Princeton Plasma Physics Laboratory
NSTX Experimental Proposal

Title: Long pulse double null development		
OP-XP-603	**Revision:**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS	
Author: D. Gates	Date 1/26/2006
ATI – ET Group Leader: D. Gates/ S. Kaye	Date
RLM - Run Coordinator: R. Raman, S. Sabbagh (Deputy)	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

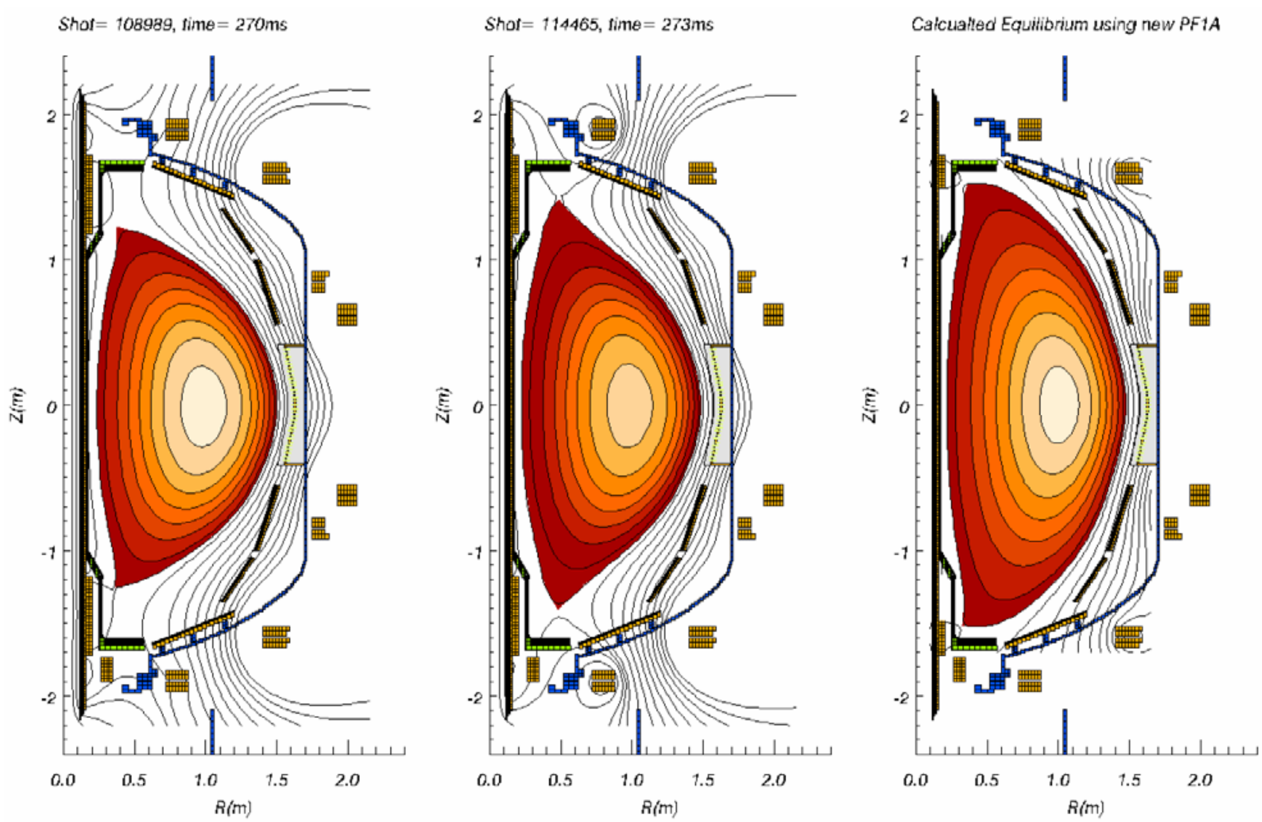
Long pulse double null development at high κ and δ **OP-XP-603**

1. Overview of planned experiment

The goal is to develop and study long pulse plasmas at high elongation and triangularity, taking advantage of the upgraded PF1A coil. The plasma will be shaped as early as feasible and the plasma will be ramped as quickly as possible, so as to minimize internal inductance. The first phase goal is to achieve early H-mode in a double null plasma with a high initial ramp rate which will then be fixed at the optimum. Upon completion of the ramp-up phase of the XP, a toroidal field and plasma current scan will be performed, with only the secondary current ramp rate being varied.

2. Theoretical/ empirical justification

This experiment is the most recent in a series of experiments designed to investigate the performance of highly shaped double null plasmas with density control using lithium. Experience from 2005 indicates that high elongation and high triangularity operation is capable of supporting interesting plasma performance regimes. This experiment directly



addresses the goals of the NSTX five-year plan. Lithium will be investigated as a means for density control

3. Experimental run plan

Scenario A:

1. Repeat shot 119040.

2. Increase plasma elongation as much as possible. Balance the PF1As slightly downwards at high kappa ~ 2.4.

3. Inject source B first a t= 0.05s and vary timing of sources A and C between 0 – 100ms after the start of H-mode. (5 shots)

4. Do I_p scan between 0.8 and 1.2MA. Bt scan between 3.0kGauss and 4.5kGauss. (30 shots)

Case	Bt	Ip
1	4.5kGauss	1MA
2	4.0kGauss	1.2MA
3	3.5kGauss	0.8MA
4	3.0kGauss	1MA
5	4.5kGauss	1.2MA
6	4.5kGauss	0.8MA
7	4.0kGauss	1.2MA
8	3.5kGauss	1.2MA
9	3.0kGauss	1.2MA
10	4.0kGauss	0.8MA
11	3.5kGauss	0.8MA
12	3.0kGauss	0.8MA

Scenario B: With lithium.

