

M3D-C1 ZOOM Meeting

12/07/2020

1. CS Issues
 1. GPU solve status
 2. Eddy status
 3. Local and other systems
 4. NERSC Time
 5. Changes to github master since last meeting
 6. C. Clauser proposal for reading pellet info
2. Physics Studies
 1. JRT Quarterly Report
 2. Stability study vs NUMVAR
 3. DIII-D shot 178555/3055 (Andreas Wingen)
 4. Status of first coupled M3D-C1/LP Simulation .. Lyons/Samulyak
 5. DIII-D shot 177040 with RE..Chang Liu and Chen Zhao
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 7. Radiation Glitches .. Cesar Clauser
 8. Status of other simulations
 9. Other?

GPU solve status

Eddy Status

- Global Parallel File System (GPFS) hardware has failed and will not be replaced.
- All files from /scratch/GPFS have been copied over to a NFS disk, which has the same directory name: /scratch/GPFS
- For now, the NFS file system is working fine, but it is NOT a parallel file system and some applications will see a slow-down
- New system is in Princeton University Procurement and we presently do not have a date when it will be available

Local Systems

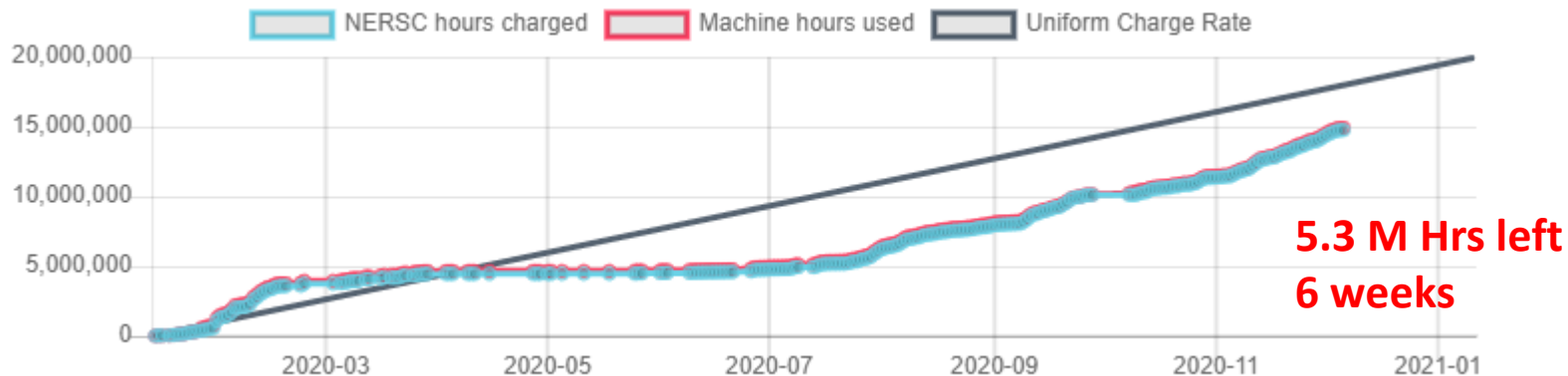
- PPPL centos7(12/7)
 - All 6 regression tests PASSED on centos7:
- PPPL greene (12/7)
 - 5 regression tests PASSED
 - No batch file found for pellet
- EDDY (12/7)
 - All 6 regression tests PASSED
- TRAVERSE(11/16)
 - Code compiles
 - Regression test failed: split_smb not found in PATH
 - Have not yet tried shipping .smb files from another machine

Other Systems

- Cori-KNL (11/16)
 - 6 regression tests passed on KNL
- Cori-Haswell (11/16)
 - 5 regression tests passed
 - KPRAD_RESTART did not pass, but differences are very small in velocity variables. All magnetic and thermal good. Similar difference as Cori-KNL
- PERSEUS
 - All 6 regression tests PASSED on perseus (J. Chen, 9/04/20)
- MARCONI
 - All regression tests PASSED on MARCONI (J. Chen, 9/04/20)
- CORI GPU (10/26)
 - ??

NERSC Time

mp288



m3163

Closed for general use

- New NERSC allocations start Jan 15 2021
- Cori Down Dec 15 10 AM ET, back up Dec 21 3:00 AM ET

Changes to github master since last meeting

- Brendan Lyons
 - 11/23/20: Fix internal KPRAD evolution of temperature for itemp=1 and ipres=0
 - 11/30/20: Create new Gaussian adaptation about arbitrary q surface
- S. Jardin
 - 11/26/20: fixed error in bf_i index when imp_bf=0 and imp_hyper=1
 - 12/04/20: fixed bug preventing restart with numvar=1
- A. Kleiner
 - 12/3/20: Added __init__.py
 - 12/3/20: Updated flux coordinates to be compatible with latest fusion-i0
- Seegyong Seol
 - 11/25/20: Fixing error with global adjacency routine
 - 11/26/20: Fixing logic error with global adjacency operator

C. Clauser proposal for reading pellet info

- Cesar wants to change some pellet parameters at restart time. So, he suggests that the following pellet variables only be read from the restart file if iread_pellet.ge.1:
- pellet_var, pellet_var_tor, pellet_verr, pellet_velphi,
pellet_velz, pellet_vx, pellet_vy, cloud_pel,
pellet_mix

(note: pellet_vx and pellet_vy are auxiliary variables)

So, if iread_pellet .eq. 0 (default) the values of these in the C1input file at the restart time will be used, allowing them to be changed

In addition, he is adding a new ablation model which sets the ablation rate to a constant. He is using the input variable “pellet_rate” for this

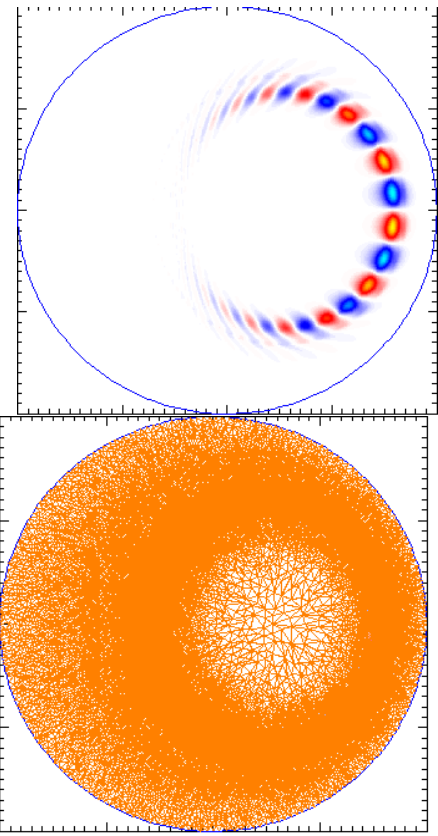
Counter proposal made by Brendan at 1:44 today involving adding new input variable irestart_pellet which defaults to what we have now. The new constant ablation model is fine with Brendan.

Who will make changes?

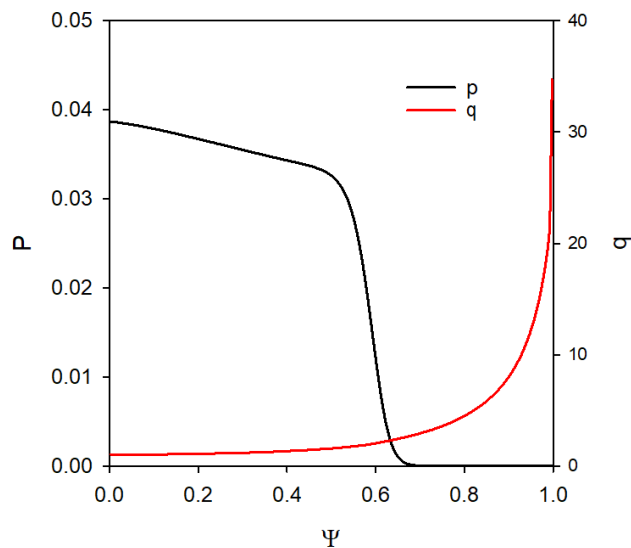
JRT Quarterly Report

- We are part of a high-level Fy21 Joint Research Target: Shattered pellet injection for disruption mitigation on ITER
- 1st Quarter Milestone Report is due end of December:
- Identify existing JRT-relevant datasets from DIII-D and Alcator C-Mod, as well as from international SPI collaborations on JET and KSTAR. Identify existing dataset of SPI simulations with extended MHD codes, and develop a plan for additional simulations utilizing latest code developments. Develop a plan for upcoming DIII-D experiments to be conducted in this fiscal year. Execute new DIII-D experiments consistent with the facility operational schedule.
- I have been asked to address item in red. Need material from Brendan and others.

