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Evaporating lithium into the SOL to reduce heat fluxes

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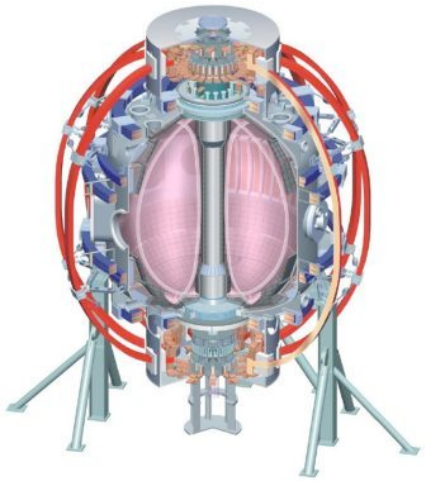
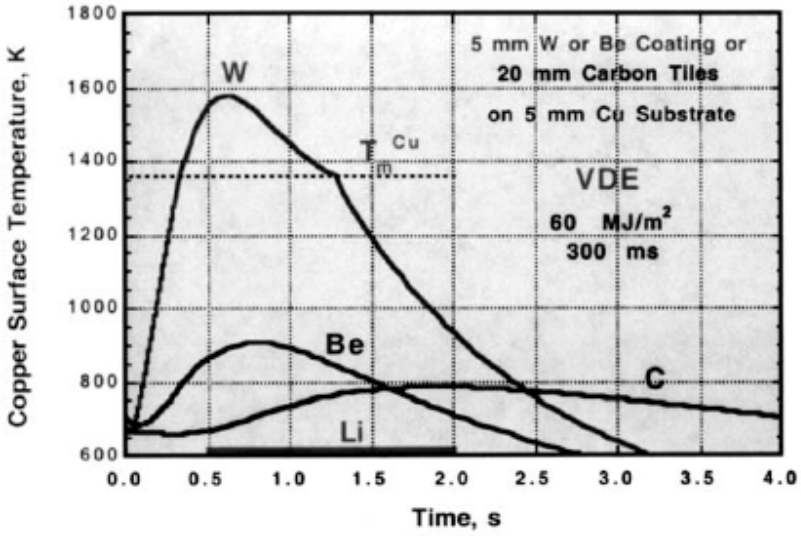
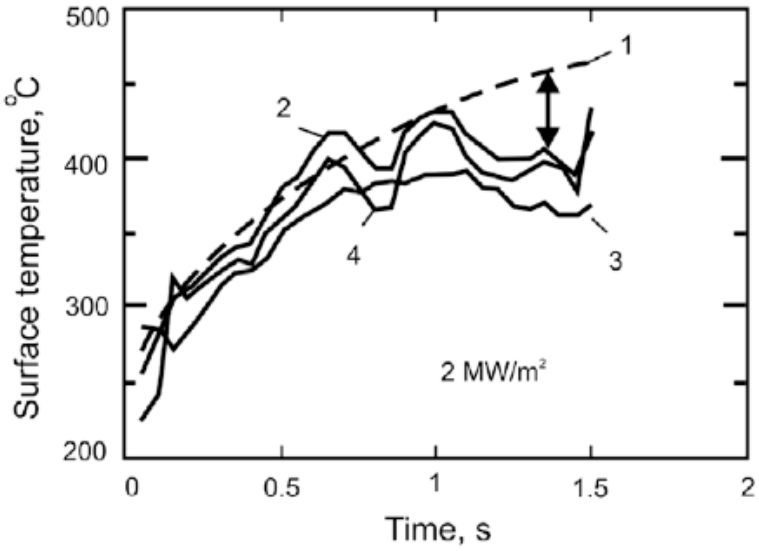
NSTX Research Forum
Princeton, NJ
December 1—3, 2009



What happens if the heat flux is too high on a liquid lithium target?

