XP 951: Monte Carlo Calculations of Li Diffusion in He

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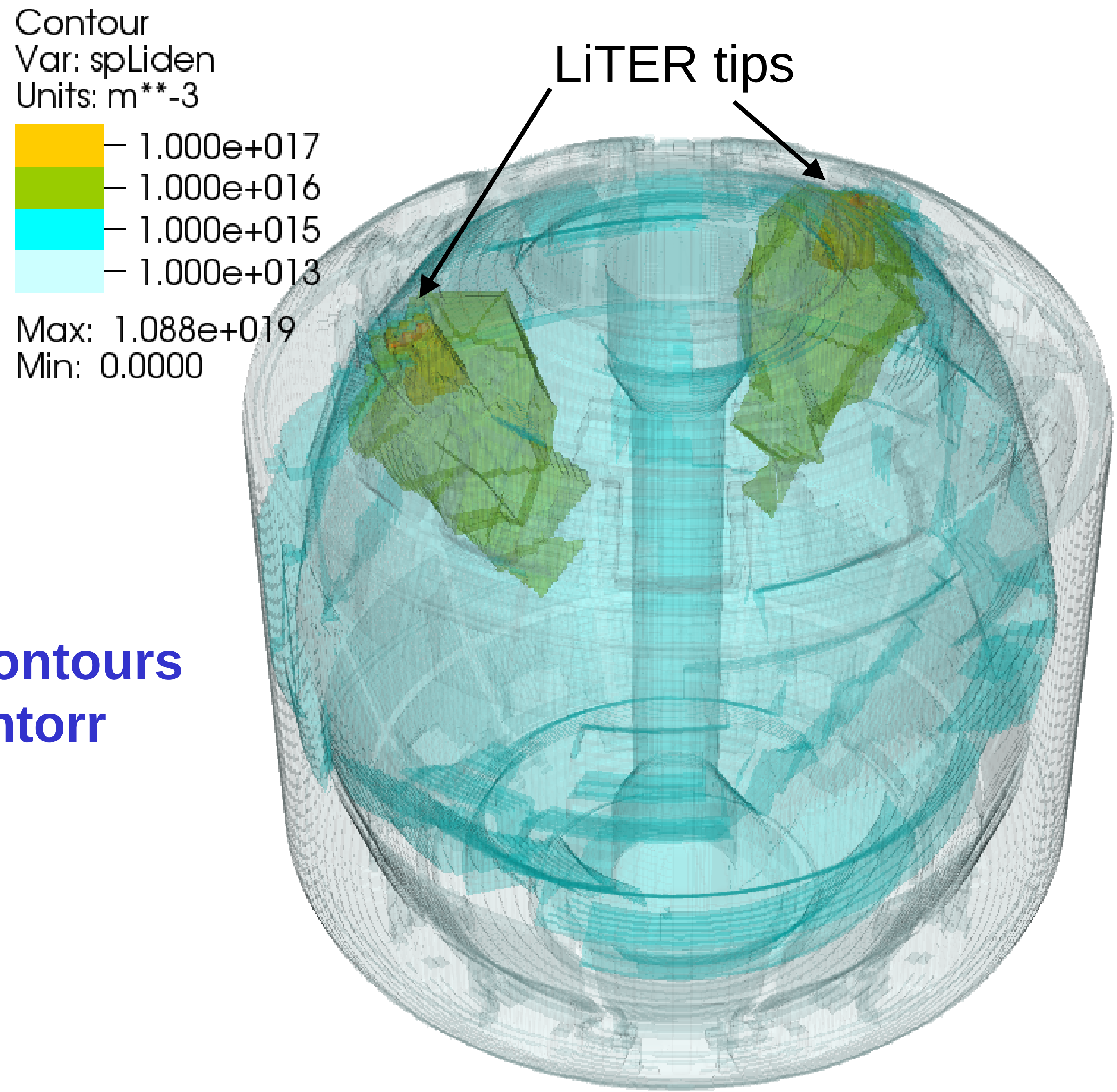
- Motivation & background: see Skinner's talk.
- Zakharov's LiTER calculations assumed straight line Li atom trajectories: Li mfp >> R.
  - But, coverage limited to bottom surfaces,
  - Significant shadowing.
- Opposite (diffusive) limit: Li mfp << R,
  - Not much harder to estimate.
  - But, coverage strongly peaked on upper surfaces.
- Optimal pressure(s) likely in between,
  - I.e., each Li has a few He collisions before hitting a surface.
  - $\Rightarrow$ Need fully kinetic (Monte Carlo) calculation.

