Task A: Plasma/Liquid Surface Interactions and Plasma-Edge Modeling

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Outline

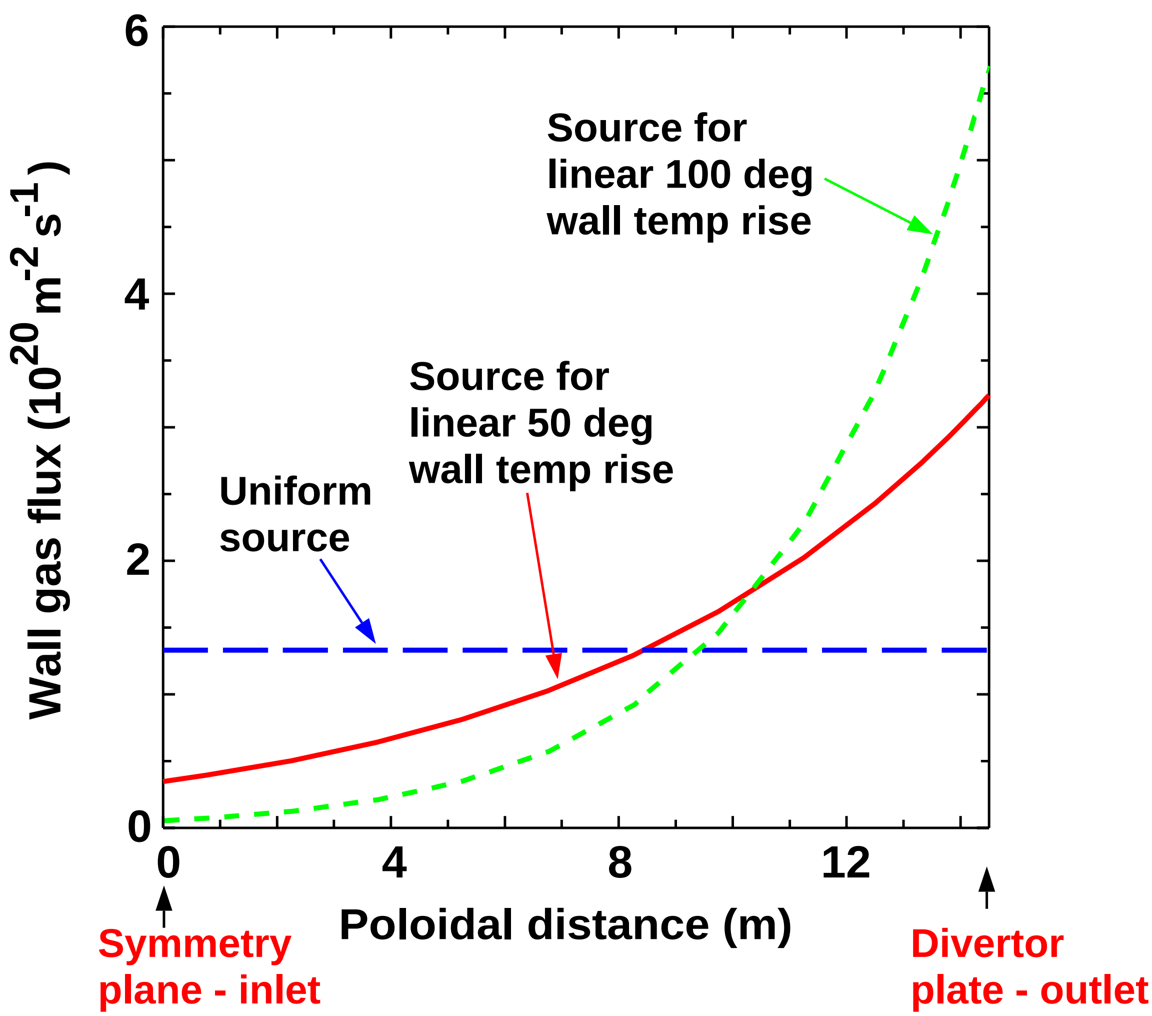
1. **Status of specific tasks**

2. **Plans**

Status of specific tasks

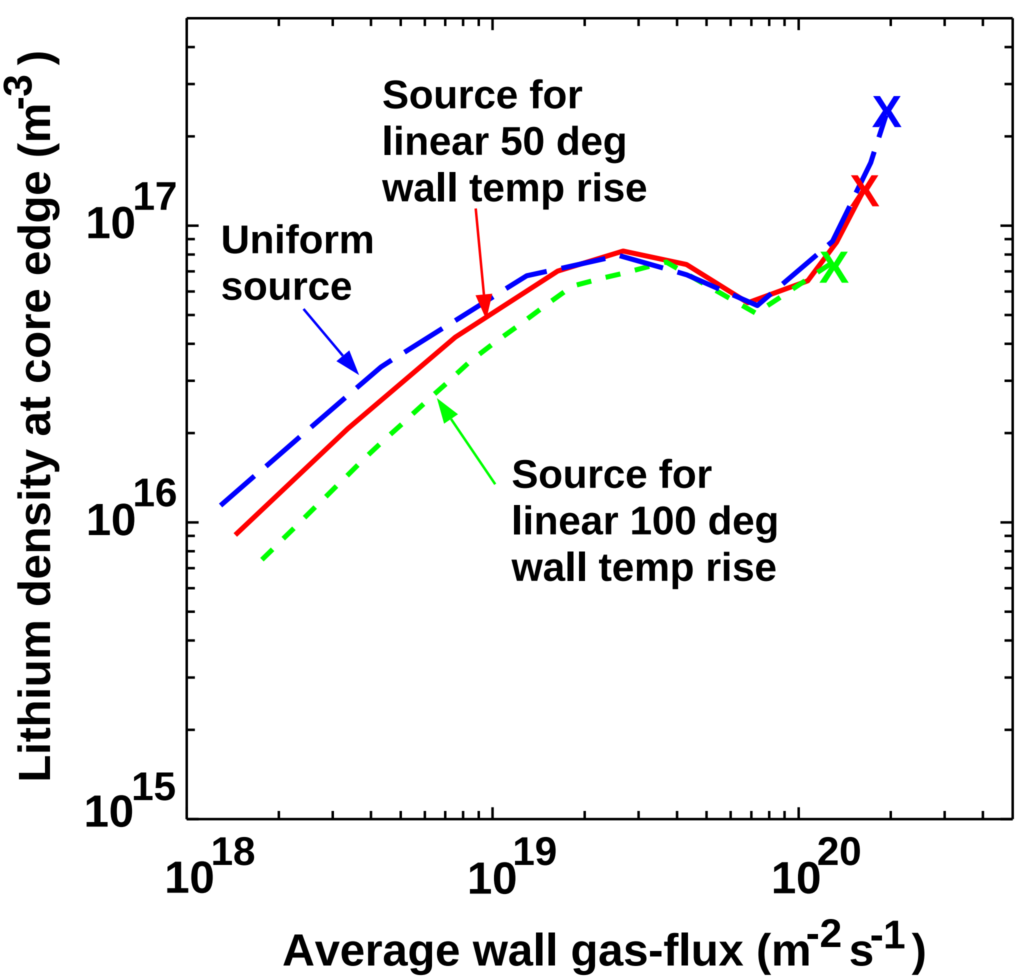
- Temperature-dependent wall evaporation
- Partition of power loss between radiation and particles
- Spectra of line radiation
- Alternate device modeling - tokamak variations, different configurations
- Kinetic modeling

Wall gas source from linear rise in T_{wall} strongly peaks at the outlet end



Core impurity density changes little from uniform to linear T_{wall} source models

Lithium wall, low-recycling hydrogen,
ncore_hyd = 2 x 10^{19} (m^{-3})



ITER considered mixture of radiation & divertor loss

- **ITER assumed the following loss channels for power:**
  - **33% via core bremsstrahlung and synchrotron radiation**
  - **17% via mantle line-radiation, injected impurities**
  - **33% via divertor, X-point line-radiation, injected & intrinsic impurities**
  - **17% via particle transfer to divertor plates**