- Li heats up and evaporation becomes strong
  - Lots of Li into the SOL
  - SOL density and Li radiation increase
  - Heat flux to target is reduced
  - Vapor shielding during disruptions
- Consistent with observations of others
  - Predicted by the HEIGHTS code
  - Shown experimentally with the liquid lithium limiter on FTU

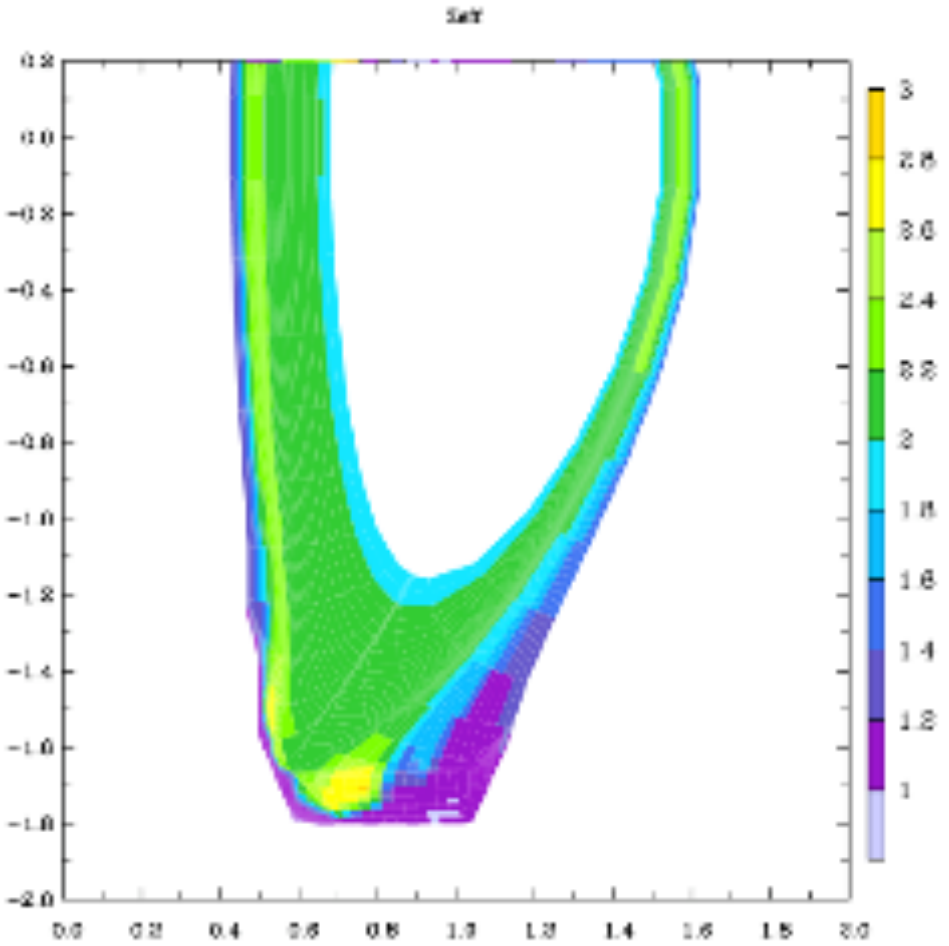




A. Hassanein, Fus. Eng. Des. 60 (2002)
M.L. Apicella, J. Nucl. Mat. 386-388 (2009) 821

SOLPS simulations indicate lithium can handle large heat fluxes

- SOLPS simulation of NHTX with Li evaporation
  - With no Li evaporation, q_{pk} = 18 MW/m^2
  - With 20% of the heat on targets dissipated by evaporation, peak heat flux q_{pk} < 6 MW/m^2
- Z_{eff} highest in the divertor
  - Limited to 2.2-2.4 in the SOL
  - Decreasing towards the core plasma



Is there a self-consistent, steady state solution where Li is allowed to evaporate into the SOL

- Will produce SOLPS modeling of NSTX to predict plasma response to highly evaporating LLD
- Establish high triangularity NSTX discharges
  - Strike point far from the LLD
  - Temperature scan of the LLD from $180 \leq T_{LLD} \leq 350$ C (or higher) to vary lithium evaporation rate into SOL plasma
  - Repeat with the strike point on or near the LLD
- What will the impact be on:
  - Target heat flux, Plasma Profiles (n_e, T_e), Stored Energy
  - Core contamination
- Time (and TPTB) permitting, LLD response to ELMs
  - Test the effectiveness of vapor shielding to limit heat flux to LLD
- Study lithium divertor power handling capability
  - Required for larger ST's: NSTX-U, CTF, FNSF, etc