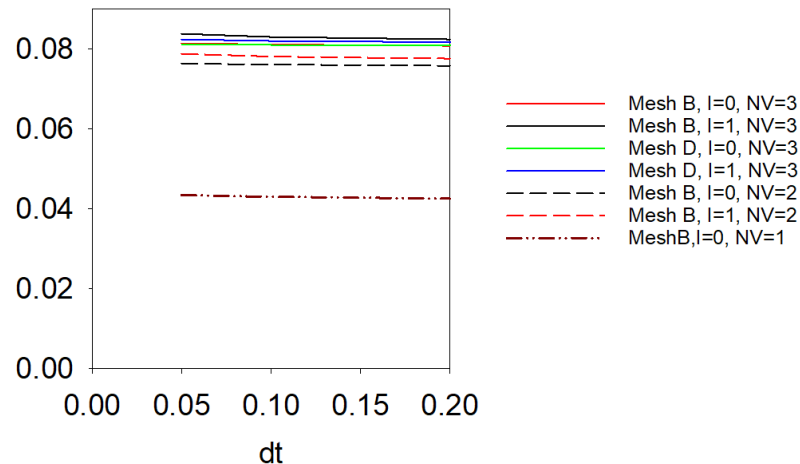
Stability Study vs NUMVAR



CBM18* n=10



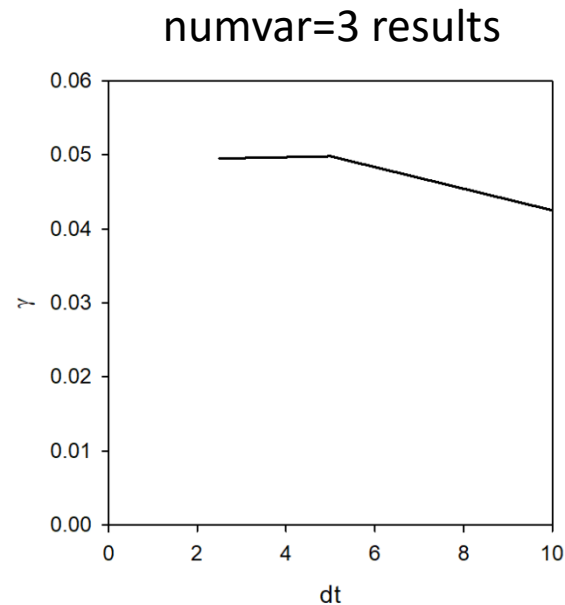
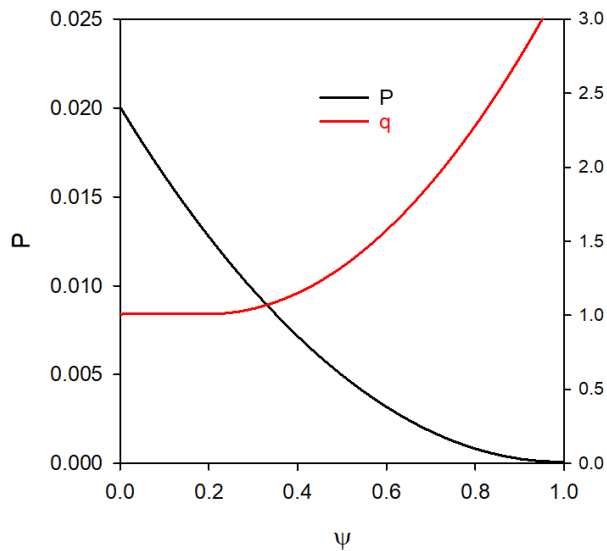
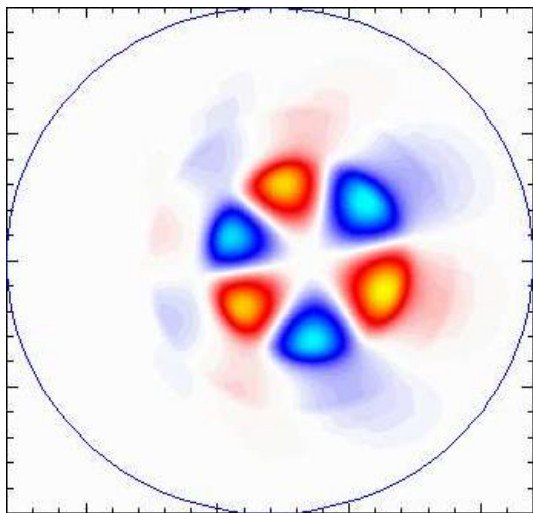
γ vs dt



$$\mathbf{V} = R^2 \nabla U \times \nabla \varphi + \omega R^2 \nabla \varphi + R^{-2} \nabla_{\perp} \chi$$

*Ferraro, et al, Phys. Plasma (2010),

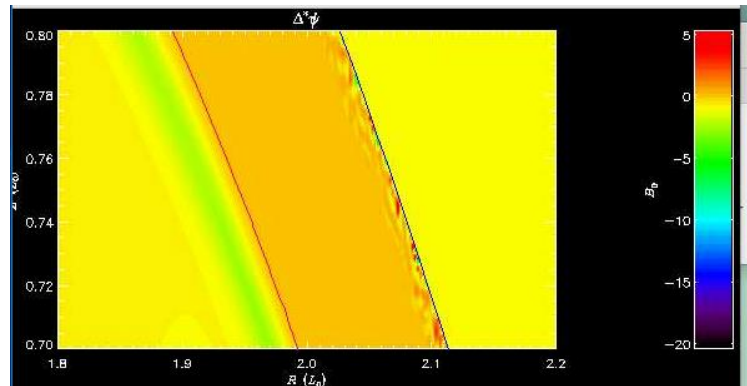
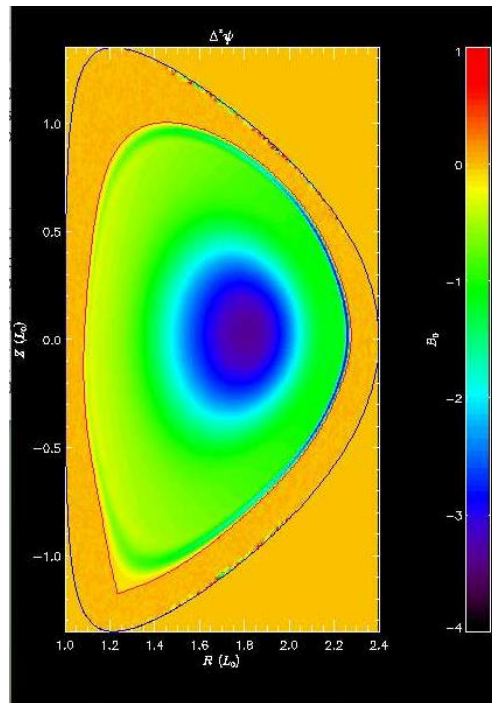
NUMVAR Study with Interchange Mode



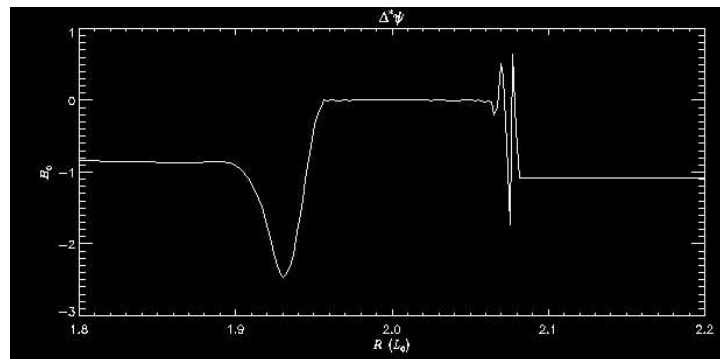
Stable for numvar = 1,2 !

