XP1000A, LLD Characterization Using Alternative Heating System

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Oct. 25, 2010

XP1000A: Goals

1. **Obtain data to synthesize the LLD characteristics observed during FY10.**

XP	OSP (cm)	Tbulk (°C)	Tsurf (°C)	Similar to Graphite
1000	63-71	(1)50+(3)320	(150-520)?	yes
1041A	78	All 57-102	165-300	no
1059	68	All 50-118	(150-318)?	yes

- Too many variables uncertain, or varying in existing database. Maintenance issues. Underlying trends difficult to discern. Need to repeat with lower impurities, controlled temperature, constant fueling, and all required diagnostics.

2. **Perform operational test of LLD Alternate Heating System for FY11-12 run.**

XP1000A is to Synthesize 5 Observed LLD Characteristics

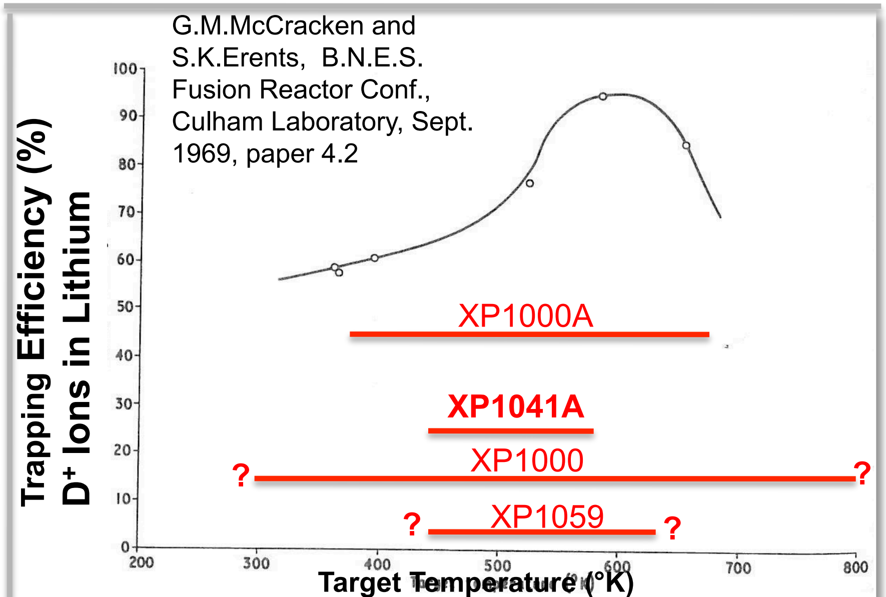


Fig.5 (b) Trapping of D^+ ions in lithium. Variation of trapping efficiency with temperature at a constant dose of 2×10^{17} ions/cm^2.

