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Li / D balance in LLD

Charles H. Skinner, PPPL

+ contribution from Vlad

Conference Room LSB-B318, PPPL
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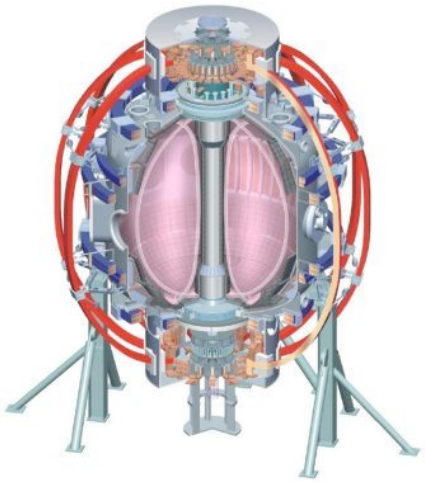

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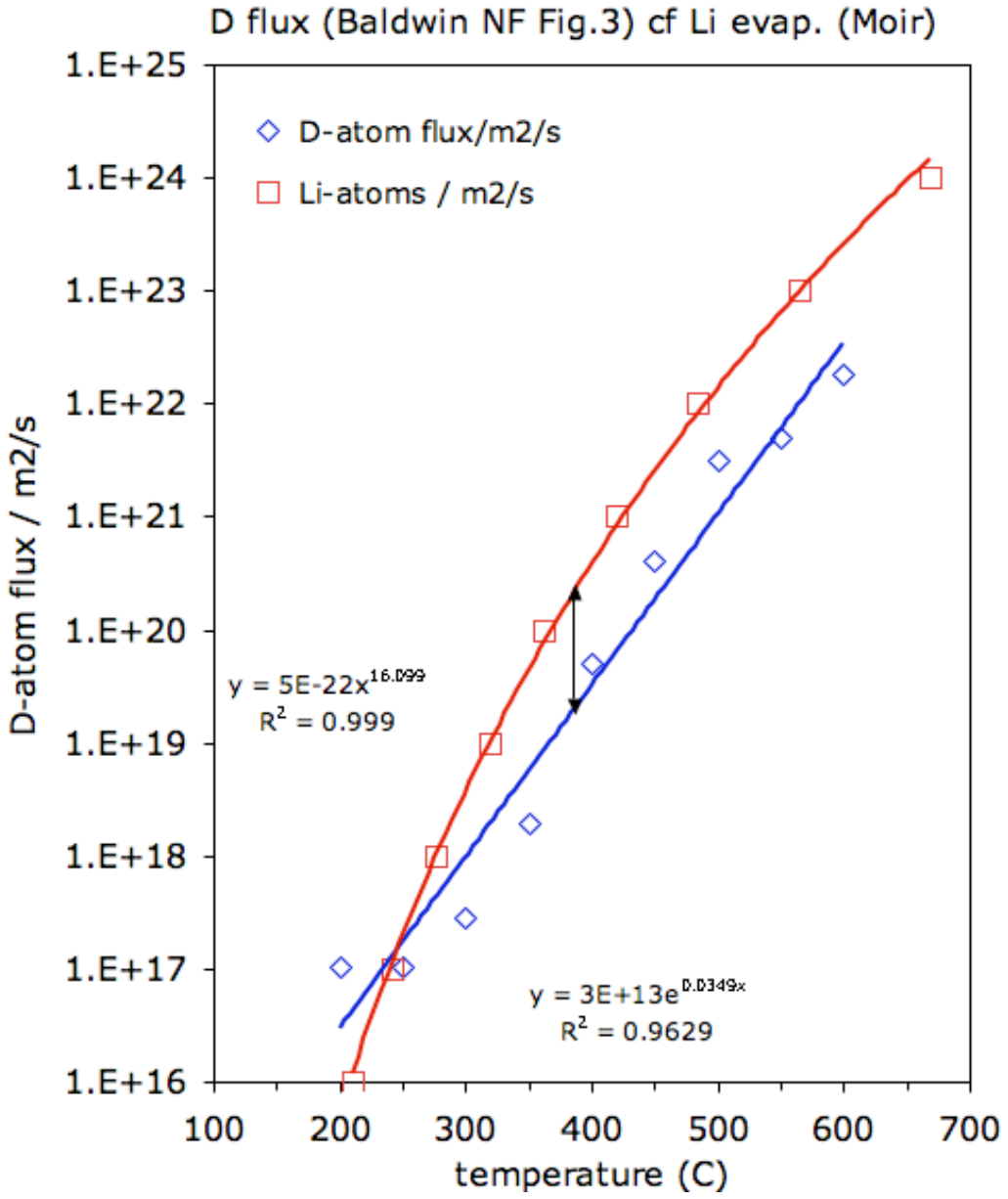
Li evaporates faster than D outgases

- Li evaporation rate from R.W. Moir.
- D outgassing from Li saturated with D (Li-LiD) [Baldwin JNM 306 (2002) 15.]
- Li evaporates faster than D !
  We cannot lower D/Li ratio by heating LLD.

