Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**			
Title: **Dependence of edge plasma on lithium dose at high doses**			
OP-XP-1113	Revision:	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*	
PROPOSAL APPROVALS			
Responsible Author: R. Maingi			Date
ATI – ET Group Leader: V. Soukhanovskii			Date
RLM - Run Coordinator: S. Sabbagh			Date
Responsible Division: Experimental Research Operations			
RESTRICTIONS or MINOR MODIFICATIONS (Approved by Experimental Research Operations)			

NSTX EXPERIMENTAL PROPOSAL

TITLE: **Dependence of edge plasma on lithium dose** No. **OP-XP-1113**

AUTHORS: R. Maingi, D. Boyle, S. Kaye, C. Skinner DATE: **June 13, 2011**

1. Overview of planned experiment

The goal of this experiment is document the dependence of the ELM-free H-mode characteristics on the lithium 'dose' between discharges. Specifically the recycling, edge profiles (particularly n_e, P_e, and P_{tot}), edge stability, and Z_{eff} will documented over a range of high doses ≥ 300 mg, as part of NSTX's contribution to the FY11 JRT on pedestal structure.

2. Theoretical/ empirical justification

The controlled introduction of lithium in 2008 provided substantial insight into lithium effects, as well as a number of refereed journal articles. References ELMy discharges in a boronized vessesl were obtained with 6.5 min of HeGDC between discharges. Lithium was then introduced in a controlled manner, resulting in growing periods of ELM quiescence [Mansfield, JNM 2009], slowly improving edge confinement [Canik, PoP 2011], and edge stability [Boyle, PPCF 2011 submitted]. Fig. 1 shows the evolution of several parameters during this scan as a function of the pre-discharge lithium dose. Note that the divertor D_α, confinement enhancement factor H97L, and profile peaking factors all varied with the lithium dose. However there were very few discharges obtained in the fully ELM-free regime with high lithium