- **Present-day tokamaks indicate these numbers are obtainable, but not unique**

- **Radiated fraction increased by both impurity and hydrogen injection**

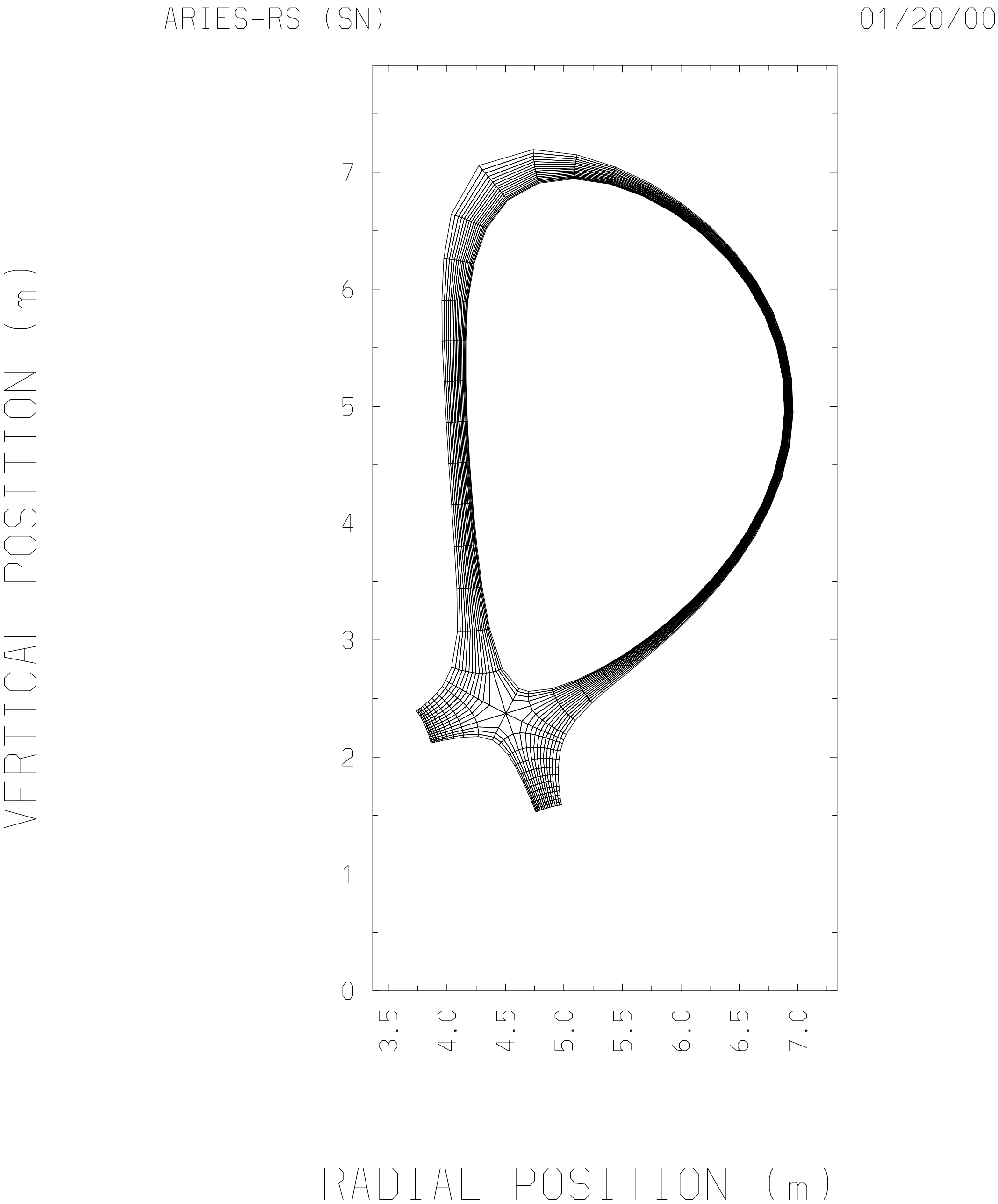
High fraction of radiated power has pros & cons

Pros:

- **Decreases heat load on divertor**
- **Increases uniformity of power deposition**

