Princeton Plasma Physics Laboratory
NSTX Experimental Proposal

Li pumping and retention on NSTX

OP-XP-824	Revision:	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author:	Date:
ATI – ET Group Leader:	Date
RLM - Run Coordinator:	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: **Li pumping and retention on NSTX – part 1** No. **OP-XP-824**

AUTHORS: **C. H. Skinner, R. Maingi, V. Soukhanovski, W. Blanchard** DATE: **4/9/08**

1. Overview of planned experiment

- To measure the fraction of the injected deuterium that is retained in the NSTX vessel both with and without PFCs coated with fresh (active) lithium.
- The measurement will compare the static pressure rise in the vessel after ohmic and RF discharges with the pressure rise in the vessel in a gas-only shot, all with the valves closed.
- This XP focusses on measuring retention before LiTER operations. Retention will be dominated by D implantation followed by outgassing. QMB measurements have shown that codeposition is small in the short term. A subsequent XP will address retetion during LiTER operations.

2. Theoretical/ empirical justification

This is important information for the NSTX lithium program which aims at density control via a reduction in the recycling of hydrogenic species using lithium pellet injection and lithium evaporation. It is also needed for the Joint US tokamak FY 2009 milestone on pumping and retention.

3. Experimental run plan

1. <u>Assume previous XP ends with standard He-GDC</u>
2. <u>2-3 Gas only shots</u> 2 puff (128266) and 4 puff (128268) to establish baseline 'retention' < 1%. If > 1% repeat one gas-only shot then continue.
3. <u>3-5 shots discharge development:</u>
   i. Use RF conditioning shot #128133 as starting point to develop and reproduce non-disruptive ohmic discharges (0.5-0.6 MA) with 100-200 ms flattop, and controlled rampdown.
   ii. Drop Bt to 0.45 T. Ramp down current before OH runs out e.g. at 0.5 s to make sure it is smooth. Replace HFS gas puff with more gas from injector #2.
   iii. NB valve is always closed. TMP valves closed 30 s before shot (RGA valve stays open).
   iv. Leave valves closed for 5 mins after each discharge.
   v. Follow with He-GDC. Establish minimum He-GDC needed for reproducible discharges.
4. 1-shot repeat of optimal ohmic discharge.
5. 1 shot repeat of gas-only shot at closest IG_110 pressure. (*7-10 shots so far.)*
6. 3 shots RF discharge 0.65 mA, 1.5 MW RF power (enough for H-mode ?). Use ohmic discharges as baseline, with steady RF power added during flattop and maybe part of ramp up.
7. 1 shot repeat of gas-only discharge.
8. 1-shot repeat of optimal RF discharge. Last shot of the day - keep TMP (and NB) TIVs closed for 24+ hrs to monitor long term outgassing.

Total 12-15 shots. If there is no time for RF part still keep TMP TIV closed after final ohmic shot.

9. Repeat above during LITER operation to measure retention fraction with fresh lithium coating and 10, 20, 30 minutes after LITER shutter closed.

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

Prior to running this XP, the feasibility of separating the He and D contributions to the total pressure should be demonstrated using variable mixtures of He and D puffed from the NSTX fueling system.

- Ion Gauges.
- Sensotec for Inj. #2
- Trend RGA trend and shot RGA
- Penning gauge
- Infrared camera
- Bolometers
- 1D Hα camera
- Quartz Microbalances

Needed for simulations:

- TS
- CHERS
- Langmuir probe – BeaP
- Edge neutral density diagnostic
- GPI for Te fluctuations

Desired capabilities:

- *Penning gauge piggy back data*
- *Penning gauge calibration data from He & D gas-only shots*
- *IG and IG_110 trending data*
- *RGA data transfer to MDS tree. Data is on PC - transfer can be done later*
- *Piggy back data on RGA impurity fraction with higher power NBI if available*

5. Planned analysis

DEGAS, UEDGE

6. Planned publication of results

Presentations at DPP APS & ITPA Div/Sol Group. Joint publication with other tokamaks.

PHYSICS OPERATIONS REQUEST

TITLE: **Li pumping and retention on NSTX** No. **OP-XP-824**

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Machine conditions (specify ranges as appropriate)

I_{TF} (kA): **-53** Flattop start/stop (s): **-0.02 / 0.9**

I_P (MA): **0.65** Flattop start/stop (s): **0.15 / 0.5**

Configuration: **LSN**

Outer gap (m): **0.05** Inner gap (m): **0.02**

Elongation κ: **2** Upper/lower triangularity δ: **0.5**

Z position (m): **-0.03**

Gas Species: **Deuterium** Injector(s): **#2**

NBI Species: D Sources: **none** Voltage (kV): Duration (s):

ICRF Power (MW): **1.5** Phasing: **0π** Duration (s): **0.3**

CHI: **OFF**

LITER: **OFF**

Shot numbers for setup: **128133**

DIAGNOSTIC CHECKLIST

TITLE: **Li pumping and retention on NSTX** No. **OP-XP-824**

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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		√
Ionization gauges	√	
Penning gauge	√	
RGA	√	
Shot RGA	√	