LRTSG XP1057: D retention with LLD

Milestone FY2011 Research Milestone R(11-3):

- "Develop and understand high-performance operating scenarios utilizing a liquid lithium divertor (LLD) for particle control."
- "D retention will be studied as a function of surface conditions such as lithium coverage and LLD surface temperature."
- "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."

Overview:

- Goal: Measure difference LLD makes to D retention.
- Repeat parts of 2009 XP911 gas balance but now with LLD.
- 1/2 run day ohmic, 1/2 run day NB heated discharges.
- Outer strike point on bull-nose outer divertor tiles for max LLD effect.
- Repeat with LLD with molten Li and unheated - see if retention changes.

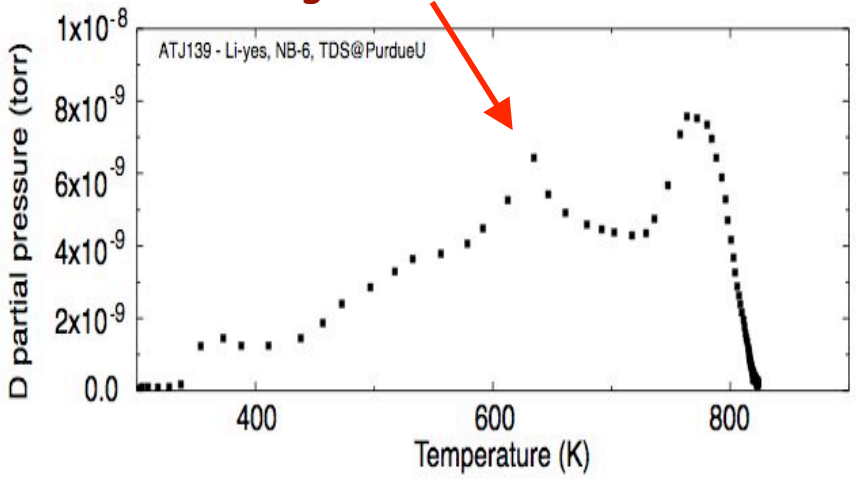
Surface analysis: Sample probe with 2 graphite, LLD and Si/Pd samples.

- Evening in-vacuo Thermal Desorption Spectroscopy of graphite sample.
- Ship to Purdue for XPS…

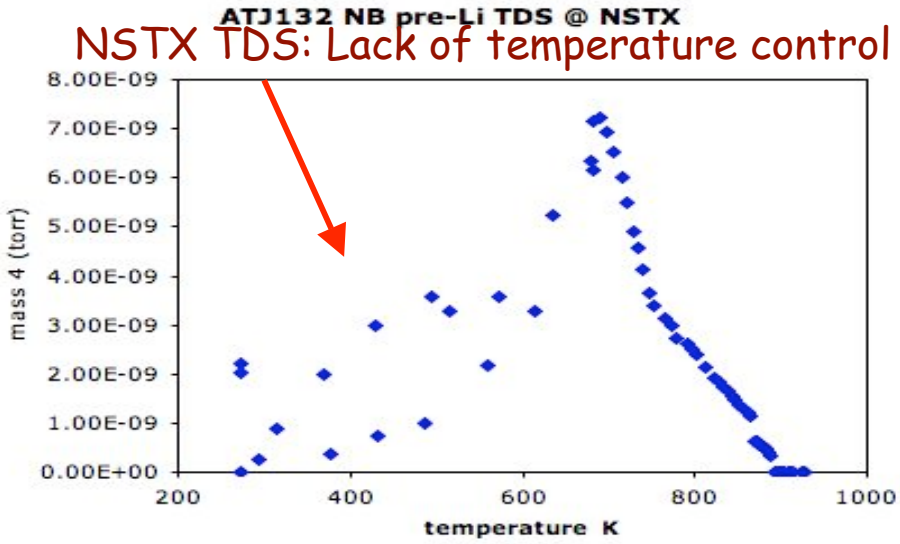
PMI probe - D retention- complete Joule Milestone for PSI19

- Completion of FY09 retention milestone for PSI-19 publication.
- Thermal desorption spectroscopy (TDS) at Purdue showed a new low temperature peak that may be behind the prompt D release after NSTX pulse.
- Same-evening TDS at NSTX was compromised by poor temperature control (simultaneous commissioning and experiment) and conduction of heat to other samples.
- Repeat measurements with upgraded equipment.
- No dedicated shots required.
- Expose PMI probe piggyback for 1 day.
- TDS same evening in NSTX cell
- Ship to Purdue for XPS etc…

Purdue TDS: 600 K peak with Li has weaker bonding of D 'in solution'.



NSTX TDS: Lack of temperature control



Retention Strategy:

- Utilize conditions with maximum LLD effect - strike point on bull nose,
  - HFS and SGI fueling to get high LLD pumping and low density if possible.
  - Use results from Henry/Vlad XPs to improve model shots.
  - SP control if indicated by previous experience.
- Compare D retention with LLD w/molten Li and LLD unheated.
  - Continuous LiTER evaporation both cases.
  - Need to average over several shots as differences in retention can be low.
- Ip rampdown programmed for 'soft landing' with minimal W_{tot} and minimal wall heating at termination.
  - Model shots from 2009 are 133014 (ohmic) and 133019 (NB) both with Li.
  - Ohmic shots have all pumping valves closed
  - No intershot GDC (as in 2009).
- Diagnostics:
  - Usual + all pressure gauges and RGAs
  - D emmission spectroscopy + divertor Langmuir probes for 'physics' retention (D retained / D fluence to wall)

Shot list and analysis:

A. LLD unheated:

- 10 'good' shots = 2 gas-only pulses, 4 ohmic, 4 NB heated.

B. LLD w/molten Li:

- 10 'good' shots = 2 gas-only, 4 ohmic, 4 NB heated.

Expect to take 1 day.

Analysis:

- Calculation of gas balance retention from mig gauge pressure.
- Wall inventory from Vlad's gas balance model.
- Wall Gas Balance model of Pigarov.