M3D-C1 ZOOM Meeting

12/20/2021

CS Issues

1. Perlmutter status
2. Mesh adaptation update (Morteza email)
3. NERSC Time
4. Changes to github master since last meeting
5. Regression tests
6. Software License update

Physics Studies

1. 2-fluid timestep limitation
2. Helical coil update
3. Update on Soft beta limit study

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

In attendance

Steve Jardin
Adelle Wright
Dingyun Liu
Hank Strauss
Chen Zhao
Nate Ferraro
P Sinha
Chang Liu
Mark Shephard
Seegyoung Seol
Usman Riaz
Morteza Siboni

Perlmutter status

From Jin Chen 12/16/21
All the changes for perlmutter have been pushed into git repo. Please followed the instructions given in README/readme.Perlmutter to run the code on perlmutter using mumps.

Note:
1) "adapt" regression test failed. Seegyoung may be the right person to look into it.
2) "ST=1" compiling fails at the current stage due to the nersc installed netcdf. I'll install it myself and update it.

(update) 3) zoltan and superlu_dist are installed and tested. All regtests passed except adapt

Mesh adaptation update

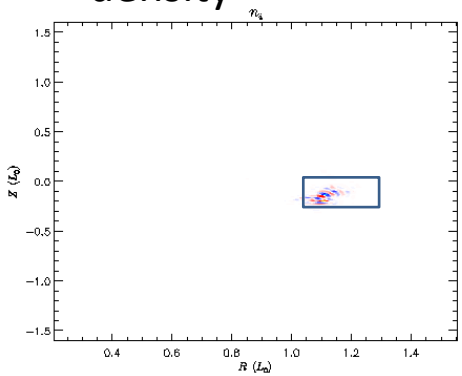
From Morteza 12/9/21

As requested in Monday call, here are a couple of runs on stellar (the relevant time_nnn.h5 and C1 files are also in the mentioned folders)

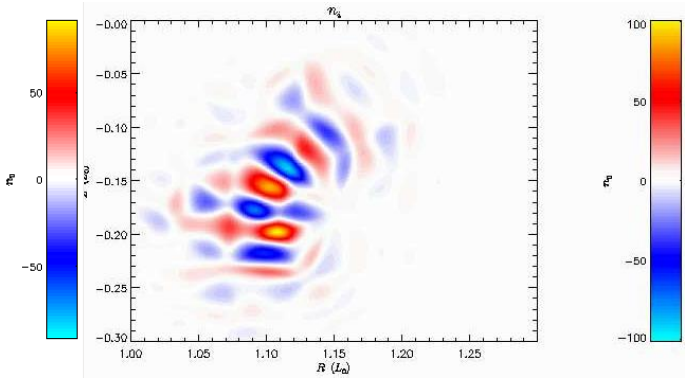
Adaptive solve with both refinement and coarsening on that diverges at time step ~245 -> /scratch/gpfs/ms9239/pellet_runs/pellet_adaptivesolve
Adaptive solve with only refinement allowed that diverges at time step ~540 -> /scratch/gpfs/ms9239/pellet_runs/pellet_adaptivesolve_coarsen_off
Solve on the same initial mesh that diverges at time step ~918 -> /scratch/gpfs/ms9239/pellet_runs/pellet_solveonly