DIII-D 178555/3055 (Andreas Wingen)

rrange=[1.8,2.2], zrange=[0.7,0.8]



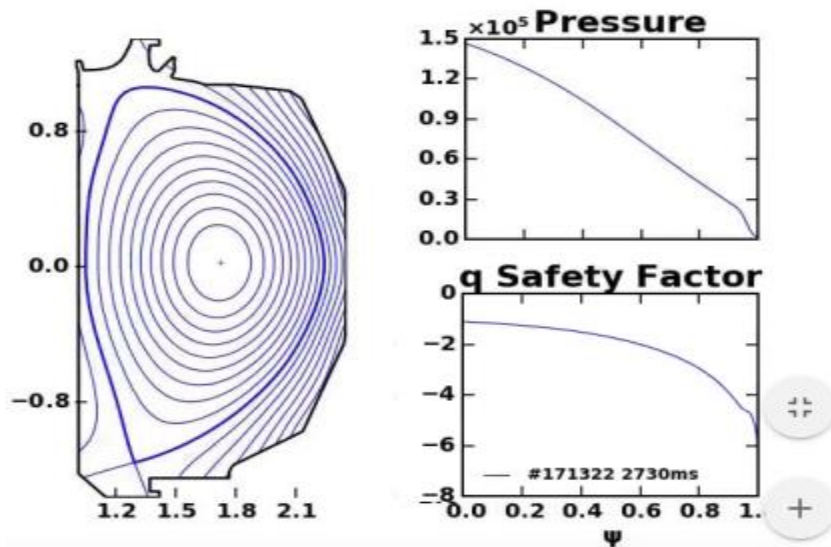
cutz = 0.74



Status of First Coupled M3D-C1 / LP Simulation

- **Iterate independent simulations of MHD and LP codes**
 - Run pellet injection in MHD code with analytic, Parks ablation formula
 - Send plasma states along pellet path to LP code to compute ablation rate at each point
 - Rerun MHD codes with LP ablation rates
 - Iterate between codes until convergence
- **Test case for DIII-D modeling**
 - 1 mm Ne pellet using extruder parameters
 - 160606, standard case for SPI modeling
 - 171322, super-H target for upcoming small-pellet ablation experiment
 - Latter will be used for predict-first of experiment

DIII-D 171322 @ 2730 ms



8/10/20 – proposed

10/5/20 – Brendan sent data from a 2D run

10/7/20 – Roman requested more concise data from around pellet vs time

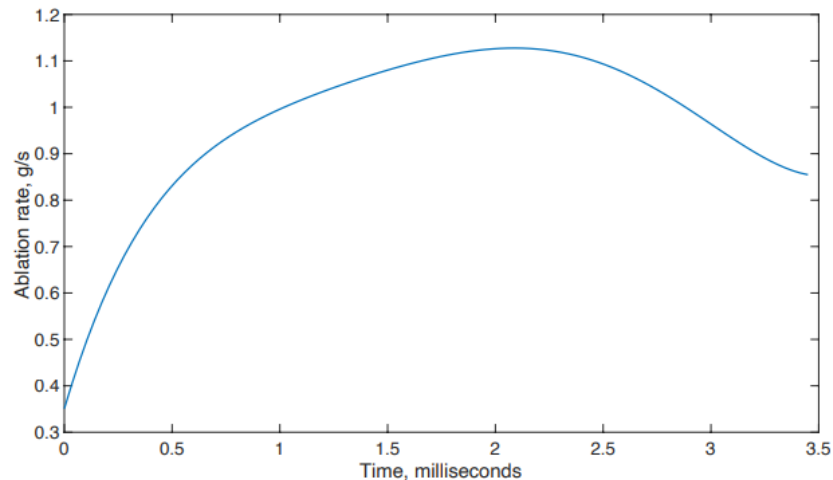
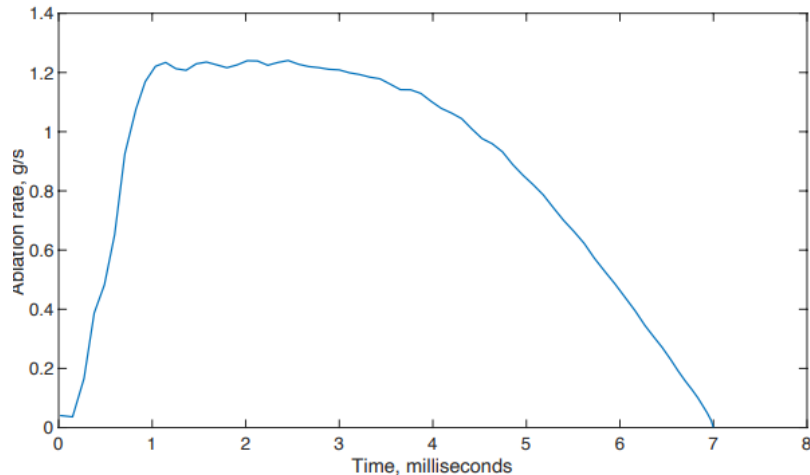
10/20/20 – Brendan developed and documented postprocessor for LP ablation code.

11/2/20 – Roman said they will use Brendan's data this week and then schedule a ZOOM

ZOOM was held 11/24/20 1:00 EST: posted on m3dc1.pppl.gov

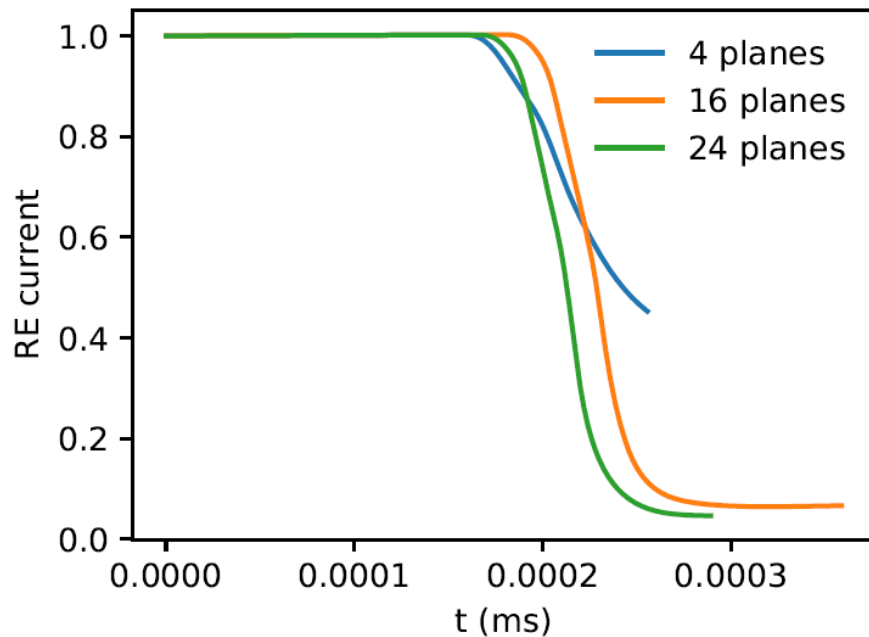
10%-20% agreement between m3dC1 and LP code

- Ablation rate plot vs time, M3D-C1 (left) and LP (right, with some numerical noise smoothed out)



