M3D-C1 ZOOM Meeting

11/15/2021

Announcements

CS Issues

1. Perlmutter status
2. ASCR Workshop on the Science of Scientific-Software Development and Use
3. Mesh adaptation update
4. NERSC Time
5. Changes to github master since last meeting
6. Regression tests
7. Fortran error in ST=1 version
8. Potential new user from ANL

Physics Studies

1. Status of SBL studies
2. Sawtooth Study (For Will Fox's group)
3. 3D Impurity Injection with RE – Chen Chao
4. RWM/RWTM study – Hank Strauss

In attendance

Steve Jardin
Adelle Wright
Jin Chen
Andreas Kleiner
Cesar Clauser
Brendan Lyons
Chang Liu
Hank Strauss
Chen Zhao
Nate Ferraro
P Sinha
Seegyoung Seol
Usman Riaz
Morteza Siboni

Announcements

- I will be on vacation next week and will not organize a meeting
- EPS 6/27 – 7/1 2022 in Maastricht, Netherlands

Perlmutter status

From Jin Chen (10/25/21)

- PETSc, SCOREC Library, PUMI Library and M3DC! Have been compiled
- Code fails at runtime with segfault
  - Comes from scorec library when it tries to allocate memory for matrices
- Seegyoung now has access also

ASCR Workshop

On the Science of Scientific-Software Development and Use: Dec 13-15 2021

- Requesting 2-page position papers that identify and discuss key challenges and opportunities in the science of scientific –software development

- Position papers due on 19th November 2021
  - Submit to https://orausurvey.orau.org/n/SSSDU.aspx

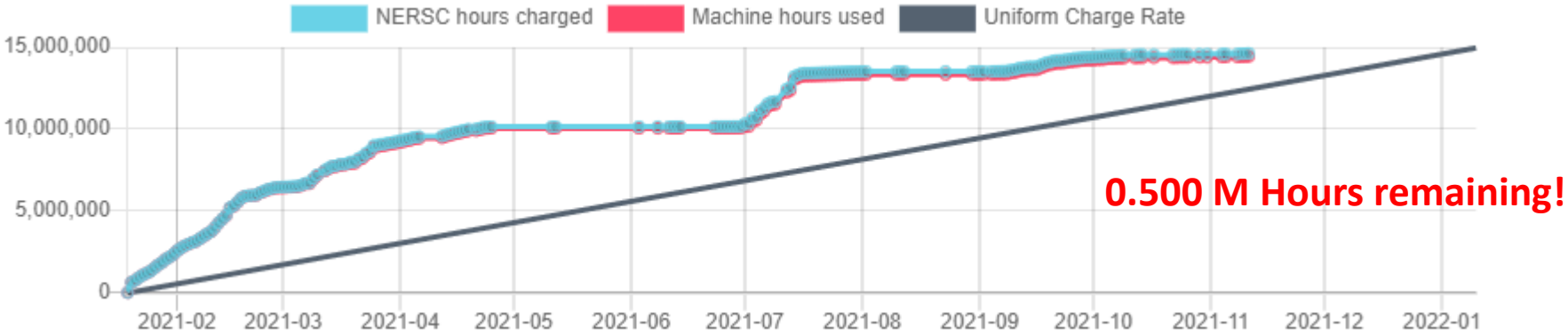
- Jin Chen considering submitting a paper on the need for improved solvers for ill-conditioned sparse matrix equations

Mesh adaptation update

Any updates?

NERSC Time

mp288



0.500 M Hours remaining!

- mp288 received 10M Hrs for CY 2021, + 5M Hrs additional
- Pearlmutter time will not be charged for this FY
- We are NESAP Tier 2. . Phase-I w GPUs We have been given a repo m3984
- N9ES-N2 M3D-C1: J. Chen , C. Liu, S. Seol are early users

Changes to github master since 11/01/21

SeegYoung Seol:
11/02/21: fixing regression test errors in centos7 & greene

Yao Zhou
11/02/21: Read in density and current drive in stellarator geometry
11/03/21: Fixed bugs in v3upsif and v3uff
11/03/21: Applying idenfunc only when iread_ne=0

Local Systems

- PPPL centos7(11/12/21)
  - 7 jobs PASSED
- PPPL greene (11/12/21)
  - 5 jobs PASSED
- STELLAR (11/12/21)
  - 6 regression tests **PASSED** on stellar
  - adapt **FAILED** field energies off by 0.02%
- TRAVERSE(11/12/21)
  - 6 regression tests **PASSED**
  - adapt **FAILED** should have passed. Energies are ok. Only gr_rate off

Other Systems

- Cori-KNL (11/15/2021)
  - 7 regression tests **PASSED** on KNL
- Cori-Haswell (11/15/2021)
  - 7 regression tests **PASSED** on cori
- MARCONI
  - All regression tests PASSED on MARCONI (J. Chen, 9/04/20)

Fortran error in git master

Jin Chen noticed the following coding on 10/21: (file metricterms_new.f90, function v3upsif (only called if ST=1)

```
4682          temp79c = temp79c + 2*ri_79* &
4683                  + f(:,OP_DR)*h(:,OP_DR) + f(:,OP_DZ)*h(:,OP_DZ)
4684        endif
```

Now corrected!

```
4682          temp79c = temp79c + 2*ri_79* &
4683                  (f(:,OP_DR)*h(:,OP_DR) + f(:,OP_DZ)*h(:,OP_DZ))
4684        endif
```

