U.S. DEPARTMENT OF ENERGY | Office of Science

NSTX-U

Lithium powder injection near the outer strike point to facilitate detachment

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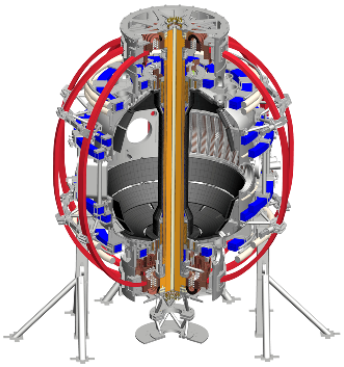
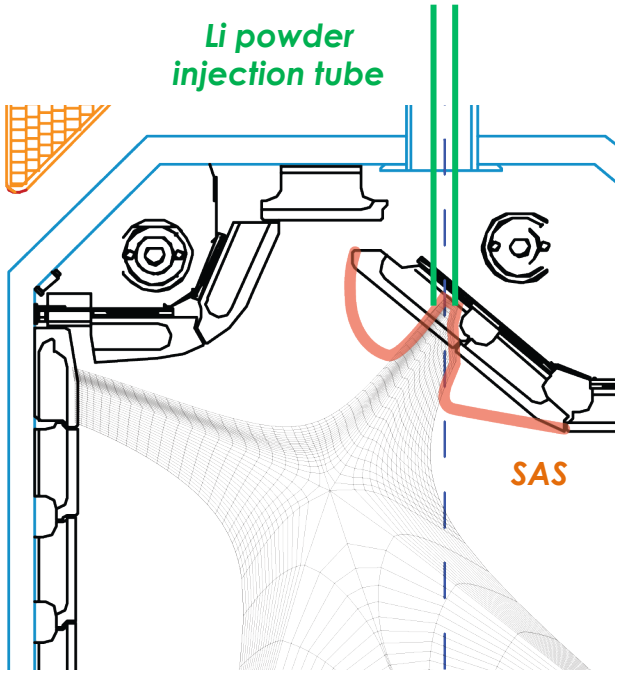
PPPL Boundary Science Group Brainstorming
Princeton, NJ
7 October 2016

PPPL

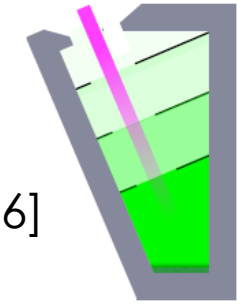


Detachment of a lithiated divertor strike point

- **Physics principle to be tested**
  - Detachment with in presence of Li vapor predicted at low $n_{e,up}$ [Goldston PSI2016]
- **Technique & *output expected***
  - Local Li delivery in vicinity of OSP, in SAS
  - *Detachment $n_{e,det}$ vs Li rate*
  - *Plasma performance with lithiated PFC*



- **Why DIII-D? / *Why now?***
  - Amazing match of closed divertor and ***local*** Li (C/B_4C) delivery
  - Continuous vapor shielding study is one of three main thrusts for Materials & PFC TSG in NSTX-U 5 year plan
  - *Potential first step on the Lithium Vapor Box Divertor concepts*



[Goldston et al Phys. Scr. 2016]

DIII-D NATIONAL FUSION FACILITY

Continuous vapor shielding study is one of three main thrusts for Materials & PFC TSG in NSTX-U 5 year plan

- Lithium evaporation off PFC increases exponentially with $T_{surface}$, which increases with SOL power
- Upstream plasma pressure saturates with SOL power, because Tsep only goes up slowly in conduction limited heat transport
- At some point, plasma pressure can be balanced by Li vapor pressure
  - Substantial power dissipation
  - Is this a stable regime?
- DIII-D SAS divertor has geometry to test this!

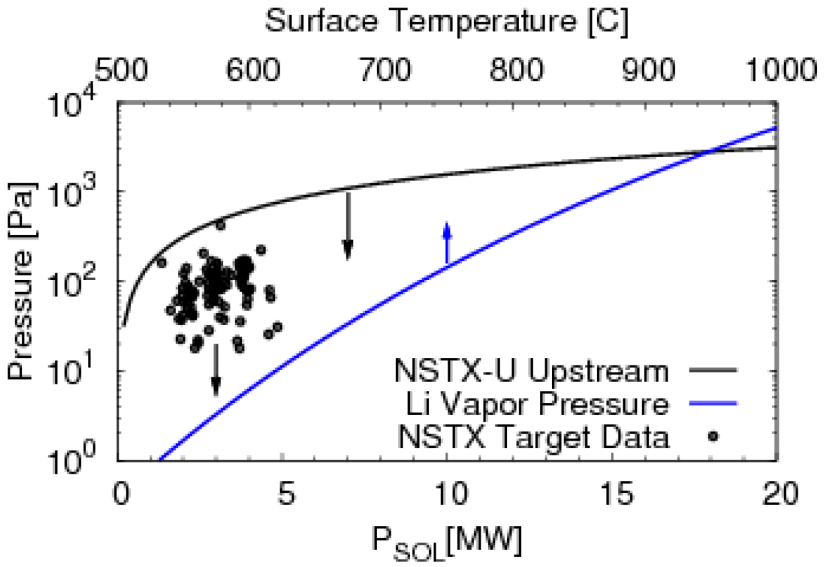


Figure 5.15: Comparison of pressures in considering vapor-shielded PFCs. NSTX-U upstream pressure estimate from equation 5 and NSTX divertor pressures as functions of power entering the SOL. The total lithium vapor pressure as a function of surface temperature is also shown for comparison. This figure indicates that even for NSTX discharges, lithium vapor pressure at surface temperatures of 750-800C would not exceed the divertor plasma pressure as measured by Langmuir probes at the target plate.