Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: Investigate Effect of Lithium-Coated Divertor on Plasma Performance with LITER-1d		
OP-XP-719	Revision: **0**	Effective Date: **4/19/07** Expiration Date: **4/19/09** *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS	
Responsible Author: H. Kugel	Date
ATI – ET Group Leader: H. Kugel	Date
RLM - Run Coordinator: D. Gates	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: **Investigate Effect of Lithium-Coated Divertor on Plasma Performance with LITER-1d** No. **OP-XP-719**

AUTHOR: **H. Kugel** DATE: **4/19/07**

1. Overview of planned experiment

The motivation for this XP is to develop lithium deposition to control the spontaneous density rise that occurs during H-modes, and thereby to facilitate the development of long pulse induction-less current drive. The approach is to investigate the effect of a lithium-coated divertor on plasma performance using the LITER-1d evaporator. This XP will start by evaporating small, pellet-size amounts of lithium between and during shots, and then proceed to larger amounts of lithium until an effect on the spontaneous density rise is observed. Subsequent experimental steps will focus on optimizing the effectiveness of the lithium deposition in controlling the density in long pulse discharges.

2. Theoretical/ empirical justification

TFTR, CDX-U, and NSTX demonstrated the ability of lithium to control density.

3. Experimental run plan

To establish baseline conditions before introduction of lithium, perform up to 3 reference discharges (D LSN H-mode shot 121323 with 2 NBI). Proceed if H-mode is obtained reliably.

Table 1 shows the experimental sequence during evaporation.

1. Without using HeGDC, start evaporating 30 mg of lithium at the same deposition rate between and during discharges for 3 discharges.
2. Then with each subsequent group of 3 discharges double the evaporated amount until a lithium pumping effect is observed. Proceed without inter-shot HeGDC to maximum evaporation rate in Table 1 or until H-mode is lost due to accumulation of injected gas on previous shots or as determined by experimenters from review of diagnostic data.
3. If no Li effect or wall loading occurs, apply HeGDC during first half of Li evaporation.
4. If no Li effect or wall loading, apply HeGDC during 2nd half of Li evaporation.
5. If no Li effect or wall loading, apply HeGDC during entire Li evaporation.
6. Choose best experimental conditions from the above steps, and then optimize.
7. Choose best condition from step 6, and repeat at increasingly higher densities.
8. Choose best condition, and repeat using increasingly lower X-pt to increase the flux expansion & reduce the recycling per unit area.

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

D LSN H-mode shot 121323-LD with 2 NBI.

HeGDC during LITER operation if requested.

5. Planned analysis

UEDGE, TRANSP, etc.

6. Planned publication of results

PSI08, Nucl. Fusion, IAEA08

Table 1. Experimental Sequence

Shot No.	Nom. Oven Temp. °C	Between Shot mg*	Σ Between Shot mg	During Shot mg	Σ During Shot mg
1	540	30	30	0.05	0.05
2	540	30	60	0.05	0.10
3	540	30	90	0.05	0.15
4	570	60	150	0.10	0.25
5	570	60	210	0.10	0.35
6	570	60	270	0.10	0.45
7	600	120	390	0.20	0.65
8	600	120	510	0.20	0.85
9	600	120	630	0.20	1.05
10	630	240	870	0.40	1.45
11	630	240	1110	0.40	1.85
12	630	240	1350	0.40	2.25
13	660	480	1830	0.80	3.05
14	660	480	2310	0.80	3.85
15	660	480	2790	0.80	4.65
16	690	960	3750	1.60	6.25
17	690	960	4710	1.60	7.85
18	690	960	5670	1.60	9.45

* For 10 min of evaporation between shots

PHYSICS OPERATIONS REQUEST

Title**: Investigate Effect of Lithium-Coated Divertor on Plasma Performance with LITER-1d** **OP-XP-719**

Machine conditions:

I_{TF} (kA): **-53** Flattop start/stop (s): **-0.01/1.1**

I_P (MA): **1.0** Flattop start/stop (s): **0.2/1.0**

Configuration: **LSN**

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

Elongation κ: Triangularity δ:

Z position (m):

Gas Species: **D** Injector(s): **CS mid, OM #2**

NBI - Species: **D** Sources: **A, C** Voltage (kV): **90** Duration (s): **1.0**

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

CHI:

Either: List previous shot numbers for setup: **121323 with 2 NBI**

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

XP-719

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