

M3D-C1 ZOOM Meeting

12/05/2022

CS Issues

1. LBL update
2. Update on Block Multigrid Preconditioner – J. Chen
3. RPI Update on Meshing and Adaptation
4. Perlmutter options
5. New Latex documentation -
6. NERSC Time
7. Changes to github master since last meeting
8. Regression tests
9. isurface

Physics Studies

1. Update on NSTX shot 124379 and infernal modes
2. Chen Zhao, Brendan Lyons updates
3. Anything else

In attendance

Steve Jardin

Hank Straus

Adelle Wright

Andreas Kleiner

Jin Chen

Chen Zhao

Chang Liu

Brendan Lyons

Mark Shephard

Seegyong Seol

Usman Riaz

Sam Williams

Sherry Li

Nan Ding

Yang Liu

LBL Update

Block MG preconditioner update

From J. Chen (11/30/22)

Hi all,

Adelle gave me a stellarator case, it uses 64 planes. For the experiment, I made 4 tests out of it: 16-plane, 32-plane, 48-plane, 64-plane. Right now I only got the 32-plane job done since CORI HASWELL is very crowded. For this 32-plane caes, here are the iteration number report

timestep	BJ	BGMG	timestep	BJ	BGMG
1	100	34	8	366	34
2	100	34	9	357	35
3	102	34	10	4446	35
4	116	34	11	diverged	35
5	128	34	12-26		35
6	128	34			
7	141	34			

RPI update on Meshing Capabilities and Adaptation

Perlmutter options

```
export M3DC1_CODE_DIR=/your code director
```

```
module use $M3DC1_CODE_DIR/unstructured/modules/perlmutter
```

```
module load m3dc1/devel (use GPU nodes but not GPU. .. Not recommended)
```

or

```
module load m3dc1/devel-cpu (use CPU nodes)
```

or

```
module load m3dc1/devel-gpu (use GPU nodes with GPU)
```

Users can try GPU version but should benchmark initial application with CPU version. Also, note that there is limited GPU node-hours available in mp288

Thanks to Chang Liu for GPU version

New LaTeX Documentation

A cleaned version of M3DC1 user's guide is uploaded to M3DC1/doc and this version compiles on all machines using the command "pdflatex M3DC1.tex".

.pdf version is available on m3dc1.pppl.gov

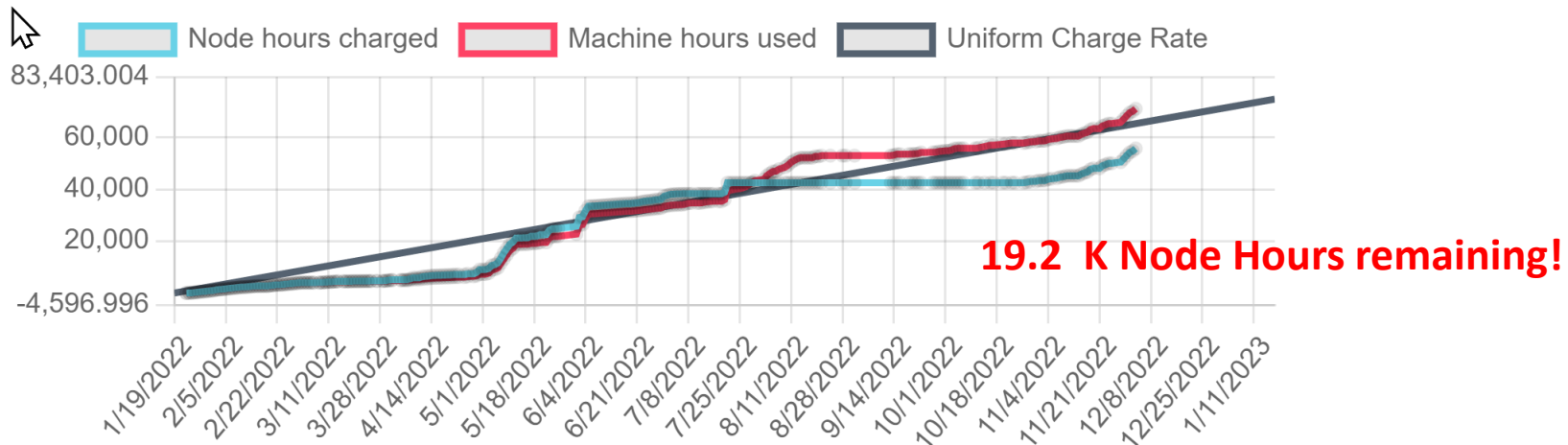
All C1input variables are now documented (section 6)

Appendix B (SCOREC API) now eliminated . (Thanks to Seegyong)

I will continue to (slowly) review sections for completeness and correctness.