pellet_solve_only N=916

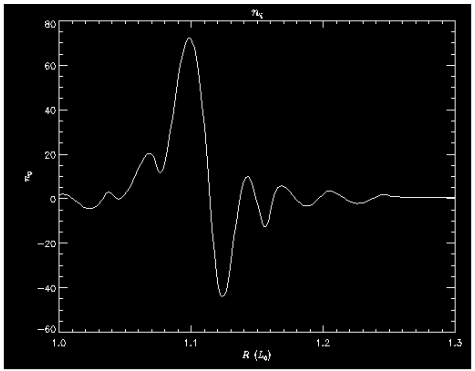
density



blowup



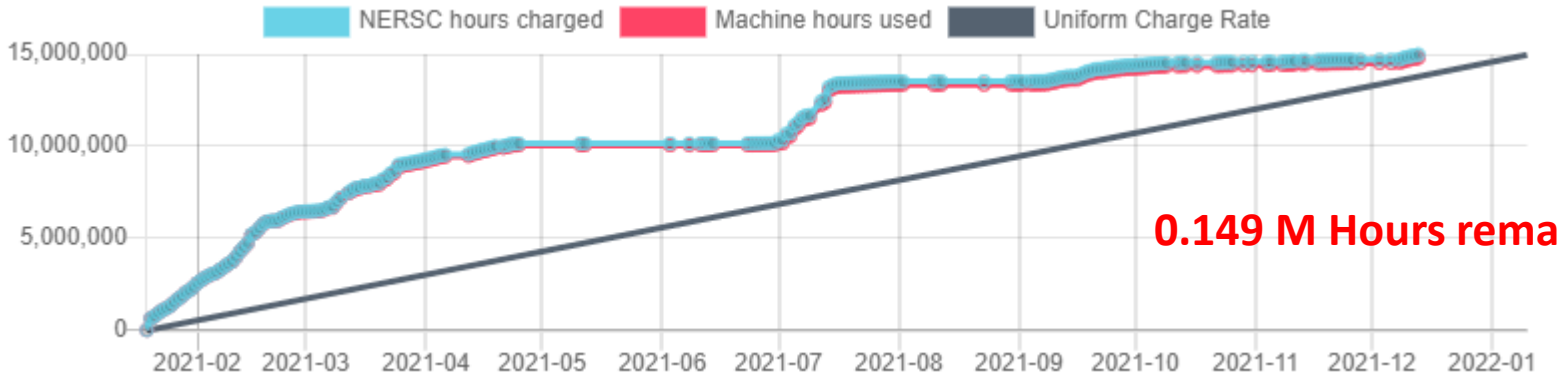
den, cutz=-.15



Negative density (den) will cause code to crash. I recommend increasing the diffusion coefficient denm from 1.e-6 to 1.e-5 or 1.e-4

NERSC Time

mp288



0.149 M Hours remaining!

- mp288 received 10M Hrs for CY 2021, + 5M Hrs additional
- Pearlmutter time will not be charged for this FY
- We are NESAP Tier 2. . Phase-I w GPUs We have been given a repo m3984
- N9ES-N2 M3D-C1: J. Chen , C. Liu, S. Seol are early users

New FY22 allocation

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 11/25/21

Jin Chen:
12/16/21 : Perlmutter code porting
12/16/21 : Perlmutter code porting + zotan + superludist

Local Systems

- PPPL centos7(12/18/21)
  - 7 jobs PASSED
- PPPL greene (12/18/21)
  - 5 jobs PASSED
- STELLAR (12/18/21)
  - 6 regression tests **PASSED** on stellar
  - adapt **FAILED** field energies off by 0.02%
- TRAVERSE(12/18/21)
  - 7 regression tests **PASSED**
  - adapt Energies are ok. Only gr_rate off

Other Systems

- Cori-KNL (12/18/2021)
  - 7 regression tests **PASSED** on cori_KNL
- Cori-Haswell (12/18/2021)
  - 7 regression tests **PASSED** on cori
- Perlmutter (12/18/2021)
  - Unable to open netdf.mod
  - Executables not found in PATH
- MARCONI
  - All regression tests PASSED on MARCONI (J. Chen, 9/04/20)

M3D-C1 Software License

- License now posted on m3dc1.pppl.gov

- First License granted to Zhisong Qu, Australian National University
  - He asked if his students also needed to sign a license agreement