Now, moving to 3D H-mode

177040 update

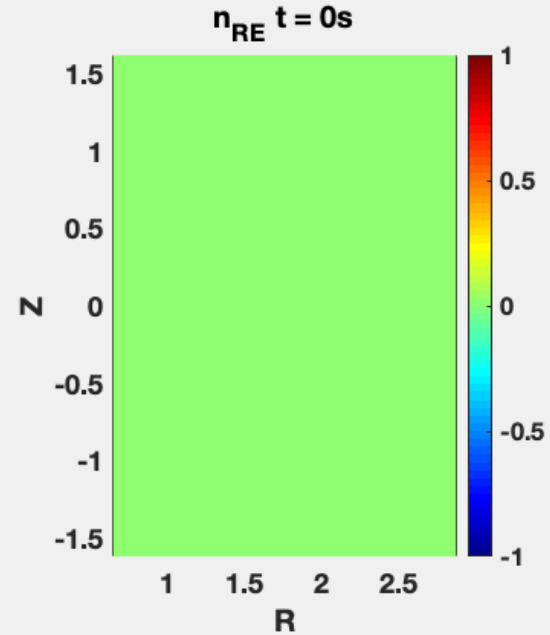
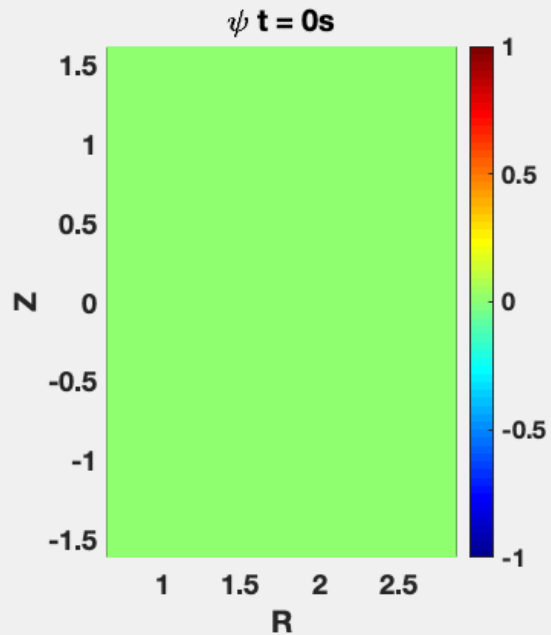


Chang Liu email 12/7

177040 case with RE

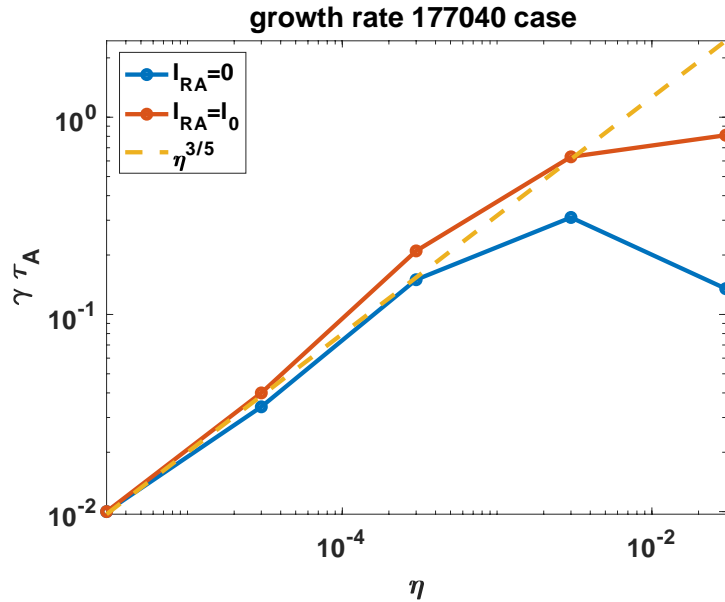
Chen Zhao email 12/7

$\text{etar} = 3\text{e-}2$, $\text{eta0}=1.0$, $\text{idenfun}=3$, $\text{dt}=0.1$, $\text{l_RE}=\text{l_0}$

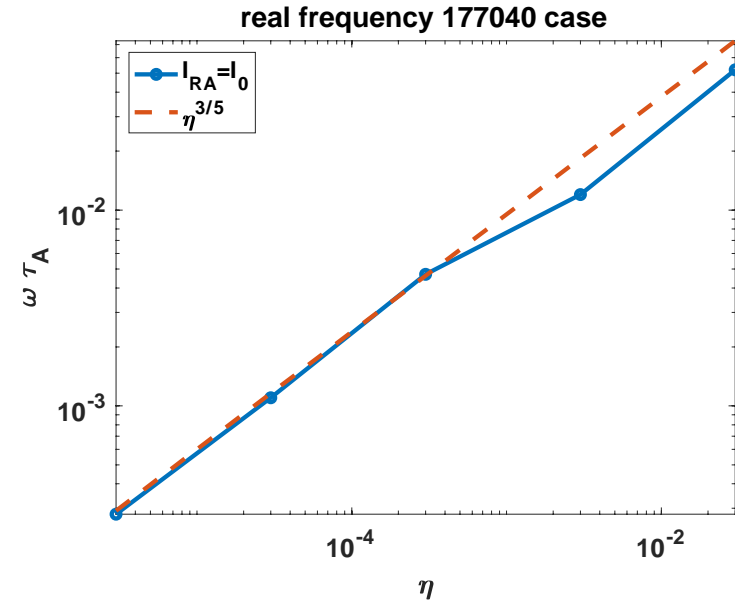


There is a 2/1 mode with rotation

eta0=1.0, idenf=3, dt=1., I_RE=I_0,
eta_fac=0.51,numvar=3, v_ra=c, isplitstep=1,
thimp=1.0,imp_mod=1,



The resistivity correction effect with runaway current is lower than without runaway current.



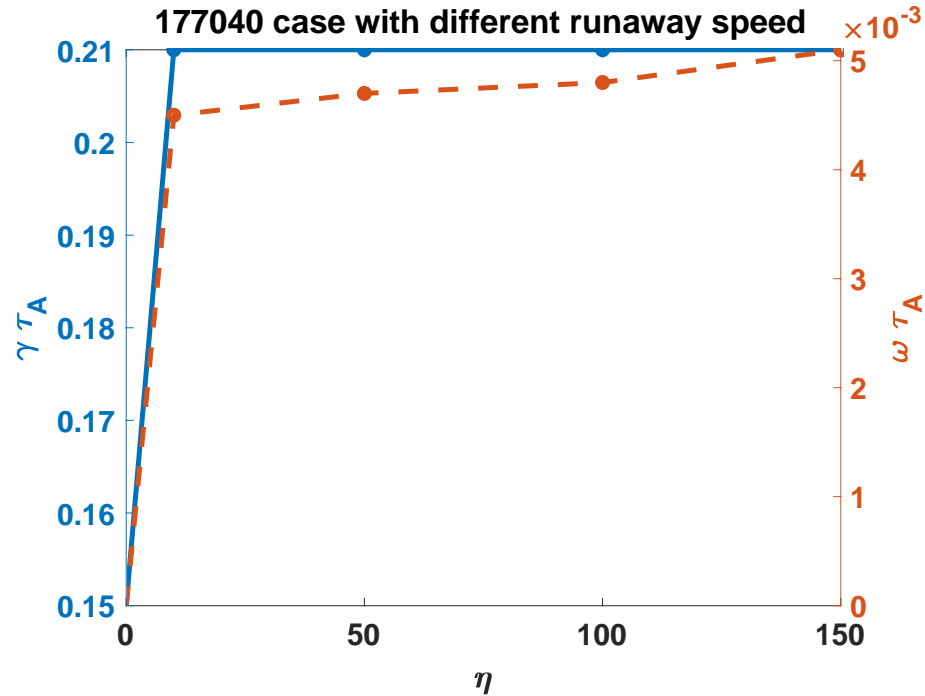
The real frequency with runaway current is also obey 3/5 law.

etar=3e-4, eta0=1.0, idenfun=3,

dt=1., l_RE=l_0,

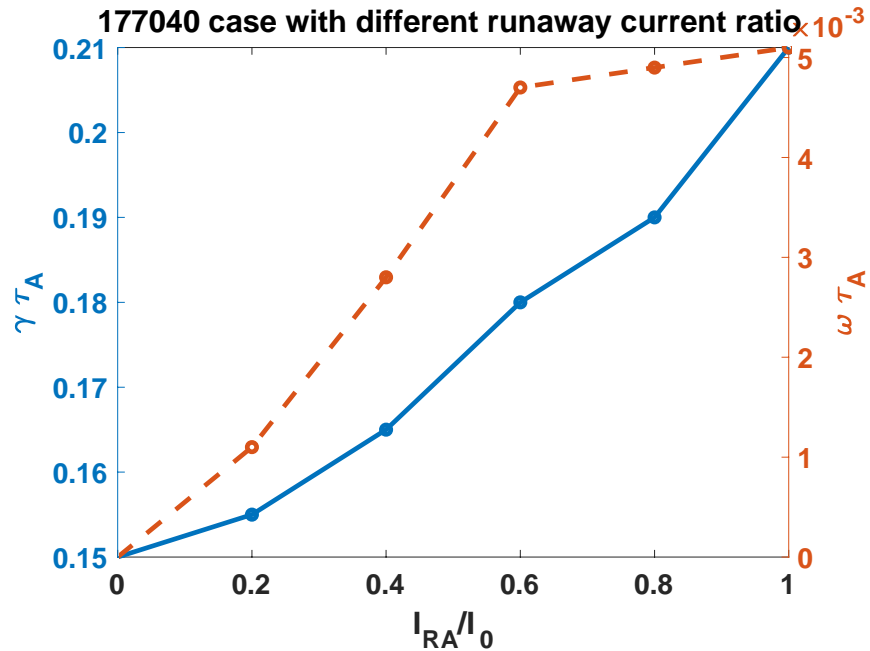
eta_fac=0.51, number=2

177040 case with different runaway speed



The real frequency and growth rate do not change very much when runaway speed larger than 10 Alfven speed

