# M3D-C1 ZOOM Meeting

8/10/2020

**Agenda**

1. Announcements
2. CS Issues
    1. Local systems
    2. Update on new cluster – J. Chen
    3. NERSC Time
    4. Changes to github master since last meeting
    5. Status of GPU solves on cori-GPU
    6. Mesh adaptation and heat flux issues -- Lyons
3. Physics Studies
    1. Comments on Collins Presentation
    2. Summary of Pellet Code Camp -- Lyons
    3. Comments on Boozer paper
    4. M3D-C1 coupling to RE code KORC
    5. RE Fluid Modeling of DIII-D Experiments
    6. Runaways with sources
    7. Other

# Announcements

- Laboratory closed unless authorized
  - Once authorized, need to get single access code at http://rtw-screen.pppl.gov
- Do people need a second monitor to attach to laptop?
  - If you have one in your office, contact J. Jones to get it. Will need permission for lab access and property pass
- NERSC Users Group Meeting August 17, 2020
  - Registration Required
  - Possibility of presenting 10 min talk
- ITPA MHD Meeting October 14-16 2020
  - Fully Remote
- IAEA Fusion Energy Conference postponed to May 2021

# Local Systems

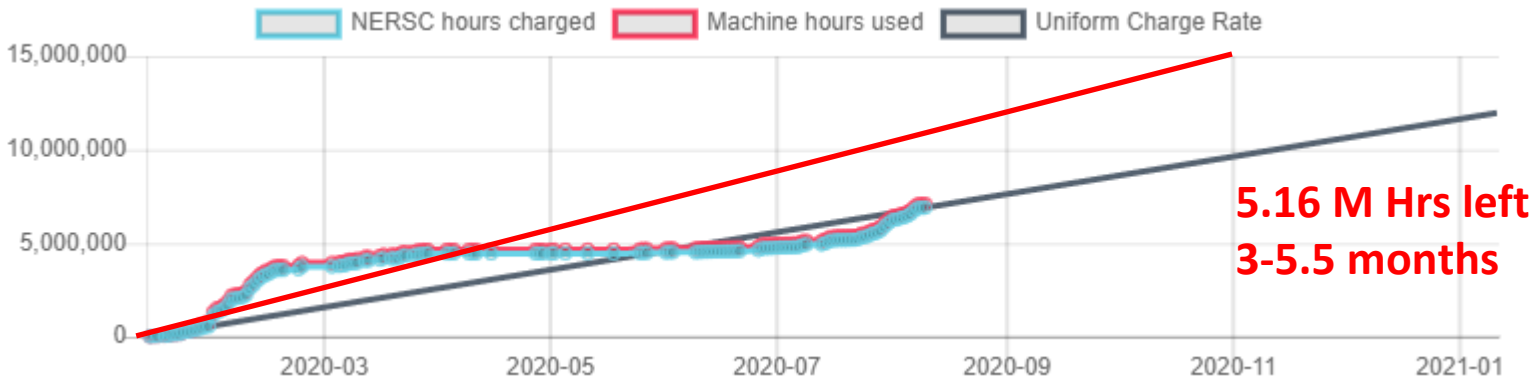
- PPPL
  - Centos7 documentation updated:  m3dc1.pppl.gov
  - All 6 regression tests PASSED on centos7
  - Separate test for partition=m3dc1 ?
- EDDY
  - All 6 regression tests PASSED this morning
- TRAVERSE
  - Being updated to RHEL8
    - updated node traverse8
    - #SBATCH –C rh8
  - Seegyoung should now have her account updated

# Update on New Cluster

- Jin Chen to present

# NERSC Time

**mp288**




**m3163**

Closed for general use

- Should be enough mp288 time to last until new PU/PPPL computer arrives in fall – red line is linear usage until Nov 1
- Please use time spareingly !

