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High resolution measurements of modifications to plasma edge parameters by lithium PFC coatings

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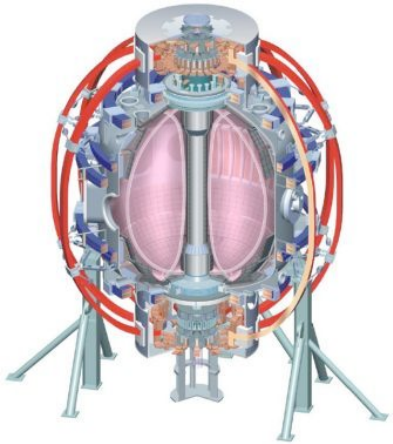
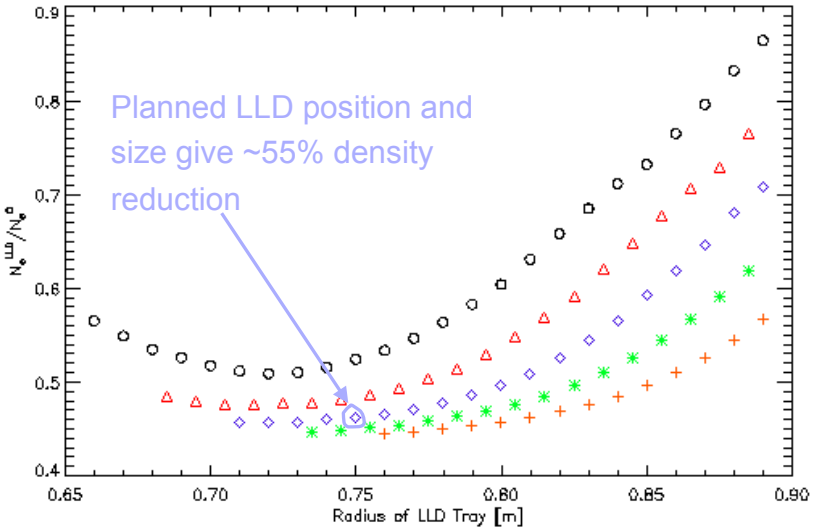
NSTX Research Forum
Li TSG
December 2, 2009



A gap exists in edge parameter understanding under lithium PFC conditions

- NSTX has installed an LLD to modify edge recycling behavior
- Existing diagnostics cover mid-plane thoroughly, but are limited in the divertor region
- In order to assess the impact of the LLD, it will be necessary to monitor changes to temperature and density in the divertor region

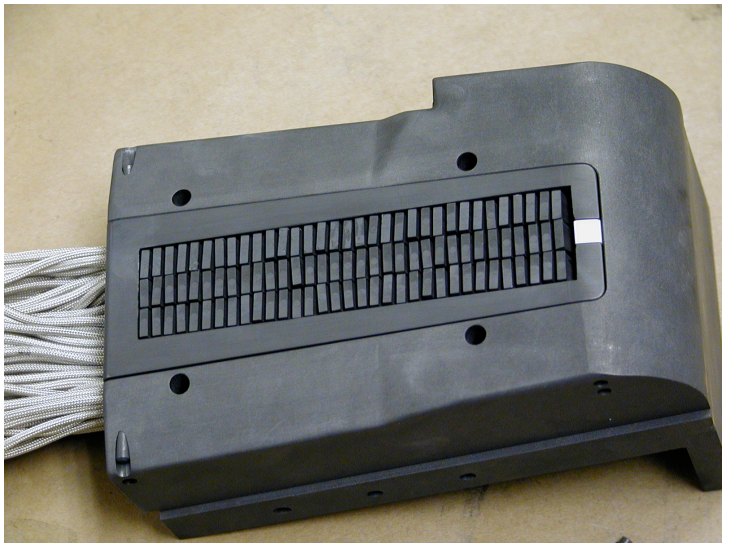


R. Maingi

- A systematic study of differing discharge shapes with varying strike point locations will provide insight into modification of edge parameters as the LLD modifies recycling