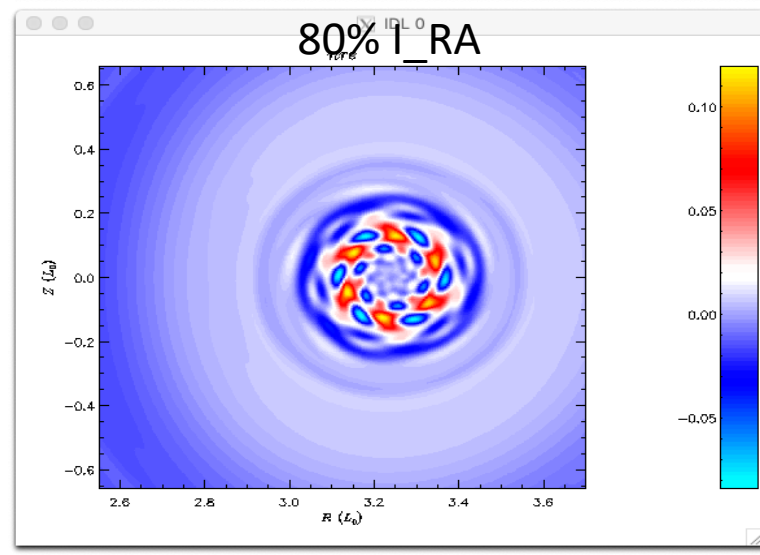
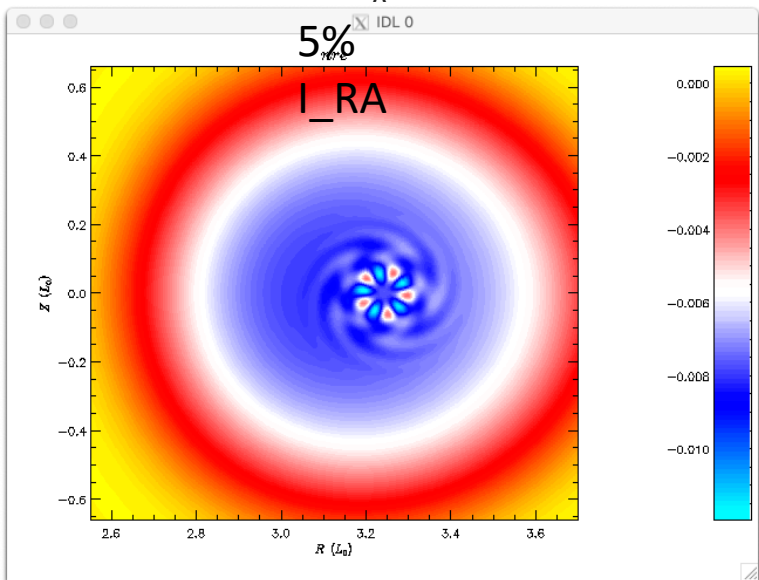
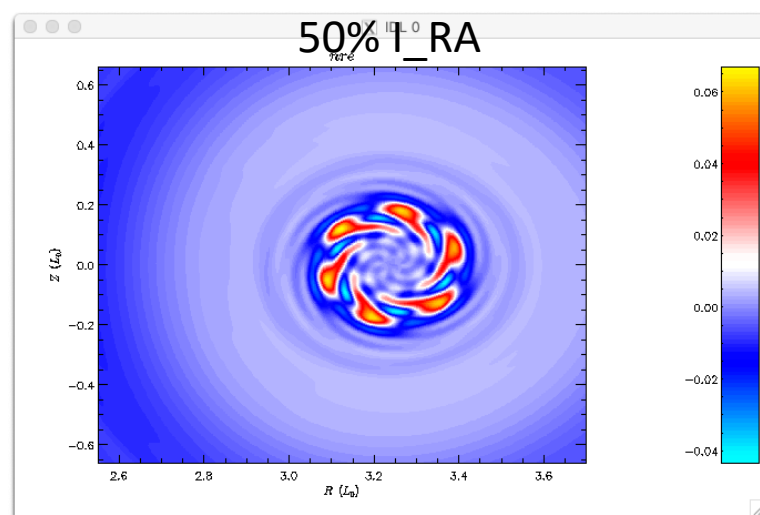
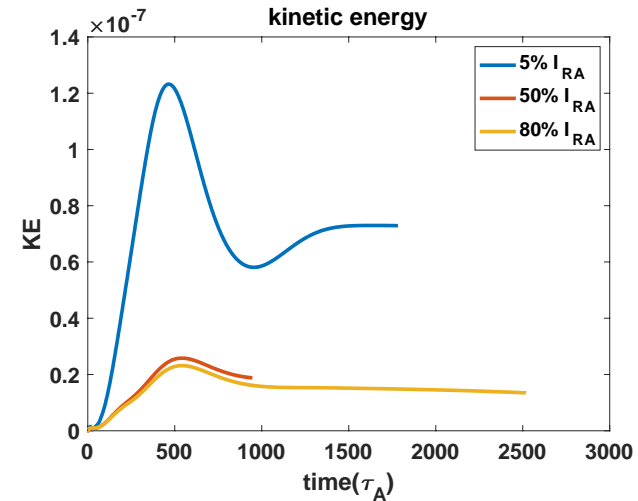
$\text{etar}=3\text{e-}4$, $\text{eta0}=1.0$, $\text{idnfun}=3$,
 $\text{dt}=1.$, $\text{l_RE}=\text{l_0}$,
 $\text{eta_fac}=0.51$, $\text{numvar}=3$,
 $\text{isplitstep}=1$,
 $\text{thimp}=1.0$, $\text{imp_mod}=1$, $\text{v_ra}=\text{c}$



