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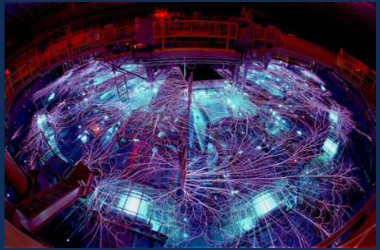

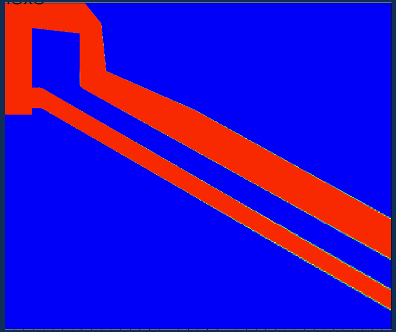

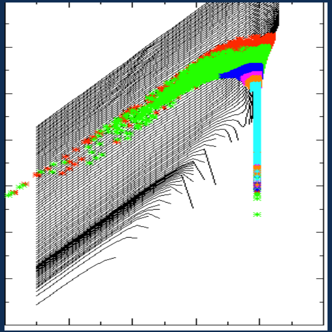

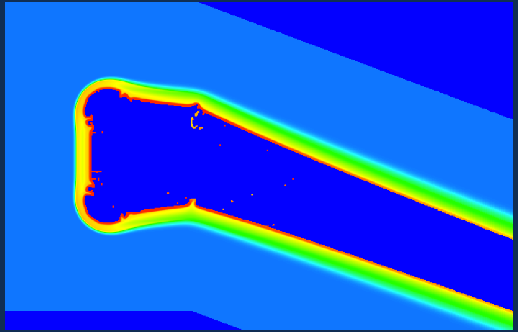

Rad-MHD Modeling the inner MITLs of Z

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Introduction?

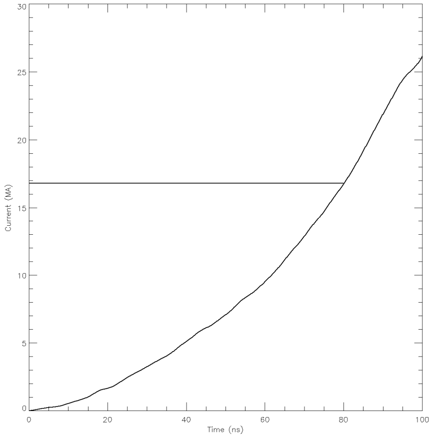
- What portions of EOS space will be accessed by the MITLs on Z-next (60MA)
- What portions are reached on Z now (25MA)
- Are our material models adequate to the task
- Side questions
  - Is thermal conduction important?
  - Is radiation transport important?
  - Can MHD simulations inform PIC (Chicago) boundary conditions?

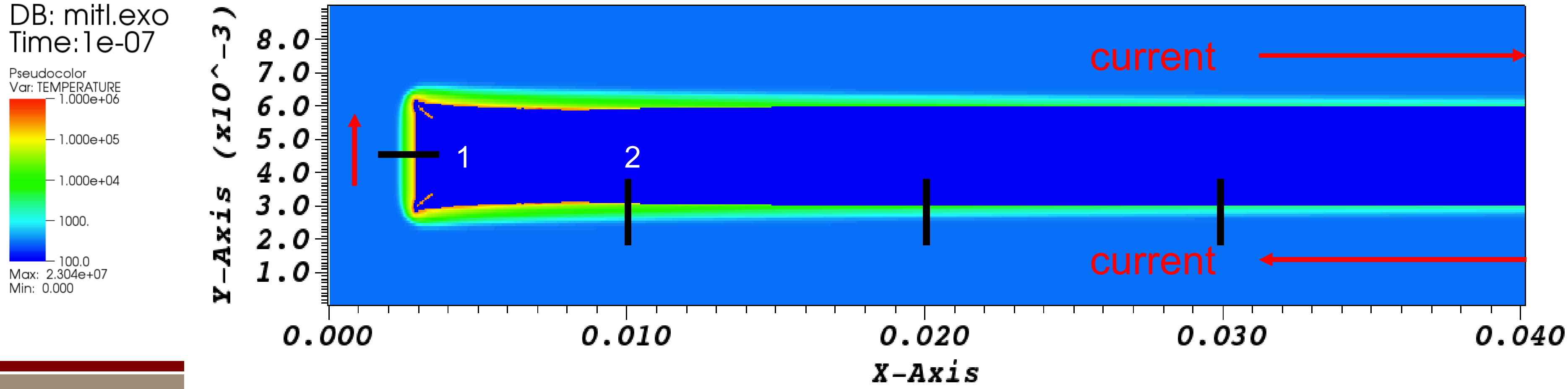
- Start with parallel disks shorted at the center as an approximation for more realistic geometries
- Material motion is small away from short so current model should be adequate ($\dot{L}$ is small)
- Current ramp to 25 MA (or 60 MA) over 100 ns

