

# M3D-C1 ZOOM Meeting

02/28/2022

## Upcoming Meetings

### CS Issues

1. Mesh adaptation update
2. Update to collapse and split\_smb
3. NERSC Time
4. Changes to github master since last meeting
5. Regression tests

### Physics Studies

1. Need for itemp=1 for large kappar with idens=1
2. Update on papers accepted
3. Update on Soft beta limit study
4. RWTM in DIII-D and JET -- Strauss

**Note:** [meeting minutes posted on m3dc1.pppl.gov](https://m3dc1.pppl.gov)

## In attendance

Steve Jardin

Adelle Wright

Dingyun Liu

Hank Strauss

Nate Ferraro

P Sinha

Chang Liu

Anders Kleiner

Brendan Lyons

Jin Chen

Chen Zhao

Cesar Clauser

Mark Shephard

Seegyong Seol

Usman Riaz

# Upcoming Meetings

- Sherwood April 4-6 Santa Rosa, CA (in person)
  - Abstracts due Friday March 4
  - CTTS Sunday April 3 – Please send presentation titles
- ITPA: MHD, Disruptions, Control April 4-8 (remote)
- Runaway Electron Modeling, May 2-6 Garching (in person)
  - Abstract deadline April 10
- IAEA Technical Meeting on Plasma Disruptions and their Mitigation 19-22 July
  - In person at ITER HQ in France
  - Abstract submission by May 31

# Mesh adaptation update

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

# Update to collapse and split\_smb

## Old usage:

```
mpirun -n 16 ./split_smb model.dmg in.smb out.smb 4
```

```
mpirun -n 16 ./collapse model.dmg in.smb out.smb 4
```

## New usage:

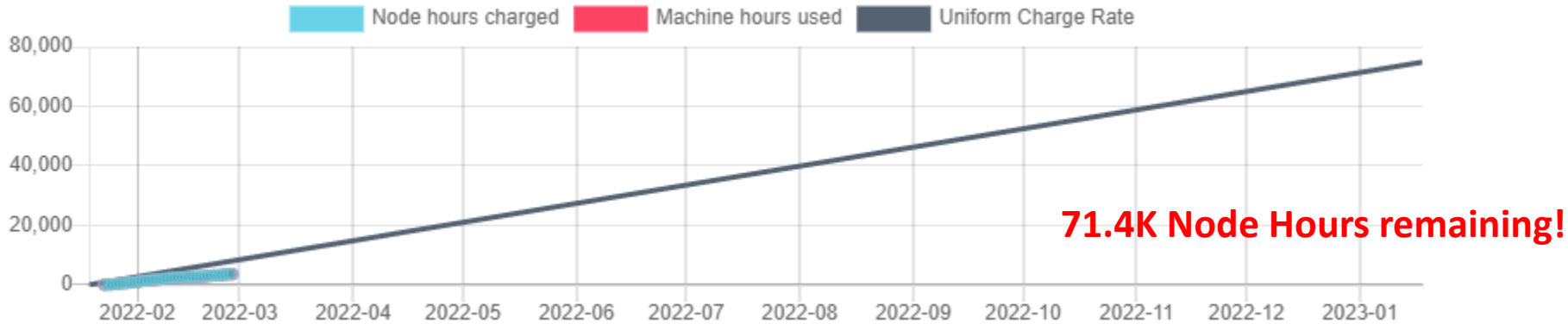
```
mpirun -n 16 ./split_smb in.smb out.smb 4  
(splits 4-part in.smb mesh to 16 part out.smb)
```

```
mpirun -n 16 ./collapse in.smb out.smb 4  
(changes a 16-part mesh to a 4-part mesh)
```

Need for .dmg file is eliminated. Documentation has been updated.

