2D VDE Simulations of SPARC

10/13/2023

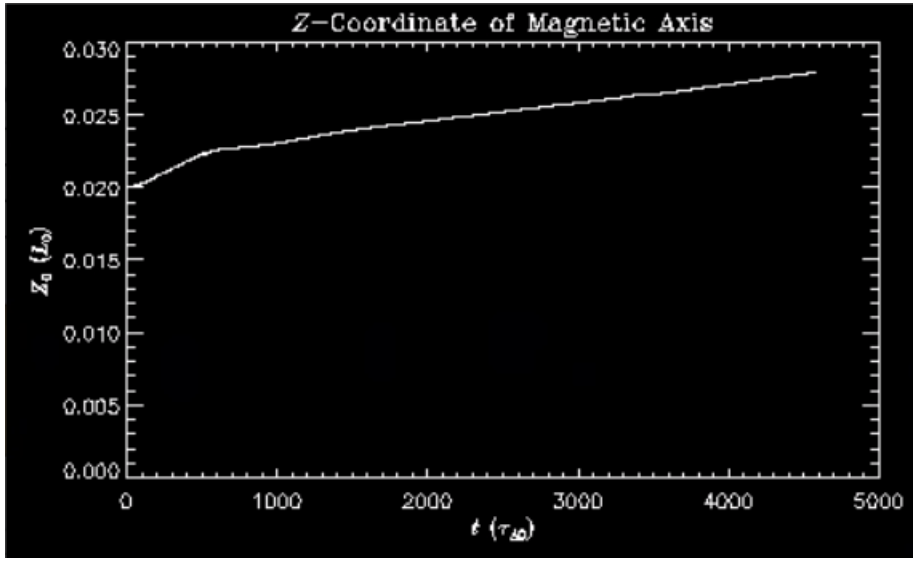
1. Initial Case on MIT Cluster
2. Features of Initial Equilibrium
3. Attempt to replicate this on stellar