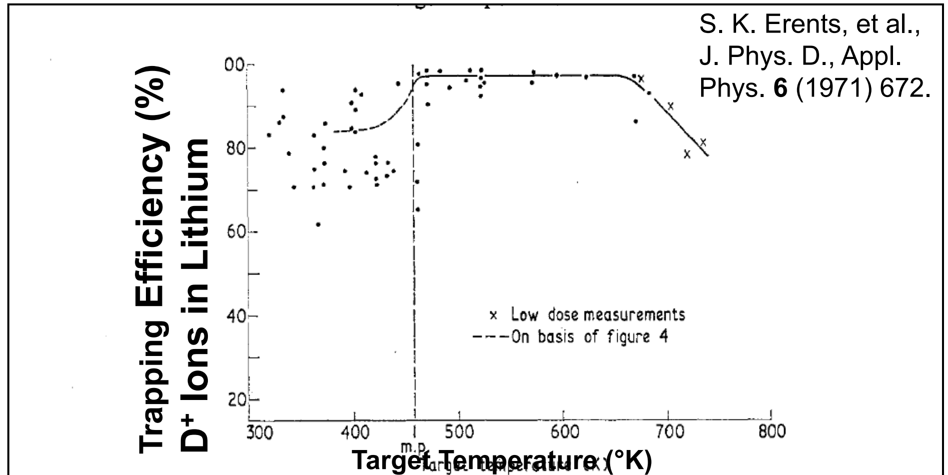


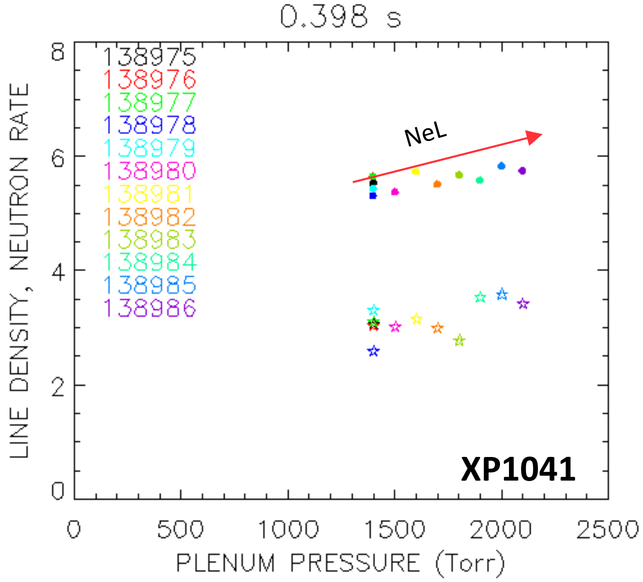
Figure 3. Trapping efficiency of lithium for 18 keV deuterons as a function of temperature for constant dose of 5×10^{17} ions/cm^2.

"The trapping efficiency varies between 70 and 95 % and no clear trend has been observed with variation in target temperature or ion current density. It was found that if a thin layer of oxide was allowed to form on the lithium surface the trapping efficiency was considerably reduced." S.K.Erents et al.

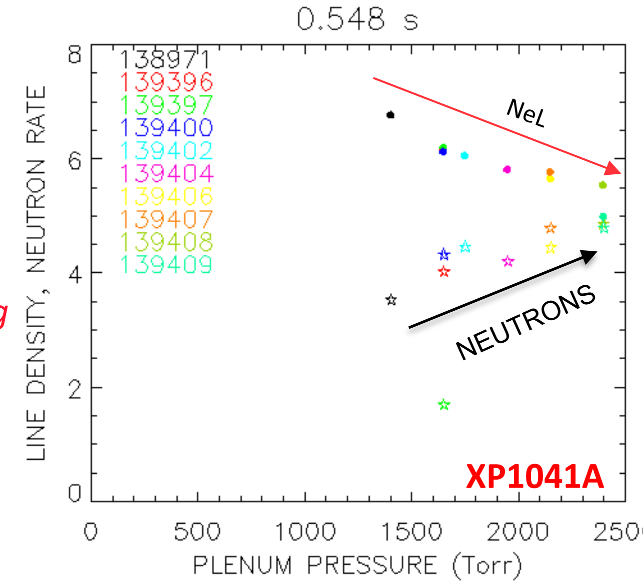
- **LLD FY10 Observations**
  1. Many LLD discharges required a fueling *similar* to those on Li coated graphite (i.e. Li wall conditions obtained for both, but no obvious higher LLD pumping).
  2. Only XP1041A exhibited *decrease* in n_e/gas ratio when LLD liquefied.
  3. During XP1041A: *no decrease* in Dα was observed over the liquefied LLD.
  4. During XP1041A: exhibited an *increase* in neutrons when LLD liquefied.
  5. During XP1041A: exhibited a *decrease* in carbon intensity.

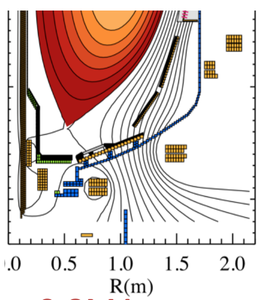
XP1041A Under Controlled Conditions Exhibited Decreasing Fueling ratio and Increasing Neutrons

- XP1041, LSN, OSPR 0.78m, <u>higher X-pt</u> With increasing HFS fueling *density increases.*