2-fluid M3D-C1

From Yao Zhou Dec 16, 2021

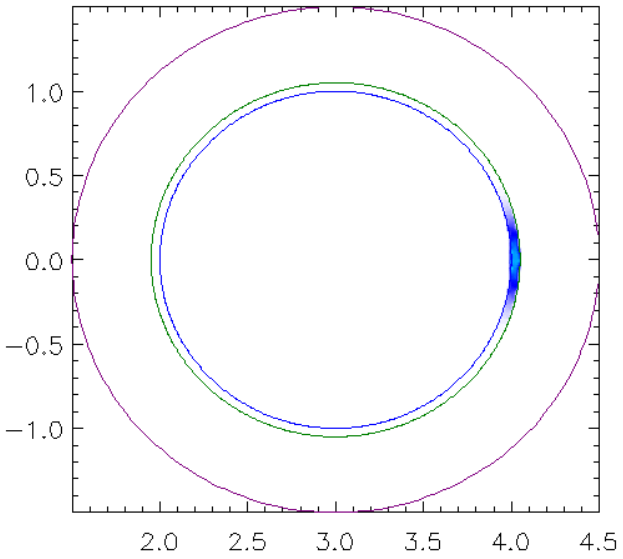
I tried to turn on two-fluid effect with itwofluid=1 but the B field advance diverges at the first step in various simulations. An example can be found at:
/scratch/gpfs/yaozhou/para/tor_beta

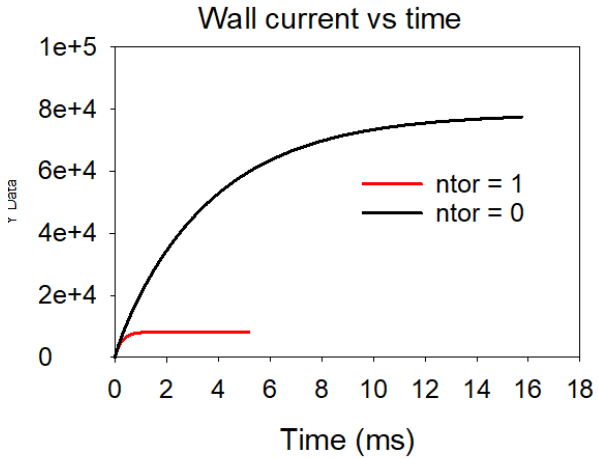
➔ I replied that his problem runs fine if he reduces the time-step from 1.0 to 0.1 Unfortunately, the 2-fluid option requires a small timestep. An improved pre-conditioner is likely needed20, 2021

From Yao Zhou Dec 20,2021

Why was Beidler able to run 2-fluid with dt=2.0 in Beidler, et al, PPCF **59** (2017) 025007 ? Could be because edge density is low

Helical coils subject to uniform loop voltage





minor radii = 1.0, 1.05, 1.5
major radius = 3.0
V_loop = 1.e-4 Volts

'/projects/M3DC1/sjardin/helical5g/C1.h5'
'/projects/M3DC1/sjardin/helical5f/C1.h5'

f = cos(ntor*phi - mpol*theta)
f = exp((f-1.)/sigma**2)
wall_resistivity = 10.**(log10(wall_resistivity)*(1.-f) + log10(eta_rekc)*f)

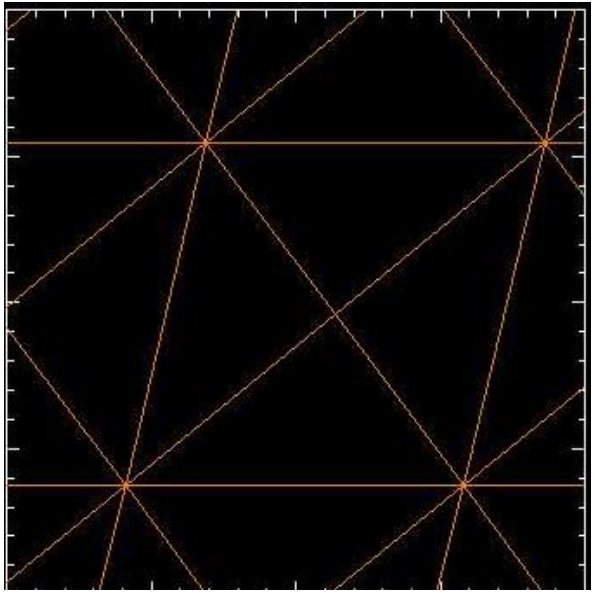
sigma = 0.5 eta_rekc = 1.e-6 etar = eta_outer_wall = 0.2
wall_resistivity = 0.001 ntor = 0,1 mpol=1

