

# M3D-C1 ZOOM Meeting

02/27/2023

## Upcoming Meetings

### CS Issues

1. RPI Update on Meshing and Adaptation
2. Cubic Hermite interpolation ... J. Chen
3. New Latex documentation -
4. NERSC Time
5. Changes to github master since last meeting
6. Regression tests
7. isurface now gone

### Physics Studies

1. Tool for setting mesh parameters in sizefieldParam ...Andreas
2. Tracking down a code “bug” ...Dingyun + SJ
3. New insights into infernal modes
4. DREKAR....observations from Shadid seminar
5. M3DC1 makes GA Weekly Theory Summary
6. Chen Zhao, Brendan Lyons updates
7. Anything else

## In attendance

Steve Jardin

Hank Straus

Adelle Wright

Andreas Kleiner

Jin Chen

Chen Zhao

Nate Ferraro

Brendan Lyons

Cesar Clauser

Priyanjana Sinha

Mark Shephard

Seegyong Seol

Usman Riaz

# Upcoming Meetings

Sherwood Theory	May 8-10	Knoxville, TN
EPS	July 3-7	Bordeaux, France (abstracts due Feb 28)
TSDW	July 19-21	Princeton, NJ
APS	Oct 30 – Nov 1	Denver, CO

# RPI update on Meshing Capabilities and Adaptation

# Cubic Hermite Interpolation

J. Chen to present

# 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](http://m3dc1.pppl.gov)

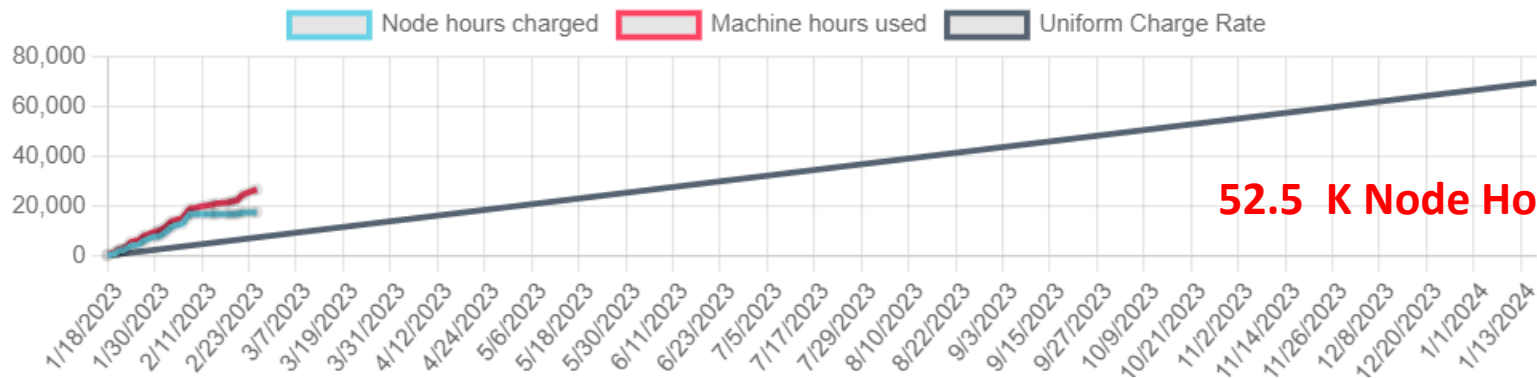
All C1input variables are now documented (sectin 6)

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

- A section on GITHUB has been added (similar to the old documentation)
- I am working on updating the IDL postprocessor documentation.
- Also added a section on publications.

