Status & Plans for UEDGE / DEGAS 2 Modeling of Li Behavior in NSTX

D. P. Stotler

A. Yu. Pigarov (*UCSD*), L. E. Zakharov
Princeton Plasma Physics Lab

NSTX LRTSG Meeting
June 16, 2009

Modeling of Li experiments in NSTX

A.Yu. Pigarov

University of California at San Diego

With contributions from

R. Smirnov (UCSD),

T.D. Rognlien, V. Soukhanovsky (LLNL)

11 December 2008, PPPL, Princeton NJ

Conclusions

- With UEDGE code we self-consistently model the plasma Li and C transport for NSTX divertor coated with Li.
- We studied Low Recycling regimes showing the high-temperature and low separatrix density plasma formation in the outer divertor.
- We showed that:
  - peak heat power loads to plate are dominated by parallel electron heat conduction where that to wall is due to blobby plasma convection
  - low upstream plasma densities results in the flat Te profiles along magnetic field lines and in a sheath-limited plasma condition at outer plate.
  - ion flux to plates is small ~3KAmp for R<0.9 and the recycling is dominated by gas-puff and main-chamber recycle.
  - Li impurities originating from Li coatings erosion and evaporation are well retained in the divertor region.
  - high peak heat fluxes to plate ~10 MW/m2
  - high surface (~900K) temperatures result in divertor transition to high recycling conditions due to excessive Li evaporation.

UEDGE is only Predictive Tool, But Utility is Limited

- Comprehensive, realistic simulations of existing discharges difficult,
  - Best examples: Sasha's work on SOL flows.
  - My attempts are simpler & don't match data.
  - Need kinetic BFITs to get $T_{e,sep}$ & $n_{e,sep}$ right.
- Sasha still having trouble generating meshes & getting solutions in high-δ DN configurations.
  - In spite of claimed UEDGE improvements.
- Going forward, may be limited to scoping studies,
  - E.g., extend Sasha's recent work to include reduced recycling at inner divertor & examine fuelling implications.
  - Insight into impurity behavior?
    - But, depends on sources & transport coefficients (poorly known).

# Planned Recycling Studies with DEGAS 2

- Essentially fitting D fluxes to targets to match camera data & neutral pressures.

- Simple prescriptions for plasma parameters using TS data,
  - E.g., sheath limited.
  - Will test using existing UEDGE runs.

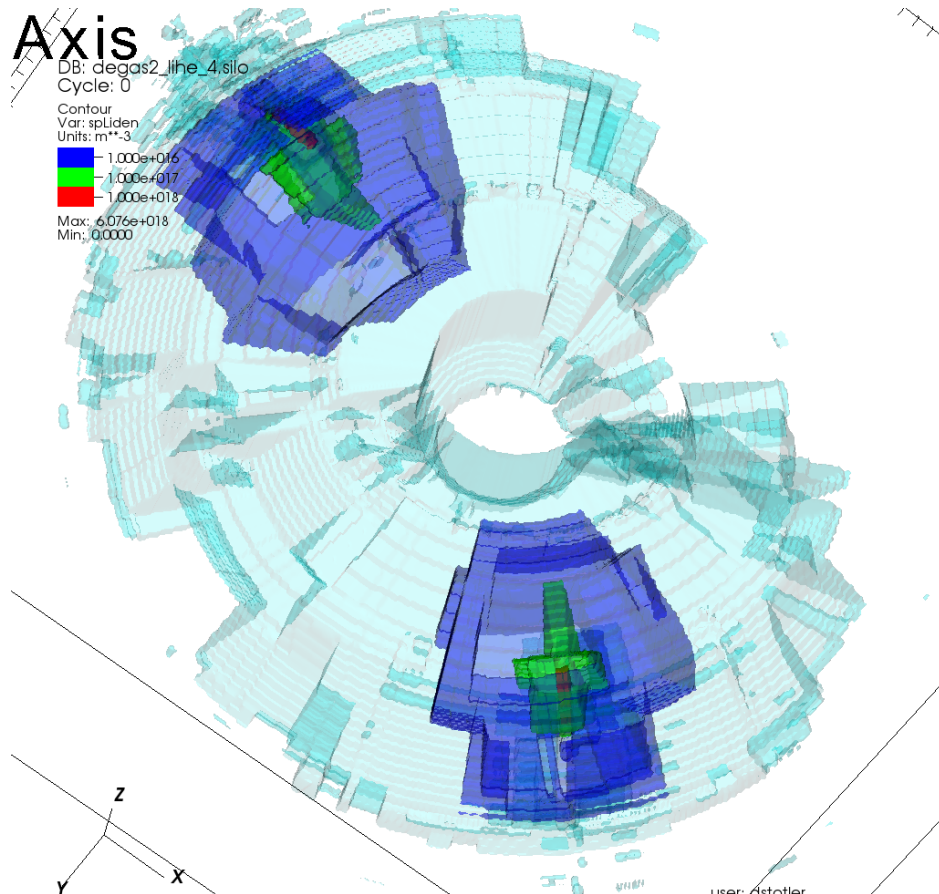# Completed Coupling to UEDGE for DN Geometry.
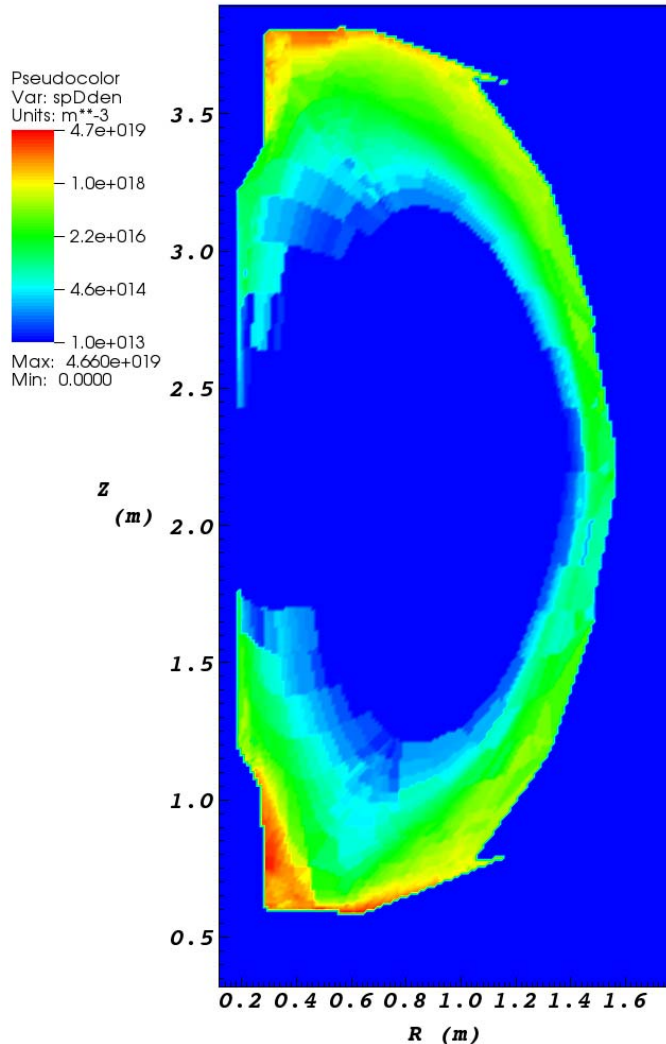
- First step in planned DEGAS 2 studies,
- Sasha also interested in D_α emission due to molecules,
  - Explain in / out asymmetry?
- May aid interpretation of existing experiments,
- But has no predictive capability,
  - $\Rightarrow$ no help for enhanced LLD planning.