# Changes to github master since last week

- N. Ferraro
  - 08-05 Updated release version to 1.13-devel
  - 08-06 Fixed coding and bug in read_lp_source
  - 08-06 Update to devel module files on cori
  - 08-06 Corrected normalized unit label for fields that include /p0
  - 08-10 Added –lgsl back into centos7.mk
- B. Lyons
  - 08-06 Numerous changes involving iread_lp_source, lp_source_dt, etc
- J. Chen
  - 08-04 typo fix for sunfire15
- S. Seol
  - 08-06 unit testcompilation command on SCOREC debian6 updated
  - 08-06 .mk and readme updated for centos7

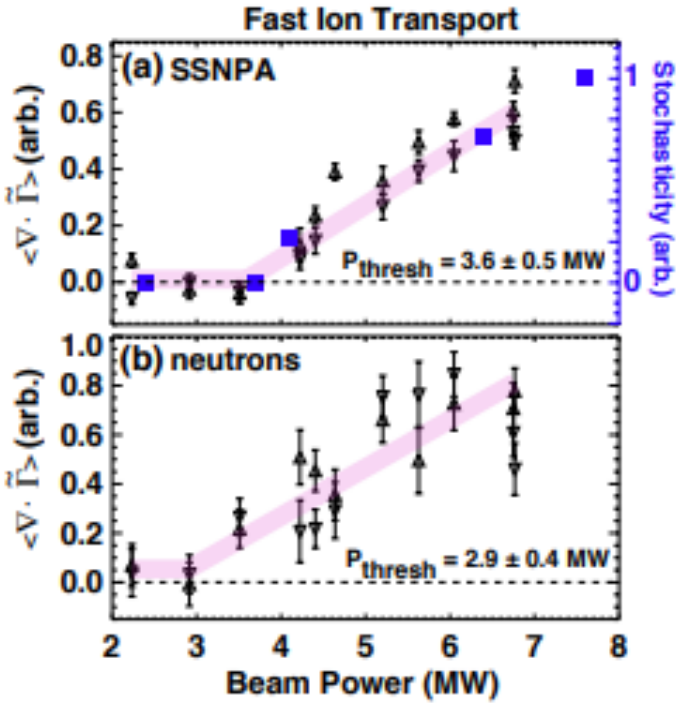
# Status of GPU solves on cori-gpu

- Any update??

# Mesh Adaptation and Heat Flux Issues

- Brendan Lyons to present

# Comments on: "Understanding & Controlling Transport of Fast Ions by Alfven Eigenmodes in Tokamaks…Cami Collins




- Trying to explain experimental result shown that anomolous fast ion transport occurs at critical beam power
- NOT self-consistent analysis: only linear NOVA + ORBIT
- Opportunity for nonlinear kinetic MHD code like M3D-C1-K

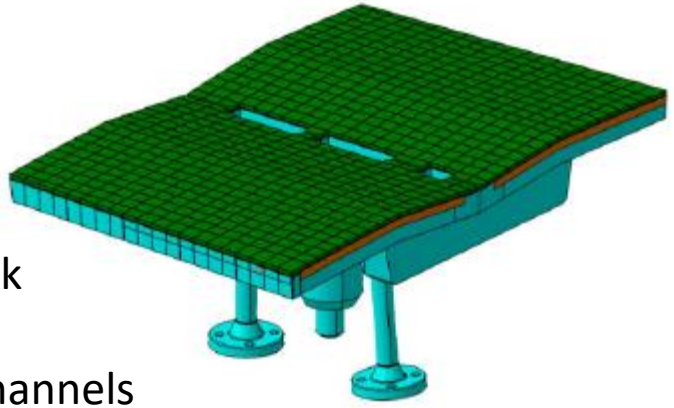
Collins PRL 116 09500 (2016)