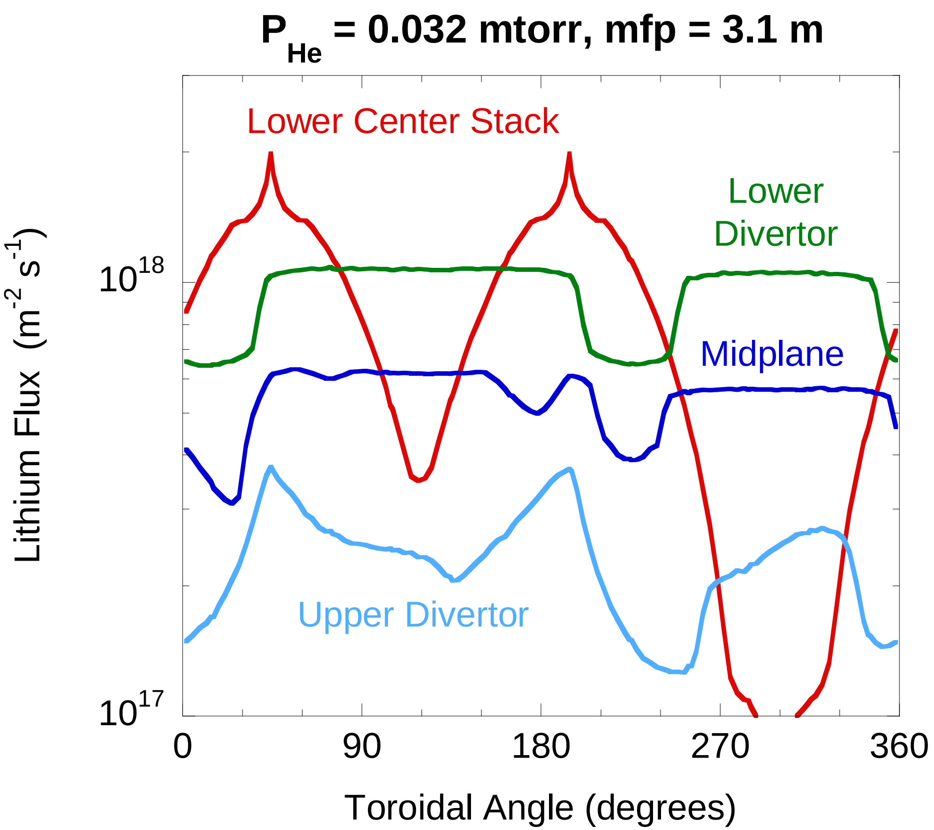
Simulate Li Flux to NSTX Tile Surfaces using DEGAS 2

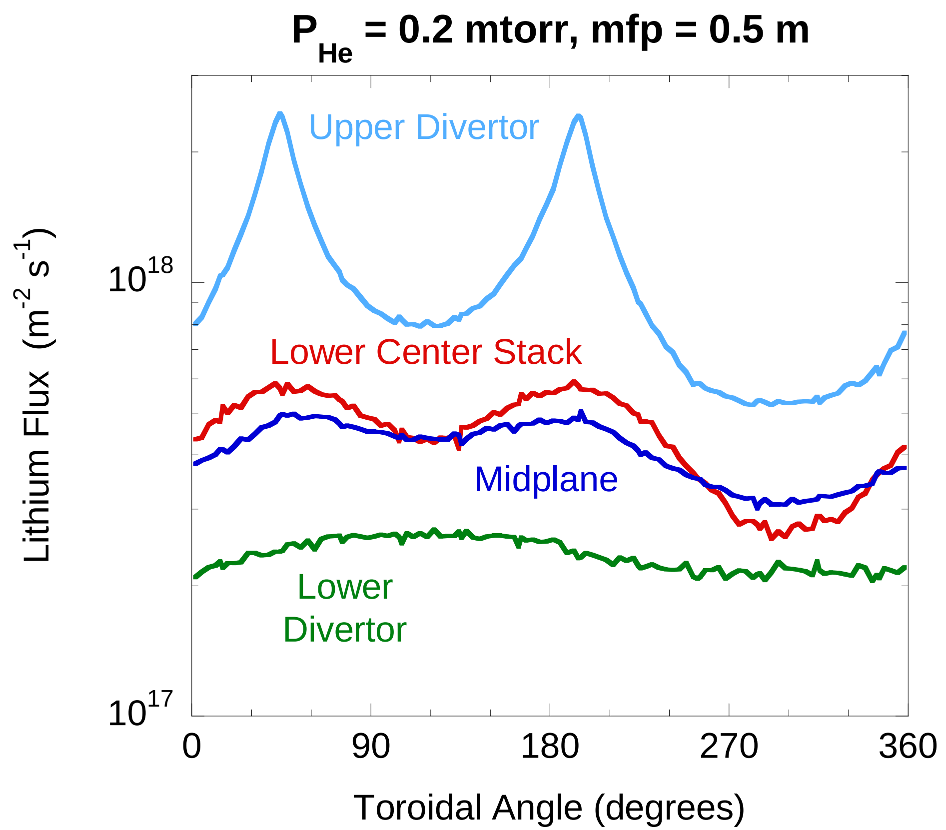
- 3-D representation of NSTX vacuum vessel,
  - Including passive plates, divertor plates, gaps, QMB's, etc.
- Vessel uniformly filled with He at specified pressure.
- Only physical process is Li + He elastic scattering,
  - Li atoms assumed to stick upon striking a surface.
- Two LiTER sources,
  - Source velocity distribution from Zakharov.
- Accumulate: flux to each surface vs. toroidal angle,
  - Repeat for range of pressures.