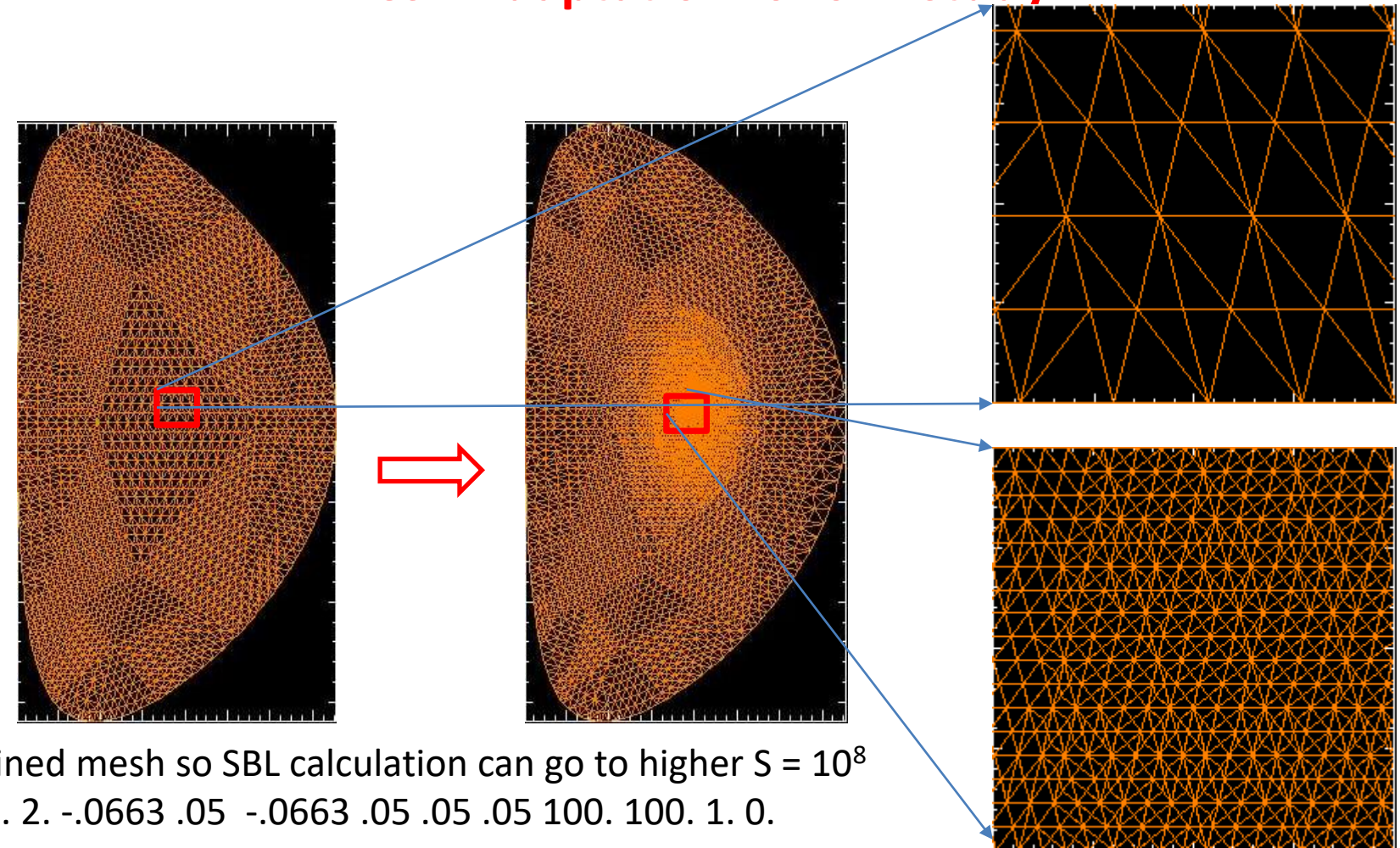
Did other compilers catch this?

Potential New User (from ANL)

From Chang Liu (11/9/21)

I received an email from Zhisong Qu from Australian National University. He is interested in using M3D-C1-K to do some studies of interaction between RMP and Alfven modes driven by EPs. He said he prefer to compile and run the code on the local clusters

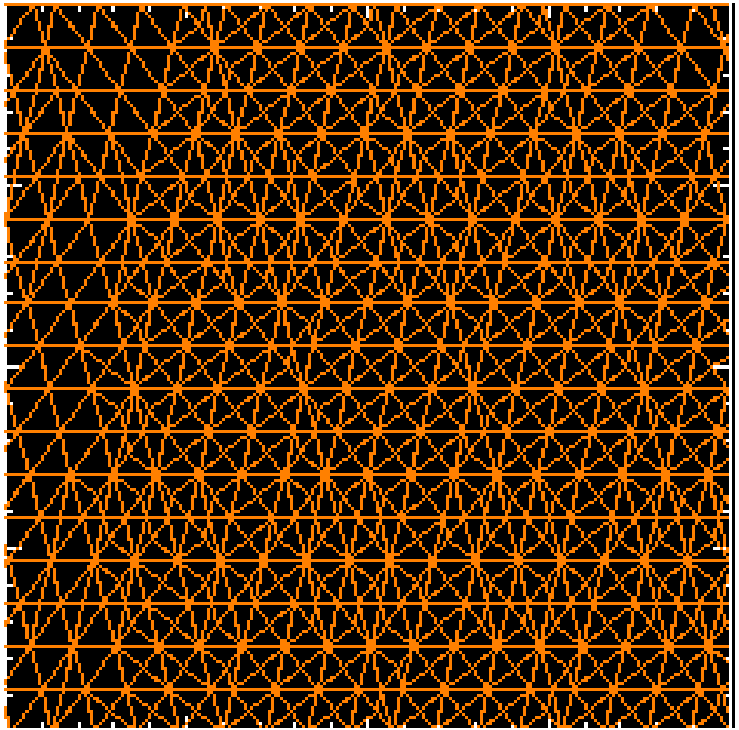
Mesh Adaptation for SBL study

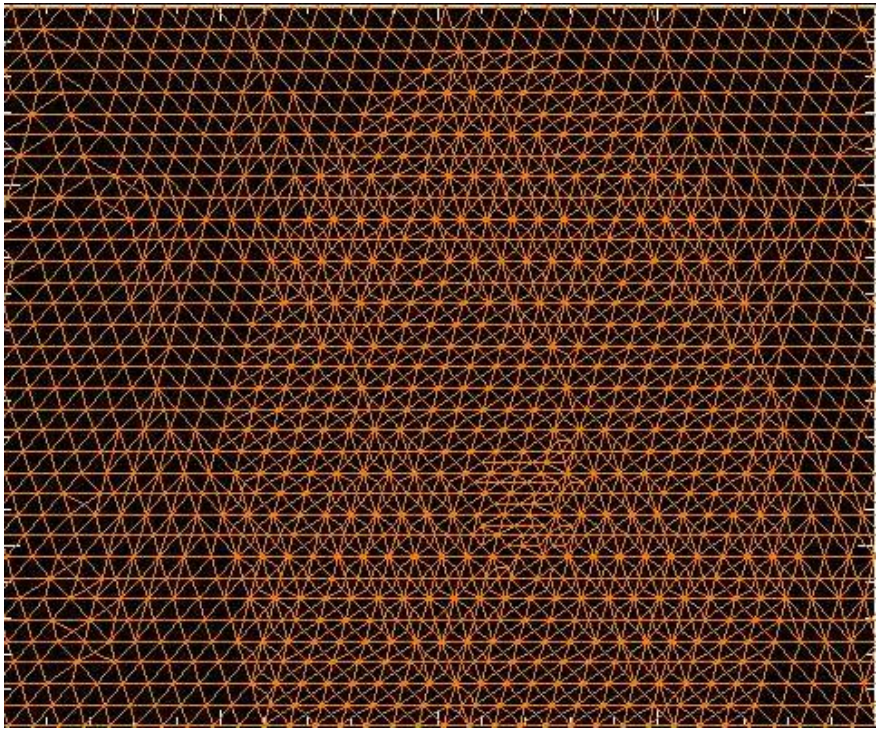


Refined mesh so SBL calculation can go to higher S = 10^8

1. 2. 2. -.0663 .05 -.0663 .05 .05 .05 100. 100. 1. 0.

