M3D-C1 ZOOM Meeting

01/10/2022

CS Issues

1. Perlmutter status
2. Mesh adaptation update
3. NERSC Time
4. Changes to github master since last meeting
5. Regression tests
6. Link to python postprocessor documentation

Physics Studies

1. Update on Soft beta limit study

Note: **meeting minutes posted on m3dc1.pppl.gov**

In attendance

Steve Jardin
Adelle Wright
Dingyun Liu
Hank Strauss
Nate Ferraro
P Sinha
Chang Liu
Anders Kleiner
Cesar Clauser
Brendan Lyons
Jin Chen
Mark Shephard
Seegyoung Seol
Morteza Siboni

Perlmutter status

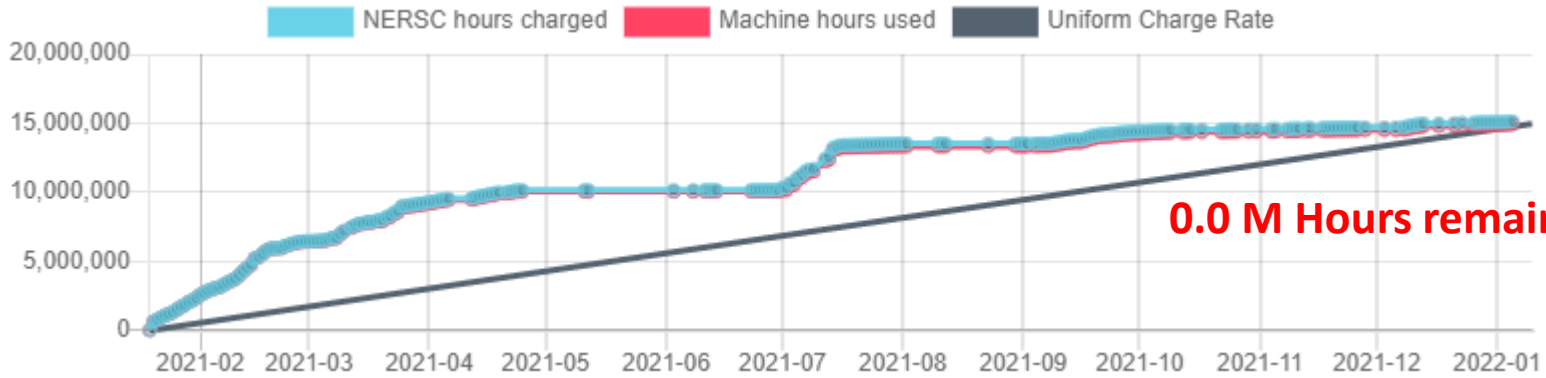
- ST=1 compiling fails due to netcdf…Jin
- Existence of “module load m3dc1/devel-Perlmutter “ ?? --Nate
- Problem with installing PETSc with NVIDIA…Seegyoung

Mesh adaptation update

- Pellet case …. Brendan
- Interest in Soft-Beta-Limit case ?

NERSC Time

mp288



0.0 M Hours remaining!

- New award period begins Jan 19
- We are NESAP Tier 2. . Phase-I w GPUs We have been given a repo m3984 with a small allocation
- N9ES-N2 M3D-C1: J. Chen , C. Liu, S. Seol are early users

New FY22 allocation (starts Jan 19)

Project name: mp288
CPU Node Hours Award: 75,000
GPU Node Hours Award: 7,000
Archive Storage Award (TB): 157
Project CFS Award (TB): 20

One "CPU Node Hour" is the equivalent of 400 "NERSC Hours“
75000 CPU Node Hours ➔ 30 M NERSC Hours !!!

➔ For 2022, the Machine Charge Factors are:

➔ Perlmutter CPU Nodes: 1.0
➔ Cori KNL Nodes: 0.20
➔ Cori Haswell Nodes: 0.34
and the charge units are "CPU Node Hours"

Changes to github master since 12/20/21

Nate Ferraro:
12/20/21: Added initial module file for Perlmutter. This will need to be updated since compilation fails due to lack of netcdf.mod at the moment

Jin Chen:
12/21/21 : Perlmutter code porting README/readme.perlmutter fix
12/28/21 : Perlmutter code porting NCSX files

Yao Zhou:
01/02/22: Read particle and heat source for ST=1
01/04/22: Reverted change to temperature initialization in init_conds