# NERSC Time

mp288



- New award period began Jan 19
- We are NESAP Tier 2 for Pearlmuter. . Phase-I w GPUs We have been given a repo m3984 with a small allocation. Presently we are not being charged.
- N9ES-N2 M3D-C1: J. Chen , C. Liu, S. Seol are early users

# Changes to github master since 02/07/22

## Nate Ferraro:

**02/15/22:** Updated mesh filenames in templates/NSTX/rw1\_adapt

**02/25/22:** Added IDL function for fitting an exponential

## Jin Chen:

**02/15/22 :** split\_smb and collapse updated on cori haswell and knl

**02/17/22:** ST=1 restart fix

**02/19/22:** fftw module changes for ST=1 on perlmutter

## Mortesa S:

**02/17/22:** Fixes uninitialized counter

**02/17/22:** Cleans up the 3D stand-alone adapt example

**02/18/22:** Adds non-trivial size field to 3D adapt test

## Seegyong Seol

**02/13/22:** adding 3D mesh removal & restoration for mesh adaptation

**02/13/22:** adding Morteza's 3D adaptation unit test

**02/26/22:** Fixing logic errors in 3D mesh construction after adaptation

## Local Systems

- PPPL centos7(02/28/22)
  - 7 jobs **PASSED**
- PPPL greene (02/28/22)
  - 5 jobs **PASSED**
- STELLAR (02/28/22)
  - 7 regression tests **PASSED** on stellar
  - NCSX timed out on first try but passed on resubmission
- TRAVERSE(02/28/22)
  - 7 regression tests **PASSED** on (01/24/22)
  - 7 regression tests **FAILED** on (02/28/22)




## Other Systems

- Cori-KNL (02/25/2022)
  - 7 regression tests **PASSED**
  - Error message “Module m3dc1/devel-haswell conflicts with the currently loaded module m3dc1/devel-knl”
- Cori-Haswell (02/25/2022)
  - 7 regression tests **PASSED**
- Perlmutter (02/28/2022)
  - 6 regression tests **PASSED**
  - NCSX timed out (twice), pellet timed out once

# Need for itemp=1 with large kappa and idens=1

For itemp=0, the pressure(s) are advanced in time

$$\begin{aligned} \frac{3}{2} \frac{\partial p}{\partial t} + \dots &= \nabla \cdot \kappa_R \frac{\mathbf{BB}}{B^2} \cdot \nabla \left( \frac{p}{n} \right) + \dots \\ &= \nabla \cdot \frac{1}{n} \kappa_R \frac{\mathbf{BB}}{B^2} \cdot \nabla p - \nabla \cdot \frac{p}{n^2} \kappa_R \frac{\mathbf{BB}}{B^2} \cdot \nabla n \dots \end{aligned}$$

 This term can lead to numerical instability since p and n are advanced separately

For itemp=1, the temperature is evolved

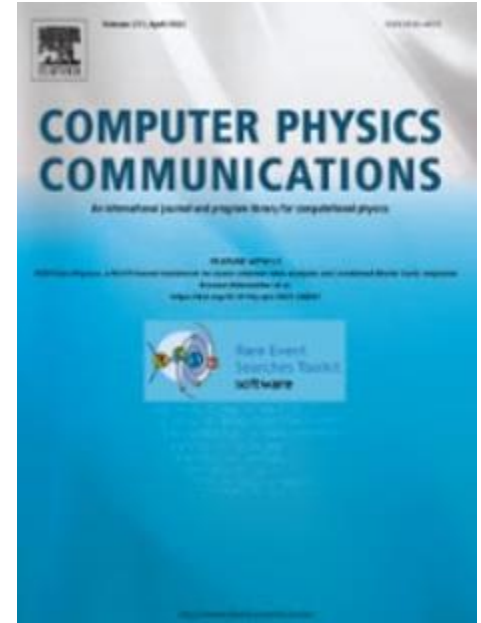
$$\frac{3}{2} n \frac{\partial T}{\partial t} + \dots = \nabla \cdot \kappa_R \frac{\mathbf{BB}}{B^2} \cdot \nabla T + \dots$$

This leads to a diagonally dominant very stable implicit scheme

## C. Liu paper accepted by CPC

Hybrid simulation of energetic particles interacting with magnetohydrodynamics using a slow manifold algorithm and GPU acceleration