# Pellet Ablation Virtual Code Camp held Aug 3-5 -- Brendan Lyons, Organizer : DIII-D Highlight below

- The SciDAC Center for Tokamak Transient Simulation (CTTS) held a virtual code camp the week of August 3rd, 2020, attended by scientists from General Atomics, SLS2 Consulting, PPPL, and Stony Brook University.
- The goal was to advance the coupling of the 3D, nonlinear, extended-magnetohydrodynamics (MHD) codes M3D-C1 and NIMROD to a Lagrangian-particle (LP) code that performs detailed, local calculations of pellet ablation.
- The coupled codes will permit sophisticated, high-fidelity simulations of disruption mitigation by shattered-pellet injection (SPI) of cryogenic deuterium and neon.
- A data format was finalized for exchanging information about the pellet-ablation cloud to the MHD codes.
- In addition, a plan was developed to perform predictor-corrector simulations using loose coupling between the codes.
- MHD calculations will be performed for H-mode and Super-H-mode DIII-D plasmas of the injection of a small neon pellet, first using an analytic model for pellet ablation developed by Paul Parks.
- The density, temperature, and magnetic field from those simulations will be passed to the LP code, and new ablation rates will be precomputed for use in subsequent MHD calculations.
- The MHD codes and LP code can then be iterated between until convergence.
- These simulations will provide a predict-first computation of the ablation rate and dynamics in an upcoming DIII-D experiment that seeks to measure the ablation rate of small neon pellets.
- The eventual goal is validation of the impurity and ablation models used in the MHD codes for disruption-mitigation modeling.

# Potential for ITER first-wall failure during disruptions

A. Boozer, 8/6/20

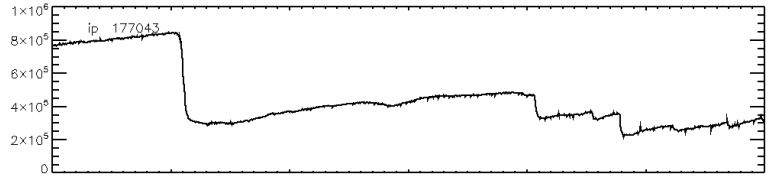


- Beryllium tiles, copper alloy with cooling channels, and stainless steel supports
- Open channels between tiles and fingers to block currents due to disruptions
- However, currents could flow if plasma shorts channels
- Fully shorted first wall has ~ 600 ms time constant

- Model as a thin shell of thickness $\delta$ =3 cm with resistivity $\eta = 36 \times 10^{-9}\,\Omega$ m separated from a prefect conductor by a distance $\Delta$ = 60 cm
- "…extensive computations will be required to assess the maximum credible force per unit area, $P_d$, that may arise during disruptions
- Expect structure failure if $P_d > 3.2$ atm $\sim 3 \times 10^5$ N/m$^2$
- Disruption forces from thermal quench, current quench, and VDE

# M3D-C1 coupling to RE code KORC

- Plan to target DIII-D shot 177053 after Chen has a full simulation with fluid runaway electrons



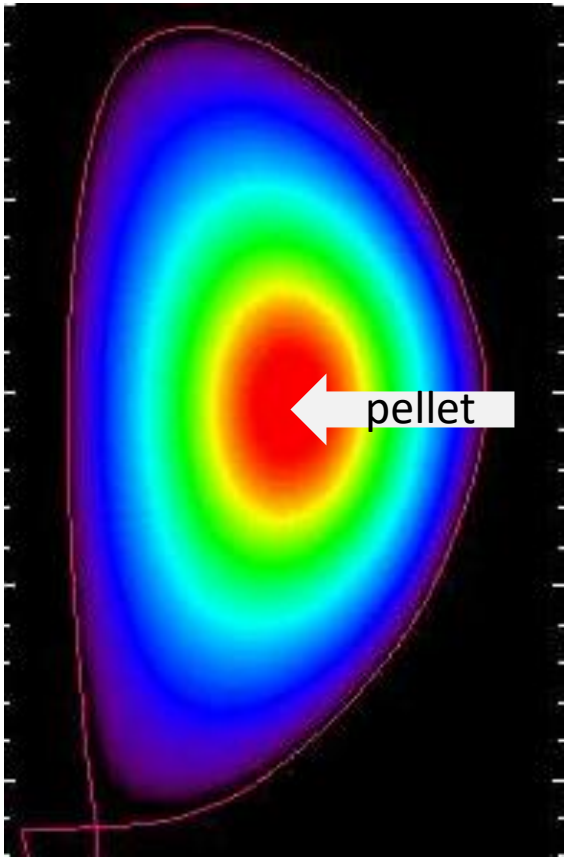

- KORC can now run using fields, densities, and temperatures from M3D-C1 hdf5 files using Nate's Fusion-IO routines