Cons:

- **Increases surface heating of liquid wall, and thus evaporation**
- **Decreases electron energy content of edge-plasma and thus decreases shielding of impurity vapor**



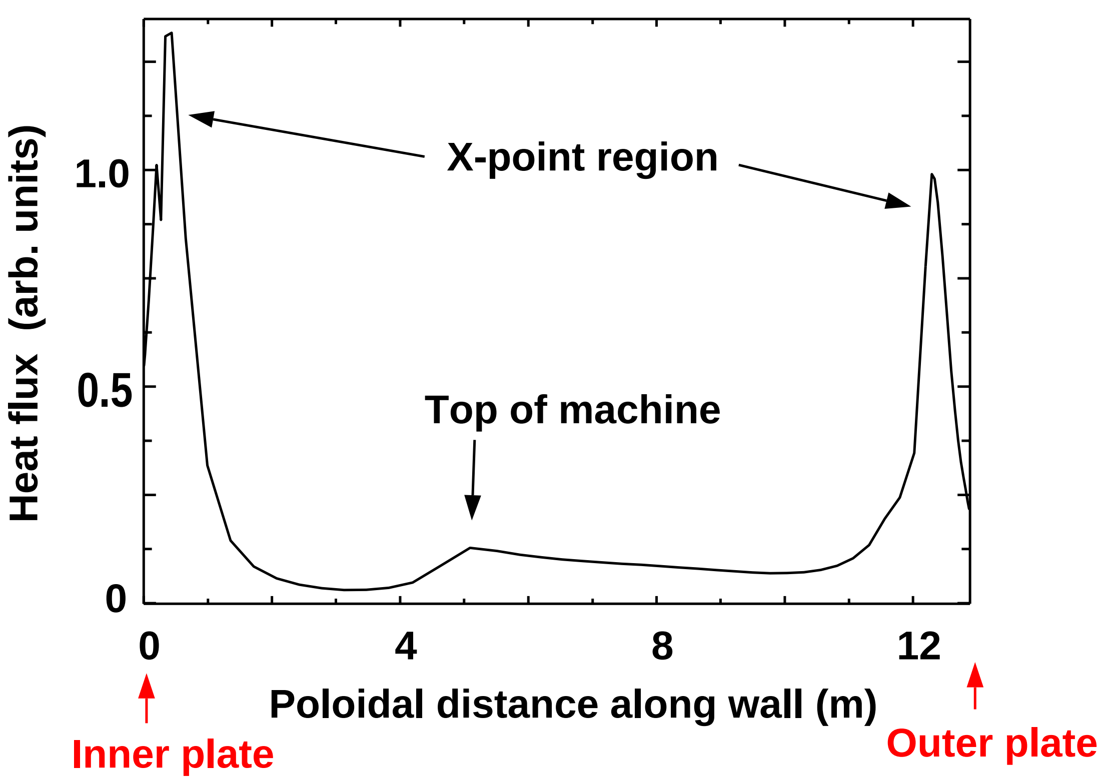
ARIES-RS (SN)
01/20/00
VERTICAL POSITION (m)
RADIAL POSITION (m)
0
1
2
3
4
5
6
7
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