Chang Liu\*



# Update on Soft Beta Limit Study

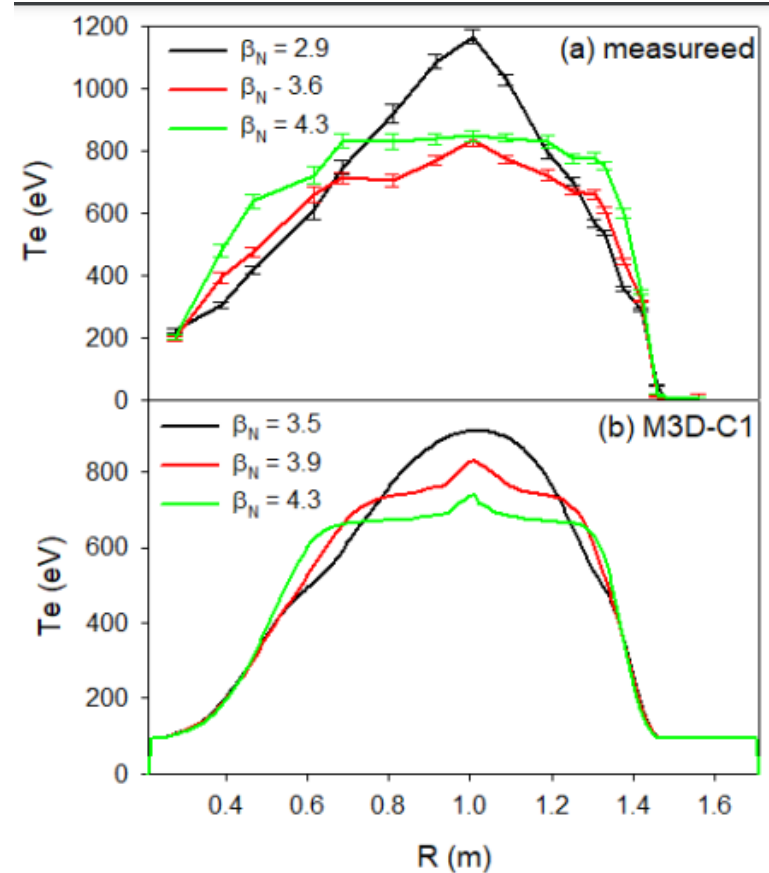
## Ideal MHD limited electron temperature in (spherical) tokamaks

S.C. Jardin, N.M. Ferraro, W. Guttenfelder, S.M. Kaye, S. Munaretto  
Princeton Plasma Physics Laboratory, P.O.Box 451, Princeton, NJ 08543 USA  
(Dated: February 28, 2022)

We demonstrate that in a 3D resistive magnetohydrodynamic (MHD) simulation of a NSTX discharge, anomalous transport can occur due to pressure-driven low toroidal mode number ideal MHD instabilities. This could explain the experimentally observed flattening of the electron temperature profile at modest  $\beta$ .

PACS numbers: 52.30.Cv 52.55.Fa 52.65.kj

- New title
- Experimental collaborators rewrote introduction and added references
- New Figure 6
- Will submit to PRL tomorrow



# **RWTM in DIII-D and JET**

Hank Strauss to present

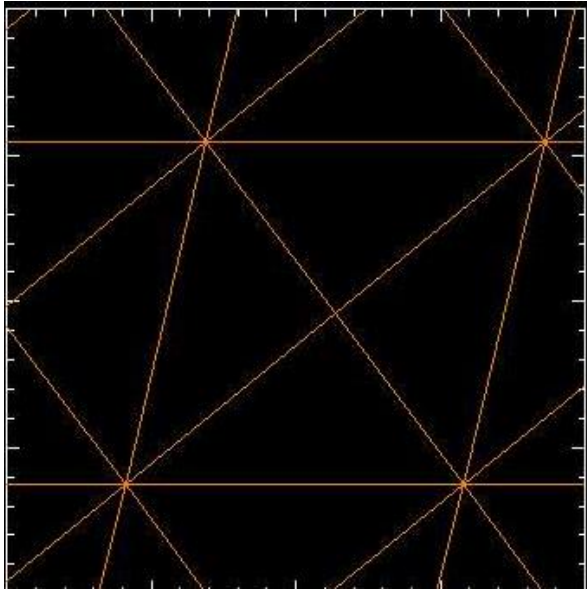
That's All I have

Anything Else ?