Andreas Kleiner:
01/02/22: Major update to Python routines
01/05/22: Updated documentation for Python routines
01/06/22: Bug fix in Python routines and documentation update

Local Systems

- PPPL centos7(01/08/22)
  - 7 jobs PASSED
- PPPL greene (01/08/22)
  - 5 jobs PASSED
- STELLAR (01/08/22)
  - 6 regression tests **PASSED** on stellar
  - adapt **FAILED** field energies off by 0.02%
- TRAVERSE(01/08/22)
  - 7 regression tests **PASSED**
  - adapt Energies are ok. Only gr_rate off

Other Systems

- Cori-KNL (01/08/2022)
  - Cannot run, out of time
- Cori-Haswell (01/08/2022)
  - Cannot run, out of time
- Perlmutter (01/08/2022)
  - ST=1 version doesn't compile: Unable to open netdf.mod
  - "make all" does not work
  - Executables not found in PATH
- MARCONI
  - All regression tests PASSED on MARCONI (J. Chen, 9/04/20)

Python Documentation

- A link to the python documentation at …./unstructured/python/Documentation.pdf was added to NEWDOC

- Andreas will give a demo next Monday of the present python capabilities

Summary of Jan 7 meeting on NSTX beta limits

In attendance: Stefano Munaretto, Devon Battaglia, Walter Guttenfelder, Nate Ferraro, Andreas Kleiner, Steve Jardin

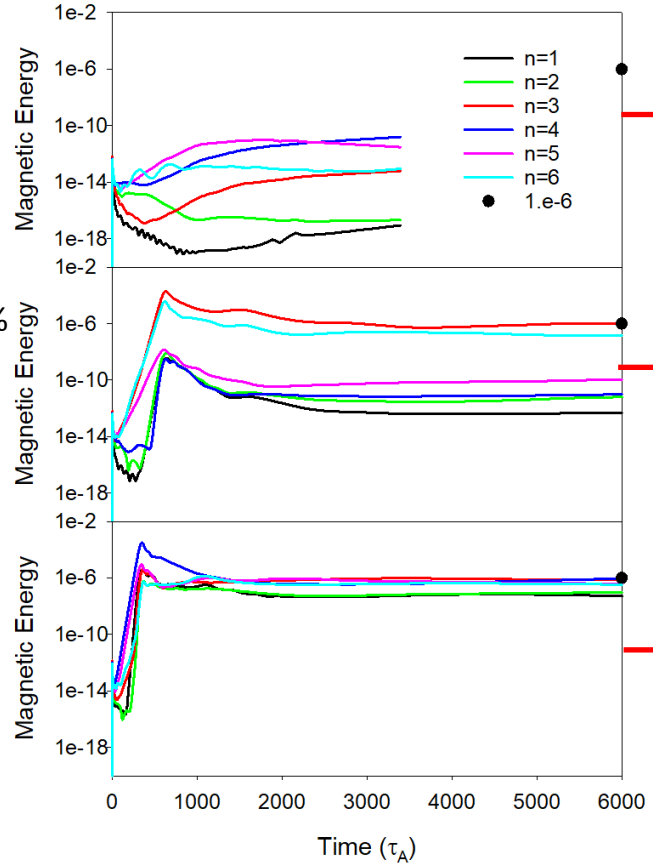
1. S. Jardin showed M3DC1 calculations of a linearly unstable NSTX plasma nonlinearly evolving into a stable configuration with lower central temperature
2. Another higher-beta, more unstable plasma did not evolve into a stable plasma with good flux surfaces (see next vg)
3. Next step is to start with a stable plasma, and apply heating source during evolution to a higher beta plasma
4. WG suggested examining shot 133964 (which I did, but it is linearly stable)
5. Also, recommended 4 papers:
    1. Gerhardt, NF 2011 -- discussion of 133964
    2. Stutman PRL 2009 -- First publication (?) showing core Te flattening with increased power
    3. Kaye PRL and NF 2007 -- especially the B_T scan data show a clear flattening of central Te,