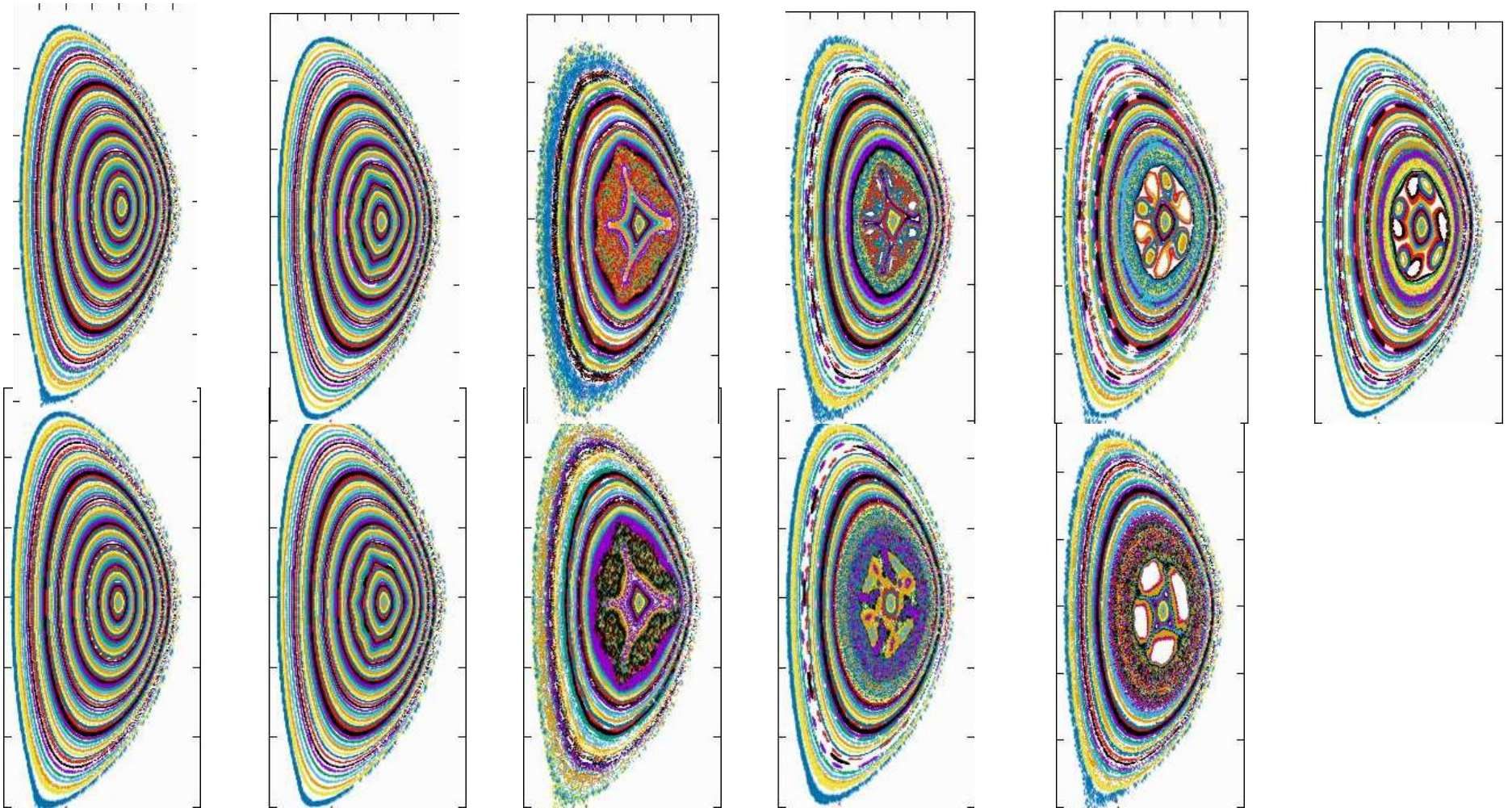
Central mesh density doubled again for convergence check



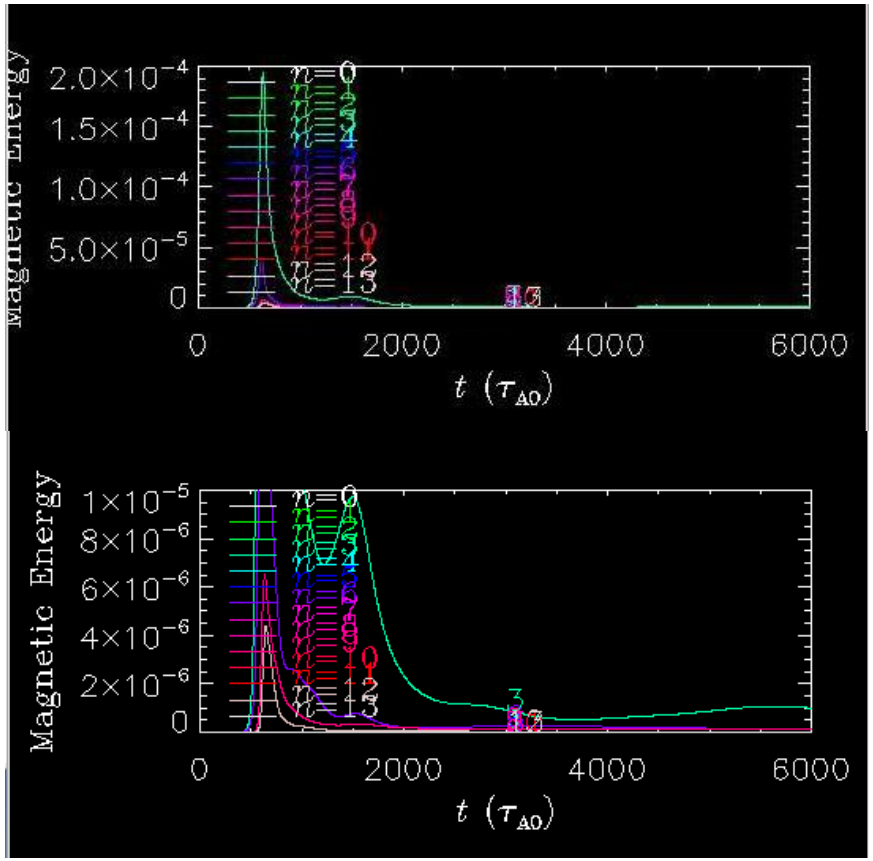


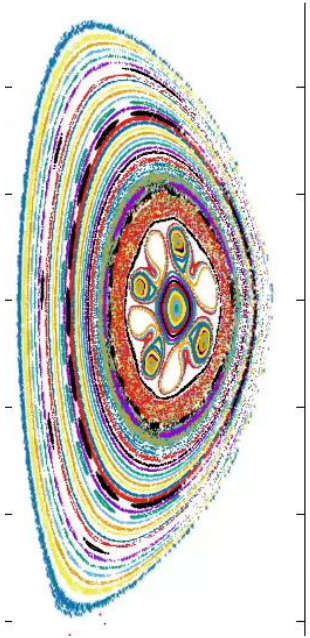
1. 2. 2. -0.07277 .05 -0.07277 .05 .05 .05 100. 100. 1. 0.