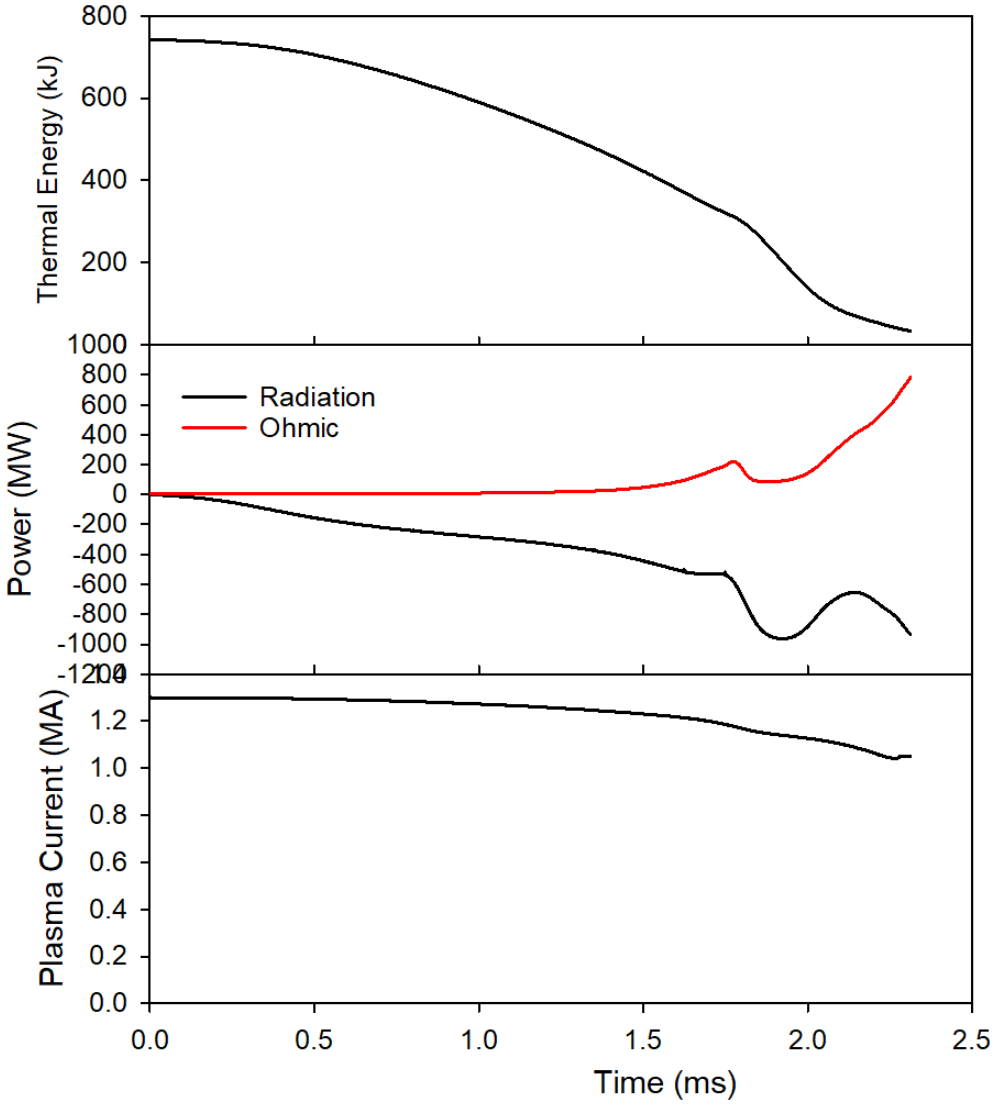
- Does Brendan have a DIII-D pellet injection case that has thermal and current quench?
  - Suitable for coupling to KORC ?

