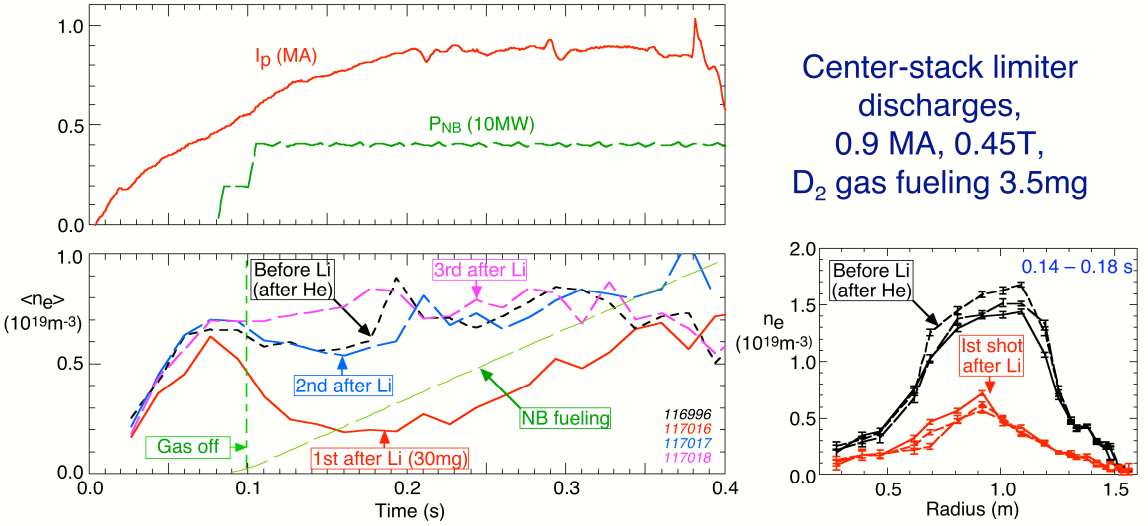
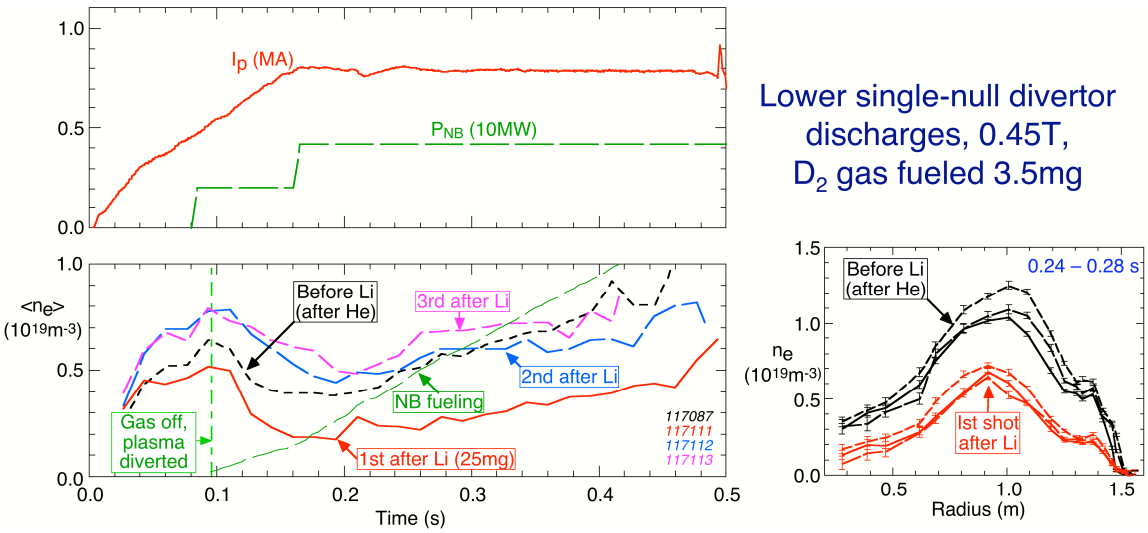
XP: Effect of Evaporated Lithium PFC Coatings on Density Control, H.W. Kugel, et al