Comparison of Poincare Plots



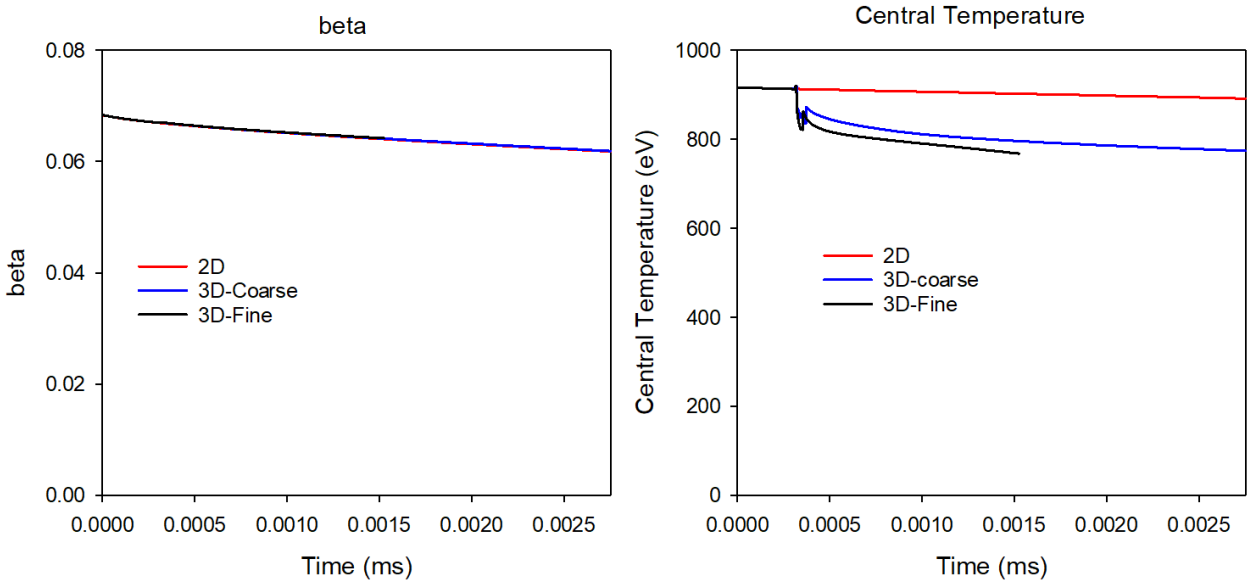
Will initially unstable equilibrium return to axisymmetry?





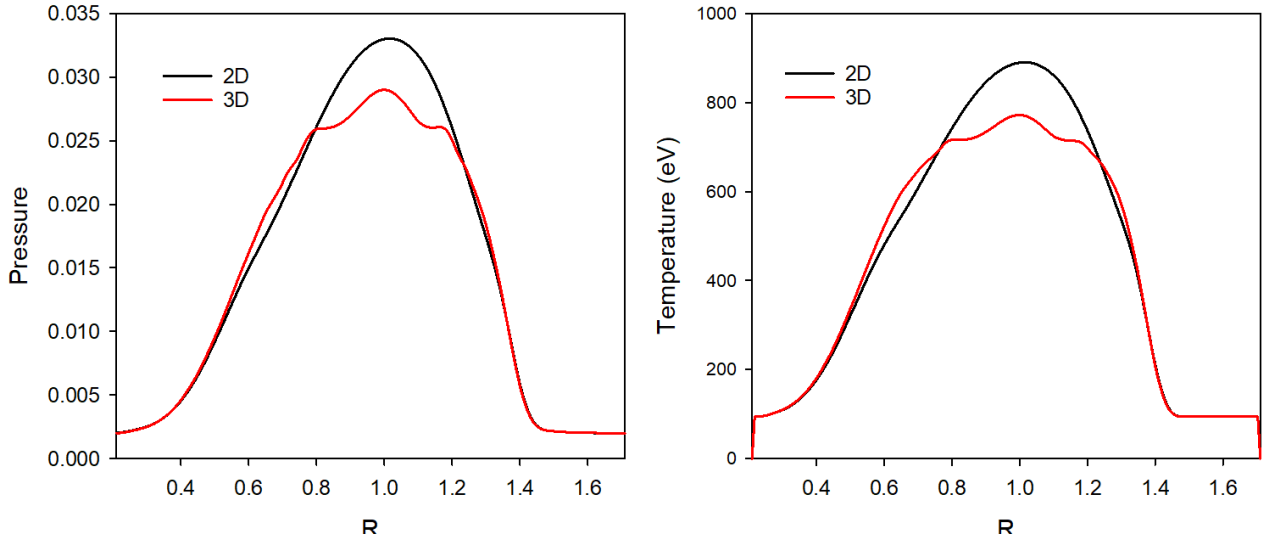
From magnetic energy and Poincare plot, looks to be a long time (4,3) island

Time historv of β and Te in 2D and 3D



Global β almost the same in 2D and 3D, but central Te lower in 3D. This could have significant implications for stability and transport calculations

