XP

Characterization of Lithium Pellet Injection

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Issue: What is the Optimum XP Overlap Between Next Step Li Needs and Eliciting New ST Pellet Physics

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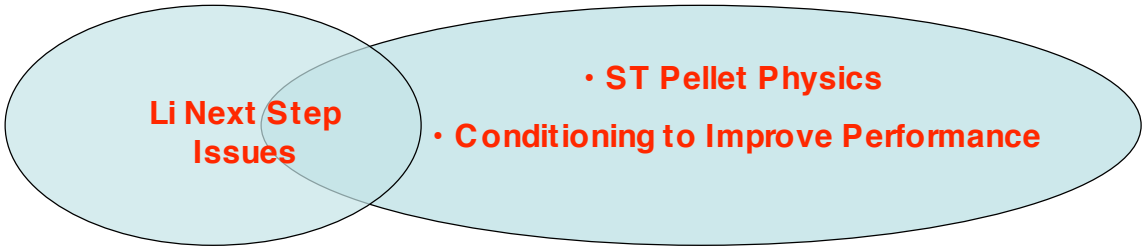
- The LPI is the first learning step in the 3 step Lithium Plan involving:
  1) Li Pellet Injection, 2) Li Evaporated Films, 3) Li Liquid Surface Module
  - Useful to have LPI Measurements in FY05 to facilitate planning and analysis for Next Step issues.

- NSTX Program Update & Forum 04 Guidance -E.Synakowski
  - "The Edge Physics plan should include a strategy for the '05 component of this, using the Li pellet injector and associated diagnostics."
  - "Are we going to try to use the Li pellet injector in earnest to see if performance improves? What is the balance between this and studies on Li edge transport & migration assessment?"



Concerns and Proposed Strategy for this XP

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- ***Concerns***

- On TFTR, eventually it was found ~40 He Conditioning Discharges were required to prepare substrate for Li deposition.

- Although mixed LPI results were found on C-Mod and D-IIID, the TFTR LPI results were not reproduced, in the allotted time, in these and other experiments with different edge conditions.

- On NSTX, 16 LPI discharges (32 mg) yielded little change in plasma performance other than a tentative downward trending of central Oxygen.

- Therefore, the probabilities point to there being insufficient Run Time in FY05 to focus on developing LPI conditioning for improving performance.

- ***Strategy***

  a) Focus a 1 Day XP on baseline LPI measurements for the Next Step efforts.
  b) Attempt to develop LPI conditioning as an XMP piggybacking on the end of other XP discharges.

• Proposed 1 Day* XP Baseline LPI Measurements for the Next Step Effort
• XMP* Conditioning Feasibility Measurements

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*1. Measure edge turbulence and perturbation on edge during LPI.

*2. Determine how LPI parameters(m,v,t) effect discharge termination.

*3. Determine beam ion contributions to LPI ablation profile by varying Ip and NBI Rtan.

*4. Measure LPI ablation radial profile.

*5. Measure Li midplane radial, and midplane-to-divertor, transport.

*6. Measure changes in Li divertor deposition and erosion.

*7. Determine optimum LPI injection time for conditioning.

*8. Determine how many Li discharges before C luminosity decreases to a lower steady state.

*9. Characterize divertor sweeping over region of Li deposition.

*10. Test TFTR LPI conditioning for improving performance.

1st Half Day of XP

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Vary injection time after preheating to vary the penetration

Shots	Shape	Ip (KA)	NBI	Arrival (ms)	Mass (mg)	Velocity (m/s)	Measure ments
2	DND	800	A,B	NBI+0	2	100	1,2,4,5,6,7
2	DND	800	A,B	NBI+2	2	100	1,2,4,5,6,7
2	DND	800	A,B	NBI+4	2	100	1,2,4,5,6,7
2	DND	800	A,B	NBI+6	2	100	1,2,4,5,6,7
2	DND	800	A,B	NBI+8	2	100	1,2,4,5,6,7
2	DND	800	A,B	NBI+10	2	100	1,2,4,5,6,7
2	DND	800	C,B	NBI+?	2	100	1-7

1. **Edge turbulence and perturbation during LPI.**
2. **Determine how LPI parameters effect discharge termination.**
3. **Fast ion contributions to LPI ablation.**
4. **LPI ablation radial profile.**
5. **Li radial and divertor transport.**
6. **Li divertor deposition and erosion.**
7. **Optimum LPI injection time for conditioning.**

2nd Half Day of XP

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Vary LPI Parameters m and v

Shots	Shape	Ip (KA)	NBI	Arrival (ms)	Mass (mg)	Velocity (m/s)	Measure ments
2	DND	800	A,B	NBI+?	1	100	1,2,4,5,6
2	DND	800	A,B	NBI+?	0.5	100	1,2,4,5,6
2	DND	800	A,B	NBI+?	0.1	100	1,2,4,5,6
2	DND	800	A,B	NBI+?	1	200	1,2,4,5,6
2	DND	800	A,B	NBI+?	1	50	1,2,4,5,6
2	DND	800	A,B	NBI+?	1	300	1,2,4,5,6

NBI+? = Select best timing from previous timing measurements.

1. **Edge turbulence and perturbation during LPI.**
2. **Determine how LPI parameters effect discharge termination.**
4. **LPI ablation radial profile.**
5. **Li radial and divertor transport.**
6. **Li divertor deposition and erosion.**

XMP Conditioning Feasibility Measurements

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- **Plan**

- **From the Baseline XP results, select the optimum LPI timing, mass, velocity, and sequence for optimum injection following the last NBI.**
- **Do LPI in piggyback mode on many other XPs.**
- **Carefully observe the succeeding discharges for noteworthy changes in performance due to the increasing Li inventory.**
- **The goal will be to obtain data for the following:**

8. How many Li discharges before C luminosity decreases to a lower steady state.

9. Characterize divertor sweeping over region of Li deposition.

10. Test TFTR LPI conditioning technique for improving performance.