

# LRTSG Forum Preparation Meeting

MA Jaworski (Deputy Leader)

R Kaita (former Deputy)

D Stotler (Theory)

C Skinner (Leader, absent)

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# Agenda for this meeting

- Discuss the following topics:
  - The Milestone and research priorities
  - Role of MAPP in meeting the research priorities
  - Schedule for MAPP
  - Scope of LRTSG/Suitability of proposed XPs to LRTSG
- Not here to debate individual XPs, that is for the forum

# LRTSG Milestone R12-1

- **R(12-1): Investigate the relationship between lithium-conditioned surface composition and plasma behavior.**
- The plasma facing surfaces in a tokamak have long been known to have a profound influence on plasma behavior. The development of a predictive understanding of this relationship has been impeded by the lack of diagnostics of the morphology and composition of the plasma facing surfaces. Recently, a probe has been used to expose samples to NSTX plasmas and subsequent post-run analysis has linked surface chemistry to deuterium retention. However, with very chemically active elements such as lithium, more prompt surface analysis is likely required to characterize the lithiated surface conditions during a plasma discharge. In support of prompt surface analysis, an in-situ materials analysis particle probe (MAPP) will be installed on NSTX. The MAPP probe will enable the exposure of various samples to the SOL plasma followed by ex-vessel but in-vacuo surface analysis within minutes of plasma exposure using state of the art tools. The reactions between evaporated lithium and plasma facing materials and residual gases in NSTX will be investigated. Correlations between the surface composition and plasma behavior will be explored and compared to laboratory experiments and modeling. Measurements of fueling efficiency and recycling will be made. The results will deepen the understanding of plasma-wall interactions and inform the plans for particle control in NSTX-Upgrade.

# LRTSG Research Priorities

- 1) Utilize MAPP diagnostic to characterize lithiated surface conditions, e.g. reactions with/between evaporated lithium and residual gases as well as the plasma facing material itself.
- 2) Compare the effect of different surface conditions on plasma performance metrics, such as stored energy, confinement time, fueling efficiency, D pumping, recycling and impurities, and/or local plasma parameters (e.g. local Ne, Te, Ti).
- 3) Assess the impact of lithiated, molybdenum inboard and outboard PFCs on plasma performance.
- 4) Assess impact of novel Li delivery systems on plasma parameters such as stored energy, confinement time, fueling efficiency, impurities and/or local plasma parameters.
- 5) For discussion:

From J. Menard ITER/CC talk 3/4/11

- Incremental/controlled Li introduction to access high-performance research-grade plasmas – with ELMs (use D glow passivation?)
  - XMP or XP? Led by LR, ASC, or BP, or ITER/CC?

# Current MAPP Schedule and Impact on Planning

- Clearly, MAPP is key to meeting the milestone, but many tasks can be accomplished leading up to MAPP-centric XPs and meeting the other milestone elements
- **Preliminary** schedule obtained from B. Heim (Purdue)
- Expect MAPP exposure and TDS capability by **Early September**
- **Total** capabilities expected by **Early October** (TDS, XPS, LEISS, DRS)
- MAPP will likely piggyback for much of run while systems are brought online
- XPs that require specific capabilities from MAPP will need to be scheduled appropriately
- LRTSG has FY12 milestone, so some time available to work out the kinks

# Should LRTSG XPs specify “conditioned” & “de-conditioned” Li PFCs?

- Two views, as an example:
  - A) Understanding the nature of Li+PFMs as general materials research problem (the Good, the Bad, and the Ugly) *versus*
  - B) Requiring certain conditions (machine, PFC or other) for Li+PFMs to be considered “worthwhile”
- Machine startup XMP to develop Li “de-conditioning”
  - LITER steadily at 20 mg/min taking discharges to determine performance changes with increasing Li deposition
  - Results in ~8gm of lithium after 40 discharge attempts (10 minute shot cycle) (~1 day) (15gm used in FY10)
  - Once lithiated conditions obtained, begin D2-glow to “de-condition” wall. Find optimal LITER+D2-glow for repeatable shot performance (one hopes with 10-12 minute shot cycle) (limit to 1 day?)
- Once XMP develops procedure for “de-conditioned” Li operation, let XPs come forward in the usual way
- Everyone can benefit from developed procedures (i.e. Li vs. saturated-Li conditions)

# Example schedule for Li conditioning vs. de-conditioning

- Day 1 of discharges: perform LITERing at steady rate until Li-wall conditioning obtained (i.e. beams in, H-mode access, reasonable shot-time) (8gm by end of day, FY10 started with 15gm)
- Continue N days until machine achieving research grade plasmas
- Day N+1: Develop optimal LITER+D2-glow combination to “de-condition” walls
- Day N+2: XP11xx – H. Kugel “Comparison of plasma operation with varying strike-point position on Mo-tiles and LLD”

# XP titles so far – sufficient to meet R12-1?

No.	Author/Speaker	Title	MAPP?
0 (XMP)	MA Jaworski	Reduced lithium deposition during machine startup (Include elsewhere? ITER/CC?)	No
1	H. Kugel	Comparison of plasma operation with varying strike-point position on Mo-tiles and LLD	No*
2	C. Skinner/H. Kugel	Relation between surface conditions and the duration of lithium conditioning	Total
3	V. Soukhanovskii	Recycling, pumping and divertor lithium flux studies with and without lithium coated molybdenum tiles	No
4	F. Scotti	Carbon sources and scalings with lithium	No
5	V. Soukhanovskii/TBD-Post Doc	Divertor/SGI gas puffing for molybdenum erosion rate measurements (BPTSG?)	No
6	D. Mansfield	Li granule and dust injection at mid-plane/ELM pacing using centrifugally injected Li granules	No
7	D. Mansfield	Startup upgrade using lithium powder before, during and after breakdown	No
8	D. Stotler	Diffusive evaporation of Li in He	No*
9	MA Jaworski	Plasma electron spectroscopy for deuterium, lithium and impurity monitoring	TDS*
10	MA Jaworski	SOL and PFC modification during in-situ lithiumization via Li dust injection and diffusive evaporation	TDS*
11	MA Jaworski	Comparison of local plasma parameters between Li and de-conditioned Li wall conditions (linked to XMP result)	Total
12	C. Taylor, B. Heim, JP Allain	Influence of outer strike-point location on lithium-deuterium chemistry observed in MAPP (H. Kugel shots redux)	Total
13	R. Maingi	Evolution of ELMs with controlled lithium introduction in high-triangularity discharges with the OSP on the Mo tiles. (BPTSG or ITER/CC?)	No

\*More MAPP is desirable, but not necessary



# Summary Discussion

- Any topics left out in support of the milestone?
- Suitability of XPs for LRTSG?