

# M3D-C1 ZOOM Meeting

07/10/2023

## Upcoming Meetings

### CS Issues

1. LBL Update
2. Adaptation update --RPI
3. Reduced precision SuperLU ...Jin Chen
4. NERSC Time
5. Changes to github master since last meeting
6. Regression tests

### Physics Studies

1. D\_R and D\_I in IDL and CHEASE
2. Resolution of “possible bug” in init\_basicq.f90
3. Anything else

## In attendance

Steve Jardin

Saurabn Saxena

Chang Liu

Jin Chen

Brendan Lyons

Cesar Clauser

Priyanjana Sinha

Chen Zhao

Nate Ferraro

Adelle Wright

Usman Riaz

Seegyoung Seol

Mark Shephard

Sherry Li

Nan Ding

Yang Liu

Hans Johansen

# Upcoming Meetings

TSDW	July 19-21	Princeton, NJ
NSTX results rev.	July 24-25	Princeton
ITPA(MHD)	Sept 19-22	General Atomics
IAEA	Oct 16-21	London, UK
APS	Oct 30 – Nov 1	Denver, CO
AAPPS-DPP	Nov 12-17	Nagoya, JP

# LBL Report

# Adaption Update

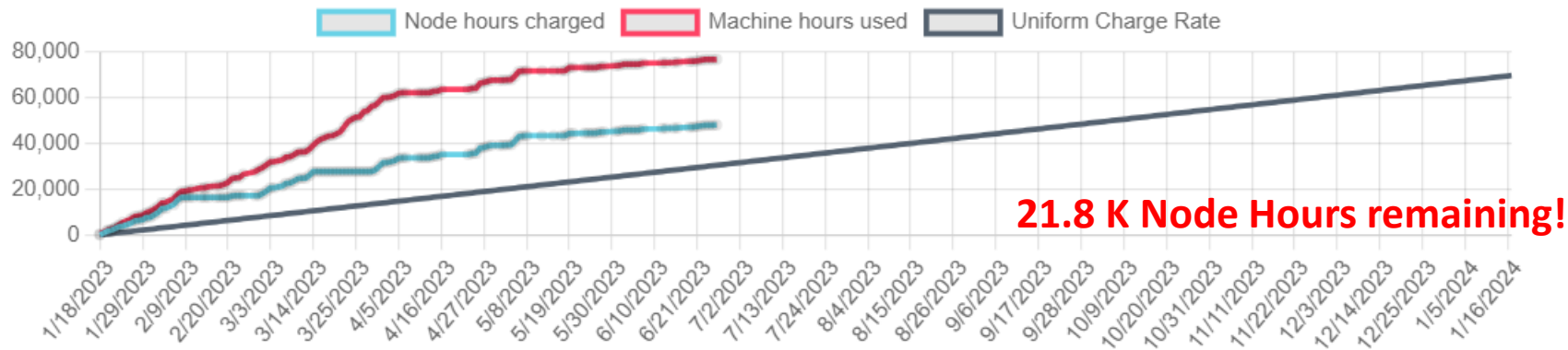
RPI?

# Reduced Precision SuperLU

Any new results –Jin Chen

# NERSC Time 2023

mp288



- MP288 usage rate is a bit high but leveling off
- Also, 8K k GPU node hours remaining (allocation increased by 3K from last week!
- I have contacted DOE to see the likelihood of getting more time – no time available now but more may become available at next clawback

# Changes to github master --after 2023-06-26

## Cesar Clauser:

**07/05/23:** Fixed KPRAD\_restart for MIT cluster

## Nate Ferraro:

**06/30/23:** Added D\_I and D\_R IDL flux\_average for ideal and resistive interchange criteria

**06/30/23:** Change normcurv output to include all boundary points, not just first wall

**06/30/23:** updated D\_I and D\_R to include factors of  $2\pi$

07/06/23: updated signs of D\_I and D\_R to account for definition of psi in m3dc1

07/06/23: updated default stellarator versio from MAX\_PTS=60 to MAX\_PTS=125

07/06/23: Added D\_H flux average plot to show H-term in interchange criteria

## Jin Chen

**06/29/23:** fix normal vectors on the boundary

**06/29/23:** traverse updates

**06/30/23:** traverse updates

**07/05/23:** mit code porting(3)

## Seegyong Seol

**07/05/23:** m3dc1\_scorec and meshgen updated to support MIT

## Usman Riaz

**06/28/23:** The issue with normal vectors on boundary has been fixed....



## Local Systems

- PPPL centos7(07/08/23)
  - 7 jobs **PASSED**
- PPPL greene (07/08/23)
  - 5 jobs **PASSED**
- STELLAR (07/08/23)
  - 7 regression tests **PASSED** on stellar
- TRAVERSE-nvhpc (07/08/23)
  - 6 regression tests **PASSED**
  - adapt **FAILED**