Radiation flux on wall has 3 components

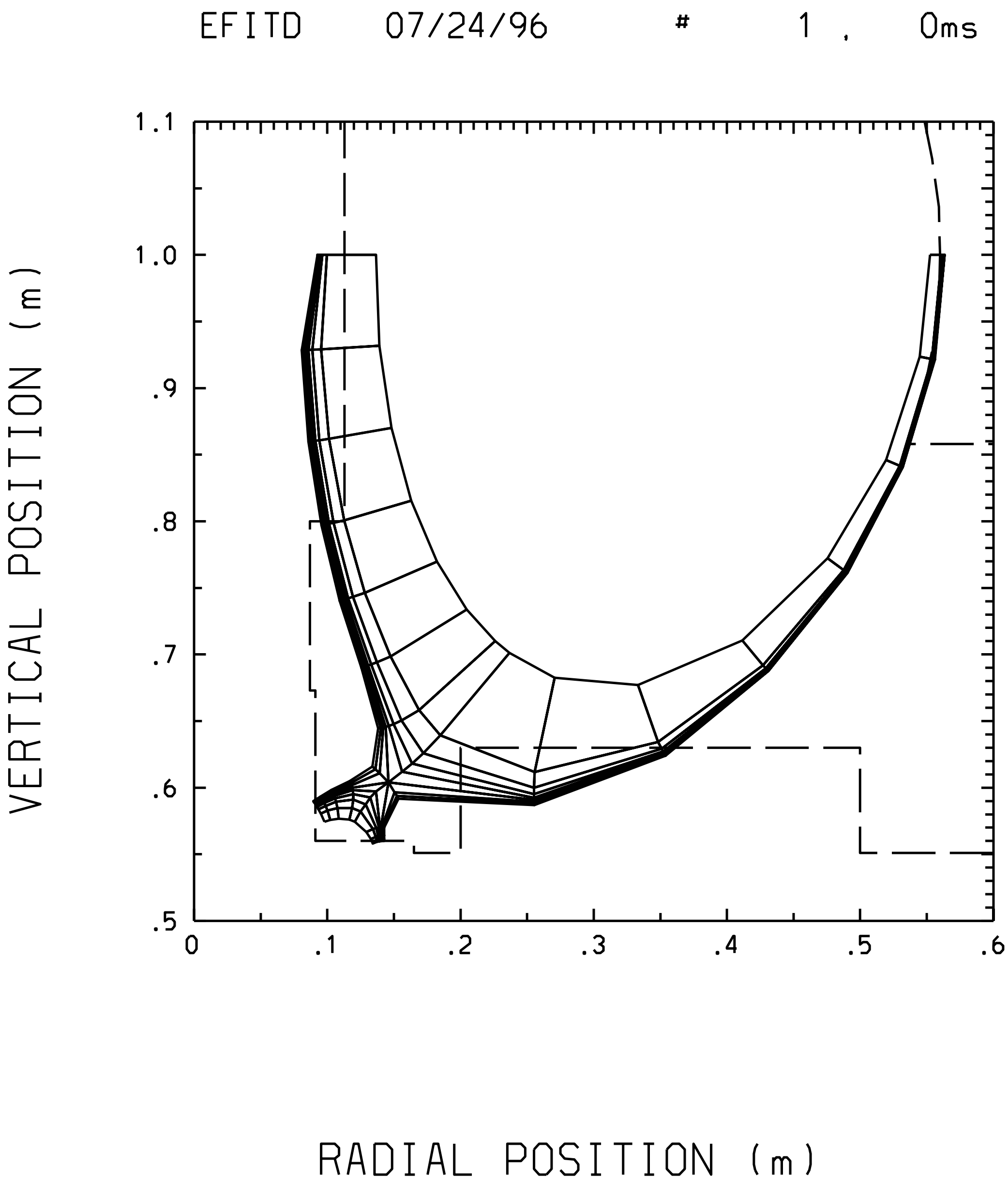
1. Core bremsstrahlung - fairly uniform, penetrating
2. Core-edge line radiation - fairly uniform, surface absorp.
3. X-point line radiation - very nonuniform, surface absorp.

For ARIES-RS, the third component is shown below:

Wall heat flux for X-point radiation source



UEDGE Mesh for CDX-U



Plans

*denotes items focused on for remainder of FY00 - IAEA & ANS

1. Enhanced impurity shielding
   - auxiliary heating*
   - hydrogen halo*

2. Alternate configurations and low recycling
   - FRC modeling with Flibe and SnLi*
   - initial CDX-U characterization*
   - benchmark with TFTR lithium experiments

3. Role of impurity line radiation
   - model edge-plasma for radiating-mantle mode
   - effect of reduced-energy SOL plasmas on shielding*

Plans - continued

4. Divertor and sheath coupling
   - power split to divertor and wall
   - coupling between UEDGE and WBC; sidewall sheath
   - helium spatial distribution for pumping

5. Kinetic modeling
   - low-recycling plasma kinetic modeling (MCI code)*
   - Monte Carlo neutral modeling for low recycling CX-loss