# NSTX-U Candidate Baseline Year-1 Lithium Plan

## - for Noteworthy Results Early in the Campaign

- Install ATJ Graphite tiles on *Lower* Inner and Outer Divertor
- Install subset of existing tile diagnostics on *Lower Outer Divertor*
- Mount the 2011 Molybdenum tiles on *Upper Inner Divertor*
- Mount the 2011 LITERs on Upper Divertor
- Mount suitable Lithium Technology for coating Upper Divertor
- Take 6 shots without lithium
- Start lithium deposition, and obtain research grade shots within 10 discharges (H.Kugel, PSI 2010, Fig.7), or do 3 TMBs and take 6 weeks (M.Bell, Startup Calendars, 2006-2010)
- Proceed to integrate, & qualify the Upgrade, & initiate characterization of NBI current drive

# NSTX-U Near Term Lithium Options

- Year-1 Startup Options for Lithium Coating Lower and Upper Divertors

  1. Coat Lower Divertor using:
     2 Upper 2011-LITERs (this provides 2 spares)
  2. Coat Lower Divertor and Upper Divertor using:
     2 Upper 2011-LITERs for Lower Divertor
     and 2 Lower 2011-LITERs for Upper Divertor (provides no spares)
  3. Coat Upper Divertor using new technologies:
     2 Upper 2011-LITERs for Lower Divertor
     and new technologies for Upper Divertor
     a. LITER-Fast (200mg flash evap, w/fast cool-down, midplane & rotatable for aiming –H. Schneider) or
        LITER-Morning (5-30g each morning – e.g., EAST)
     b. Electrostatic Injection (UIUC)

- NSTX-U research progress beyond present lithium coatings and passive liquid lithium surfaces requires laboratory R&D on
  - maintaining a chemically-active, moving, liquid lithium divertor surface
  - demonstrating capability to be solidified and re-liquefied for recirculation many times
  - developing diagnostic capability to measure surface quality and flow between discharges

# Backup

# Laboratory Experiments 2012-2014 Will Provide Guidance for Design of NSTX-U Flowing Liquid Divertor

- Analysis of 5 proposed flowing liquid concepts indicates common questions that impact the selection, fabrication, installation, and operation of a reliable flowing liquid divertor system for NSTX-U.

- How does D retention in CPS mesh behave in presence of high power densities?

- How does the selected liquid lithium substrate wet, accumulate impurities, effect D retention versus vacuum impurities, discharge impurities, and operating temperature.

- Will continuous impurity buildup impede restart after cooling? What is the required maximum system temperature for restart? Is it is best to drain system before cooling?

- What is the range of Li flow rates as determined by D retention, impurity accumulation, and long term reliability.

- What is the optimum heating fluid and technique for the NSTX-U environment?

- How to provide diagnostics for real-time Li surface quality indication, internal Li flow measuring, external flow metering, ….

# Pathway for Development of a Clean, Continuously Moving, Liquid Lithium Divertor Surface for NSTX-U

- The R&D pathway to develop this capability could proceed as follows:
  1. Test simple-as-possible Single-Pass and Cyclical Flow concepts
  2. Characterize simple-as-possible operation in tokamak-like vacuum
  3. Characterize behavior in vacuum of candidate NSTX PFC prototypes
  4. Move portable candidate PFC to high power density source & characterize
  5. Characterize PFC in applied magnetic fields with high power densities

- The Proposed R&D
  - The goal would be to assemble a simple facility to accomplish R&D Steps 1, 2, and 3
  - The developed system should be portable enough to enable the performance of Steps 4 and 5 on a suitable Test Stand