# NERSC

- Perlmutter\_cpu (07/08/23)  
6 jobs **PASSED**  
NCSX failed with very small difference in C1ke
- Perlmutter\_gpu (07/08/2023)
  - pellet, RMP, & RMP\_nonlin, adapt all **PASSED**
  - KPRAD\_2D, KPRAD\_restart, NCSX all failed with very small differences

# MIT cluster

## **Jin Chen email 7/5/23:**

Finally the M3DC1 code works now on the mit clusters and passed the regtests except **KPRAD\_restart/devel\_mit**:

## **Cesar Clauser email 7/5/23**

Code compiled and all regression tests passed except NCSX  
PC failed due to SUBPC\_ERROR ....need to modify options\_bjacobi file?

## **Seegyong Seol email 7/10/23:**

The mesh generation programs are installed.

# Ideal and Resistive Interchange Criteria

$$E = \frac{-p'V'}{q'^2(2\pi)^2} \left\langle \frac{B^2}{|\nabla\psi|^2} \right\rangle \left[ \frac{Fq'}{\langle B^2 \rangle} + \frac{V''}{(2\pi)^2} \right]$$

$$F = \left( \frac{p'V'}{(2\pi)^2 q'} \right)^2 \left[ F^2 \left( \left\langle \frac{B^2}{|\nabla\psi|^2} \right\rangle \left\langle \frac{1}{B^2 |\nabla\psi|^2} \right\rangle - \left\langle \frac{1}{|\nabla\psi|^2} \right\rangle^2 \right) + \left\langle \frac{B^2}{|\nabla\psi|^2} \right\rangle \left\langle \frac{1}{B^2} \right\rangle \right]$$

$$H = \frac{-Fp'V'}{(2\pi)^2 q'} \left( \left\langle \frac{1}{|\nabla\psi|^2} \right\rangle - \frac{\langle B^2/|\nabla\psi|^2 \rangle}{\langle B^2 \rangle} \right)$$

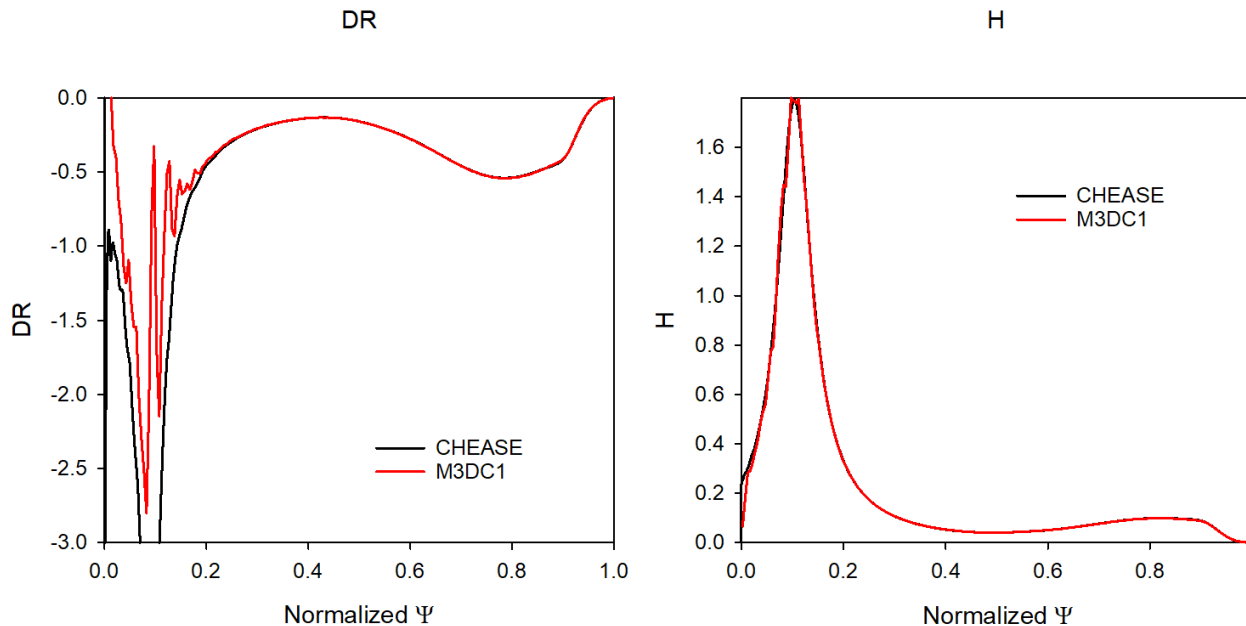
$$D_I = E + F + H - \frac{1}{4}$$

$$D_R = E + F + H^2 = D_I + \left( H - \frac{1}{2} \right)^2$$

Equilibrium is stable to ideal and resistive interchange modes if  $D_I < 0$  and  $D_R < 0$ . These are now available in the IDL routine “plot\_flux\_average” by specifying D\_I or D\_R