New probe array will provide high-resolution edge data

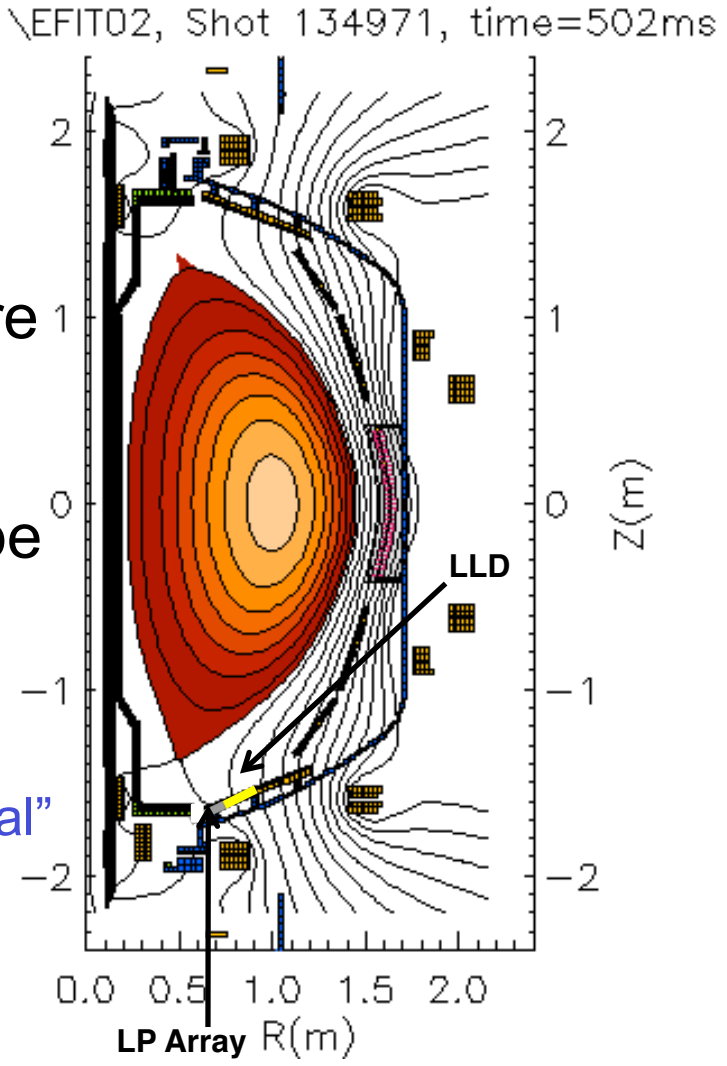
- Langmuir probe array will provide several key measurements
  - local n_e and T_e at outer divertor target
  - verification of OSP location
- Tile is located in bay B gap bull-nose tile between LLD plates to provide proximate measurements



- Probes can be run in various modes: triple, single swept, Isat, floating
- Spatial resolution is 3mm radially, 8mm toroidally, compared to temperature and density scale lengths of ~1 cm radially
- DAQ and electronics allow for 250 K-samples/sec

Desire to obtain edge data under differing Li conditions

- During FY09, an LLD-optimized intermediate-δ discharge was developed to balance plasma performance with expected pumping
- Profiles using existing diagnostics were taken during XP919 last run year
- During LLD commissioning XP low, medium, and high-δ discharges will be run as LLD is filled, which will be the primary source of data (no run time requested initially)
  - will supplement with data from LLD "fiducial" shots during run
- Possibility for additional run-time



Plasma shots under additional conditions if required

- "Fiducial" - 2 discharges at fixed R_{OSP}=.63m on cold LLD
  - 2 MW w/NBI overdrive of 6 MW in startup to achieve early H-mode
  - establish stable fueling scenario
  - no evaporation between discharges
- Scan in OSP position
  - R_{OSP} will start at .63m and make small excursions closer/on to LLD in 3 cm increments before returning to original position (will eventually connect with low-δ case at R=.78)
  - plan for 2 discharges at each position with cold LLD as fueling will likely change
    - consider coarser resolution for cold LLD to decrease number of shots
    - no evaporation planned, but can be evaluated as necessary
  - repeat with hot LLD, allowing for 5 baseline discharges at R=.63 and 3 discharges per position to allow for fueling changes
    - consider finer resolution at LLD edge (i.e. .64m, .65m) before going to 3cm increments
- Total is approximately 30 shots, possibly spread over two days for cold vs. hot operation
- Need for repetition as LLD fills? Discharges could also take place during LLD 'fiducials'

Analysis and publications

- LRDfit will confirm magnetics strike point data and compare to heat flux locations from IR cameras, still a discrepancy from 2009
  - validated by direct probe data
- 2D codes such as UEDGE will be used to connect observations of edge profile data to recycling rates
  - high spatial-resolution data from probes will be used to better constrain code runs
- Predictions of LLD effects on edge plasma conditions can be tested
  - the eternal question: Yes, but does it pump?
  - if so, what are the consequences vis a vis alterations to target density, temperature, particle flux, etc
- Major publication will be my thesis, and additional papers will also be prepared

Backup

But divertor strike point did not coincide with peak heat flux from IR camera data