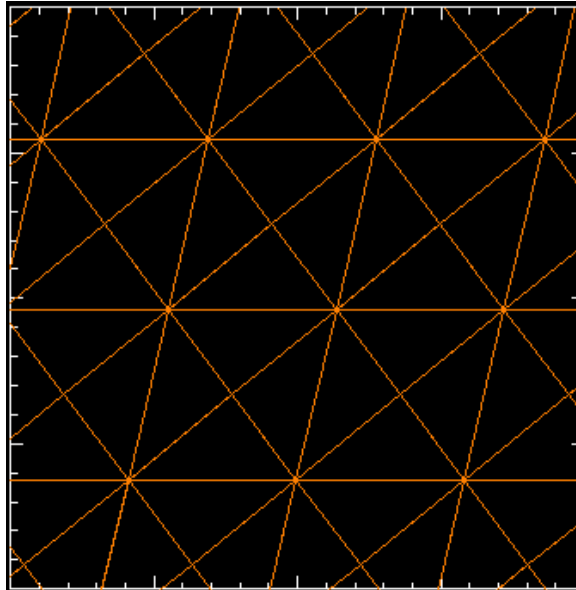
Next Meeting in 1 week with LBL: March 7

# Update on Soft-Beta-Limit Study

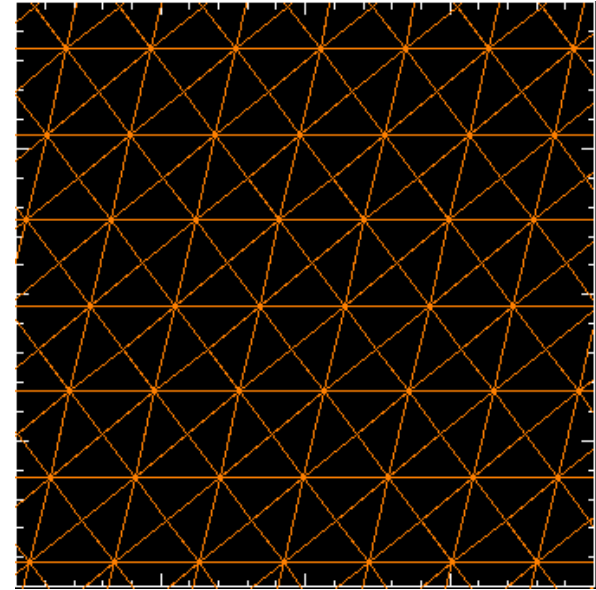
0.8 cm



0.4 cm

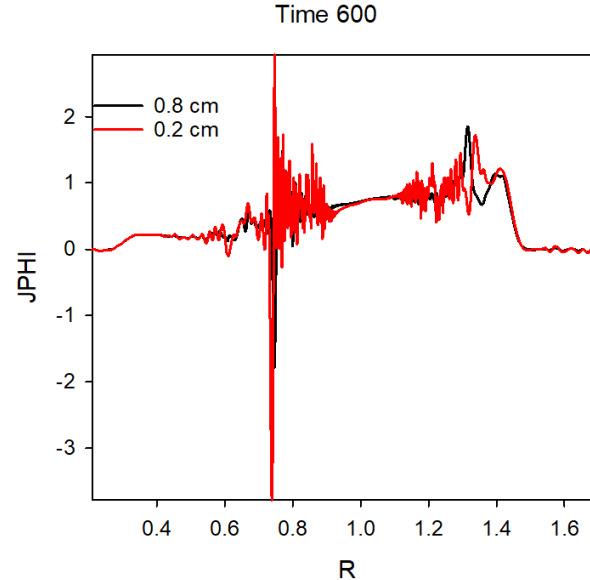
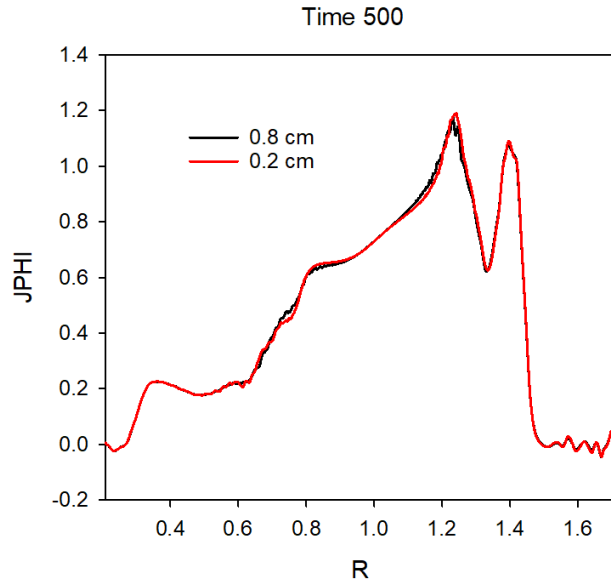