# NERSC Time 2023

mp288



52.5 K Node Hours remaining!

- MP288 usage rate is a bit high
- Also, 10k GPU node hours
- Cori to go away end of April 2023

# Changes to github master --after 2023-01-25

## Nate Ferraro

**01/30/23:** Fixed bug in rmp.f90 where sf array was being allocated with length 0 when iread\_ext\_field=0

**01/30/23:** Changes to allow restarting 3D simulation with extsubtract=1 from 2D simulation with extsubtract=0

**02/07/23:** Removed more isurface=1 coding

**02/08/23:** more changes removing isurface=1 option

**02/08/23:** Updates to .gitignore to ignore intermediate build/latex files

**02/09/23:** Change debugging flags in stellar.mk

**02/09/23:** Minor change to vmec interpolation to fix floating point exception

**02/22/23:** Added new scalar diagnostics E\_MPC, E\_MTC, E\_MPV, E\_MTC to track poloidal and toroidal magnetic energy in the conductor and vacuum region. Updated energy.pro and energy\_conservation.pro to account for this. Updated "version" to 43

## Jin Chen:

**01/30/23:** Changes made for BGMG optimization

**02/11/23:** function call interface minor change



# Changes to github master --after 2023-01-25

## Seegyung Seol

**01/30/23:** adding config.sh, makefile and readme for traverse gpu

**02/04/23:** adding config.sh and makefile for traverse.nvhpc

**02/06/23:** fixing linking error with Perlmutter\_gpu

**02/07/23:** adding config.sh and makefile for Perlmutter\_GPU

**02/21/23:** readme for m3dc1\_scorec removed

**02/21/23:** adding readme for stand-alone adaptation test

## S. Jardin:

**01/31/23:** Added GITHUB section to Latex documentation

## Brendan Lyons:

**02/01/23:** IDL scripts for line integration and energy-conservation monitoring

## Yao Zhou

**02/17/23:** Added ikappafunc=21

## Local Systems

- PPPL centos7(02/27/23)
  - 7 jobs **PASSED**
- PPPL greene (02/27/23)
  - 5 jobs **PASSED**
- STELLAR (02/27/23)
  - 7 regression tests **PASSED** on stellar
- TRAVERSE\_gpu(11/04/22)
  - Compilation error (being looked at by Seegyound , Jin, and Chang)

# NERSC

- Perlmutter\_cpu (02/19/23)  
6 jobs **PASSED**  
NCSX failed with very small difference in C1ke
- Perlmutter\_gpu (02/19/2023)
  - pellet, RMP, & RMP\_nonlin, adapt all **PASSED**
  - KPRAD\_2D, KPRAD\_restart, NCSX all failed with very small differences
  - adapt not submitted
- Perlmutter-nvidia(02/19/23)
  - Batchfiles not available

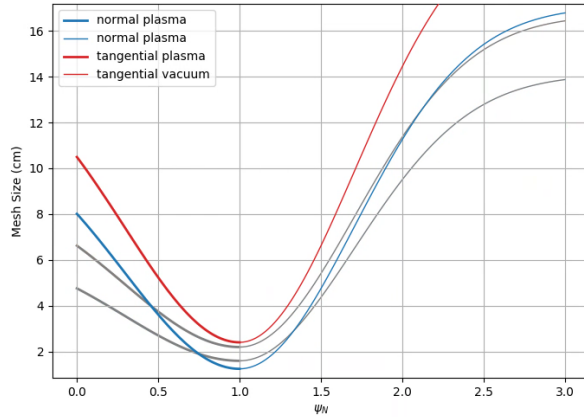
# isurface

- Nate is removing the isurface=1 option

Now only in 4 places !!

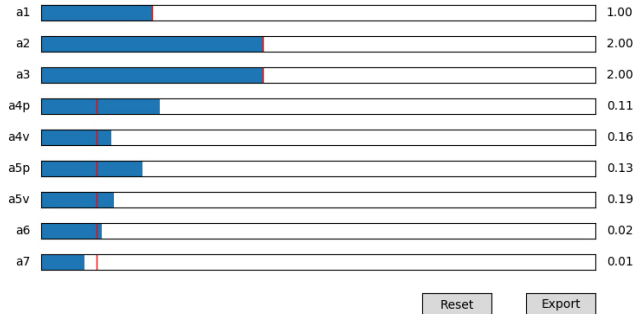
isurface has now been removed from the input manual!