NERSC Time

mp288



- MP288 usage is on track. Both value and rate are ok.
- We are now being charged for Perlmutter and Perlmutter_cpu.
- We have 224 (out of 7000) GPU node hours as well. Chang is requesting more.
- Cori is scheduled to go away March 2023

Changes to github master --after 2022-11-20

Seegyung Seol

11/22/22: removing obsolete appendix from user's guide

Chang Liu

12/05/22 Fix adapt regression test on Perlmutter_gpu

11/23/22: enable matrix assembling using GPU on perlmutter

Local Systems

- PPPL centos7(12/04/22)
 - 7 jobs **PASSED**
- PPPL greene (12/04/22)
 - 5 jobs **PASSED**
- STELLAR (12/04/22)
 - 7 regression tests **PASSED** on stellar
- TRAVERSE_gpu(11/04/22)
 - Compilation error (being looked at by Seegyound , Jin, and Chang)

NERSC

- Perlmutter (12/04/2022)
 - 6 jobs **PASSED**
 - NCSX failed with very small difference in C1ke
- Perlmutter_cpu (12/04/22)
 - 6 jobs **PASSED**
 - NCSX failed with very small difference in C1ke
- Perlmutter_gpu (12/04/2022)
 - pellet, RMP, & RMP_nonlin, adapt all **PASSED**
 - KPRAD_2D, KPRAD_restart, NCSX all failed with very small differences

isurface

- We plan to remove this option

Update on NSTX shot 124379

I have asked Kathreen Thome and Joey McClenaghan (GA) to look at these cases with the ideal MHD codes GATO and DCON.

So far they have not found instabilities!

Email from Alan Turnbull (12/05/22):

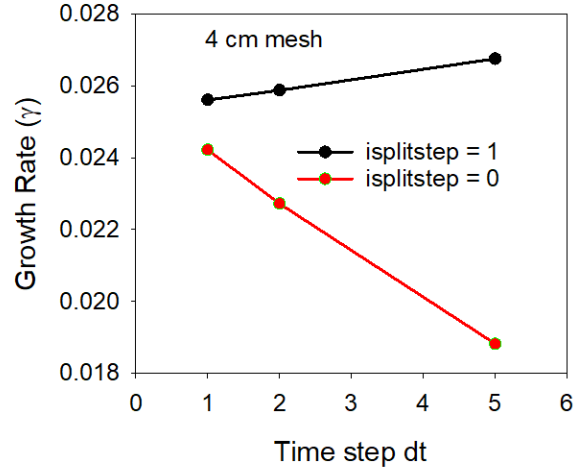
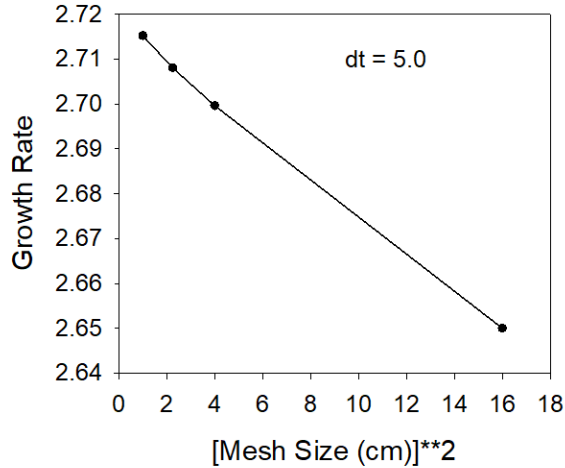
“Joey knows how to run GATO but the high n are hard to get. They take a long time - probably more than Joey is willing to do. What size is the geqdisk ? It needs to be bigger than 129x129 to be sure GATO is not just processing spline data.”

Now, trying to resurrect the PEST linear ideal MHD code as a check (with J. Chen)

Should we ask the MARS code?

Can we generate a high-resolution geqdisk with M3D-C1 IDL?