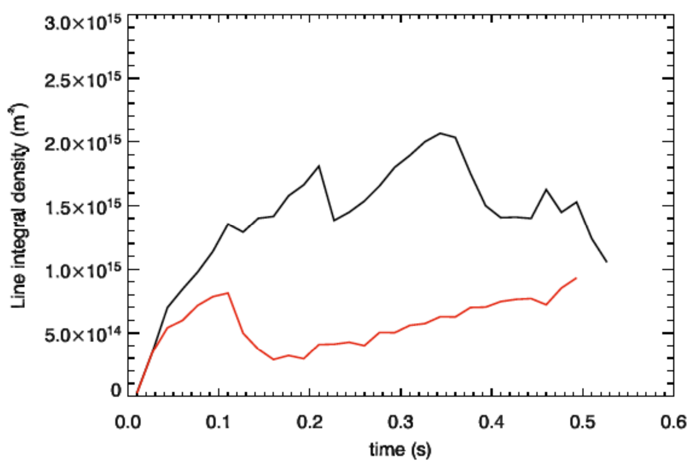
1. Start from “best” shot of lithium boundary XP or 117814. (2 shots)

2. Use lithium scenario that leads to steady wall pumping conditions. (Requirement to have good pumping combined with reasonable shot rep rate). Vary glow time between 5 an 15 minutes to measure effect on density rise.

3. Adjust fueling to obtain steady state density n_e ~$3x10^{19}m^{-3}$ in flat-top. Requirement is to maintain H-mode and good confinement) Use shoulder, midplane puffers, lower dome and SGI.

Start with shoulder and vary start pressure form 1200-1500Torr maintaining early H-mode (at t~120ms). Add in shoulder during ramp if necessary. Try SGI as a steady fueling source. Start at full flow, and binary step down. Consider adding a second high field side plenum at lower pressure.

4. Time permitting do again at n_e ~ $5x10^{19}m^{-3}$.



Comparison between shot 117111 and shot 117075 (before and after 30mg lithium pellet)

The goal should be to create a long pulse discharge with steady density that mimics the control shot (117814).

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

Reliable high power NBI is a prerequisite. Thomson is required. CHERS and MSE are highly desirable. A recent boronization is required. It would be best to have investigated the use of the movable glow probe ahead of time. LITER will be required for Scenario B.

5. Planned analysis

EFIT is required. TRANSP will be run on select shots according to data availability. TSC analysis is a possibility. Time dependent DCON analysis will be run on select shots.

6. Planned publication of results

These types of discharges have typically been the subject of our invited talks about long pulse and steady state (Physics of Plasmas, Nucl. Fusion). If performance is as expected, this should be the case again.

PHYSICS OPERATIONS REQUEST

Long pulse double null development at high κ and δ **OP-XP-603**

Machine conditions (specify ranges as appropriate)

I_{TF} (kA): **36kA-54kA** Flattop start/stop (s): **N/A**

I_P (MA): **0.8 - 1.2MA** Flattop start/stop (s): **200ms/as long as possible**

Configuration: **Double Null**

Outer gap (m): **10cm**, Inner gap (m): **2-4cm**

Elongation κ: **2.5**, Triangularity δ: **0.8**

Z position (m): **0.00**

Gas Species: **D**, Injector: **Midplane CS gas valve**

NBI - Species: **D**, Sources: **A/B/C**, Voltage (kV): **90kV**, Duration (s): **400ms**

ICRF – Power (MW): **None**, Phasing: **N/A**, Duration (s): **N/A**

CHI: **Off**

Either: List previous shot numbers for setup: **See chart above.**

Or: Sketch the desired time profiles, including inner and outer gaps, κ, δ, heating, fuelling, etc. as appropriate. Accurately label the sketch with times and values.

DIAGNOSTIC CHECKLIST

Stability limits vs. normalized current at high delta with new PF1A **OP-XP-603**

Diagnostic	**Need**	**Desire**	**Instructions**
Bolometer – tangential array		✔	
Bolometer array - divertor		✔	
CHERS		✔	
Divertor fast camera		✔	
Dust detector		✔	
EBW radiometers		✔	
Edge deposition monitor		✔	
Edge pressure gauges		✔	
Edge rotation spectroscopy		✔	
Fast lost ion probes - IFLIP		✔	
Fast lost ion probes - SFLIP		✔	
Filtered 1D cameras		✔	
Filterscopes	✔		
FIReTIP		✔	
Gas puff imaging			
Infrared cameras		✔	
Interferometer - 1 mm		✔	
Langmuir probe array			
Magnetics - Diamagnetism	✔		
Magnetics - Flux loops	✔		
Magnetics - Locked modes		✔	
Magnetics - Pickup coils	✔		
Magnetics - Rogowski coils	✔		
Magnetics - RWM sensors		✔	
Mirnov coils – high frequency		✔	
Mirnov coils – poloidal array		✔	
Mirnov coils – toroidal array		✔	
MSE		✔	
Neutral particle analyzer			
Neutron measurements	✔		
Plasma TV	✔		
Reciprocating probe			
Reflectometer – core			
Reflectometer - SOL			
RF antenna camera			
RF antenna probe			
SPRED		✔	
Thomson scattering	✔		
Ultrasoft X-ray arrays		✔	
Visible bremsstrahlung det.		✔	
Visible spectrometers (VIPS)		✔	
X-ray crystal spectrometer - H			
X-ray crystal spectrometer - V			
X-ray PIXCS (GEM) camera			
X-ray pinhole camera			
X-ray TG spectrometer			