0.2 cm



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

# Result of Convergence Study

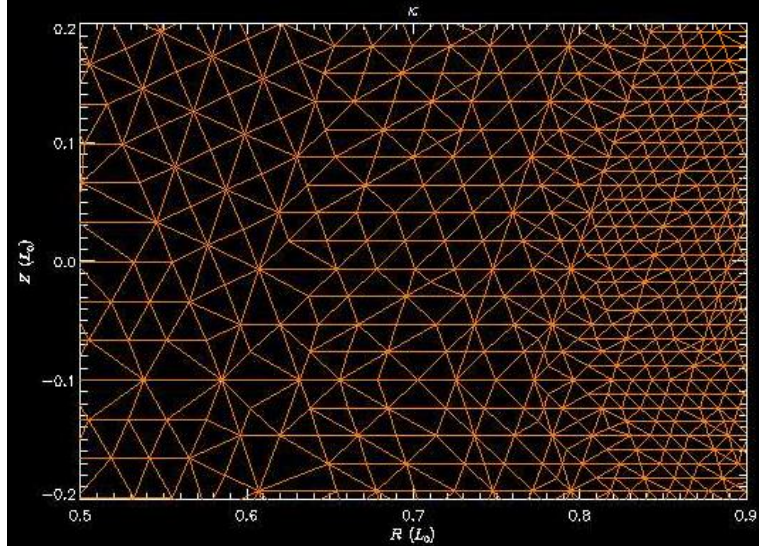


Solution for jphi still very noisy in region  $0.5 < R < 0.9$ , even for the finest grid with 0.2 cm in center

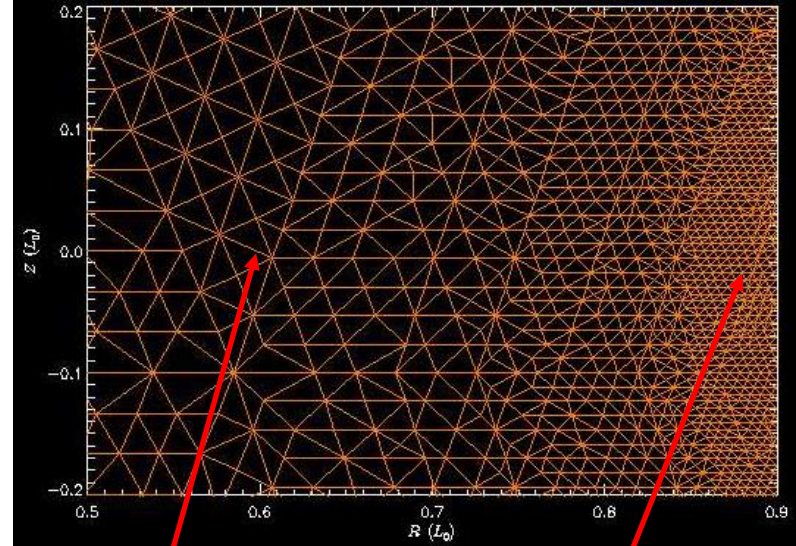


# Grid was not refined where J gets jagged

0.8 cm



0.2 cm



But not here

Resolution increased here

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