DEGAS 2 Modeling of Li Deposition with He Fill
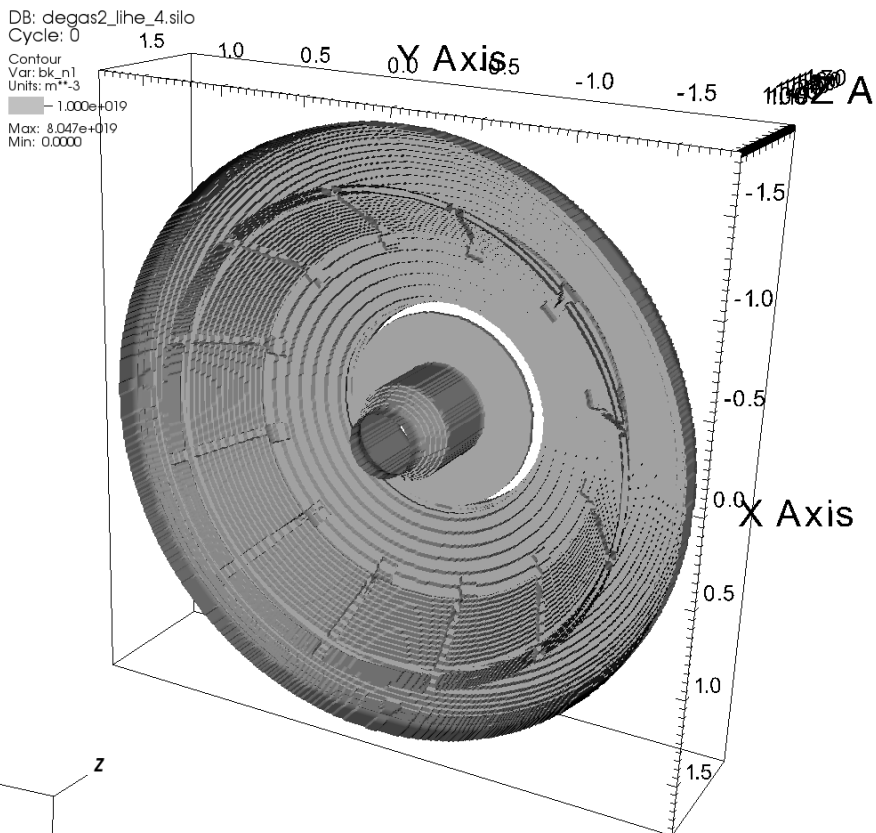
Simulation boundary
(upper divertor)

Li density contours