• Goals

1. Compare an evaporated coating (LITER) with a plasma deposition coating (LPI). [Q3 Milestone & PSI 2006]

2. Initiate understanding of density control for ISD. [Q4 Milestone]





Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: Effect of Evaporated Lithium PFC Coatings on Density Control

OP-XP-	**Revision:**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Author H.W. Kugel	Date
ATI – ET Group Leader: R. Maingi	Date
RLM - Run Coordinator: R. Raman	Date

Responsible Division: Experimental Research Operations

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

Effect of Evaporated Lithium PFC Coatings on Density Control

1. Overview of planned experiment

This XP will investigate the effects of evaporated lithium coatings on density control prior to its application in other XP's.

First, this XP will make contact with the LPI thin coating results, and then proceed to thicker coatings and long pulses.

2. Theoretical/ empirical justification

• NSTX Phase I (Li Pellet Injection) experiments demonstrated that surfaces *pre-coated with lithium*, edge pumped a diverted plasma and exhibited an increased peaking of the density profile.

• These results motivated preparations for Phase II installation of a LIThium EvaporatoR (LITER-1) for performing routine thick lithium coating depositions over a significant fraction of the plasma facing surfaces.

3. Experimental Plan: Thin Coatings, LPI Discharges

3.1 Document initial conditions using fiducial discharge (117087). [1 discharge]

3.2 Apply about 6 He LSN Ohmic discharges to obtain the same wall conditions as for LPI. [8 discharges]

3.3 Compare the density control provided by a thin evaporated coating of 30-90 mg (2-6 nm) with the similar deposition using LPI into LSN Helium discharges.

1. Deposit 30-90 mg Li
2. Apply LSN fiducial 117087
3. HeGDC
4. Repeat 117087
5. HeGDC
6. Repeat 117087 [3 discharges]

3.4 How do lithium wall conditions change if no He LSN Ohmic discharges as for LPI?

1. HeGDC
2. Deposit 30-90 mg Li
3. Apply LSN fiducial 117087
4. HeGDC,
5. Repeat 117087
6. HeGDC,
7. Repeat 117087 [3 discharges][Total=15 discharges]

4. Experimental Plan: Thick Coatings, Long Pulse

4.1 Determine if lithium wall conditions allow <u>duplication or enhancement</u> of the best LSN long pulse discharges to date, e.g. 116313, 116318, 117147. Use HeGDC between discharges.

1. Deposit 30-90 mg Li
2. Apply 117147
3. Apply 117147
4. Apply 117147 [3 discharges]

4.2 Increase lithium thickness and restore density flattop.

1. Deposit 200 mg Li
2. Increase LFS fueling during Li pumping
3. Apply 117147
4. Continue increasing LFS fueling until density reaches a flattop during Li pumping
3. If not successful repeat by increasing HFS fueling [10 discharges]

4.3 Once density flattop is achieved, find H-mode, and perform density scan at longest pulse length achievable.

1. Move NBI earlier to find the highest stable ramp rate before Li pumping [4 discharges]
2. If no H-mode,
   - 2.1 Adjust HFS fueling [4 discharges]
   - 2.2 Pause Ip ramp [4 discharges]
   - 2.3 Reduce lower x-point [4 discharges]
3. Vary Ip to increase Ip flattop [4 discharges]
4. Increase density in four steps while retaining density flattop to find density limit at longest achievable pulse length. [5 discharges]

[Total =25 discharges]

4.4 If necessary deposit 200 mg of lithium as required to maintain stable operating conditions.

4.5 How does systematically changing edge neutral density effect the RF breakdown voltage.

1. Apply an RF-blip during all of the above flattops.

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

Prerequisites: Boronization, low recycling walls.
Required Configuration: Machine, NBI, and RF-blip conditions for LSN (117087) and LSN (117147)
Required Diagnostics: Standard.
Required Run Time: 50-60 discharges (2 days).