- Resolution study
  - 20 microns appeared to be converged in heating rates
  - Simplified reduced simulation space did not conclusively confirm resolution (more study required)

Simulation Set Up

- Center Hot Surface is along line 1
- Radius 10 mm is along line 2, and so on.
- Figure clipped to 1e6 Kelvin
- 2D RZ axisymmetric geometry.
- Single group (Grey) diffusion
- The AK gap is 3mm
- The simulation is 8 cm in radius.





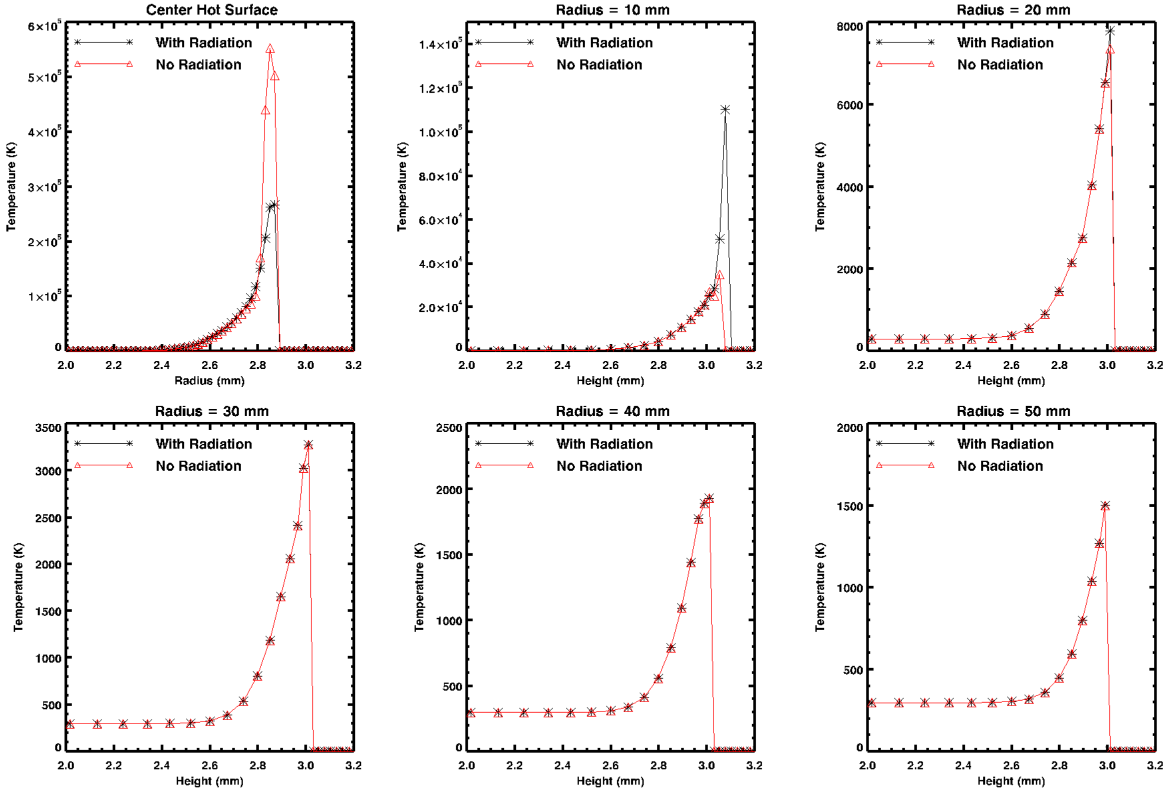
Radiation Transport and Thermal conduction