Convergence Tests



Focus on LRDfit06 Time 640

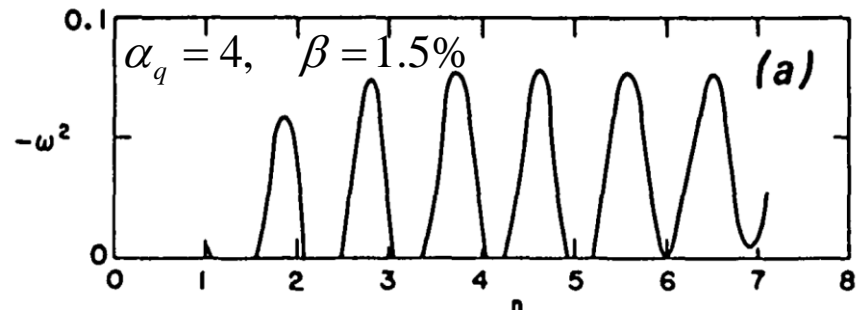
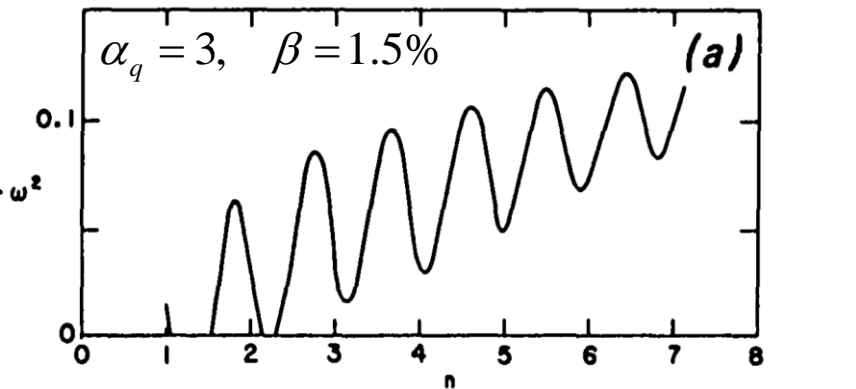
(files in /p/tsc/m3dnl/NSTX/124379/Convergence

Benchmark from Manickam, et al NF (1987)

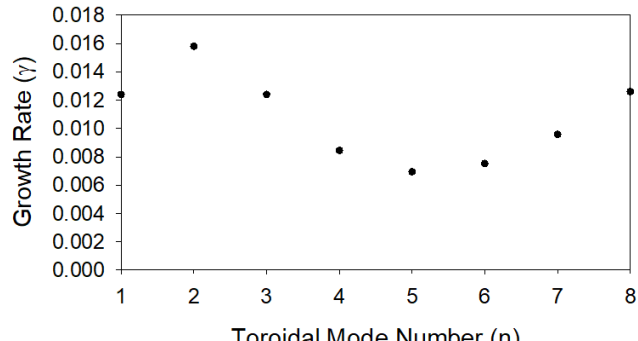
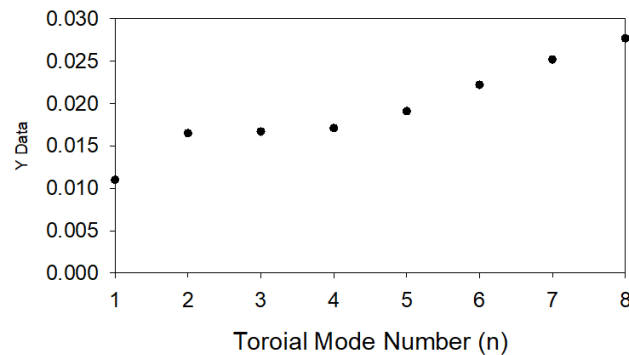
$$q = q_0 + q_1 \Psi^{\alpha_q} \quad q_0 = 1.05, \quad q_1 = 2.05 \quad R/a = 4 \quad \text{circular}$$

$$p = p_0 (1 - \Psi^{\alpha_2})^{\alpha_1} \quad \alpha_1 = 4, \quad \alpha_2 = 1.5$$