To get SI resistivity multiply by μ_0 = 1.256 E-6

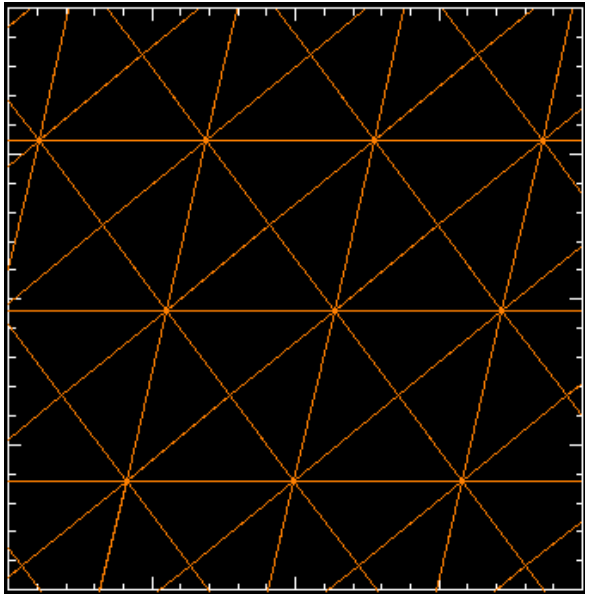
JOREK/Starwall not able to prescribe loop voltage…need new test case