  ➢ DIII-D M3D-C1 neon pellet mitigation simulation performed July 02, 2020 by Brendan Lyons on cori.nersc.gov

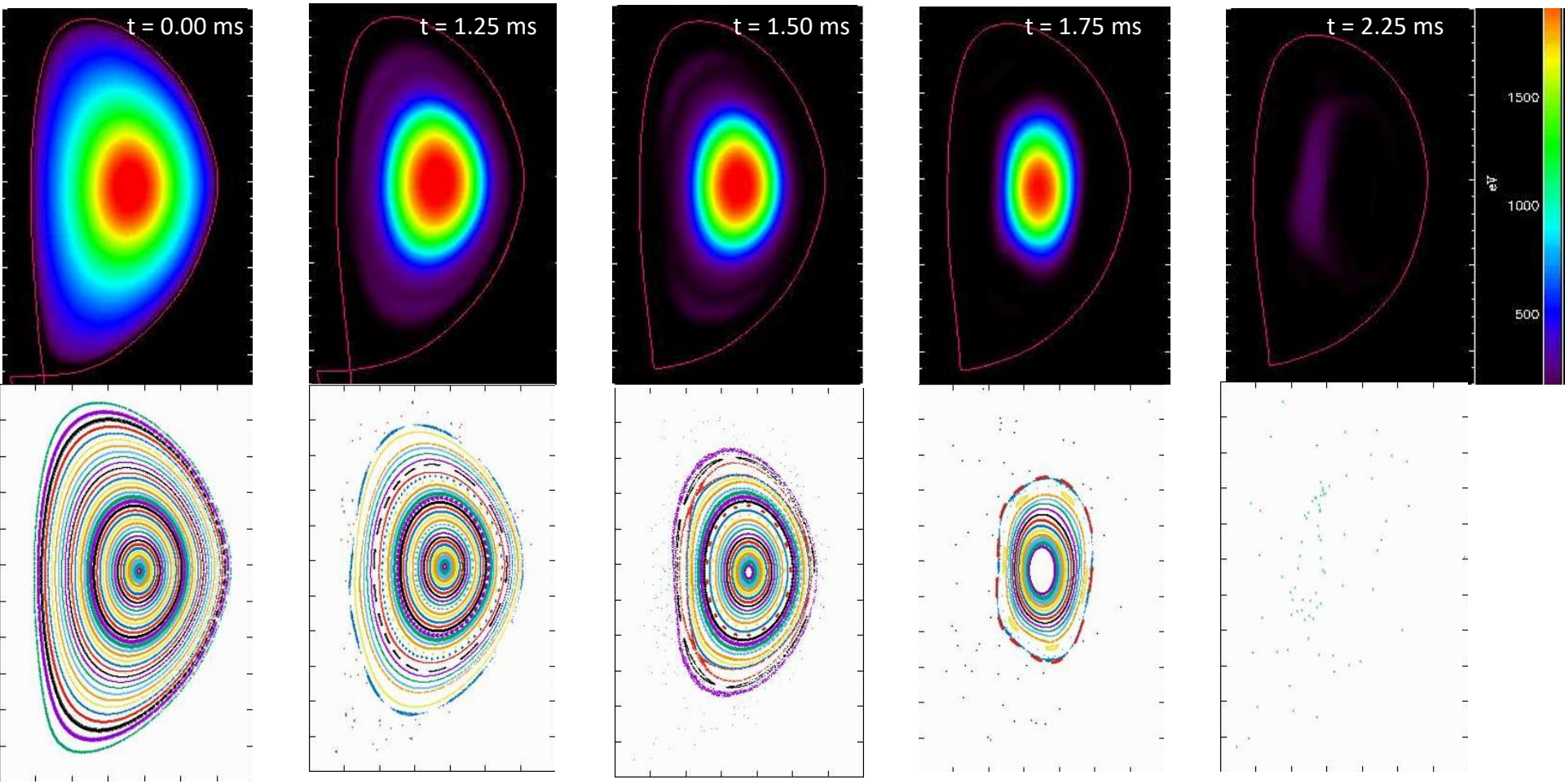
  - NERSC Directory: /global/scratch1/sd/blyons/C1_32218323