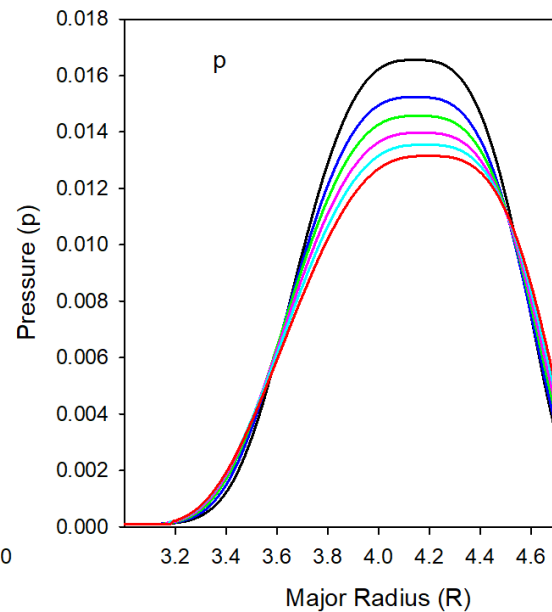
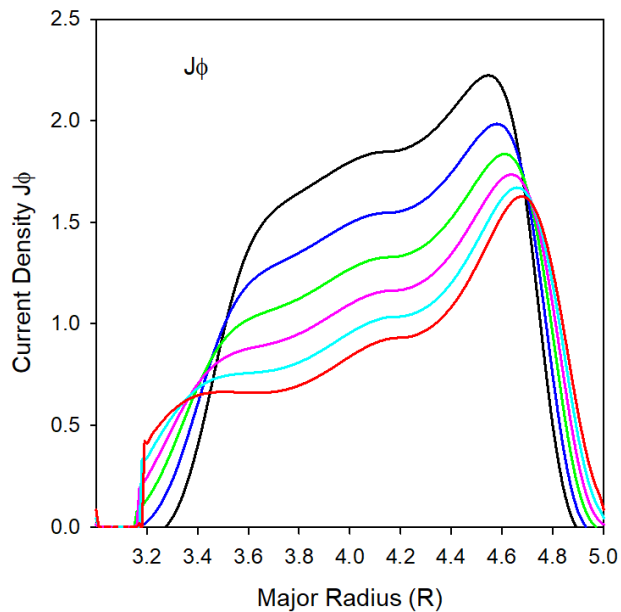
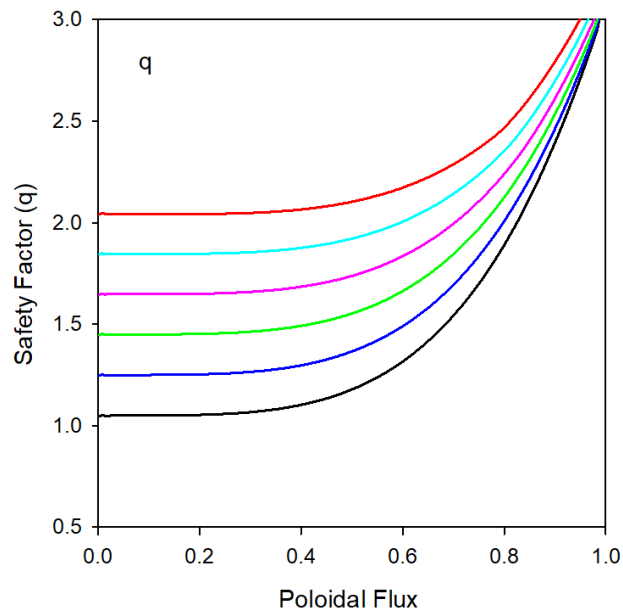
Results
somewhat
ambiguous