# Tool for adjusting mesh parameters

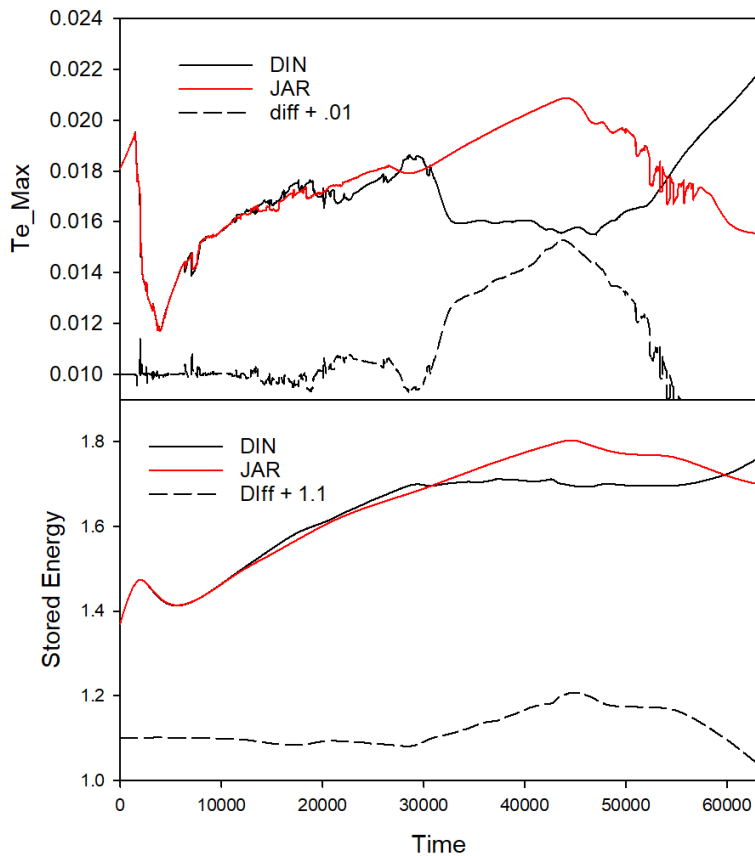


For use in defining  
sizefieldParam

Andreas to discuss



# Dingyun is trying to reproduce a case in my 2020 paper



Need to find when these differences first occur:

```
git log --after 2018-06-30 > logout
```

```
git clone
```

```
https://github.com/PrincetonUniversity/M3DC1
```

```
git checkout 8a6a036
```

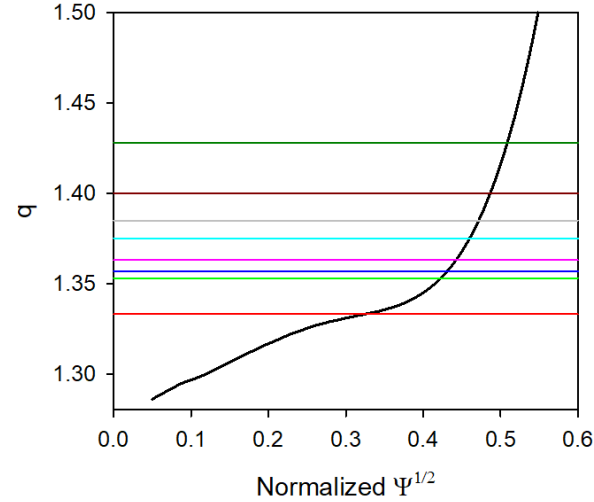
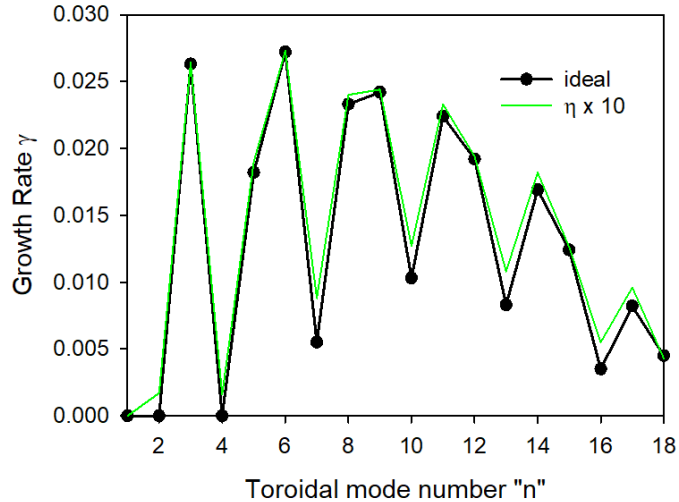
Had to:

- remove `wrrestartglobal` from `output.f90` and `restart.f90`
- Comment out `MPI_Comm_split` in `newpar.f90`
- Copy `stellar.mk` from current version

## Progress on debug

07/02/18	baseline
02/07/19	good
01/12/20	good with kappa0 halved
02/10/20	good “ “ “
02/21/20	good “ “ “
02/27/20	now running (had to comment out MPI_Comm_split)
03/10/20	bad
06/02/20	bad
01/05/21	bad

# New Insight into Infernal Modes



For a mode with toroidal mode # n to be unstable, there has to be a poloidal mode number m such that m/n is in the low shear region

- n=2 NO ..... $3/2$  is too high shear
- n=3 YES..... $4/3$  is low shear
- n=4 NO..... $5/4$  not resonant,  $6/4$  too high
- n=5 YES..... $7/5$  is low shear



# DREKAR

- SIAM presentation by John Shadid (Sandia) at Arizona State (thanks Adelle)
  - Title: Scalable Multiphysics Block Preconditioning for Solution of Implicit Stabilized Finite Element Resistive MHD Formulations with Application to Magnetic Confinement Fusion
- This was developed by the other disruption SciDAC, run out of LANL
- Goal was to develop a new code in the class of JOEKE, M3D-C1, NIMROD
- However, they use only linear finite elements and need to impose a Div  $\mathbf{B}$  constraint
- Results presented were underwhelming.
  - VDE with  $S=10^4$
  - Mostly concentrated on scaling studies (# of processors)

# GA Theory Summary week of Feb 24

## THEORY AND COMPUTATIONAL SCIENCE

The next generation of large tokamaks, including ITER, will be equipped with a disruption mitigation system (DMS) that can be activated if a disruption is deemed to be imminent. The goal of the DMS is to lessen the thermal and electromagnetic loads from the disruption without generating enough high-energy (runaway) electrons to damage the device. The DMS of choice for ITER is presently the injection of a frozen impurity pellet, which shatters into many pieces during the injection process. Variations of this DMS are presently being tested on many experiments. One such DMS experiment on DIII-D was modeled using the M3D-C1 nonlinear 3D extended MHD code (Jardin et al., 2012 J. Comp. Sci. Discovery), The model includes neon pellet injection and ablation, impurity ionization, recombination, and radiation, and runaway electron formation and subsequent evolution, including both Dreicer and avalanche sources. Reasonable agreement with the experimental results was obtained for the timescale of the thermal and current quench and for the magnitude of the runaway electron plateau formed during the mitigation. This provides a partial validation of the M3D-C1 DMS model.

**Kudos Chen Zhao**

# Update on other Jobs

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## Simulation of DIII-D disruption with pellet injection and runaway electron beam

C. Zhao<sup>1,2</sup>, C. Liu<sup>2</sup>, S. C. Jardin<sup>2</sup>, N. M. Ferraro<sup>2</sup>, B. C. Lyons<sup>1,2</sup>

<sup>1</sup>*General Atomics, San Diego, CA, United States of America*  
<sup>2</sup>*General Atomics, San Diego, CA, United States of America*

- Chen's paper is going through DIII-D review
- Intends to send it to PRL
  
- Brendan, status of ITER DM run?
  
- Other

That's All I have

Anything Else ?