NSTX

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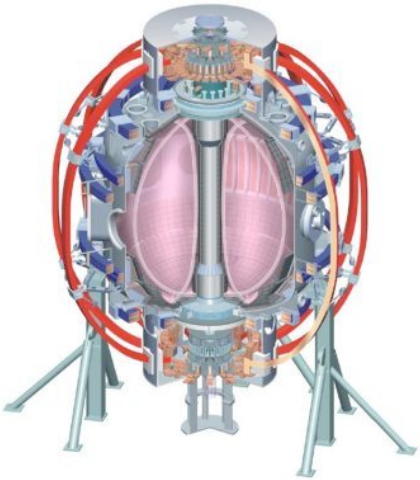
# First Preliminary Results from LLD


Chaired by Charles H. Skinner, Robert Kaita
PPPL


**Conference Room LSB-B318, PPPL**
**April 14th, 2010**



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# Motivation for LLD as presented to PAC Feb'10

- **LLD to extend density control for NB CD**
- **LLD compatible with high flux expansion divertor solutions.**

FY10 priorities:

- Develop and understand high-performance operating scenarios utilizing a liquid lithium divertor (LLD) for pumping and particle control.

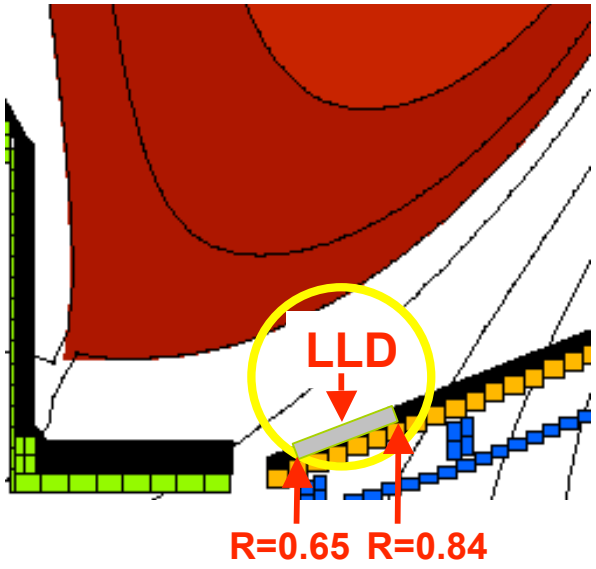
FY11 priority: Milestone R11-3:

- Assess the relationship between lithiated surface conditions and edge and core plasma conditions.

FY10 goal: test LLD predictions of 33% - 56% reduction in Ne with LLD compared to no-Li.

- Analyse results with particle balance models and 2D fluid (e.g. UEDGE) modeling.
- Study pumping in SGI-fueled discharges vs.
  - strike point location,
  - core ion density,
  - divertor ion flux (vary by SGI fueling),
  - LLD temperature
- Qualify a range of $I_P$ and $P_{NB}$ scenarios for subsequent XPs.

Particle balance model [R. Maingi]:
High $\delta$: $n_e$ reduced by 33%
cf no-Li case.