M3D-C1 Results



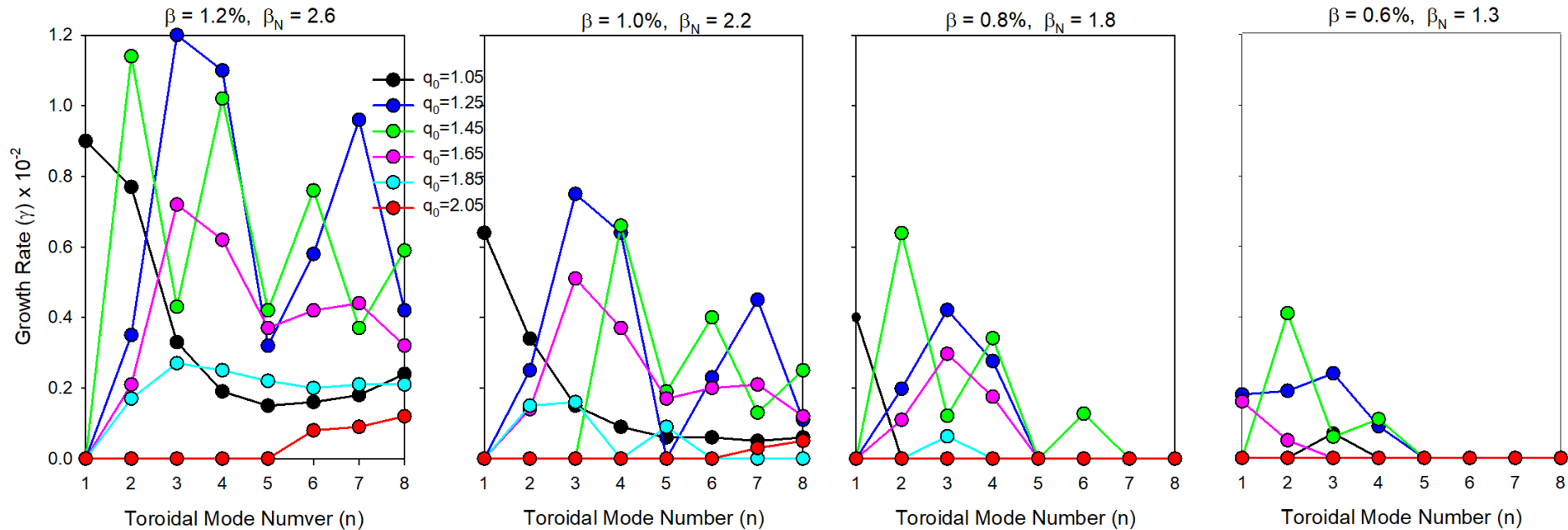
Extension of Manickam, et al study to other q_0 and β



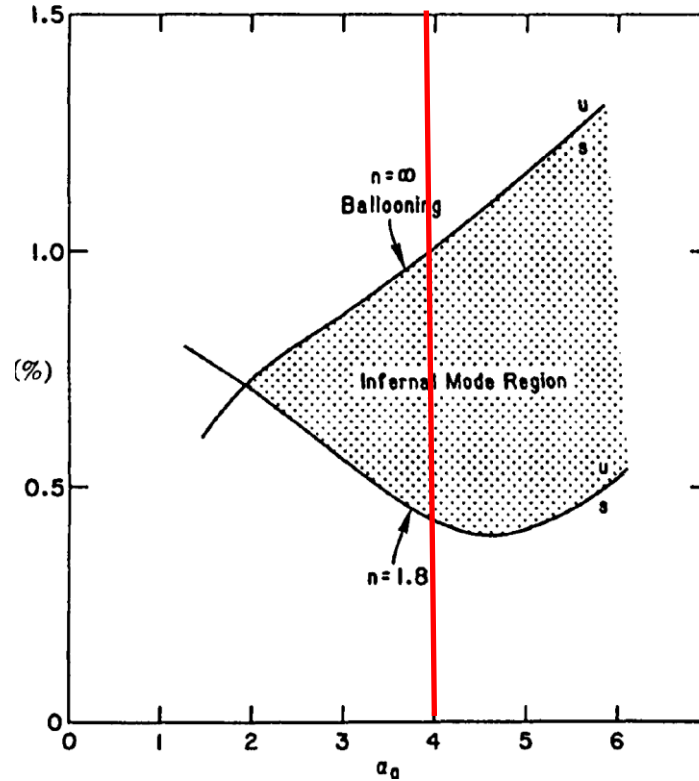
$$q = q_0 + q_1 \Psi^{\alpha_q} \quad 1.05 \leq q_0 \leq 2.05 \quad q_{\text{lim}} = 3.10 \quad R/a = 4 \quad \text{circular}$$

$$p = p_0 \left(1 - \Psi^{\alpha_2}\right)^{\alpha_1} \quad \alpha_1 = 4, \quad \alpha_2 = 1.5 \quad \alpha_q = 4 \quad 0.6\% \leq \beta \leq 1.5\%$$

Growth rates for different q_0 , β , and n



Seems to be consistent with Manickam, et al, paper



Update on other Jobs

- Chen Zhao produced a new revision of his paper “Simulation of DIII-D disruption with pellet injection and runaway electron beam”
 - I’m still going thru it. Will finish by tomorrow
 - Why doesn’t the temperature decrease near the end when all the current is carried by the RE (no Ohmic heating)
 - Should we have an experimental co-author? Will this need to go through DIII review?
- Brendan, status of ITER DM run?
- Other

That's All I have

Anything Else ?