Radiation modified the MITL temperature at radius < 30mm

Next steps

1) **Need to compare with 3D wedge for possible 2D axisymmetric radiation transport issues (do not expect to see any difference)**
2) **Multigroup diffusion and multigroup IMC (3D only) to confirm single group diffusion is an upper bound on energy transport**
3) **Run at 60 MA**
4) **More realistic geometries (MagLIF)**

With and Without Thermal Conduction showed virtually no difference

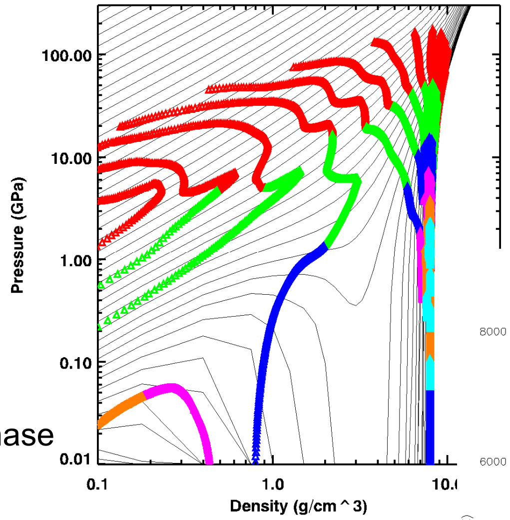


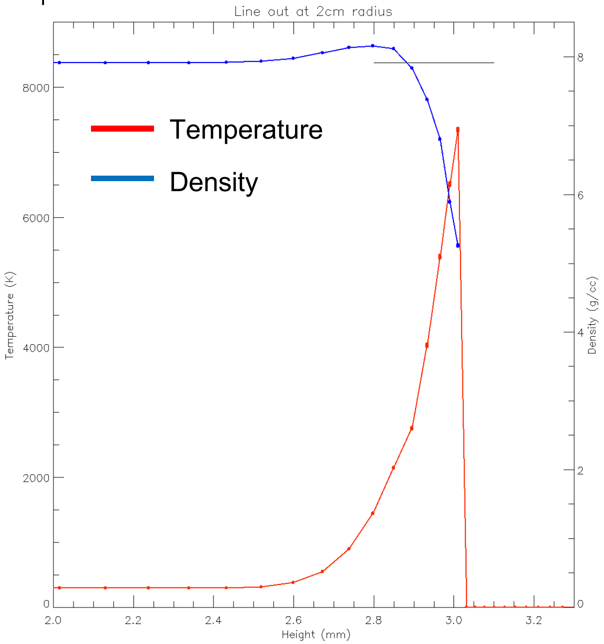
Initial 25 MA Alegra-MHD simulations in EOS space

- 10 micron resolution
- Red = 4mm < radius < 5mm
- Green = 5mm < radius < 10mm
- Blue = 10mm < radius < 15mm
- Magenta = 15mm < radius < 20mm
- Orange = 20mm < radius < 30mm
- Cyan = radius > 30mm

- Most of the stainless is compressed but still solid
- EOS (worm) plot shows some expansion

- NOTE: any material entering the vapor dome/mixed phase regime will be misrepresented.





Initial 60 MA Alegra-MHD simulations

Sandia National Laboratories

- 20 micron resolution
- Lines are isotherms
- Red = 4mm < radius < 5mm
- Green = 5mm < radius < 10mm
- Blue = 10mm < radius < 15mm
- Magenta = 15mm < radius < 20mm
- Orange = 20mm < radius < 30mm
- Cyan = radius > 30mm
- Density figure (below) clipped at 30 g/cc
- Temperature ~ 200,000 K

- Next Steps

•Analyze inner MITL steel for compositional maps

•Get post shot pieces for cut away to examine melt

•DFT simulations at higher densities to check EOS and conductivity models

•Dedicated Z experiments to confirm models (to about 5 Mbar)