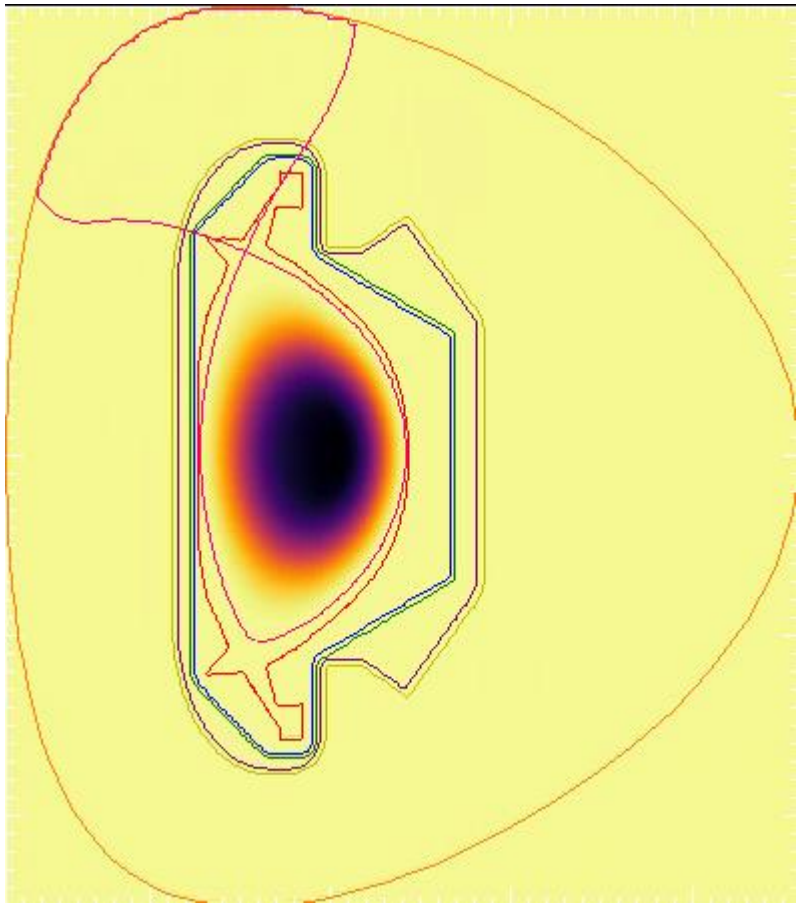
Initial Case on MIT Cluster

1. First calculate equilibrium displaced upward 2 cm

2. Run for 500 steps with increased κ = 1.E-4 to reduce β by 20%, causing plasma to move inward, generating eddy currents (non up-down symmetric)

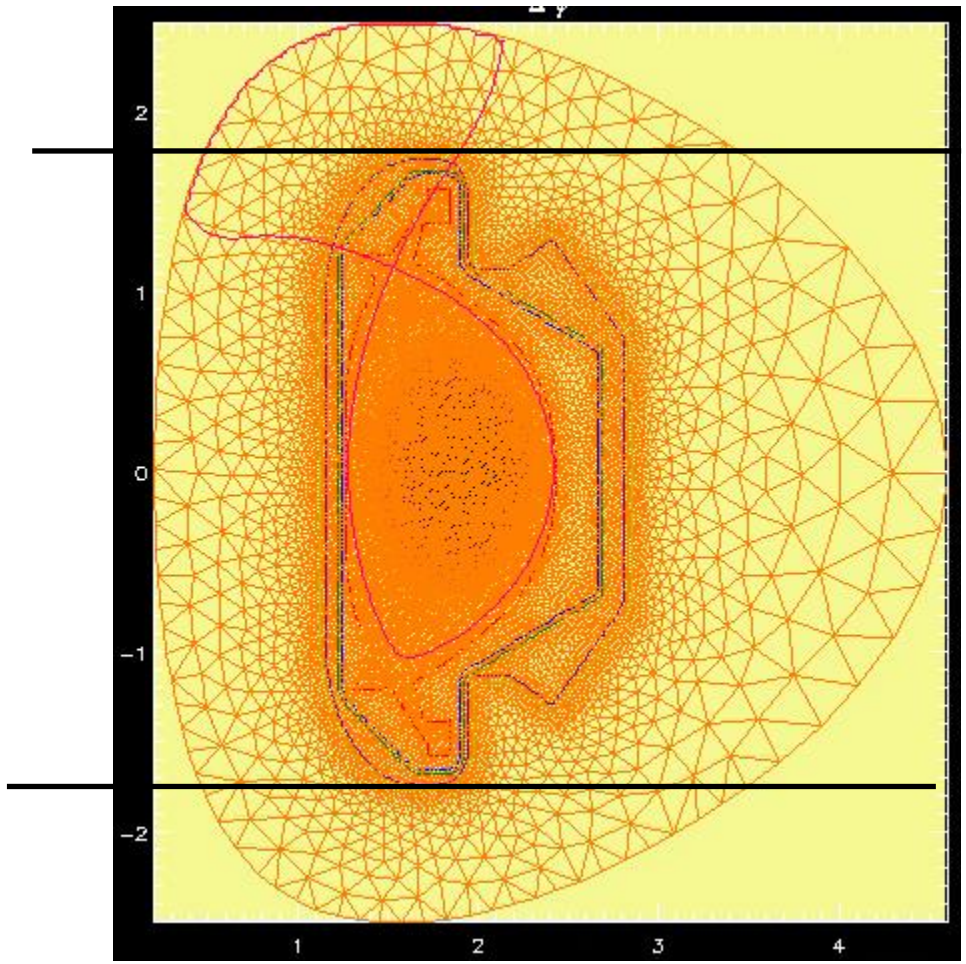
3. Next decrease κ=1.E-6 and let VDE proceed