sawteeh recent

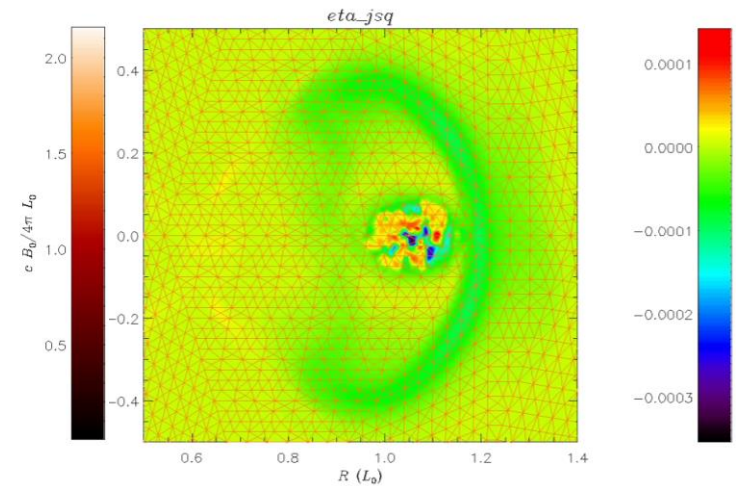
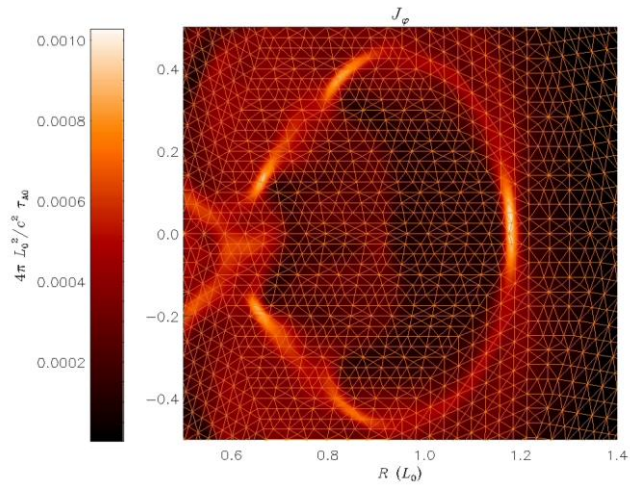
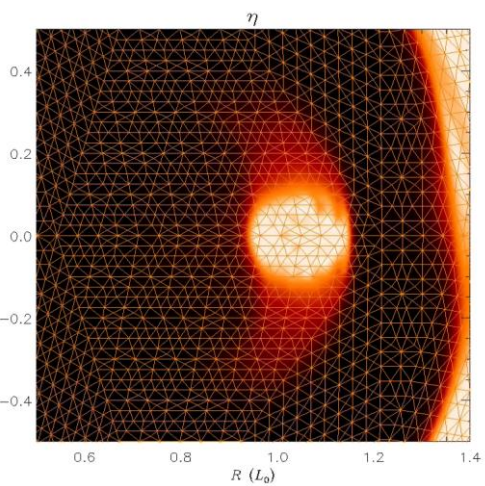
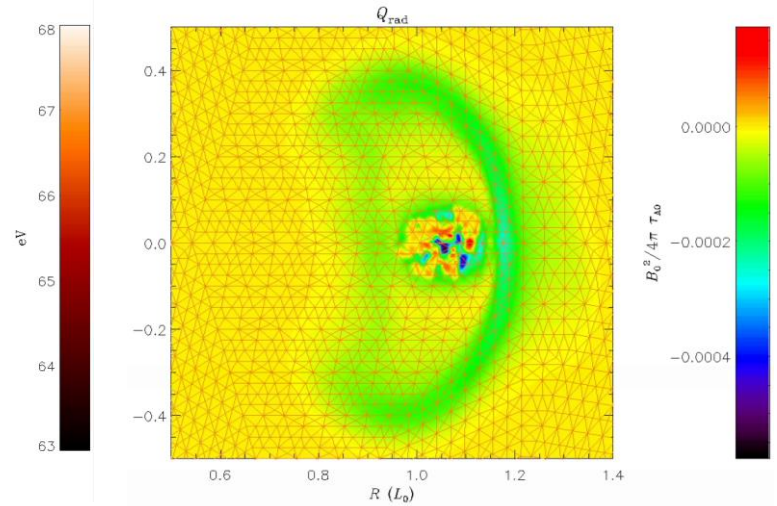
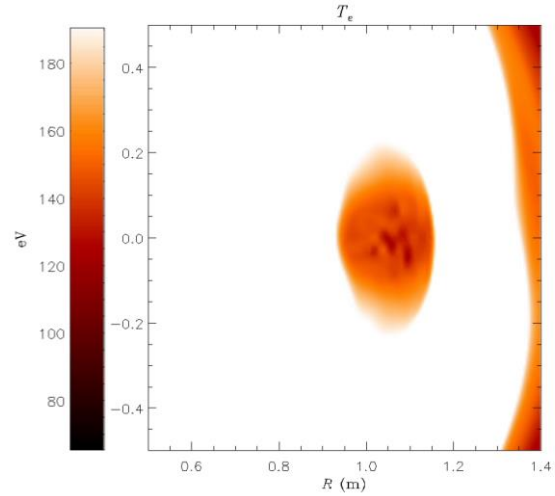
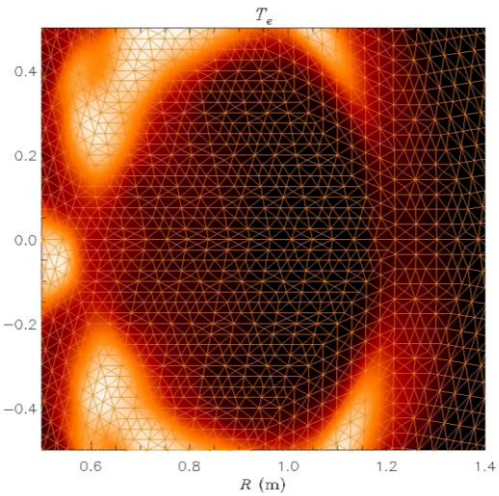
12/7/2020

Chen Zhao

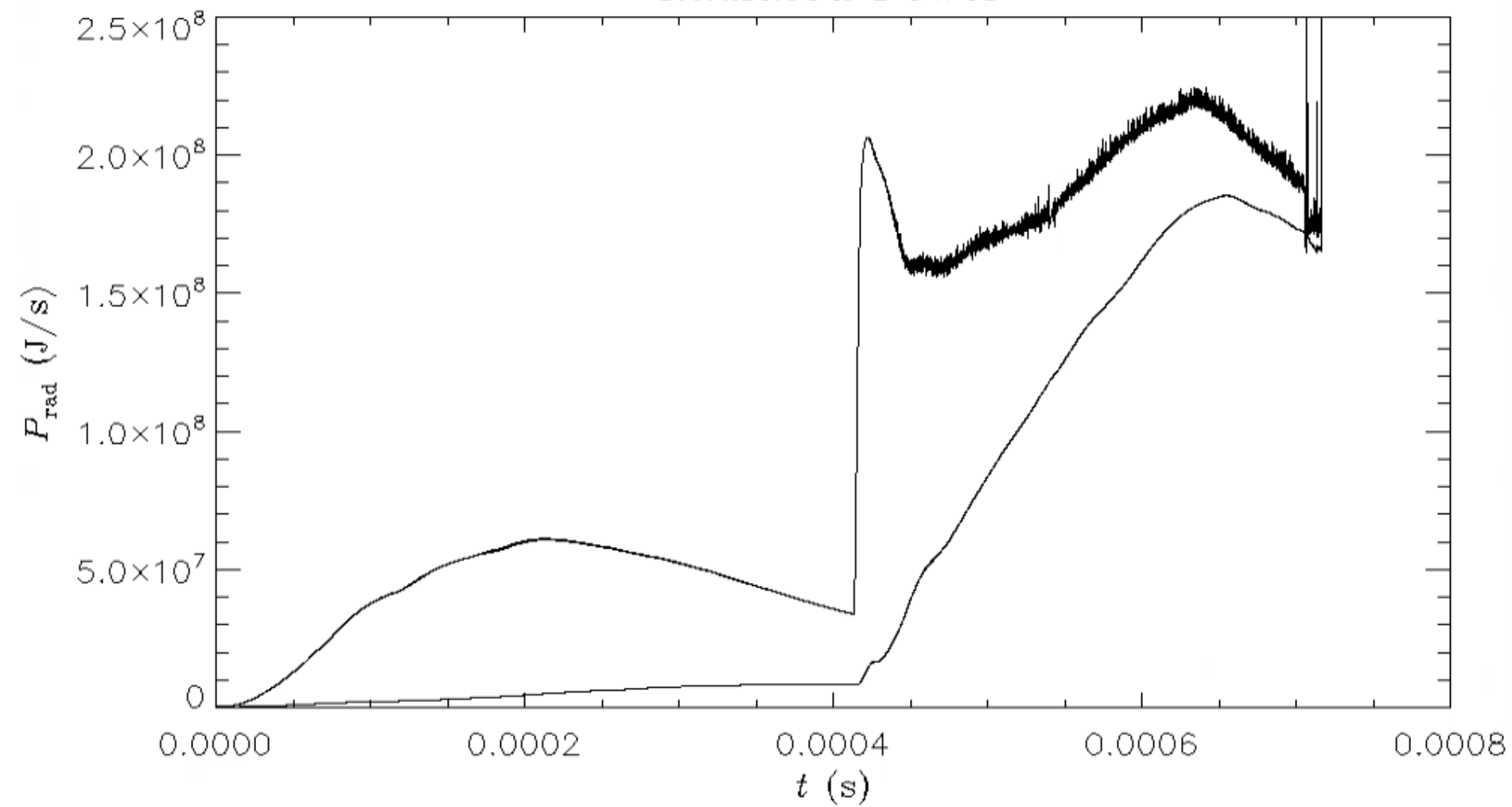


Radiation Glitches

Cesar Clauser



Radiated Power



Progress on other shots?