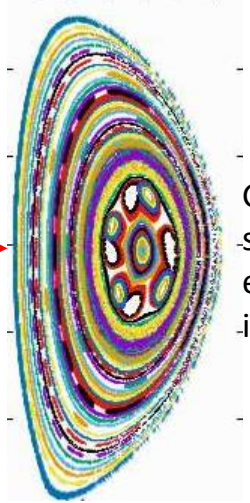
Comparison of the 3 scaled equilibria

BS=1.1
β=5.8%

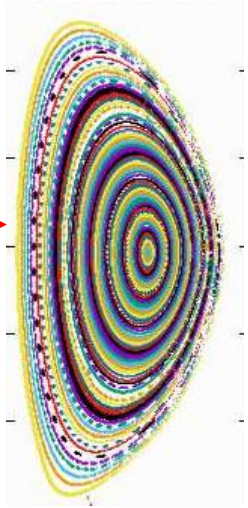
BS=1.0
β=6.8%

BS=0.9
β=8.2%

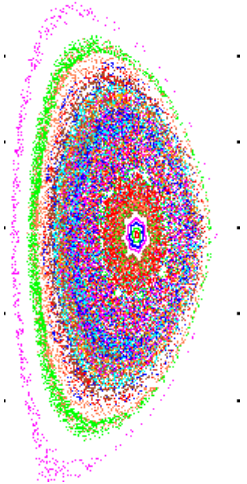




Good surfaces except n=3 in center

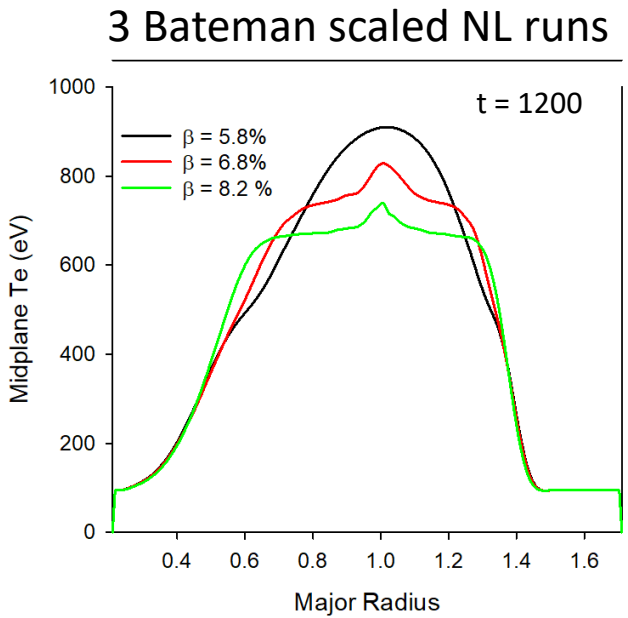


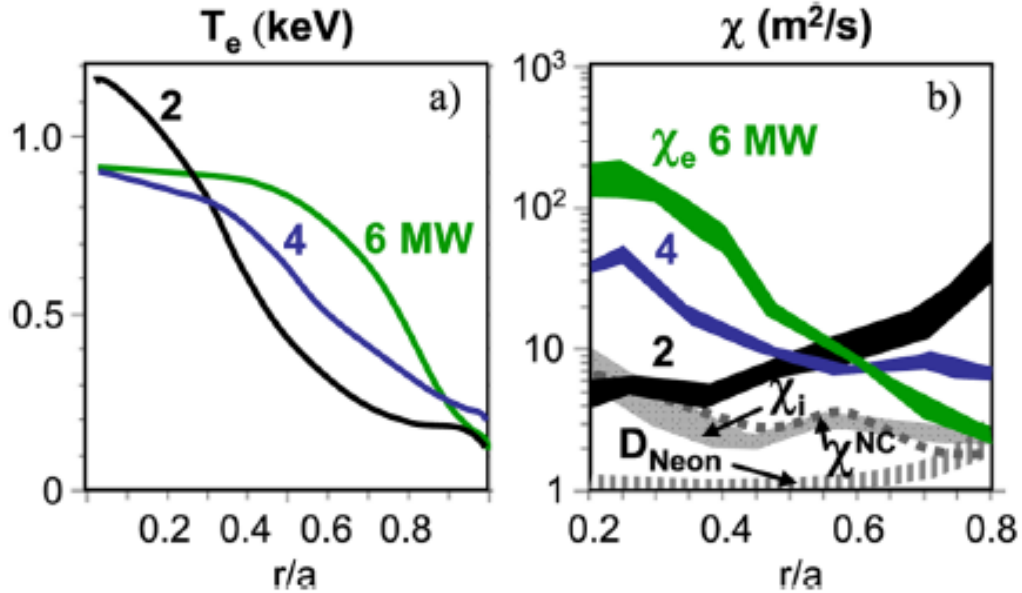
Good surfaces everywhere



Poor surfaces with multiple n-modes