# Time Traces of Thermal Energy, Power Radiated, and Plasma Current

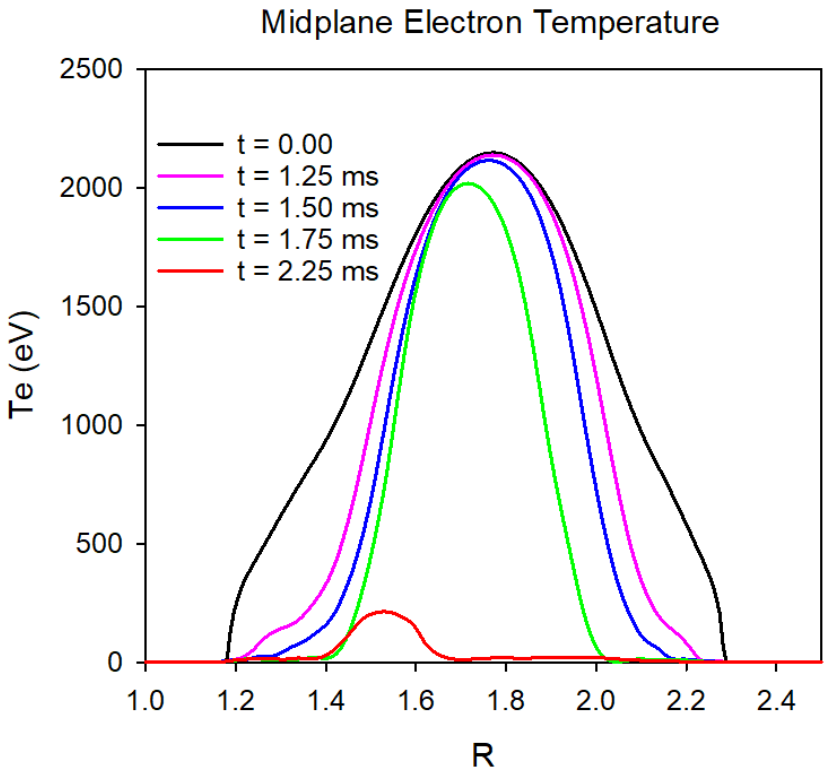


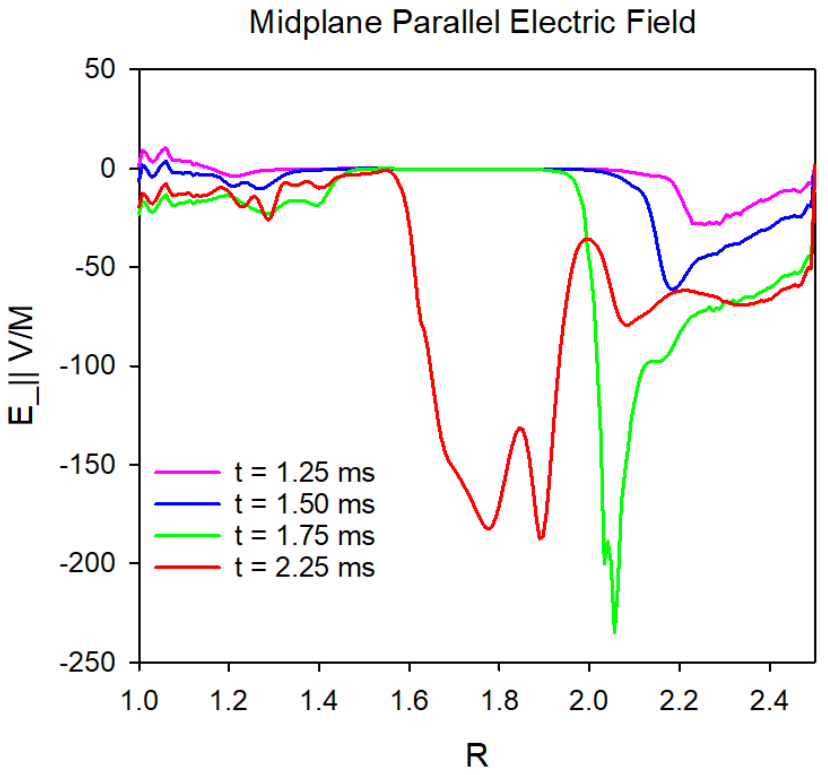



# Electron Temperature and Poincare Plots at 5 Times



# Midplane Profiles of Te and E_par at 5 times



# Comments in EMAIL from Matt Beidler (8/7/20)

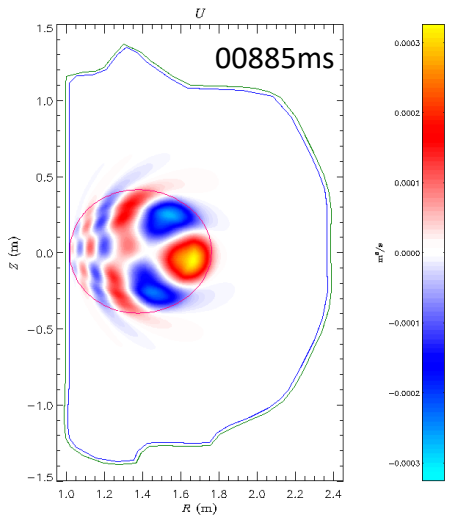
Thanks for sending along the details on this case; it does look promising. Just a few thoughts before the weekend:

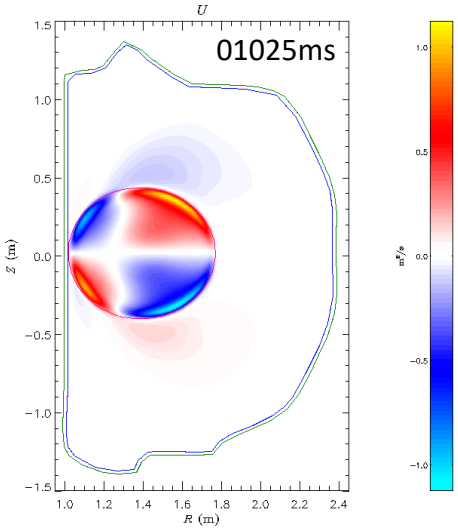
In most work I've seen dealing with RE generation, the generation process usually considers a parallel electric field that is toroidally dominant. I had looked into this for Nate's NF (2019) and Cesar's cases and saw that the parallel electric field is dominated by the poloidal component, where the toroidal component was small. My