Li Density Contours at 0.032 mtorr

Magnitude of Fluxes & Toroidal Uniformity Vary with Pressure



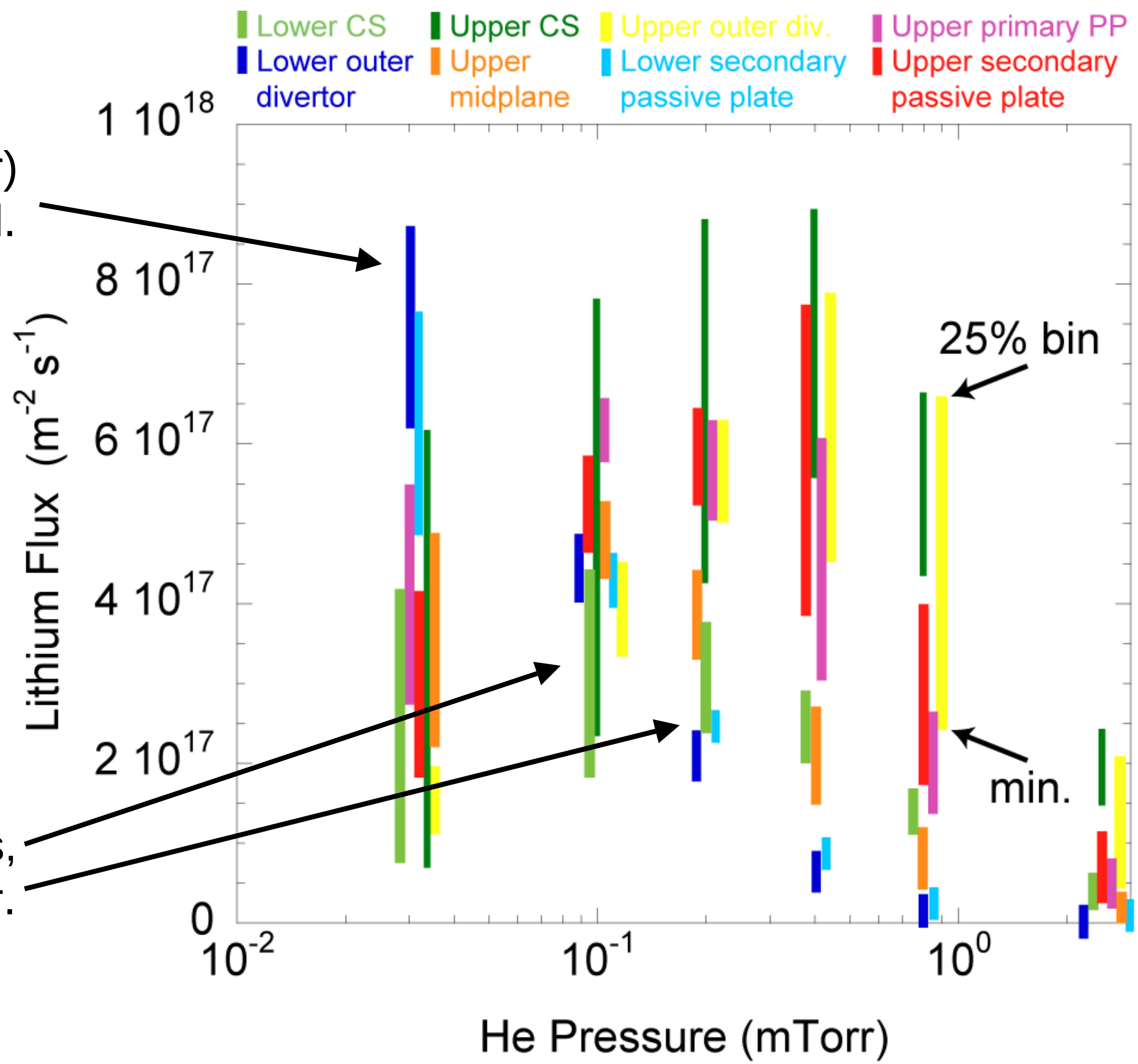


- Both LiTERs operating at 10 mg/min each.
- Higher pressure plots resemble 0.2 mtorr case, but with greater range of fluxes.

Summarize Runs to Identify Best Pressures for Each Surface

Low pressure (0.032 mtorr) covers lower surfaces well.

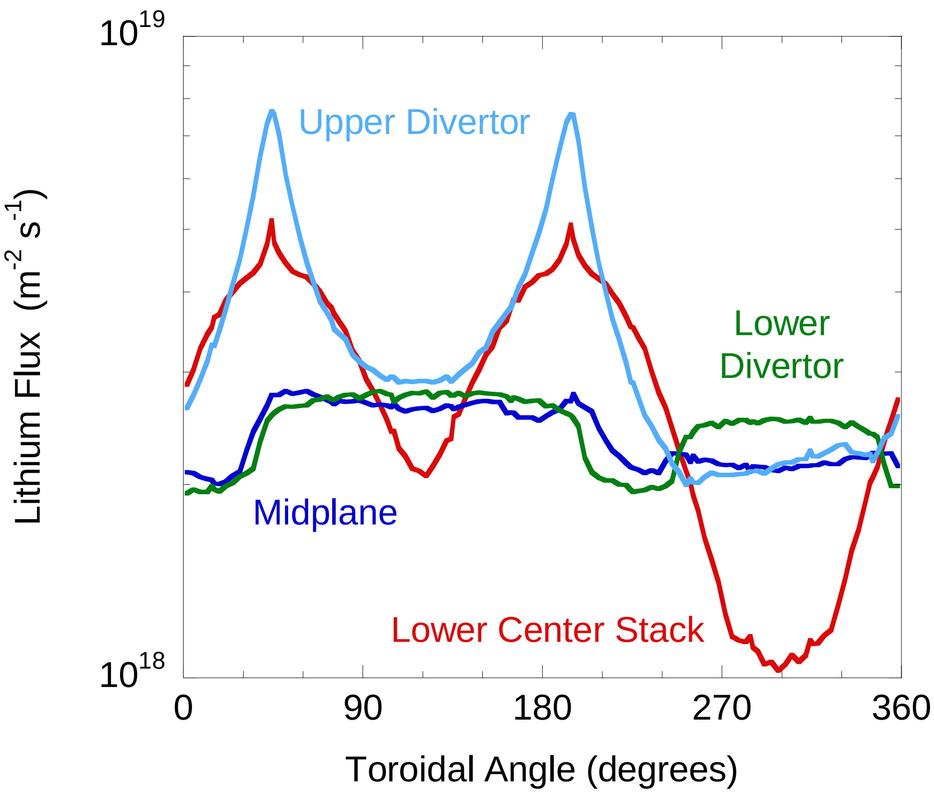
0.1 & 0.2 are "Goldilocks" values: provide most uniform coverage on a surface.
0.1: midplane surfaces,
0.2: upper PP, divertor.



Optimize Prescription via Linear Combination of Runs

- Use 3 He pressures for simplicity,
- Goal: obtain some minimum coverage everywhere,
  - Avoid excessive peaks & valleys.
  - No algorithm; just eyeballing!
- Portion of CS partially shadowed because LiTER's 130 degrees apart.
- This is essentially prescription used in XP 951.

1 @ 0.032 mtorr / 2 @ 0.1 mtorr / 2 @ 0.2 mtorr



Future Work

- Better spatial calibrations for critical components,
  - LiTER location, tile edges around QMB.
  - Underway / just completed.
- Account for D_2 outgassing & scattering,
  - Incremental D_2 pressure was ~20 – 40% in these experiments.
  - Li + D_2 cross section probably similar.
- Design XP to validate / calibrate this procedure,
  - Need poloidally varying QMB data for validation,
    - Likely to uncover shortcomings.
  - Can use pressure trends to calibrate & improve model,
    - E.g., Li + He cross section.