Trend is similar to experiments on NSTX

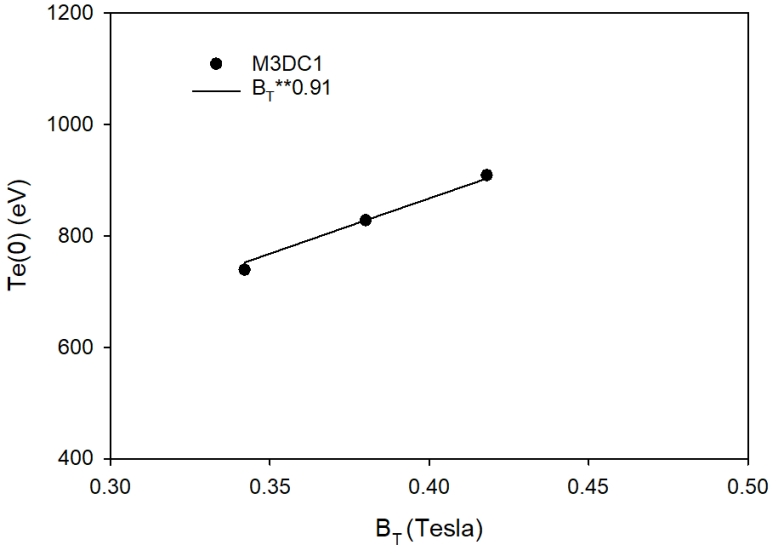




- M3D-C1: Central temperature decreases with β
- Exp data: Central transport increases with β

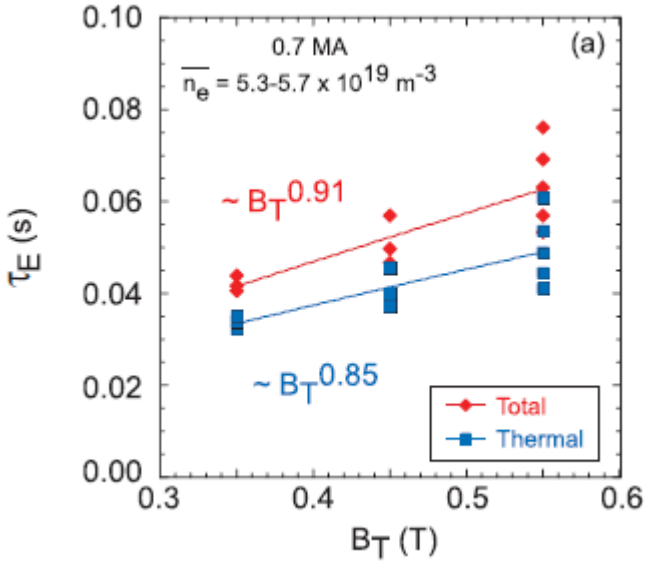
Stutman, et al. PRL (2009)

M3DC1 shows similar scaling with B_T as experiment



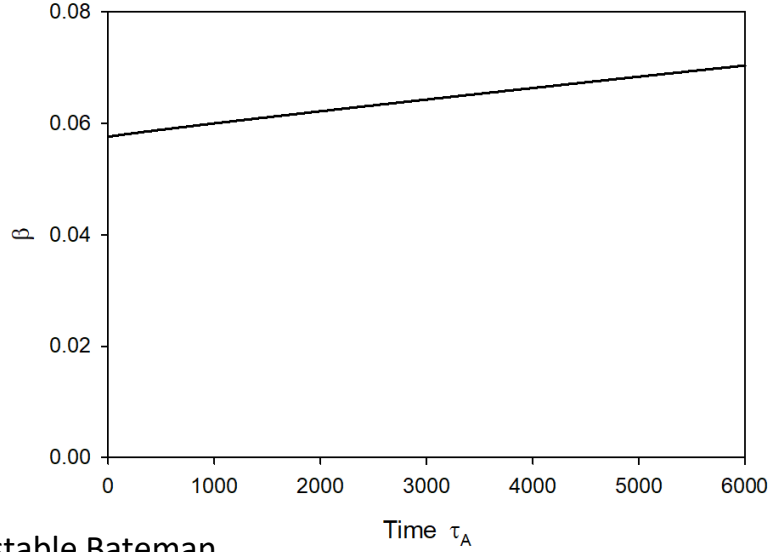
Note: Plot on left is Te(0). On the right is τ_E