intuition tells me that a toroidal electric field will be induced as the current quenches, so as Brendan's simulation is continued.

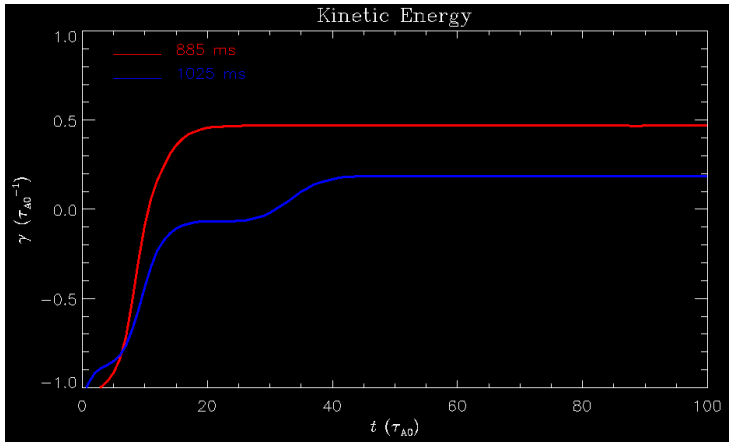
I am interested in how this strong parallel electric field driven by the MHD would affects RE orbits though, as the magnitude appears to be well above the Connor-Hastie or Dreicer fields.

# RE Fluid Modeling of DIII-D Experiments

- Carlos Paz-Soldan and Yueqiang Liu (GA) are interested in having M3D-C1 perform some nonlinear runs on shots where kink-modes de-confined Res
- Brendan Lyons suggested shot 177040. These have been looked at by Liu with the (linear) MARS code
- ZOOM call held Tuesday July 28 @ 1:00 PM ET
  - Chang Liu, Chen Zhao, Steve Jardin, Yueqiang Liu, Carlos Paz-Soldan
- Brendan sent around initial free-boundarv equilibrium & results:

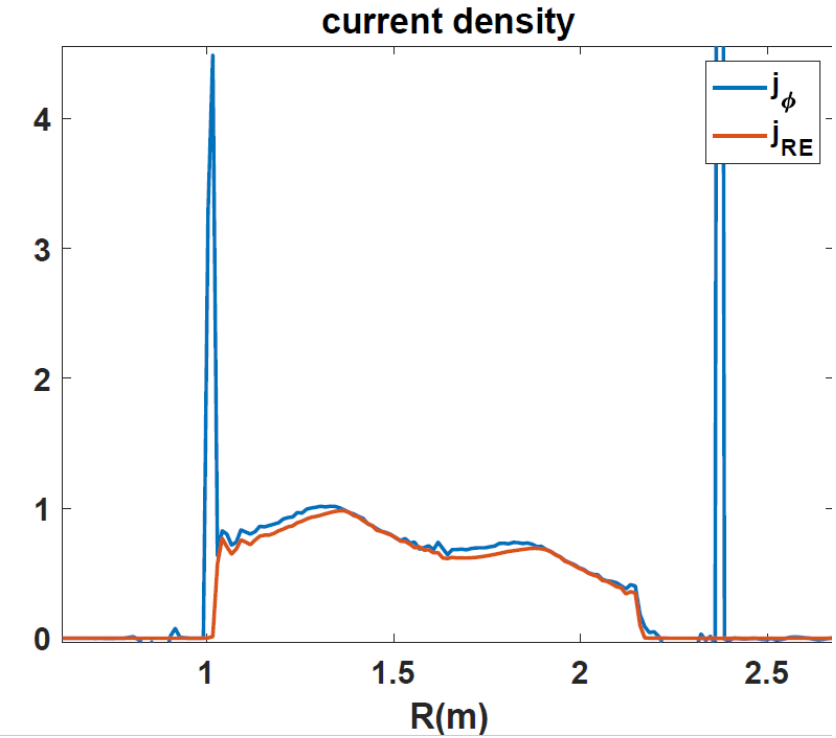


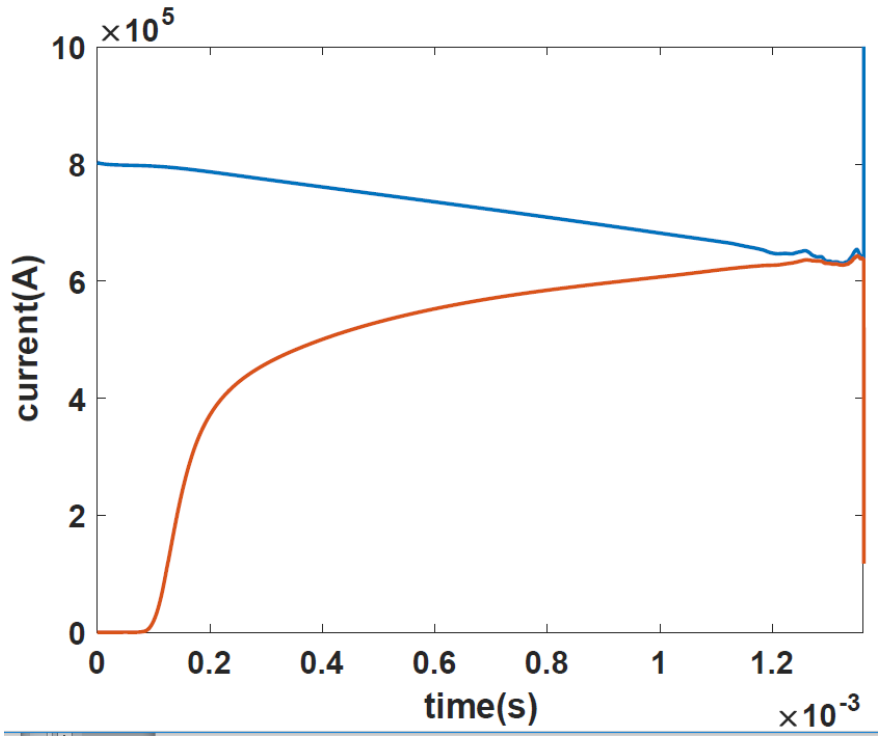




- Chang Liu to compare with MARS results, extend to non-linear

# Runaways with Sources




Suggestions

- Move inside limiter so plasma is not in contact with wall
- Increase wall resistivity to reduce large gradients in current
- Restart from slice before crash, plot more frequently to determine cause of crash…(what goes bad first)
- Does hyper-resistivity help smoothJ_phi ?

# That’s All I have

Anything Else ?