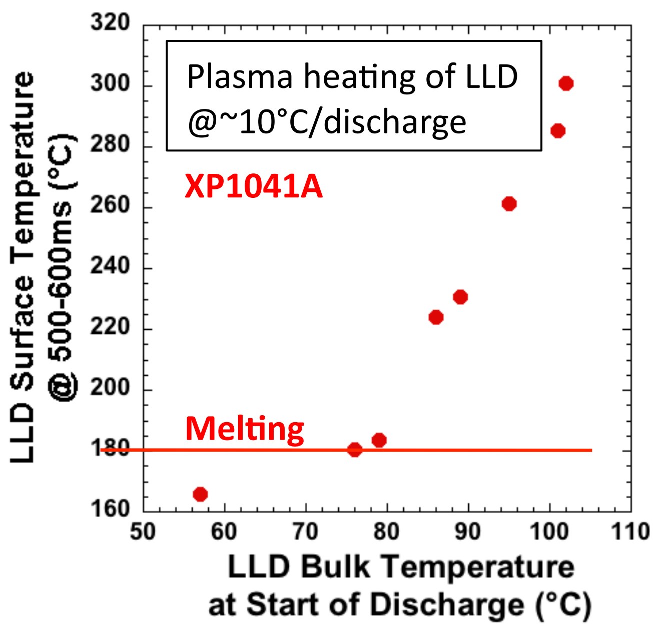


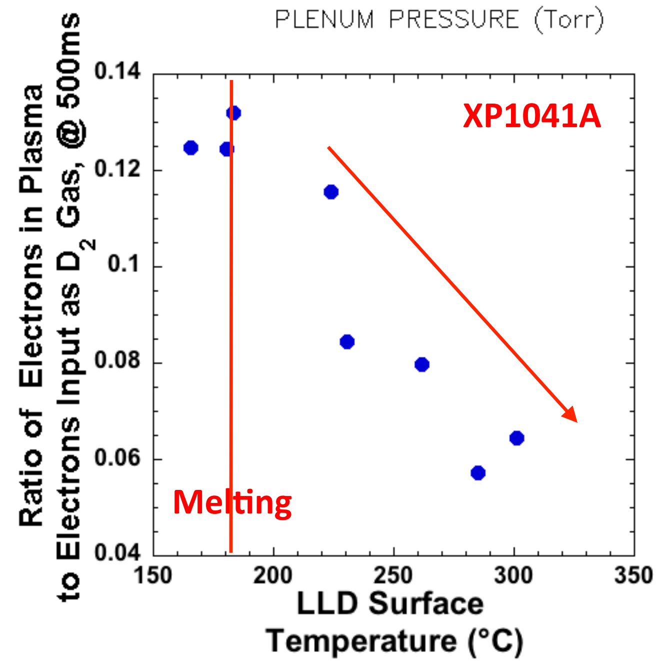
- XP1041A, LSN, OSPR = 0.78m, <u>lower X-pt</u>: With increasing HFS fueling, *density decreases, peaking factor increases, neutron rate increases.*





I_p = 0.8MA,
P_{NB} = 4.0MW
B_T = 0.48T
R_{OSP} = 0.73m
LLD ~%5 full
(~0.5mm)





Prerequisites

1. LITER-K shall be evaporating at 20mg/min starting at 6:30am until discharges start.
2. The 2-color IR camera shall be monitoring LLD Tsurf using previous calibrations if necessary to provide between discharge measurements.
3. The slow IR camera shall use the previous 2-color and other calibrations to provide between discharge measurements.
4. The LLD viewing fast cameras shall be operating with carbon filters.
5. The LLD viewing 1D-CCD-Da and 1D-CCD-Li cameras shall be operating for radial and time dependent documentation.
6. The DIMS spectrometer shall be centered on the oxygen and carbon luminosities for impurity time dependent documentation.
7. ZEUS, LOEUS, SPRED Fiberscope systems shall be operating.
8. Apply 10 ms SGI pulses for Tau p* measurements

Experimental Procedure

1. Take standard morning fiducial (1) with LLD at Rm temp.

2. At OSPR=35cm, take XP1041A ref discharge (3) with LLD at Rm temp. and constant fueling (1650 torr).

3. Move to OSPR=55cm. Keep fueling constant. Observe LLD Tsurf.
   - If LLD Tsurf < 100°C, take ref discharge (3) at OSPR(55cm)
   - If LLD Tsurf >100°C, cool LLD Tsurf to <100°C and take ref discharge (3).

4. Move to OSPR=78. Keep fueling constant. Observe LLD Tsurf.
   - If LLD Tsurf < 150°C, take ref discharge (3)
   - If LLD Tsurf >150°C, cool LLD Tsurf to <150°C and take ref discharge (3) at OSPR(78cm)

5. Set LLD Heating for Tbulk at 160°C.

6. Stay at OSPR=78cm. Hold LLD heating at Step #5. Using plasma auto heating, take ref discharges until Tsurf reaches 500°C.

Day-1, About 24 shots, total