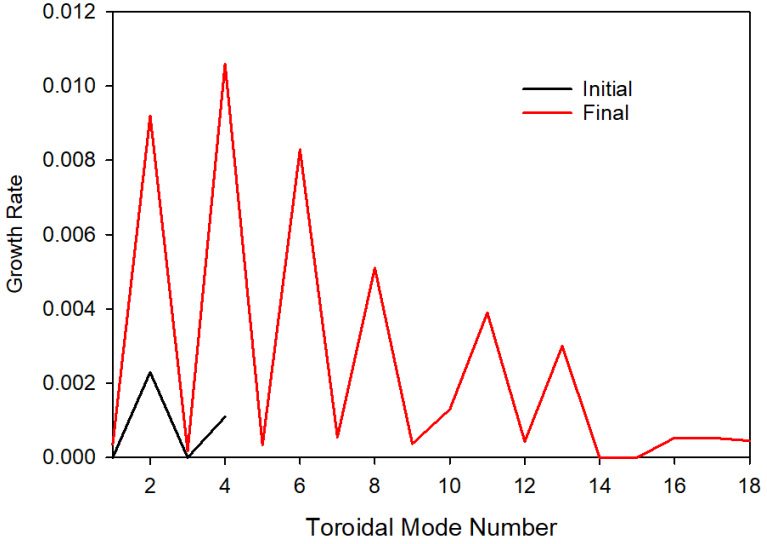
Kaye, et al, PRL (2007)



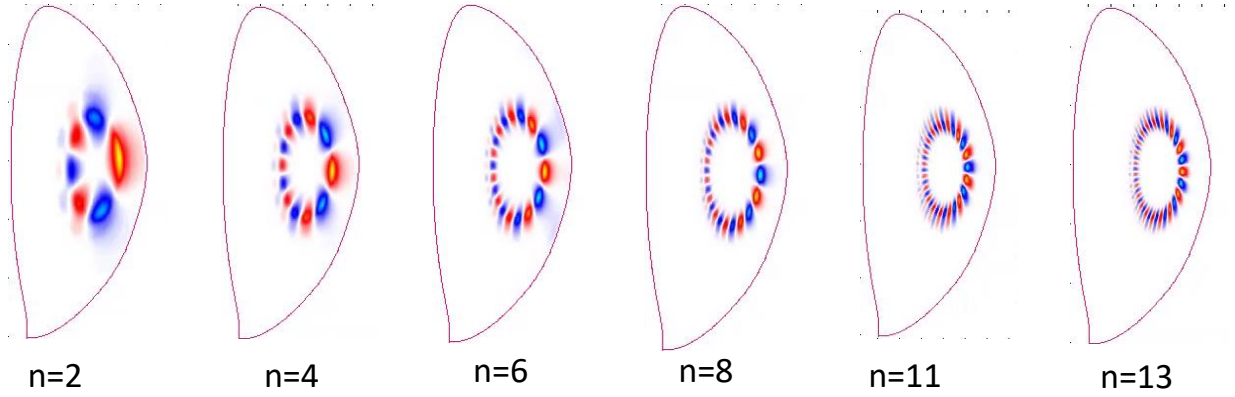
"Some of the discharges in this study did exhibit both low amplitude low-n MHD activity as well as the fast ion driven Alfven eigenmode (AE) activity,"

More realistic: Start with stable equilibrium and apply heating power: First in 2D





- Start with stable Bateman scaled equilibrium with β = 5.8%
- Run in 2D with heating source, increasing β to 7%
- Linear analysis shows final equilibrium unstable to many modes (shown on right)
- Now repeat with 3D run. Do these saturate nonlinearly?