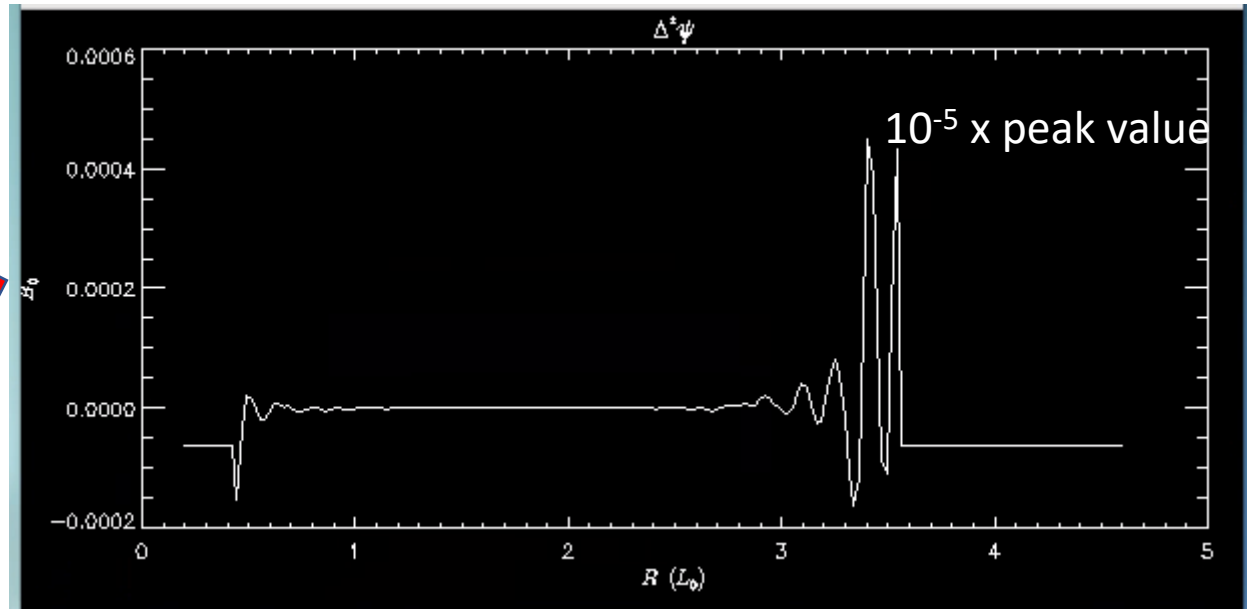




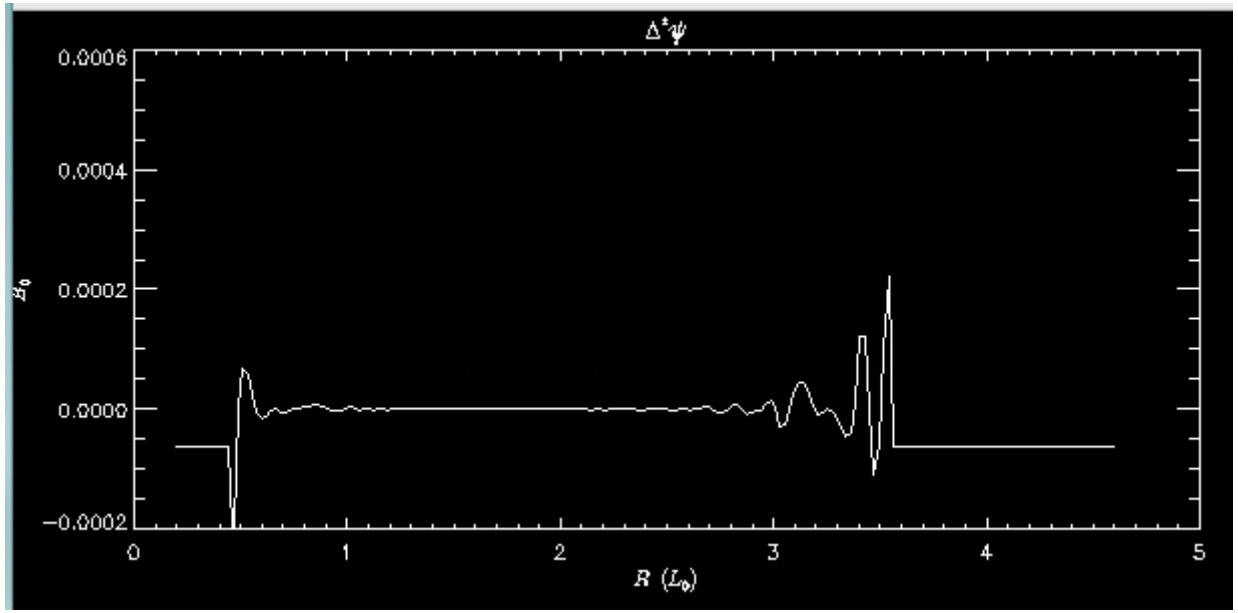
- Moves upward, but not clear if it is linear or exponential in time. Need to run further.