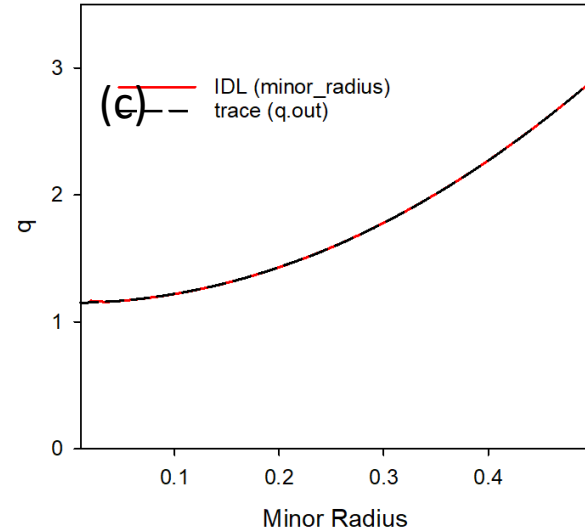
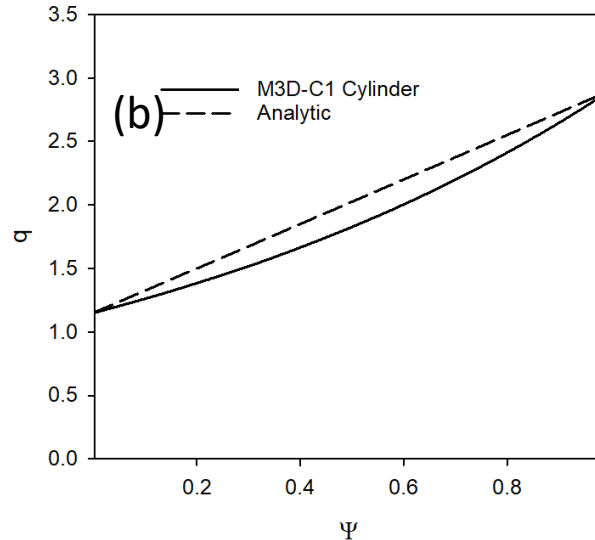
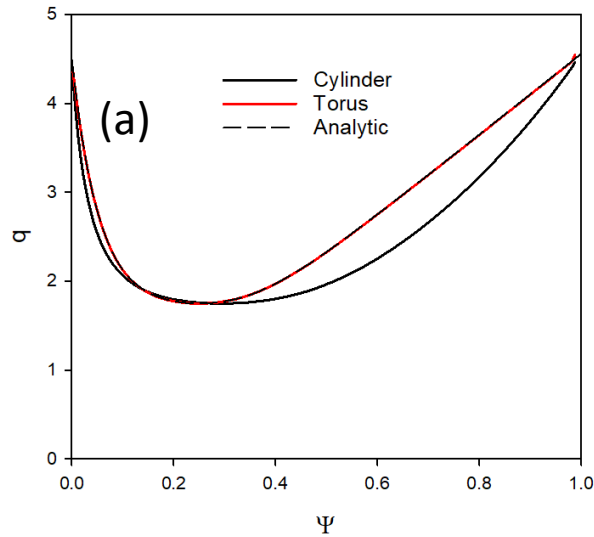
A. Glasser, J. Greene, and J. Johnson, “Resistive instabilities in a tokamak”, Phys Fluids **19** (1976)

# Verification with CHEASE Equilibrium Code



Agrees with CHEASE except near origin. This needs to be sorted out. Does not improve with increasing “points” or “bins”, or decreasing m3dc1 grid size. **Can we do double precession?**

## Possible problem in init\_basicq.j90



- (a) low  $\beta$  fixed- $q$  equilibrium defined in torus (QSOLVER) and cylinder (ITOR=0, ITAYLOR=35)
    - IDL plot of  $q(\Psi)$  in torus agreed with analytic formula, but not for the Cylinder
  - (b) Another cylindrical case with itor=0, itaylor=26 also showed disagreement
    - Both cases use the routine “fixed\_qprofiles()” to define equilibrium
      - as do itaylor=21,22,25,27,28,30,32,34
  - (c) as a check on the IDL plot\_surface\_average, “q”, we compared with “trace”  $q$
- ➔ IDL  $q$ -calculation looks correct, must be problem in fixed-qprofiles equilibrium
- ➔ Resolution: in m3dc1, itor=0, psi is  $(r/a)**2$  .... Not normalized poloidal flux!!

That's All I have

Anything Else ?