LLD effective area ?

- Baldwin: D_2 outgassing from Li-LiD at 250 C is 1.8 e17 D-atoms/m^2/s
- NSTX D_2 outgassing at 250 C from Trend RGA and TMP speed (2009 calibration) is
  2.1 e16 D-atoms / s
- #'s match with effective LLD area of ~0.1 m^2 (10% geometric !)
- *Where is Li-LiD ?*
- *Does Mo affect chemistry of thin Li layer ?*



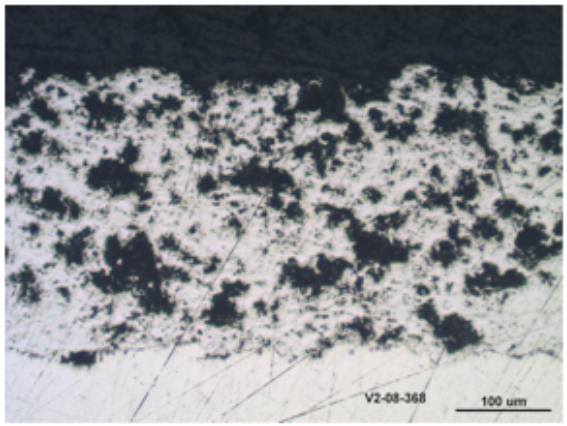
Starvation diet

- We typically supply 0.9 e21 Li-atoms to heatable LLD between discharges (3/4 of 7% of 20 mg/min for 10 mins).
- Typical D fueling is 4 e21 D-atoms (137605).
- LLD is on 'starvation diet'.
  It can only supplement pumping by graphite and lithiated graphite.
  Need substantial Li prefill every shot for large pumping effect.

- Li evaporation rate at 260 C = 3 e17 Li-atoms / m^2 / s (Moir)
- For an effective area of LLD of 3/4 of 8 m^2 for 600s = 1.1 e21 Li-atoms
- Potential Red Queen situation @ 260 C
  - No net filling of LLD with Li !

Evaporation drops steeply with temp.:

- 241 C = 3.6 e20 Li-atoms / m^2 / s
- 210 C = 3.6 e19 Li-atoms / m^2 / s



Red Queen

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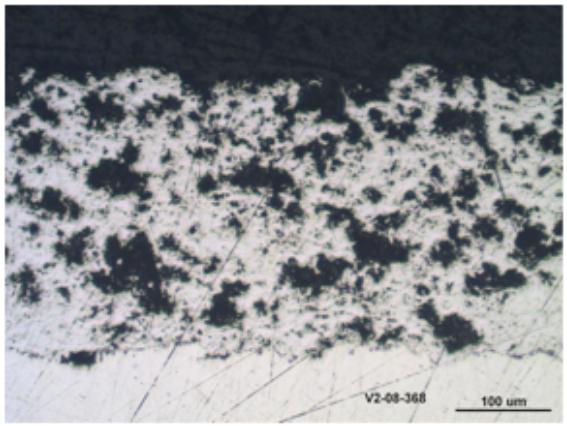

"The Red Queen has to run faster and faster in order to keep still where she is. That is exactly what you all are doing!"

Contribution from Vlad.

My apologies - due to schedule conflicts I have not been able to prepare data plots and I will not be able to come to the LLD meeting. However, at Charles's request I provide some bullets from my control room analysis. Would it be possible to show them at the meeting? Also, Filippo will show an interesting presentation that may help understand LLD conditions.

1. No steady-state molybdenum influx observed from LLD, except in several shots where singular transient events interacted with lower divertor and Mo I lines were clearly seen (from VIPS 2 spectra, Bay C location)
2. In general, D-alpha intensity was always higher on LLD than on bullnose carbon tile (from 1D CCD, Bay D location). Will use Langmuir probe ion flux to calculate recycling coefficients.
3. D-alpha on LLD typically increased with the 220-250-320 C temperature trend (from 1D CCD, Bay D location)
4. Li II emission was increasing with the 220-250-320 C temperature trend (from 1D CCD, Bay D location)
5. In hotter LLD divertor (320 C vs 220 C), it appears that 1) much reduced oxygen flux was observed 2) much higher LiD molecular flux was observed (VIPS 2 spectra, Bay C location)
6. No clear trend was seen in core deuteron inventories and deuteron densities (from CHERS analysis) with LLD cold, warm, hot trend and strike point trend
7. Propose to run XP 1001 ASAP to document LLD regime through an accurate particle balance accounting and tau-p-star measurements.I can back up these preliminary statements with data analysis and plots at a later time if necessary.Thank you.Vlad Soukhanovskii