Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**		
Title: **I_p Dependence of L-H threshold, Hysteresis and Confinement Quality**		
OP-XP-922	Revision: **0**	Effective Date: Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS	
Responsible Author: Stanley Kaye	Date 2/9/09
ATI – ET Group Leader: Kevin Tritz	Date
RLM - Run Coordinator: Roger Raman	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: **I_p Dependence of L-H threshold, Hysteresis and Confinement Quality** No. **OP-XP-922**

AUTHORS: **S. Kaye, R. Maingi, W. Solomon** DATE: **Feb. 9, 2009**

1. Overview of planned experiment

The goal of this experiment is to the measure the dependence of the L-H threshold power on plasma current, confinement quality for powers just above the threshold, and H-L hysteresis.

2. Theoretical/ empirical justification

This XP studies the effect plasma current on the L-H threshold. This has direct bearing on developing an understanding of the thresholds in future devices at both low rotation (ITER) and at higher rotation (NHTX, ST-CTF). This study is an element of an ITPA JEX. It further assesses confinement quality for powers just above the threshold power (can H~1 be attained at this power level?) as well as the H-L hysteresis. Both these issues are the foci of ITPA JEXs.

3. Experimental run plan

- Establish L-H threshold power in high-κ, δ LSN discharge (127267 baseline, but with I_p=700 kA). This shape was chosen in order to avoid OH H-modes. The power will be varied by either lowering the beam voltage, or modulating the source if necessary.
    - Use optimal n=3 error field correction (-300 A in SPA1) and n=1 mode control
- Maintain plasma discharge at $P \sim P_{LH}$ (once in H-mode) for as long as possible
    - Assess confinement quality
    - Determine H-L hysteresis as density increases (does P_{heat} drop below "new" P_{LH}?)
- Vary I_p in two additional steps (150 kA each step)
    - Establish threshold, H, H-L hysteresis in same manner at each level (may not be possible at highest current)
- Use 10-15 mg/min Li evaporation.
- No HeGDC between shots.
- Start with Source A on 10 ms after I_p flattop reached
    - Do not use preheat unless necessary to achieve good discharge conditions. If necessary, preheat with Source A from 80 to 140 ms.

TABULAR SHOT LIST

Condition	**I_p (MA)**	**B_T (T)**	**SPA 1 Current (+low-n feedback)**
1	0.7	0.45	-300 A (optimum)
2	0.850	0.45	-300 A (optimum)
3	1.0	0.45	-300 A (optimum)

Total: ~12 shots

If there is additional time, assess confinement quality, hysteresis at one current at different powers (2 shots each)

$P \sim 1.15\ P_{LH}$

$P \sim 1.3\ P_{LH}$

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

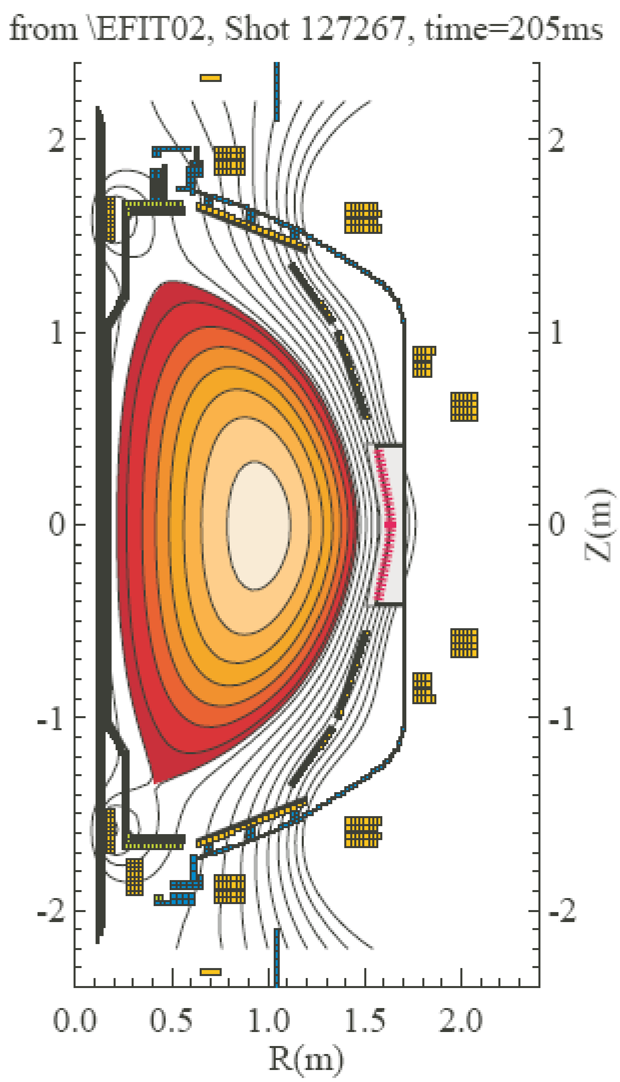
Discharge reproducibility, ability to achieve H-mode with one source.

5. Planned analysis

EFIT, TRANSP, specialized codes

6. Planned publication of results

Joule milestone, TTF, ITPA, IAEA



PHYSICS OPERATIONS REQUEST

TITLE: **I_p Dependence of L-H threshold, Hysteresis and Confinement Quality** No. **OP-XP-922**

AUTHORS: **S. Kaye, R. Maingi, W. Solomon** DATE: **Feb. 9, 2009**

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

Discharge reproducibility, ability to achieve H-mode with one source.

List any pre-existing shots: 127267

Machine conditions (specify ranges as appro priate)

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

I_P (MA): **0.7, 0.85, 1.0** Flattop start/stop (s):

Configuration: **LSN**

Outer gap (m): Inner gap (m):

Elongation κ: ~**1.9** Upper/lower triangularity δ: ~**0.65**

Z position (m): **0**

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

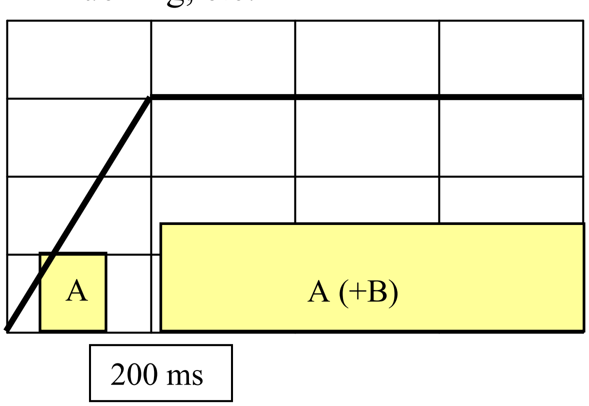
NBI Species: **D** Sources: **3** Voltage (kV): 55-**80 (B, C), 90 (A)** Duration (s): **<0.6 s**

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

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

LITER: On **15 mg/min**

Or: Sketch the desired time profiles, including inner and outer gaps, κ, δ, heating, fuelling, etc.



Start without Source A preheat; use only if necessary.

DIAGNOSTIC CHECKLIST

TITLE: **I_p Dependence of L-H threshold, Hysteresis and Confinement Quality** No. **OP-XP-922**

AUTHORS: **S. Kaye, R. Maingi, W. Solomon** DATE: **Feb. 9, 2009**

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		√