Lithium Research Topical Science Group Research Forum Wednesday Dec 2nd, 2010.

Priorities from http://nstx-forum-2010.pppl.gov/lithium_research.html

- NSTX is the only diverted, NBI-heated, high-confinement-mode tokamak studying lithium for particle pumping and power handling, and is the first toroidal device to deploy a liquid lithium divertor (LLD).

LRTSG Priorities for FY2010:

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

B. Understand and minimize the sources and accumulation of plasma **impurities** arising from lithium conditioning of the PFCs

C. Assess the relationship between lithiated surface conditions and edge and core plasma conditions (Milestone R11-3) (next slide)

ITPA Participation:

D. DSOL-21 Introduction of pre-characterized dust for dust transport studies in divertor and SOL (also in BPTSG)

Menard email Nov 17: "This year, the ITER emphasis will very likely target ELM control with small(er) ELMs and impurity control in ELM-free scenarios.

Candidate ideas/proposals :-

E. further exploration of increased Li coverage using He neutral gas or dropper."

FY2011 Research Milestone R(11-3): Assess the relationship between lithiated surface conditions and edge and core plasma conditions

The plasma facing components (PFC) of fusion devices play a key role in determining the performance of the fusion plasma edge and core by providing particle pumping and fueling and acting as a source of plasma impurities.

On NSTX, coating the divertor carbon PFCs with evaporated lithium has resulted in transient particle pumping, increased energy confinement, and suppression of edge localized modes (ELMs).

1. To extend the duration of particle pumping, and to investigate the impact of liquid lithium on plasma performance, a liquid lithium divertor (LLD) will be installed in FY2010, and the relationship between lithiated surface conditions and edge and core plasma conditions will be determined.
2. To understand pumping, D retention will be studied as a function of surface conditions such as lithium coverage and LLD surface temperature, and plasma exhaust parameters such as divertor electron density and temperature, strike-point location, and flux expansion.
3. The temperature evolution of the LLD surface will be measured to understand the heat transfer properties of the LLD, to determine the allowable peak flux onto the LLD, and to relate the LLD surface temperature to the measured influx of lithium and hydrogenic species.
4. Recycling and retention on the divertor carbon and LLD surfaces are particularly important, so a Lyman-α AXUV diode array will be utilized for deuterium recycling measurements in the presence of the highly-reflective liquid lithium surface.
5. Further, an in-situ materials analysis particle probe placed near the LLD will provide measurements of retention and surface composition in the outer divertor region for selected shots.
6. These retention measurements will be compared to dynamic retention measurements and to retention models.
7. Finally, D, Li, and C sources from the divertor and Li transport from the plasma edge to the core will be measured.

This research will provide the scientific understanding of LLD operation necessary to begin to comprehensively assess liquid lithium as a possible PFC solution for NSTX and next-step ST facilities.

From Michael Bell presentation Tuesday Dec 1st:

The Liquid Lithium Divertor will be a Major New Element in NSTX Research for 2010

- Priorities for the Lithium and Boundary Topical Groups in FY2010
  - Develop and understand high-performance operating scenarios utilizing a liquid lithium divertor (LLD) for particle control
  - Understand and minimize the sources and accumulation of plasma impurities arising from lithium conditioning of the PFCs
  - Assess H-mode pedestal characteristics and ELM stability as a function of collisionality and lithium conditioning (Milestone R10-3)
    - ...Particle pumping and density control in these experiments will utilize the liquid lithium divertor (LLD). ...
  - Assess the relationship between lithiated surface conditions and edge and core plasma conditions (Milestone R11-3 — preparation)
    - ... To extend the duration of particle pumping, and to investigate the impact of liquid lithium on plasma performance, a liquid lithium divertor (LLD) will be installed in FY2010, and the relationship between lithiated surface conditions and edge and core plasma conditions will be determined. ...

Does the LLD provide additional and more long lasting pumping than solid lithium on the PFCs?

From Jon Menard presentation Tuesday Dec 1st:

- Q: Is this a Lithium or Boundary or ASC proposal?
  - A: A bit of a gray area… but here is the **Lithium Research TSG** scope:
    - Diagnostic and PMI/divertor proposals focusing on LLD-specific issues and operation
    - XPs to "commission" and "characterize" the LLD, compare to LITER-only from FY09
    - Li dropper research, and Li-related development work – such as evaporation of Li into He, on-purpose evaporation of Li from plates
    - XPs to diagnose, understand, and reduce/eliminate **sources** of impurity accumulation during Li ELM-free H-mode
    - Tests / challenges of Li-related theory and modeling

Presenter:	Time	Title
Skinner	8:35	Introduction
Kugel	8:40	LLD-1 Commissioning.rtf
Kugel	8:50	LLD-1 Decommissioning.rtf
Particle Control		
Gerhardt	8:57	Optimization of High-In Scenarios at Reduced Density.rtf
Kallman	9:04	High resolution measurements of modifications to edge parameters by lithium PFC coatings.rtf
Skinner	9:11	D retention with LLD.rtf
Soukhanovskii	9:18	Recycling and Pumping characterization of the LLD-1 module.rtf
Impurity control		
Gray	9:25	Study of Neoclassical Transport Mechanisms of High Z Impurities.rtf
Mansfield	9:32	Can Impurities be Purged from the Core by Allowing Early Elms with Shaping and Eliminating Later ELMs with Aerosol _.rtf
Mansfield	9:39	Understanding _ Eliminating High-Z Accumulation During ELM-Free H-Modes .rtf
Skinner	9:46	Impurity Reduction by Diffusive Li Injection.rtf
Soukhanovskii	9:53	Core impurity density and radiated power reduction using variations in LLD divertor conditions .rtf
Stotler	10:00	Validation of DEGAS 2 Model for Li - He Diffusive Evaporation.rtf
Coffee Break	10:07	

Other	Time	
Abrams	10:21	Novel Concept for Measurement of Deposited Lithium Films on NSTX.rtf
Gerhardt	10:28	Qualification of LLD Operation at Various Levels of Plasma
Gerhardt	10:35	Disruption Characteristics with a Warm LLD
Gray	10:42	Evaporating lithium into the SOL to reduce heat fluxes.
Jaworski	10:49	Effective SOL particle lifetime and generation of SOLC and effects on edge.rtf
Pigarov	10:56	Experiments on the physics of hot spots .rtf (remote)
McLean	11:03	Characterization of the LLD with a two-color infrared camera.rtf
McLean	11:10	Creation of a disruption database during LLD operation.rtf
McLean	11:17	Study of Li condensation in NSTX .rtf
Takahashi	11:24	Mapping of Te along Divertor Surfaces for Studying Lithium Effect on SOLC and ELMs.rtf
ALL	11:31	DISCUSSIONS