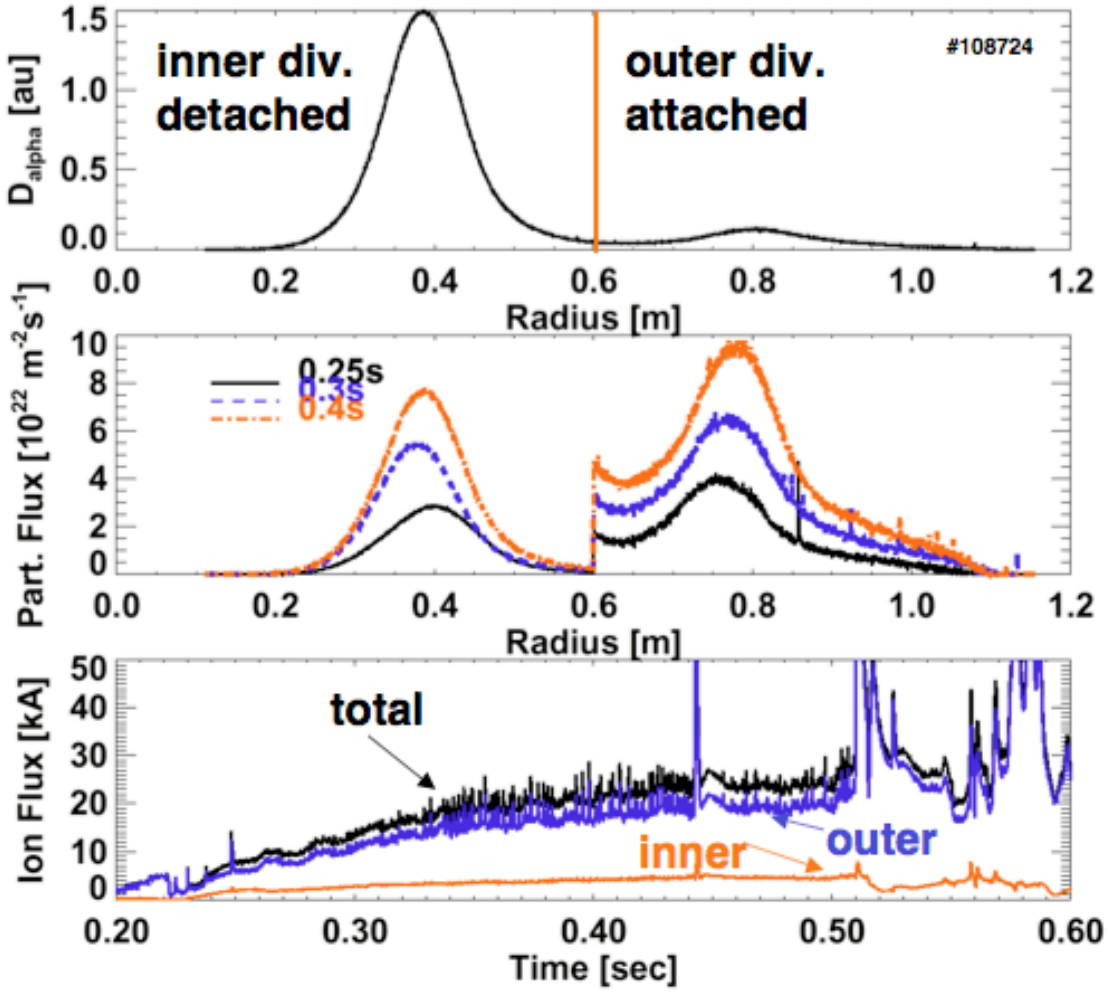



Low $\delta$: $n_e$ reduced by 56%
cf no-Li case with strike point on LLD.

Look for LLD effect with LLD molten Li @ 210°C but LiTER shuttered.

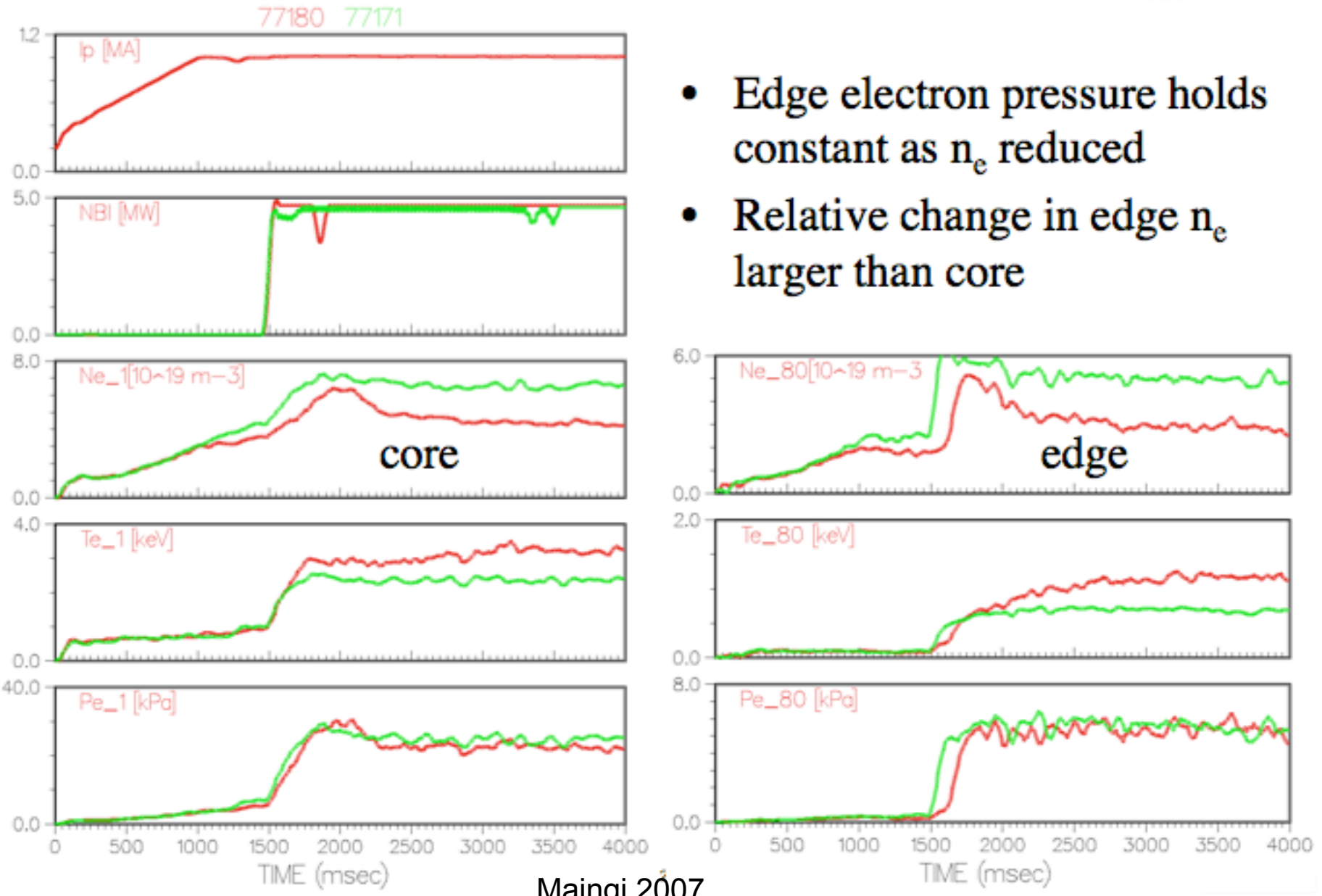
Liquid lithium divertor physics design discussion Princeton, NJ April 3, 2007
"Liquid Lithium Divertor 0-D Pumping Projections and Sensitivities"
R. Maingi, ORNL *With Acknowledgement to V.A. Soukhanovskii for Lower Divertor D α data