Features of initial equilibrium



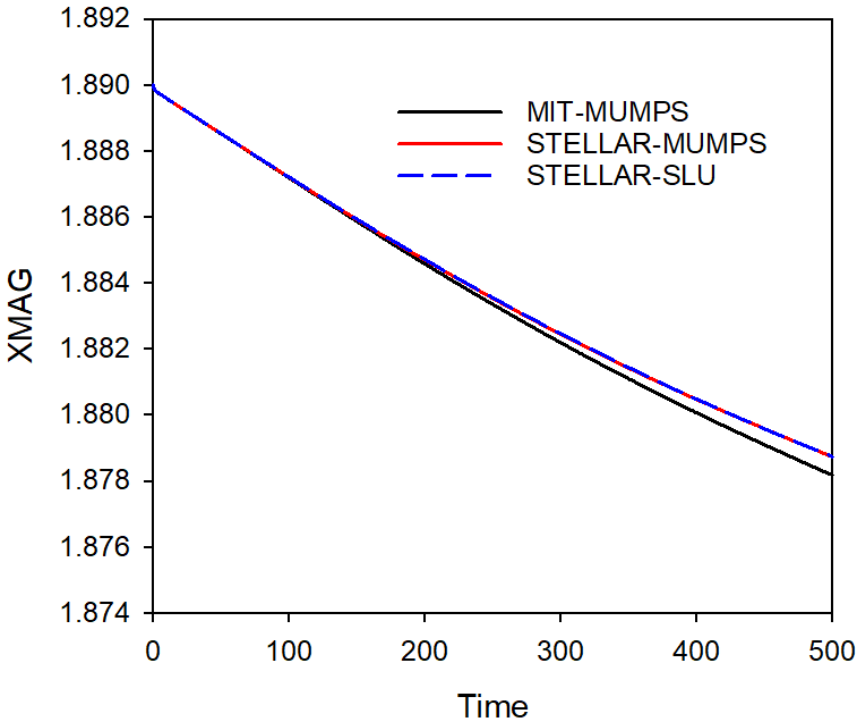


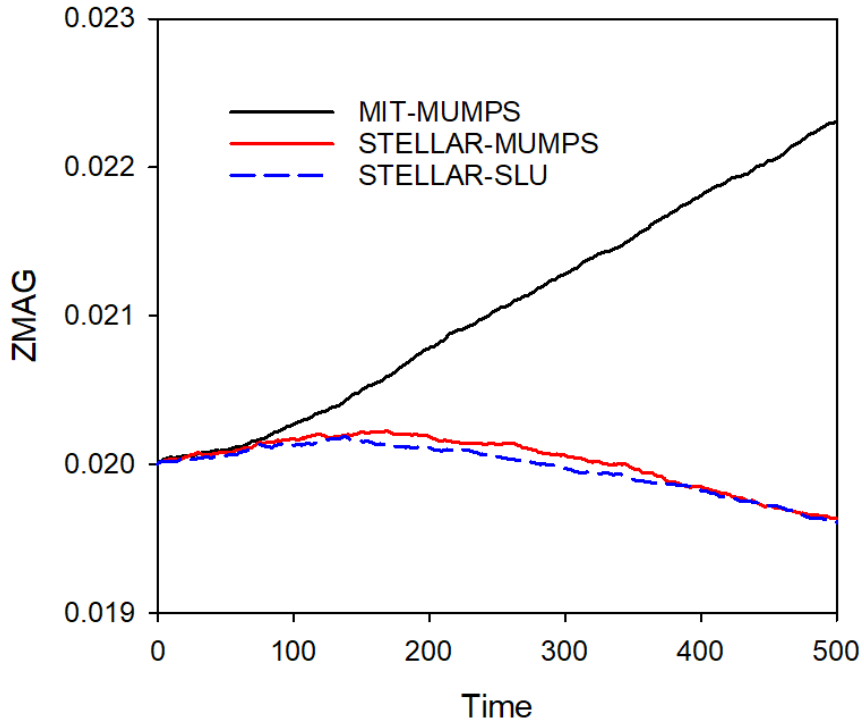
10^{-5} x peak value



Max error in J is 10^{-5} x peak value

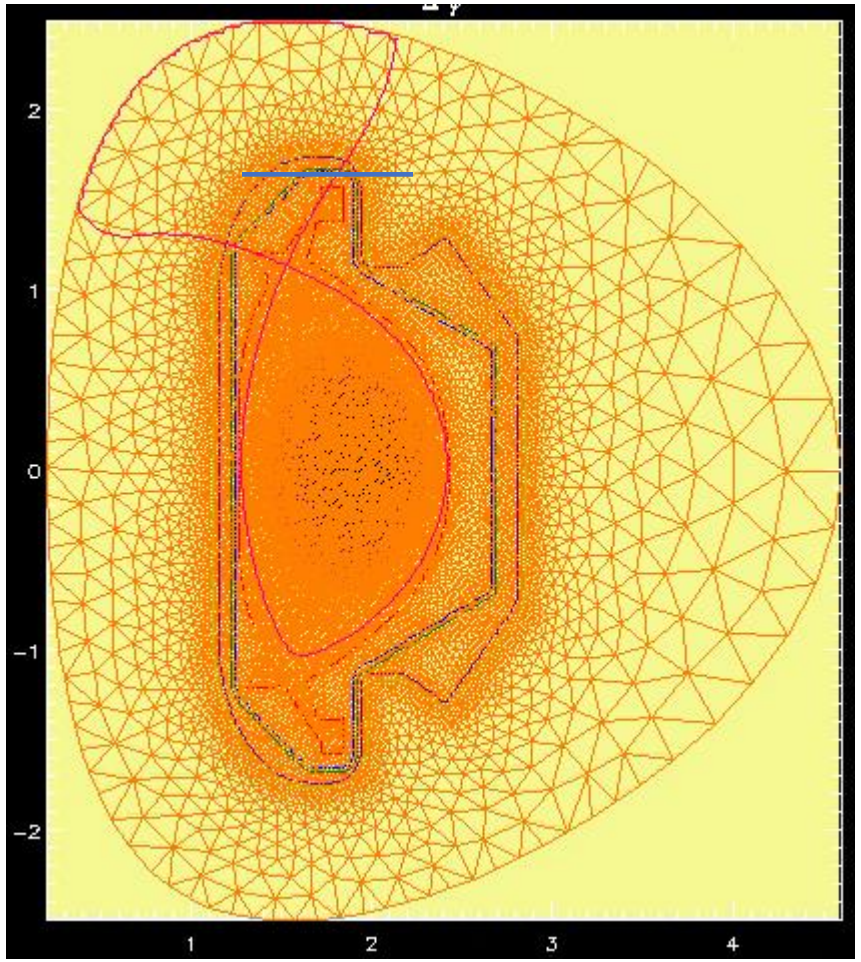
Comparison of MIT and Stellar

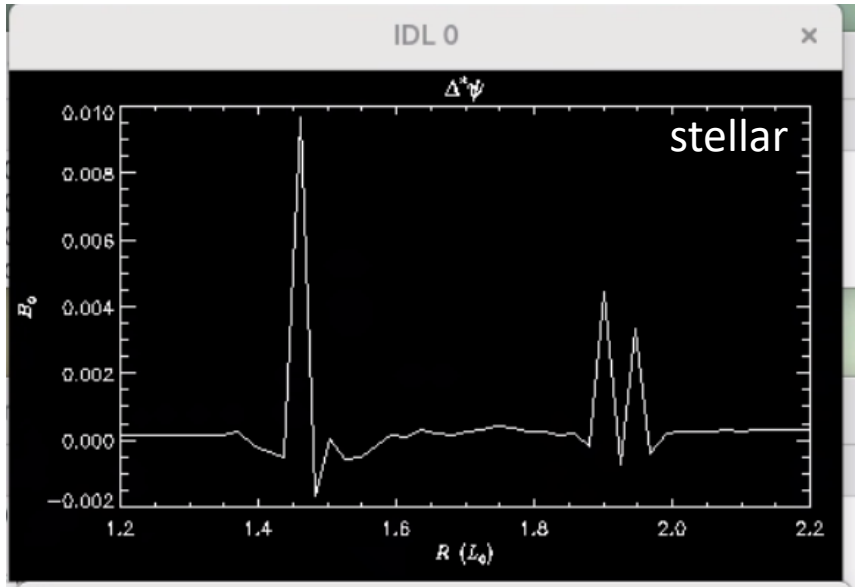


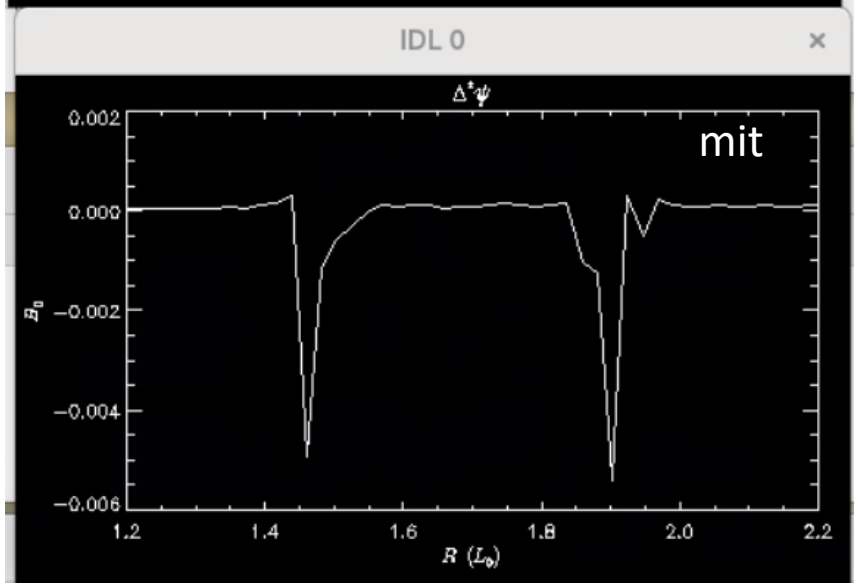


- Reasonable agreement for XMAG during the β-drop
- Poor agreement with ZMAG
- MUMPS and SLU give almost the same result on Stellar, differs from MIT

J_phi at end of β-drop (time 500)







- plot_field,'jphi',cutz=1.7,xrange=[1.2,2.2]
- stellar and MIT give very different currents in conductors

Summary

- Stellar and MIT give very different results for time evolution of plasma + structure
- Initial equilibrium are identical (to 7 decimal places)
- mumps and SLU give very similar results on stellar
- Should try test cases with older mesh generation routine: m3dc1_meshgen
- Should rerun old ITER case on both machines