Comparison of p and Te, 2D vs 3D

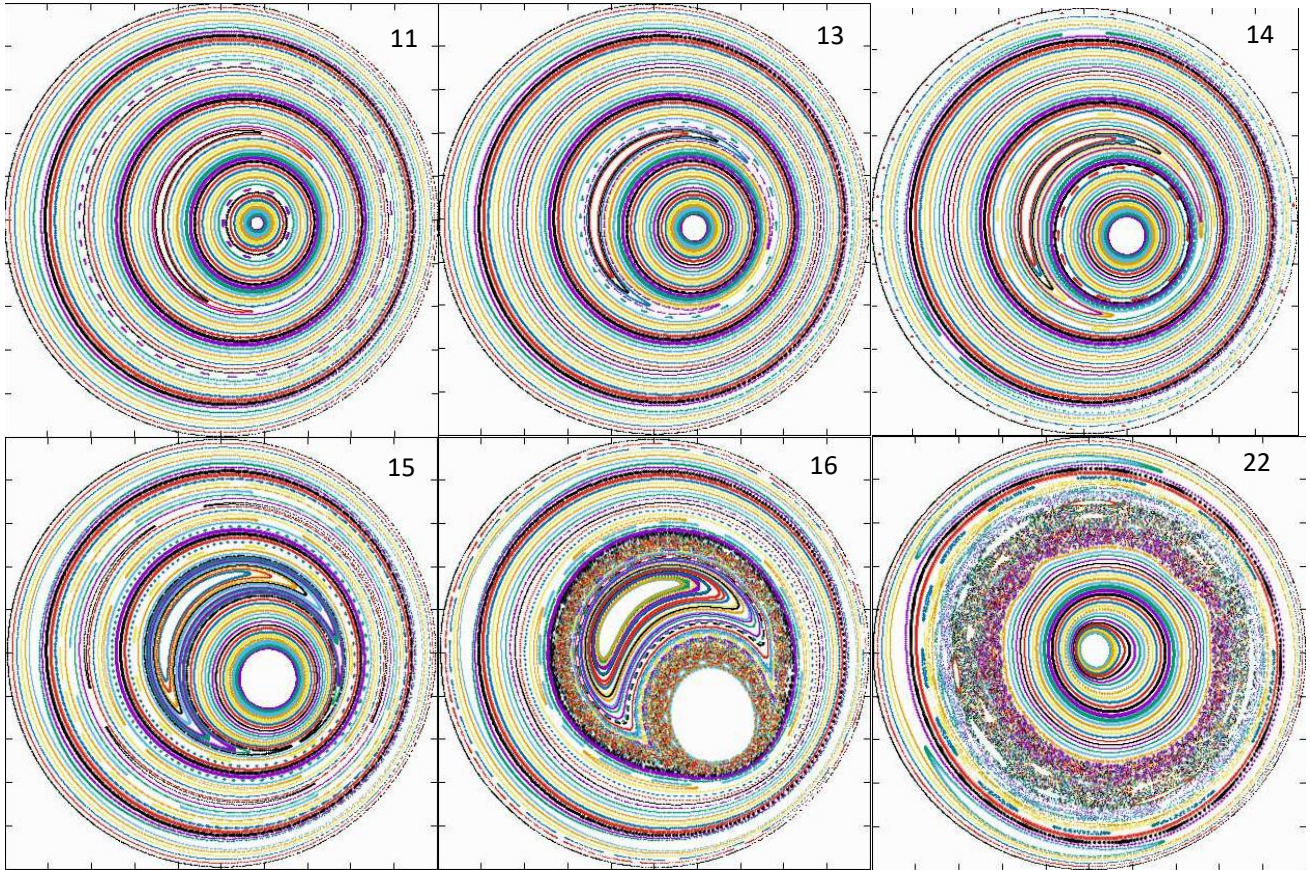


As a result of MHD instability, the 3D run produced extra transport in the center. Volume averaged β's are the same, but Te(0) lower in 3D

New equilibrium that shows Kadomtsev reconnection for Will Fox's group

Submission directory: /home/sjardin/data/Ideal/Low_q03

Run directory: /scratch/gpfs/sjardin/Low_q03 (Poincare plots in subdirectory ../Plots)



This was easily generated with qsolver code. Initial equilibrium has

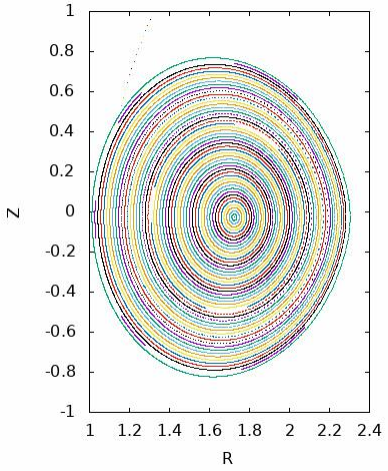
0.9 < q < 2.5

3D case with pellet

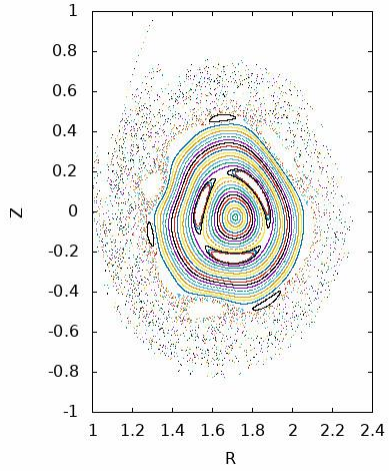
111521

Poincare plot (0ms~4ms)

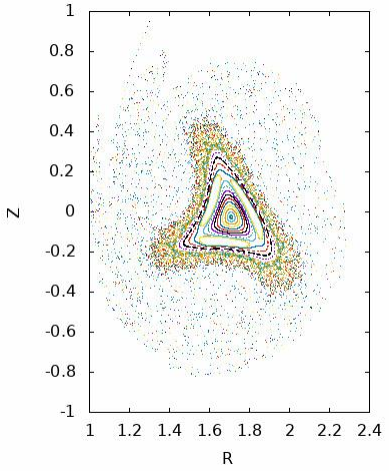
0ms



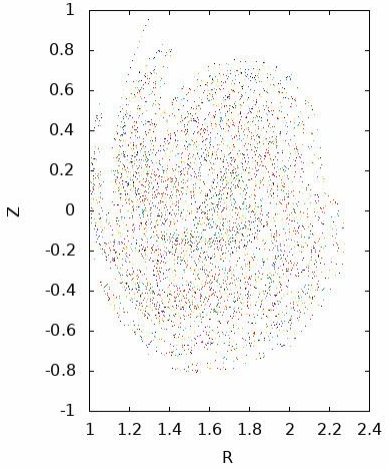
1ms



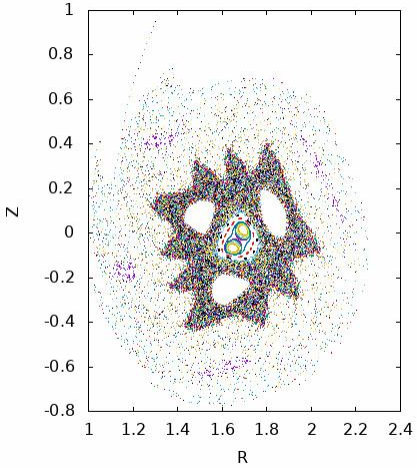
2ms



3ms

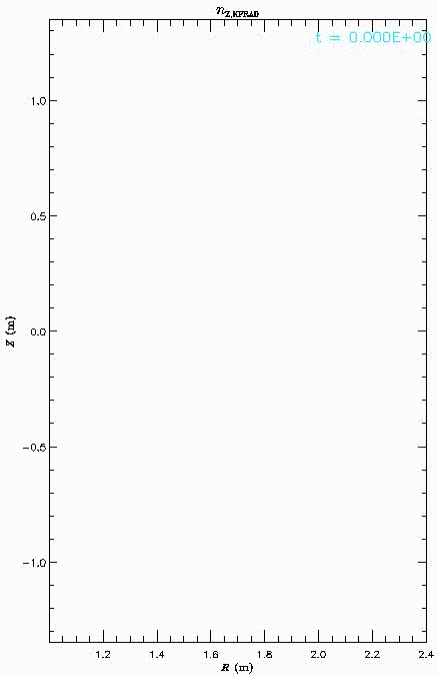


4ms

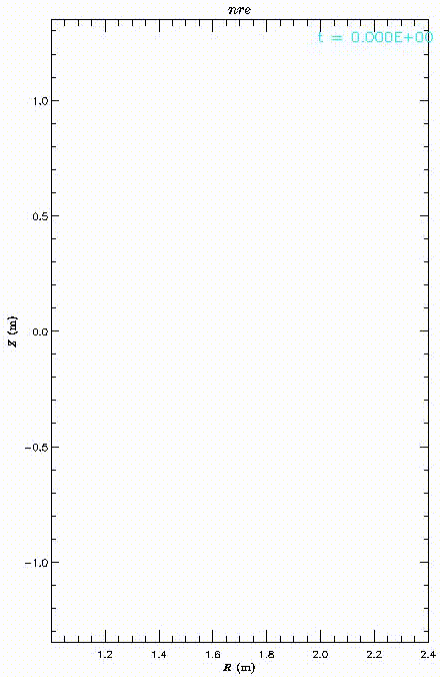


- There is a 3/2 mode at q~1.5 surface when t~1ms.
- The magnetic field becomes all stochastic at about 3ms.
- At t~4ms the 3/2 mode at q~1.5 surface comes back and there is a new mode in the center which I think induced by the runaway current but not sure.