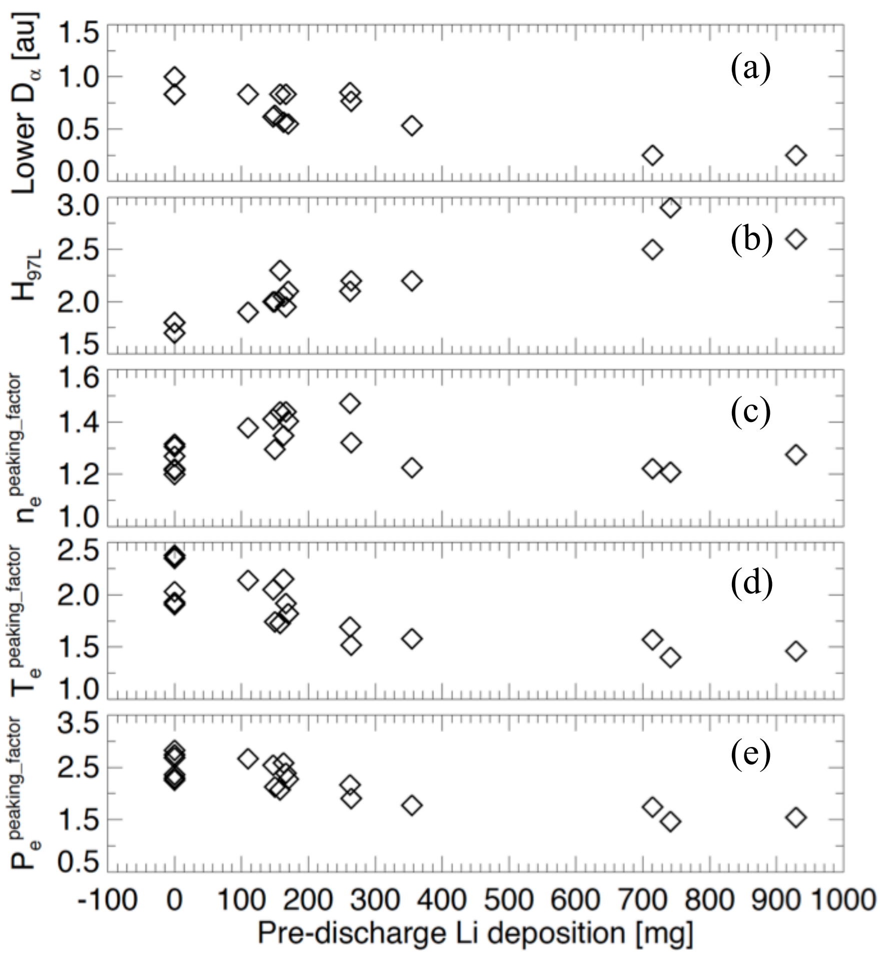

Figure 1: Evolution of plasma parameters as a function of pre-discharge lithium 'dose': (a) Lower divertor D_α baseline value at t=0.4 sec, (b) energy confinement relative to ITER97-L scaling, (c) n_e profile peaking factor, (d) T_e profile peaking factor, and (e) P_e profile peaking factor. Panels (b)-(e) were computed at the time of peak W_{MHD}. [Maingi, PRL 2011 submitted]

dose > 300mg. These are needed to determine if the trends observed in Fig. 1 are continuous as they appear to be. As a specific example, we would like to determine if the shift of the edge n_e profile from the separatrix varies monotonically with the lithium dose at high dose rates; the answer has implications to general edge stability regimes dominated by kink/peeling modes, as NSTX appears to be [Maingi, PRL 2009].

3. Experimental run plan (1/2 day)

1. Start with a low triangularity 4 MW ELMy reference discharge, e.g. 129019, if time permits (2)
2. Add 300 mg of lithium and document, with constant fueling and NBI if possible (3)
3. Repeat step 2 with 450 mg of lithium; probably will need to increase HFS gas and drop NBI power in this step or in previous step, to 2-3 MW (5)
4. Repeat step 3 with 600 mg of lithium (4)
5. Decision point: either use 850mg or 1200mg of lithium, or both if time permits (4-8)

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

Up to 4 MW NBI, no rf, no CHI. Nominally plan for 2-3 MW NBI.

5. Planned analysis

EFIT, TRANSP, and pedestal profile/stability analysis.

6. Planned publication of results

Results allowing, this will be published at the next APS meeting, and as part of the final FY2011 JRT report.

PHYSICS OPERATIONS REQUEST

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AUTHORS: R. Maingi, D. Boyle, S. Kaye, C. Skinner DATE: **June 9, 2011**

Brief description of the most important operational plasma conditions required:

Medium delta discharge that produces ELMy H-mode before lithium is added, i.e. 129019. When high lithium does is added, it becomes ELM-free, as in 129038.

Previous shot(s) which can be repeated:

Previous shot(s) which can be modified: 129019, 129038, 129041

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

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

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

Configuration: Limiter / DN / LSN / USN: **LSN drsep=-5mm**

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

Outer gap (m): **8-11 cm** Inner gap (m): **2-4 cm** Z position (m):

Elongation: **1.8-2** Triangularity (U/L): **0.5-0.6** OSP radius (m):

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

NBI Species: **D** Voltage (kV) **A: 90** **B: 90** **C:** 70-90 Duration (s):

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

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

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

LLD: Temperature (°C): **unheated**

EFC coils: Off/On Configuration: **Odd / Even / Other**

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	√	
Divertor L-alpha array	√	
Divertor visible camera		√
Dust detector		
Edge deposition monitors		√
Edge neutral density diag.		
Edge pressure gauges		√
Edge rotation diagnostic		
Fast cameras – divertor/LLD		√
Fast ion D_alpha - poloidal		
Fast ion D_alpha - toroidal		
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 camera – standard		√
Infrared camera – 2-color		√
Infrared camera – wide-angle		√
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		√

Note special diagnostic requirements in Sec. 4

Diagnostic	**Need**	**Want**
MAPP		√
Mirnov coils – high f.		√
Mirnov coils – poloidal array		√
Mirnov coils – toroidal array		√
Mirnov coils – 3-axis proto.		
MSE-CIF		√
MSE-LIF		
NPA – E‖B scanning		
NPA – solid state		
Neutron detectors		
Plasma TV		√
Reflectometer – 65GHz		√
Reflectometer – correlation		√
Reflectometer – FM/CW		
Reflectometer – fixed f		√
Reflectometer – SOL		
RF edge probes		
Spectrometer – divertor		
Spectrometer – SPRED		√
Spectrometer – VIPS		
Spectrometer – LOWEUS		√
Spectrometer – XEUS		
SWIFT – 2D flow		
TAE Antenna		
Thomson scattering	√	
USXR – pol. arrays		√
USXR – multi-energy		√
USXR – TG spectr.		
Visible bremsstrahlung det.		√
X-ray crystal spectrom. - H		
X-ray crystal spectrom. - V		
X-ray tang. pinhole camera		