NSTX shot 1224020 – Fast ion transport with coupled kink and tearing modes
Chang Liu

DIII-D shot 177053 (with Argon)

DIII-D Neon pellet mitigation simulation for KORC

- Brendan Lyons trying to extend 8 plane case to 32 planes

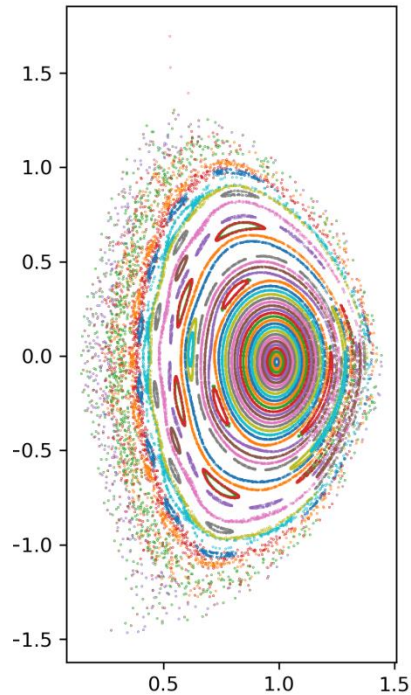
SPARK ? Do we need to do anything?

That's All I have

Anything Else ?

NSTX shot 1224020 – Fast ion transport with coupled kink and tearing modes

Chang Liu

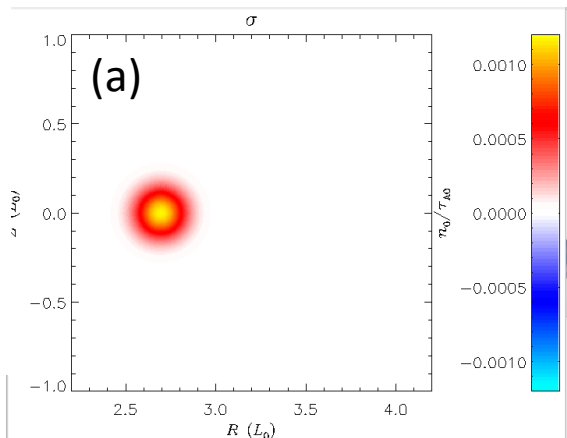


- In the original geqdsk file, the equilibrium was poorly converged. New one is much better. Has $q(0) = 1.3$
 - Chang has analyzed new equilibrium (left)
 - No ideal (1,1) mode, several tearing modes
-
- If goal is to get unstable (1,1) mode, likely need to lower $q(0)$
 - Adding sheared toroidal rotation should help stabilize resistive modes.

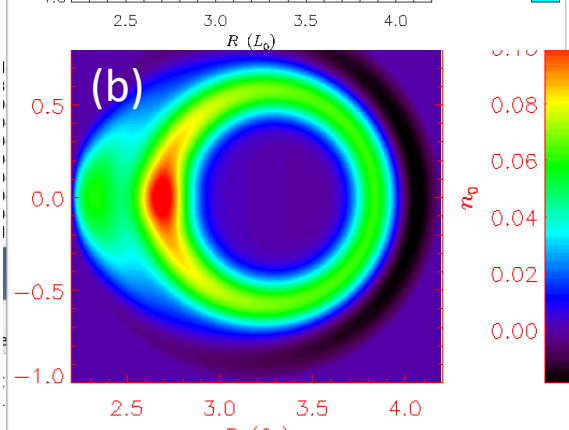
Grad-B drift in M3D-C1—HF side

Request to calculate grad-B drift in M3D-C1 and to compare with that being put into the LP Code

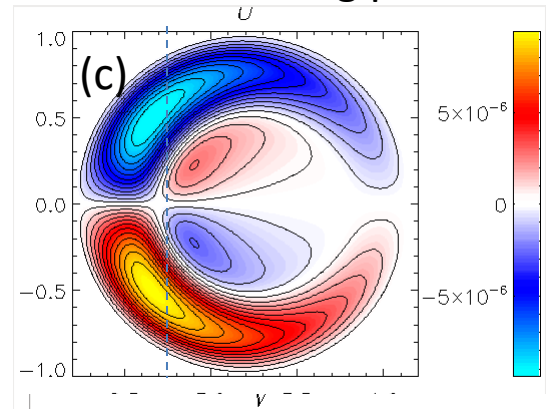
(a) Density source in 1F toroidal equilibrium



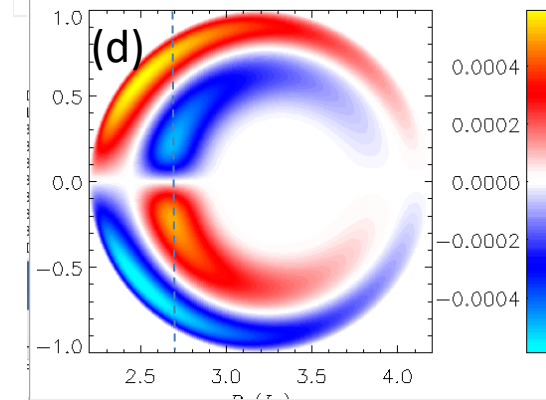
(b) Change in density after $10^3 \tau_A$



(c) Poloidal velocity stream function



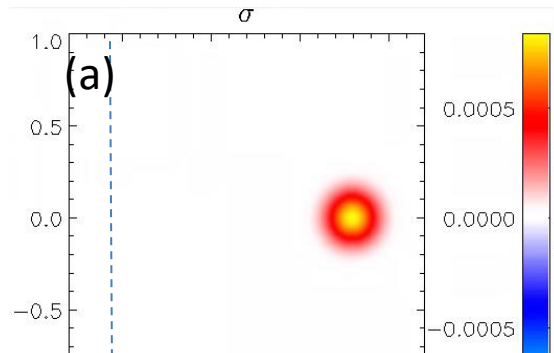
(d) Toroidal velocity contours



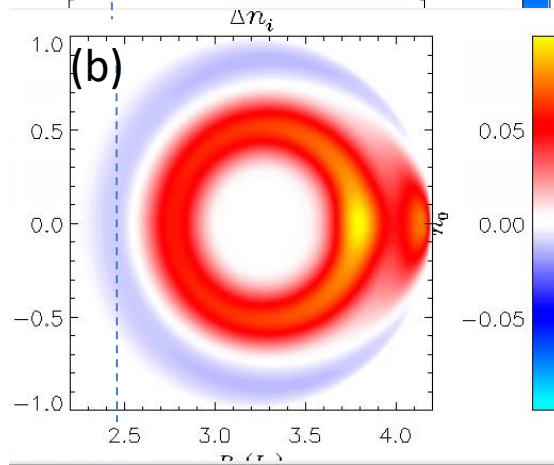
Grad-B drift in M3D-C1– LF source

Request to calculate grad-B drift in M3D-C1 and to compare with that being put into the LP Code

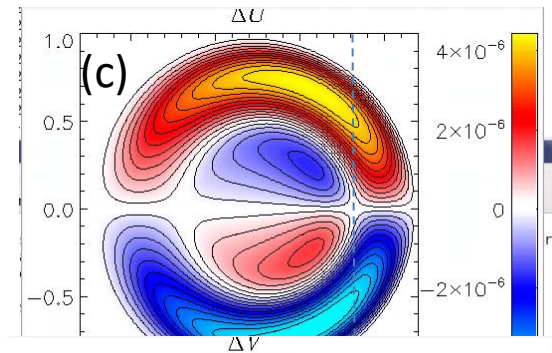
(a) Density source in 1F toroidal equilibrium



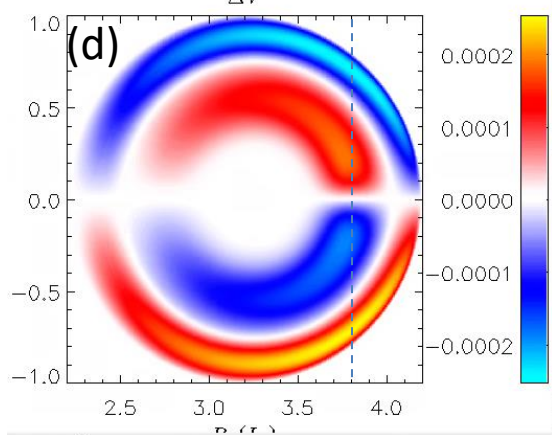
(b) Change in density after $10^3 \tau_A$