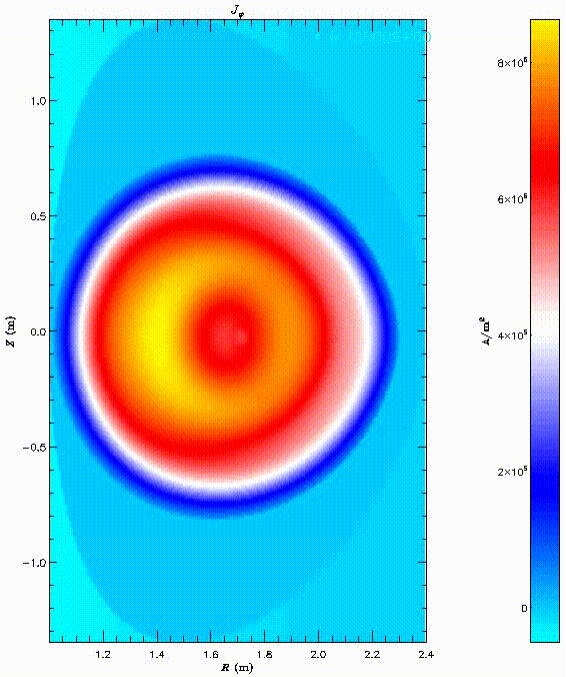
Pellet density 0-4ms



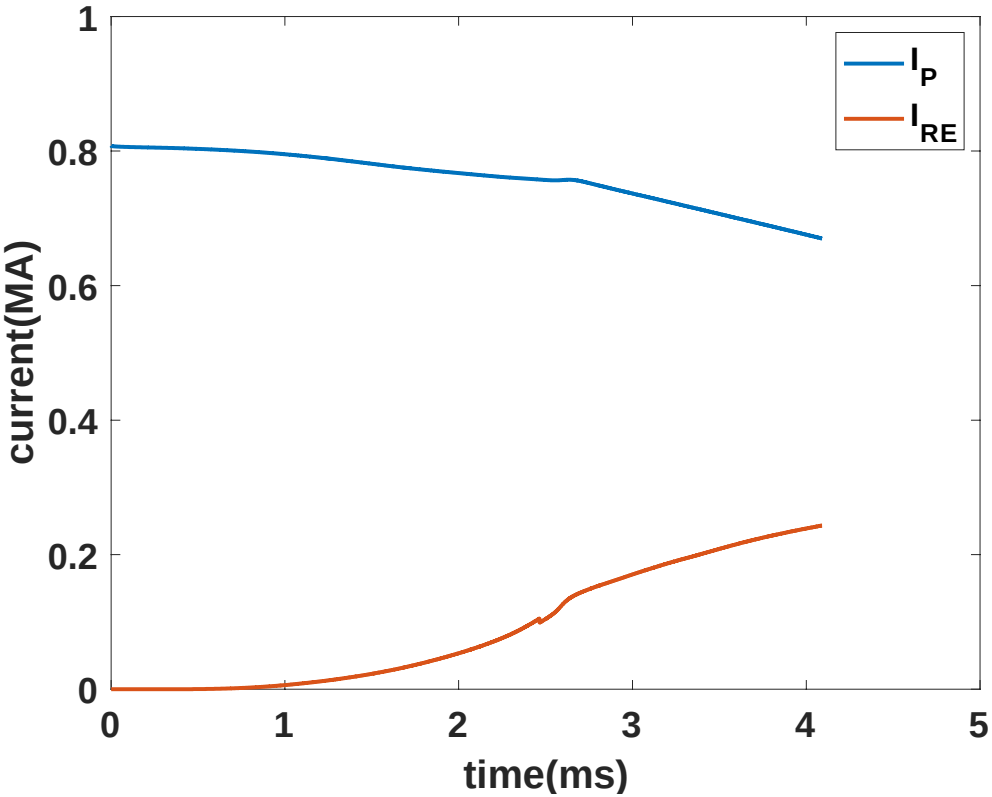
Runaway density 0-4ms



Toroidal current 0-4ms



- The runaway electrons generated first near the pellet.
- The runaway electrons is concentrated in the center which I think maybe related to the 4ms Poincare plot previous slice.



- The growth rate of both runaway current and toroidal current have changed at about 2.7ms which the magnetic field becomes fully stochastic.

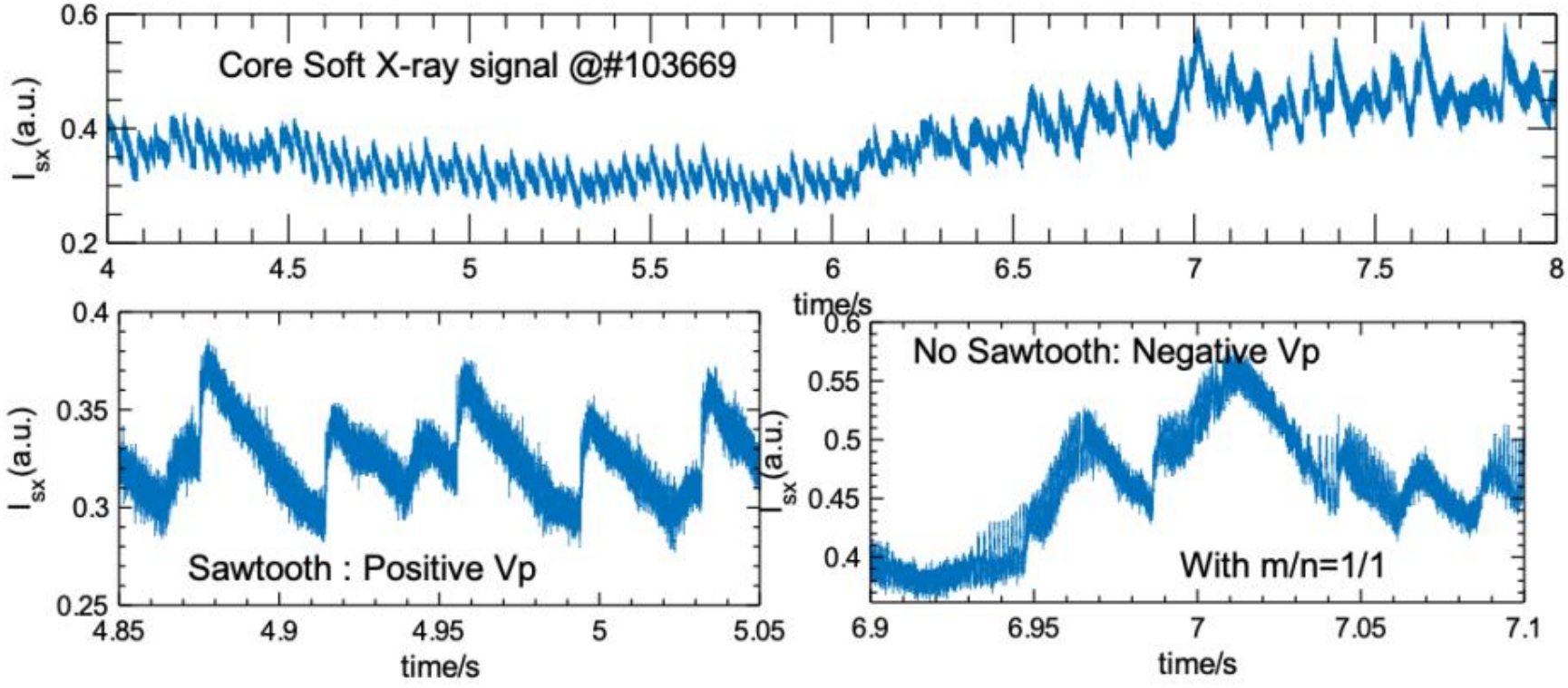
RWM/RWTM Study

Hank Strauss to present.

