg/min): as in 132717

EFC coils: On Configuration: **optimum EF correction to start, n=1 f/b**
Coils on at 150 ms.

DIAGNOSTIC CHECKLIST

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Note special diagnostic requirements in Sec. 4

Diagnostic	**Need**	**Want**
Bolometer – tangential array	√	
Bolometer – divertor		
CHERS – toroidal	√	
CHERS – poloidal	√	
Divertor fast camera		
Dust detector		
EBW radiometers		
Edge deposition monitors		
Edge neutral density diag.		
Edge pressure gauges		
Edge rotation diagnostic		
Fast ion D_alpha - FIDA		√
Fast lost ion probes - IFLIP		
Fast lost ion probes - SFLIP		
Filterscopes	√	
FIReTIP		
Gas puff imaging		
Hα camera - 1D		
High-k scattering		√
Infrared cameras		
Interferometer - 1 mm		
Langmuir probes – divertor		
Langmuir probes – BEaP		
Langmuir probes – RF ant.		
Magnetics – Diamagnetism		√
Magnetics – Flux loops	√	
Magnetics – Locked modes		√
Magnetics – Pickup coils	√	
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 – ExB scanning		
NPA – solid state		
Neutron measurements	√	
Plasma TV		
Reciprocating probe		
Reflectometer – 65GHz		
Reflectometer – correlation		
Reflectometer – FM/CW		
Reflectometer – fixed f		√
Reflectometer – SOL		
RF edge probes		
Spectrometer – SPRED		√
Spectrometer – VIPS		
SWIFT – 2D flow		
Thomson scattering	√	
Ultrasoft X-ray 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 fast pinhole camera		
X-ray spectrometer - XEUS		√