## NSTX $D_\alpha$ Peaked on Inboard Side, but Particle Flux Peaked on Outboard side because Inner Divertor is Usually Partially Detached




- Inner side detached
- Outer side attached
- Ions/photon =1 (detach)
- Ions/photon =20 (attach)
- Division at R ~ 0.6m
- Out div. has ~ 4x times current of inner div.

# Comparison of Unpumped and Pumped DIII-D Discharges




- Edge electron pressure holds constant as $n_e$ reduced
- Relative change in edge $n_e$ larger than core

Maingi 2007

# Agenda

Presentations:

- Skinner — Introduction
- Kugel — *"XP1000 LLD Characterization-Preliminary Results."*
- Jaworski — *"Necessary conditions for pumping with liquid lithium."*
- Kallman — *"LLD lithium inventory and outgassing studies."*
- McLean — *"Status of IR measurements of LLD surface temperature."*
- Scotti — "*Preliminary results from LLD fast cameras diagnostic: reflectivity, D-alpha and Li II emission profiles.*"
- Skinner — *"Li / D balance in LLD."*
- Soukhanovskii: — bullets on Mo, D-alpha (recycling) and change in Ne (given by Skinner).
- Finkenthal ? — Mo emission ?
- Paul ? — Mo emission ?
- Allain — *"Surface chemistry analysis of hot lithium coatings on porous Mo substrates"*

Available in DragNDrop:

- Gerhardt "*A Few Observations on Global Particle Balance During XP-1000"* presented at Monday 12 April NXTX physics Mtg.
- Maingi *"Liquid Lithium Divertor 0-D Pumping Projections and Sensitivities"* presented April 3 2007.

Discussion

- How to interpret data so far ?
- Next experiments on LLD ? Implications for 10 other XPs that involve Li ?
  Menard email 4/13 comment:
  *"one could argue that being able to diagnose when the LLD is really clean enough and in a "pumping" condition should be a pre-requisite to performing additional experiments with plasma."*

# XPs with 'LLD' in the title

| LLD XPs | | | | run days |
|---|---|---|---|---|
| LR/CC | **1000** | H. Kugel | LLD Commisioning | 3.00 |
| LR | **1001** | V Soukhanovski | LLD Pumping Group XP | 2.00 |
| LR | **1002** | V Soukhanovski | Core impurity density and radiated power reduction using variations in LLD divertor conditions | 1.00 |
| ASC | **1006** | Gerhardt | High-kappa Neutral Beam Heated Scenarios with Improved Control and LLD | 1.00 |
| MS | **1021** | Gerhardt | Halo current study w/ extended diagnostic capability + LLD | 1.00 |
| BP | **1049** | Maingi | Dependence of edge profile modifi-cation by lithium to proximity to LLD | 0.50 |
| BP | **1050** | Soukhanovski | Divertor heat flux reduction and detachment studies with impurity seeding and LLD pumping for NSTX-U | 0.50 |
| BP | **1051** | Zweben | Test of LLD Electrodes for SOL Control | 0.50 |
| LR | **1057** | Skinner | D retention with LLD | 1.00 |
| CC/ALL | **1066** | Gerhardt | LLD Physics Survey | 2.00 |
| CC/LR | **1054** | Kugel | LLD deCommissioning | 0.50 |
| | | | total: | 13.00 |