That’s All I have

Anything Else ?

Soft X-ray diagnostic #103669



The 'inverted' sawtooth shown in Core SXR signal, is due to the formation of hollow SXR profile.

New adapt option

Author: Morteza H. Siboni <hakimm2@rpi.edu>
Date: Tue Sep 21 16:16:15 2021 -0400

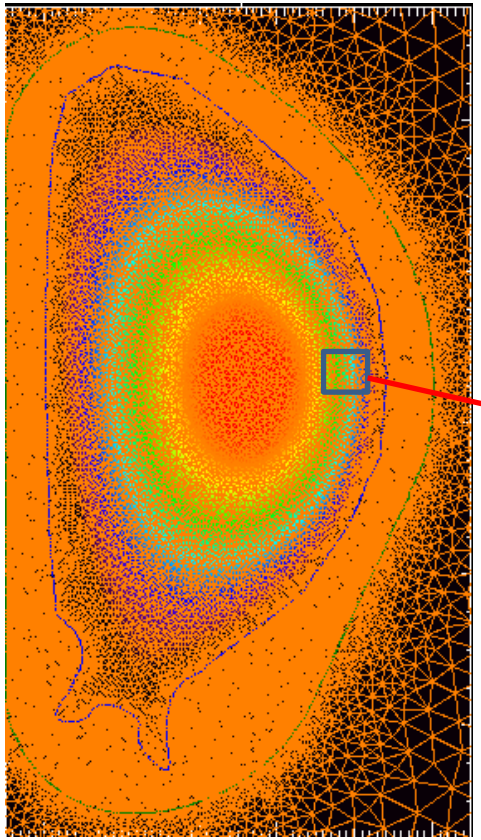
Updates the new logic for adapt_by_field

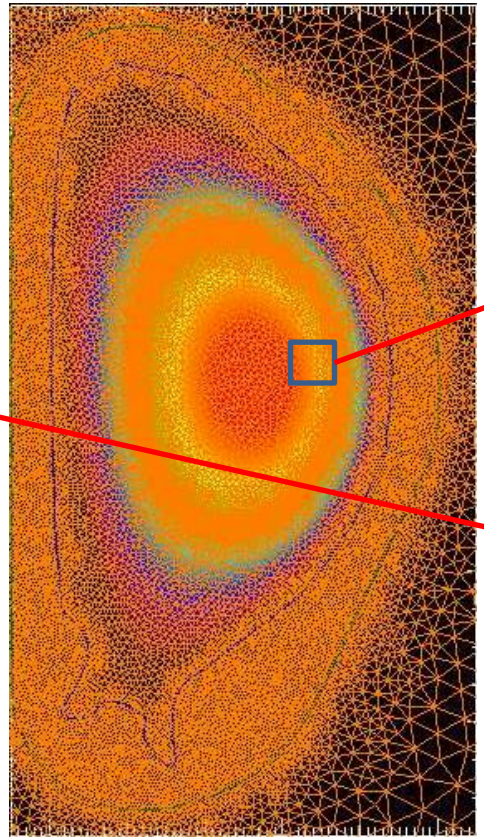
The 14th parameter in sizefieldParam (if exists) should be either 0 or 1 and with this change the following behaviours can be expected

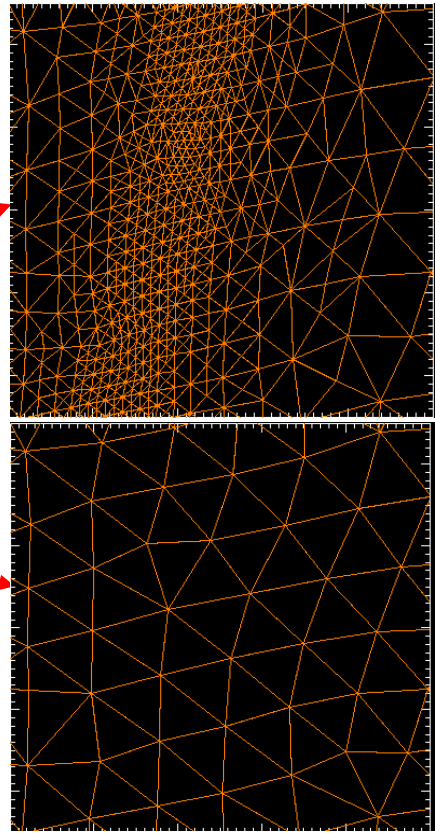
(1) if there are 13 parameters things will work as before
(2) if there are 14 parameters the last parameter should be either 0 or 1 (any other value will cause an error).
  (2a) value of 1 will leave coarsening "on"
  (2b) value of 0 will turn coarsening "off"
(3) if there are more than 14 or less than 13 parameters in "sizefieldParam" this will cause an error.