(c) Poloidal velocity stream function

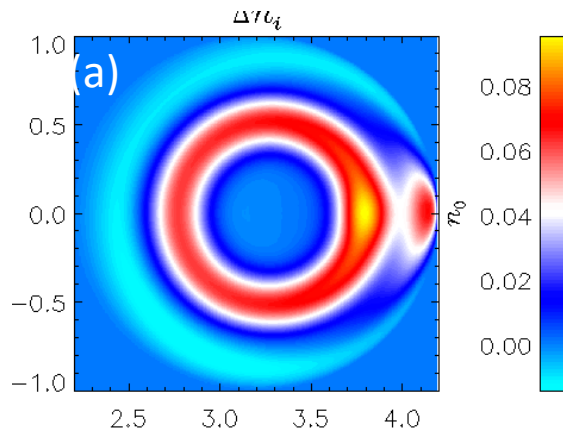


(d) Toroidal velocity contours

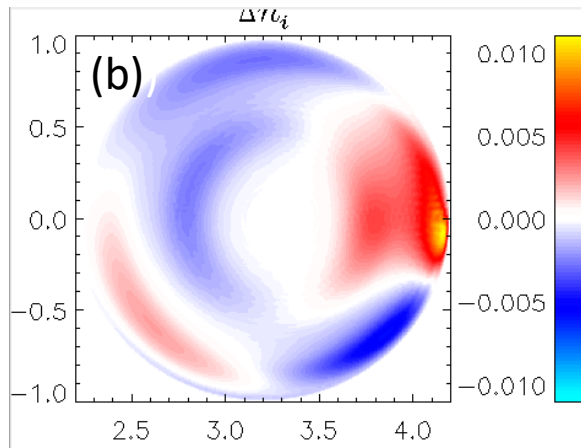


Grad-B drift in M3D-C1—2F effects

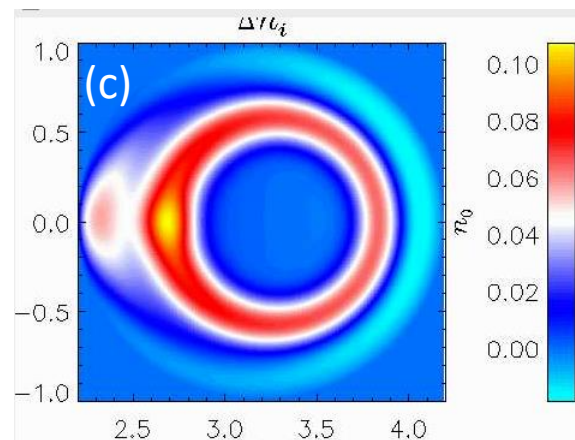
(a) 2F density change
after $10^3 \tau_A$ for LF
side source



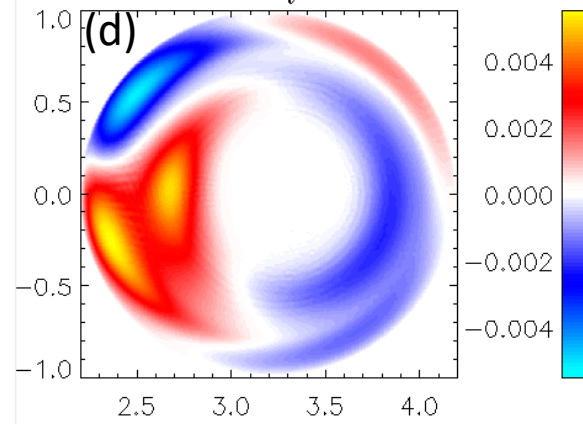
(b) Difference in 1F and
2F density (LF)



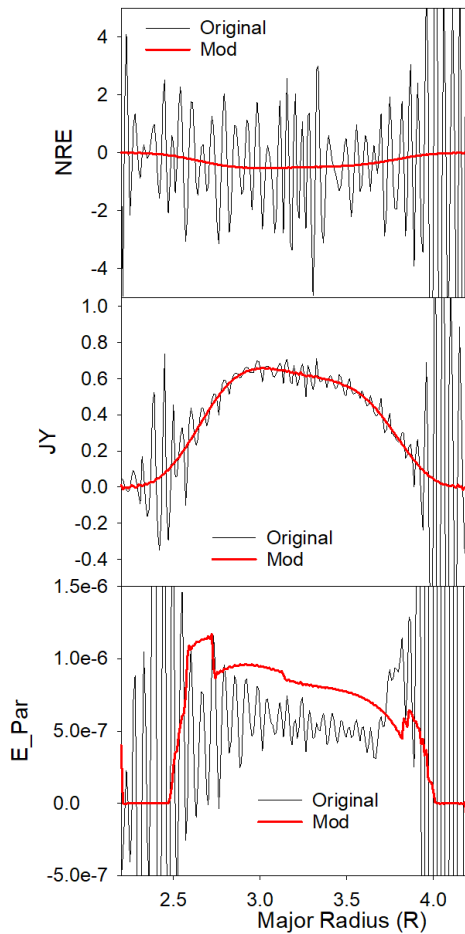
(c) 2F density change
after $10^3 \tau_A$ for HF
side source



(d) Difference in 1F and
2F density (HF)



Sawtoothing discharge with runaway electrons



Profiles of nre, jy, and E_par after 30 timesteps

Original: /p/tsc/m3dnl/Isabel/Chen2D

Mod: /p/tsc/m3dnl/Isabel/Chen2D-mod1

Changed:

mesh size

“regular”

“integration points”

ipres=1

cre

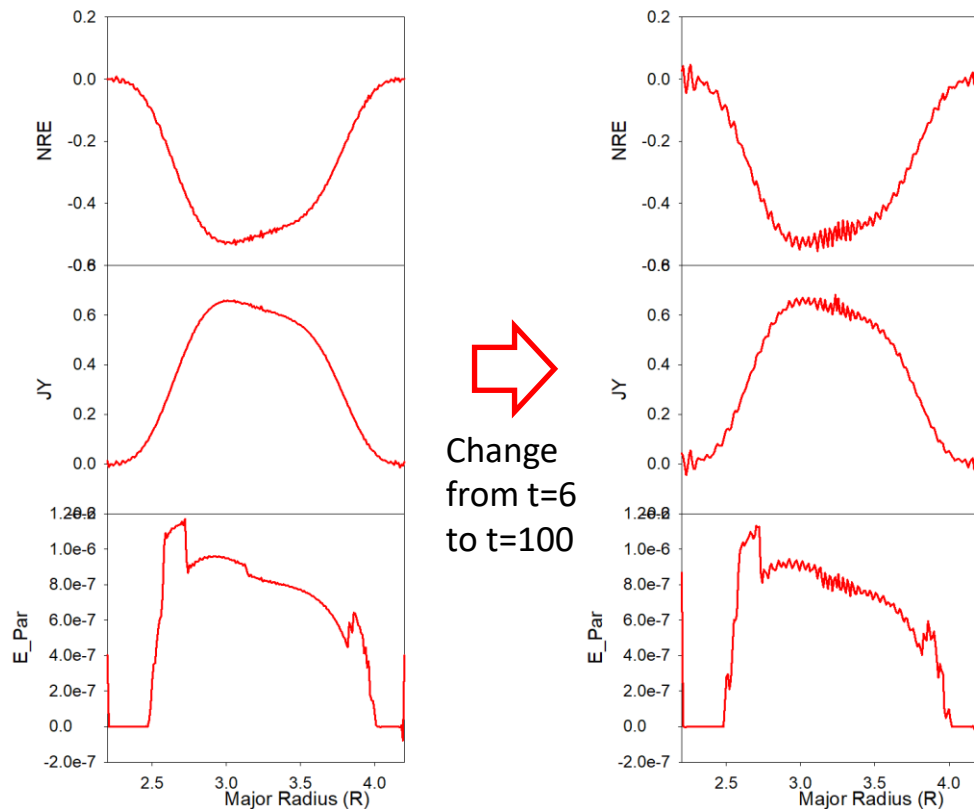
pedge

viscosity

denm

equilibrium density

Longer times develops oscillations



- Short wavelength oscillations occur first in nre and then in other quantities (jy, e_par)
- Could we add some smoothing?