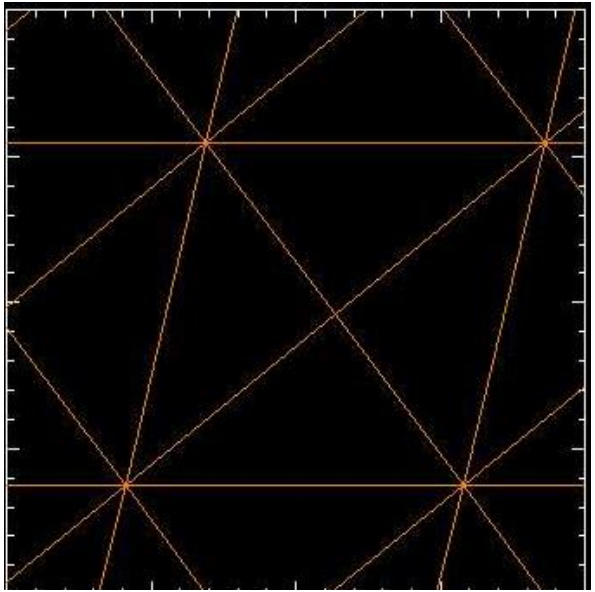


That’s All I have

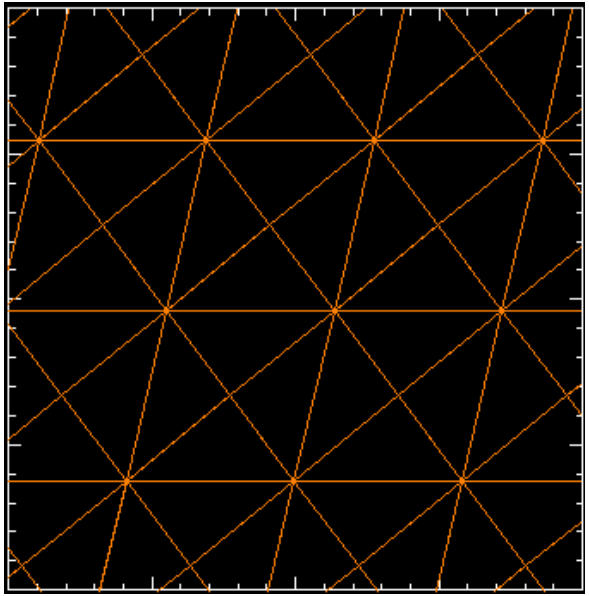
Anything Else ?