1. 2. 2. .01 .4 .01 .4 .1 .1 .01 .02 .05 .5 0

Testing on ITER equilibrium -- 1



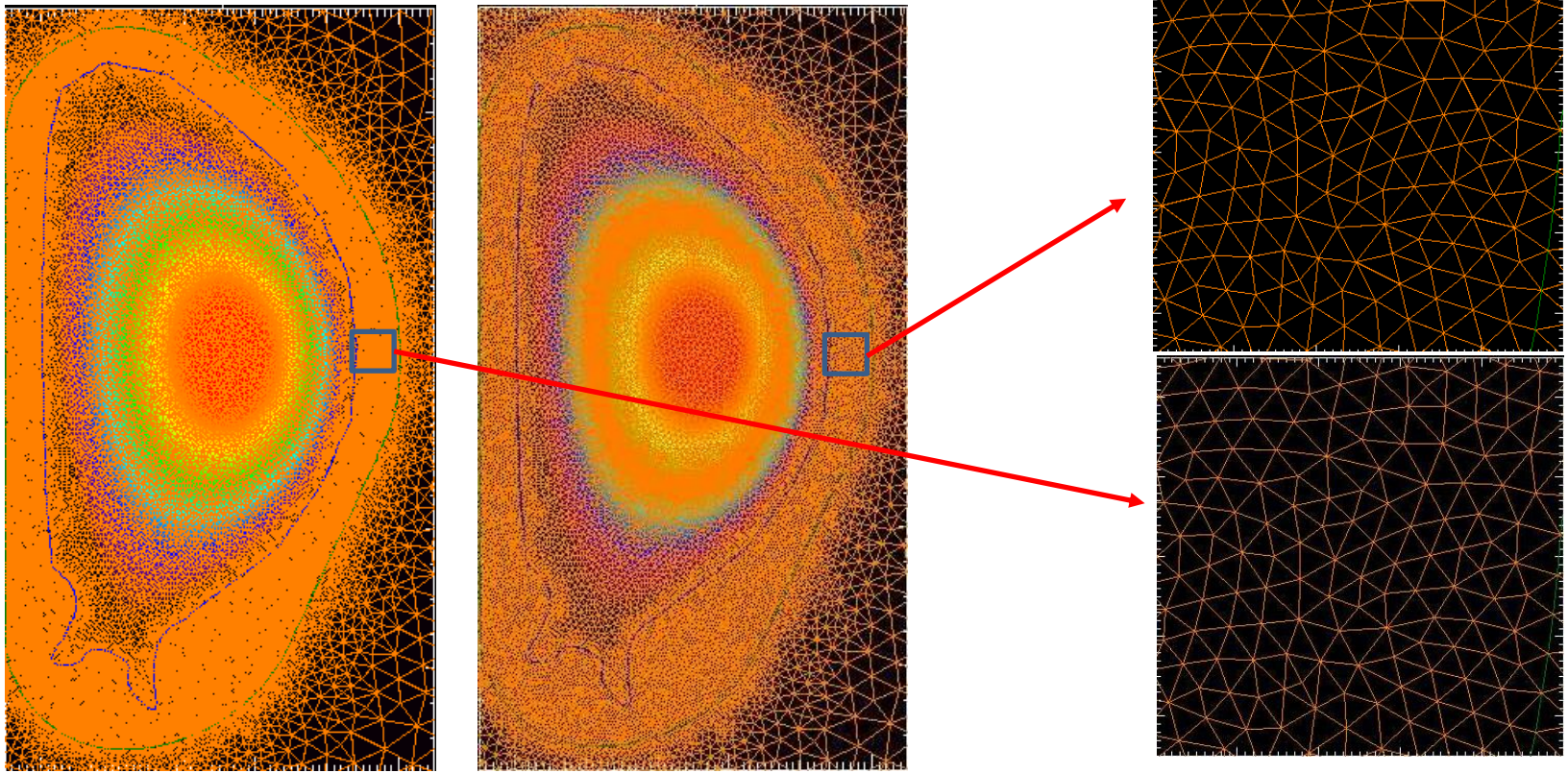




/p/tsc/m3dnl/ITER/NewMesh/Eq2 and …/Adapted

Refines plasma region ok

Testing on ITER equilibrium -- 2

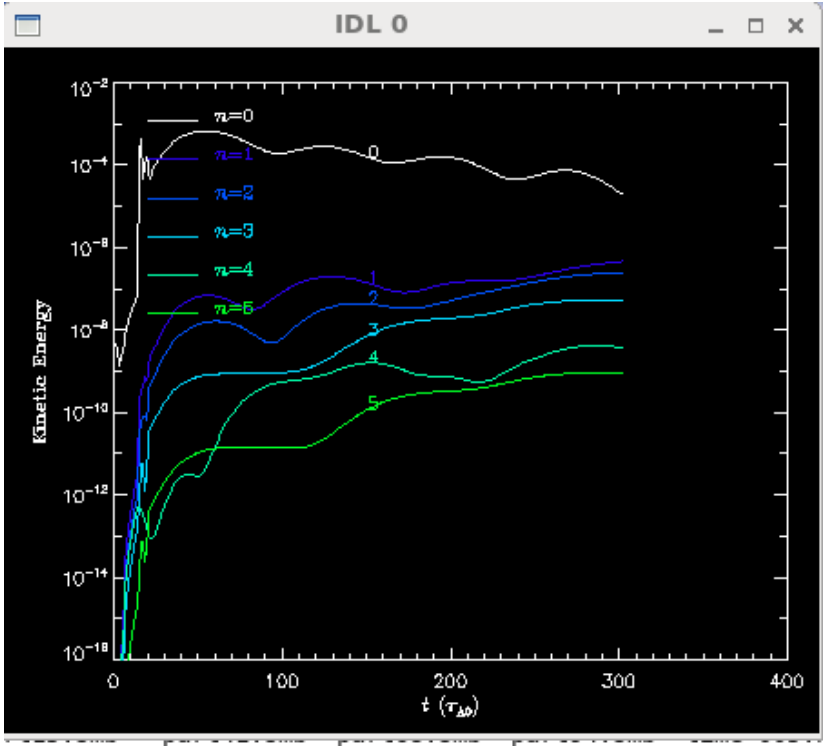


/p/tsc/m3dnl/ITER/NewMesh/Eq2 and …/Adapted

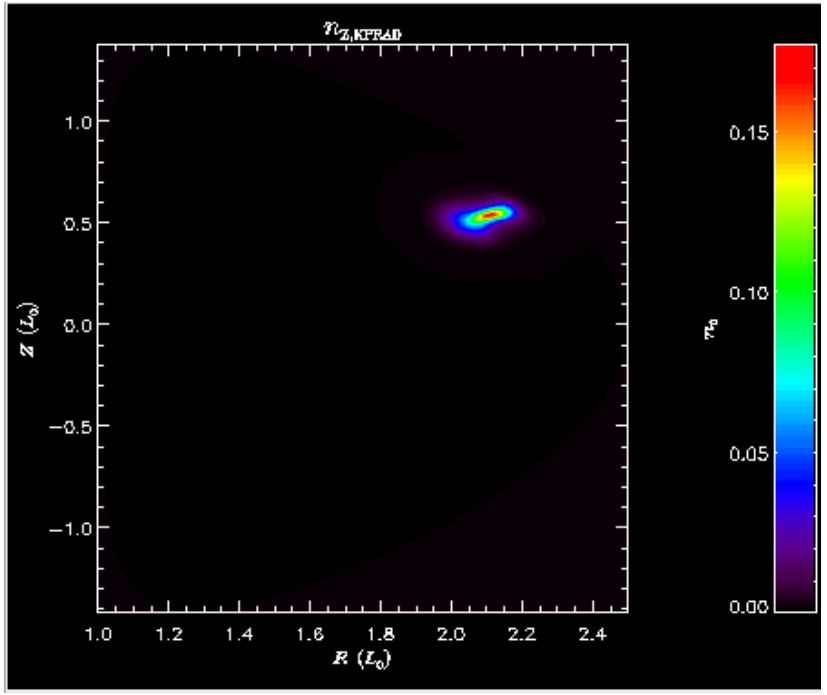
Leaves wall zones untouched!

DIII-D Pellet injection case goes unstable (without RE)

plot_hmn



plot_field, 'kprad_totden'



Could the impurity density be going negative?

See /scratch/gpfs/cz12/kprad2_test

Chen Zhao

Chen Zhao paper in preparation

Simulation of the runaway electron plateau formation during current quench

C. Zhao[1], C. Liu[1], S. C. Jardin[1], N. M. Ferraro[1], B. C. Lyons[2], V. Bandaru[3], M. Hoelzl[3]

[1] Princeton Plasma Physics Laboratory, Princeton, NJ, United States of America
[2] General Atomics, San Diego, CA, United States of AmericaGeneral Atomics, San Diego, CA, United States of America
[3] Max Planck Institute for Plasma Physics, Boltzmannstaße, Garching, Germany

E-mail: czhao@pppl.gov

- Now only contains formulation and 2 test problems (1 cylindrical and 1 with JOREK)
- No section on experimental comparisons or on sawtooth
- Need some discussion on validity of Dreicer model (from Chang)
- Add section on comparison with characteristics model of advancing runaways?