Update on Soft-Beta-Limit Study

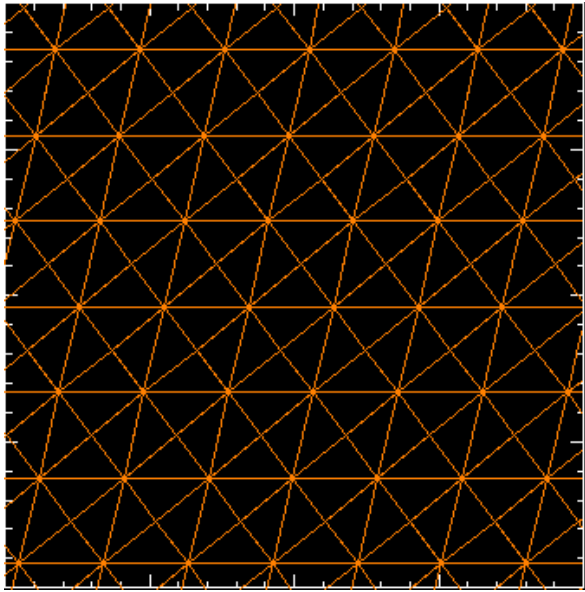
0.8 cm



0.4 cm

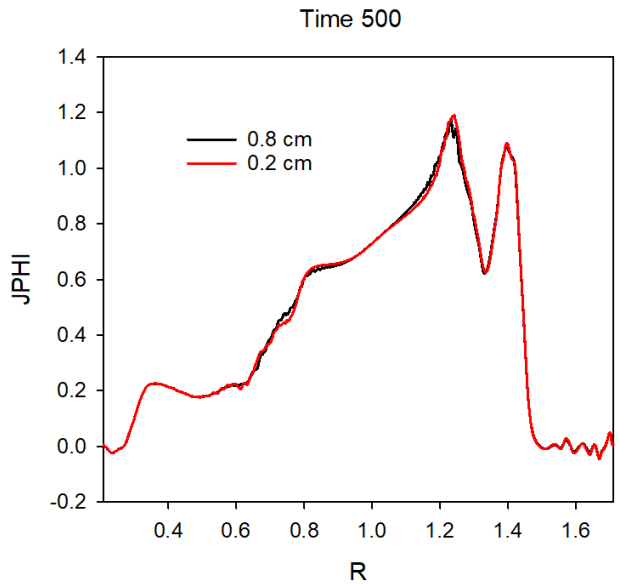


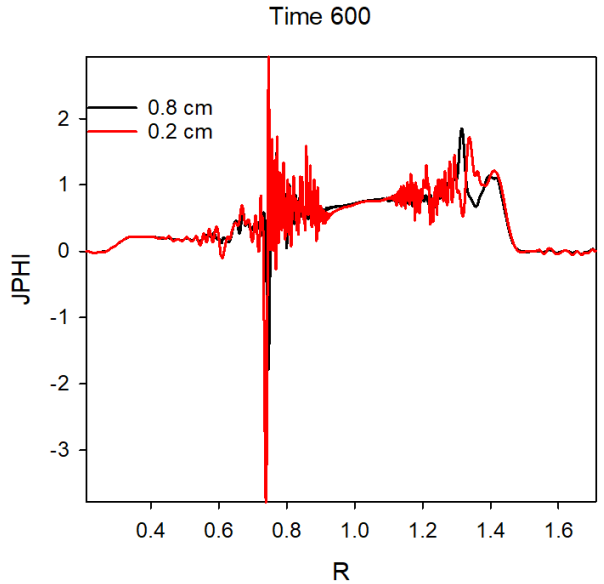
0.2 cm



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

Result of Convergence Study

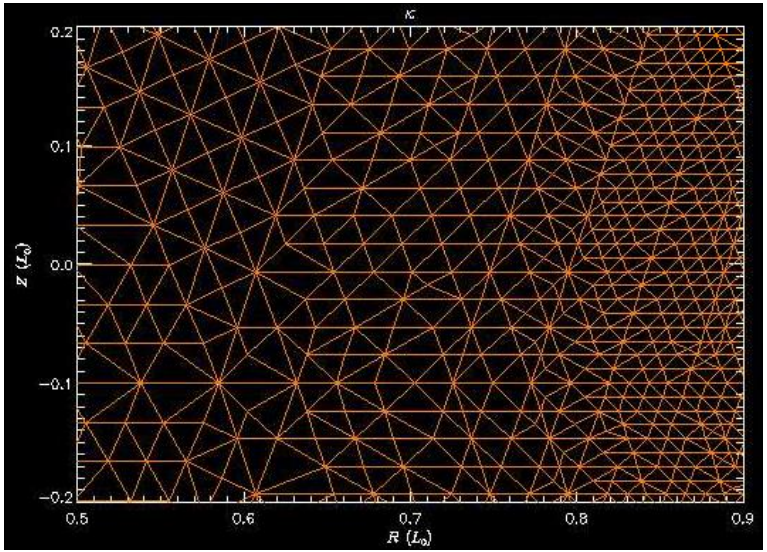




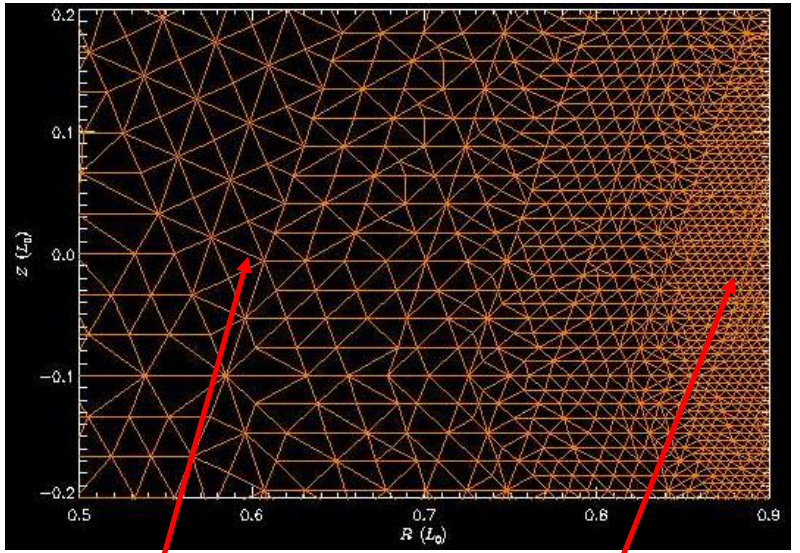
Solution for jphi still very noisy in region 0.5 < R < 0.9, even for the finest grid with 0.2 cm in center

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

That’s All I have

Anything Else ?