Update on Soft-Beta-Limit Study

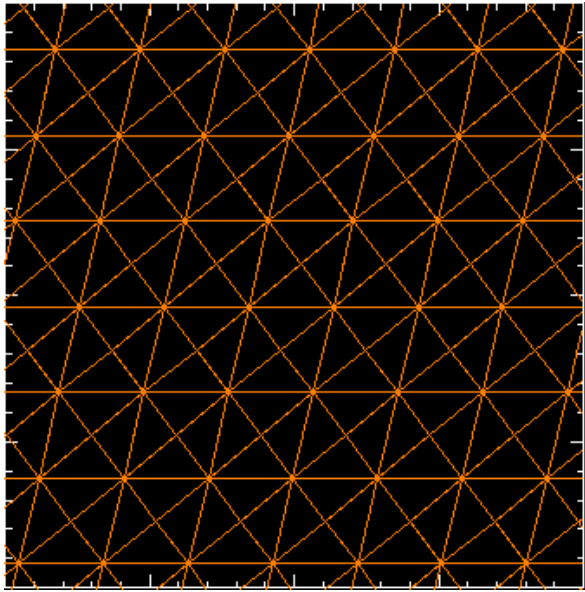
0.8 cm



0.4 cm

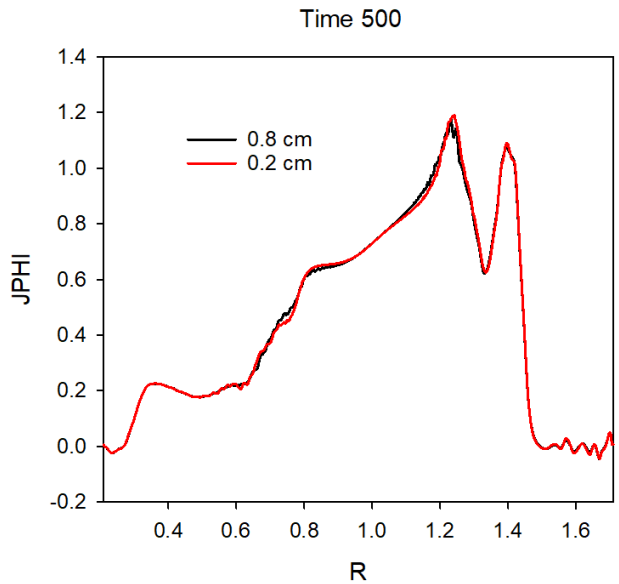


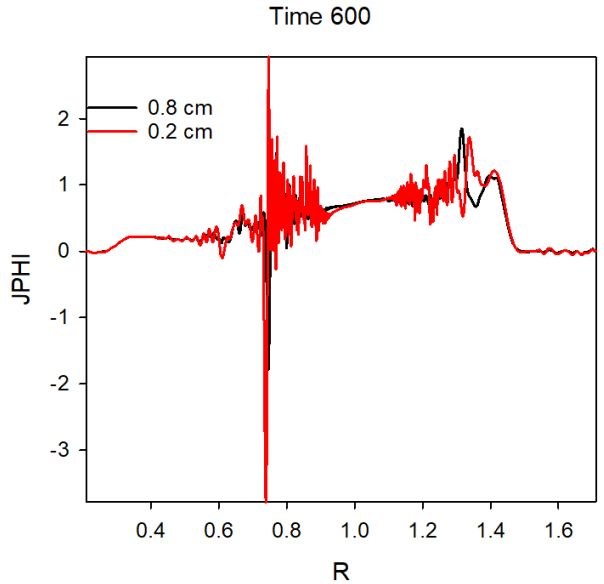
0.2 cm



These are close-ups in center of grid (near magnetic axis)

Result of Convergence Study

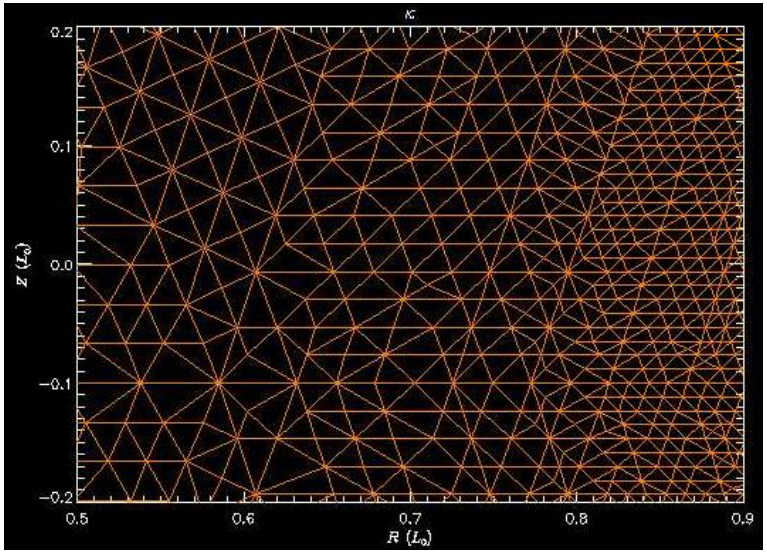




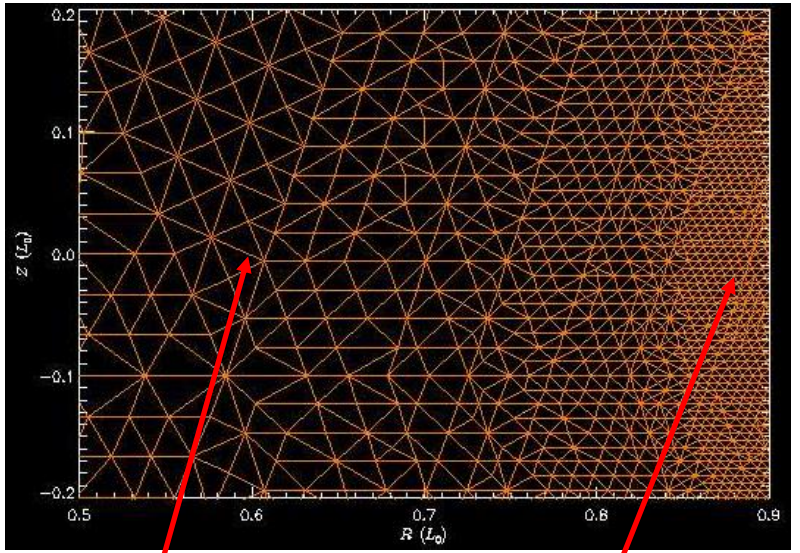
Solution for jphi still very noisy in region 0.5 < R < 0.9, even for the finest grid with 0.2 cm in center

Grid was not refined where J gets jagged

0.8 cm



0.2 cm



Resolution increased here

But not here

Now producing better grids that are refined where the current gets jagged