

M3D-C1 ZOOM Meeting

10/18/2021

Announcements

CS Issues

1. Mesh adaptation update
2. RPI long range plans
3. NERSC Time
4. Changes to github master since last meeting
5. Regression tests
6. Discussion of queues on stellar

Physics Studies

1. Update on EAST – Yao Zhou
2. Pellet toroidal distribution in NIMROD and M3D-C1
3. Adaptation example to allow $S=10^8$ in Soft-beta-limit studies
4. Test of ikapparfunc=1 ..Hank Strauss
5. Pellet with Runaway Electrons – Chen Zhao

In attendance

Steve Jardin

Adelle Wright

Jin Chen

Andreas Kleiner

Cesar Clauser

Brendan Lyons

Chang Liu

Hank Strauss

Mark Shephard

Seegyong Seol

Usman Riaz

Morteza Siboni

Announcements

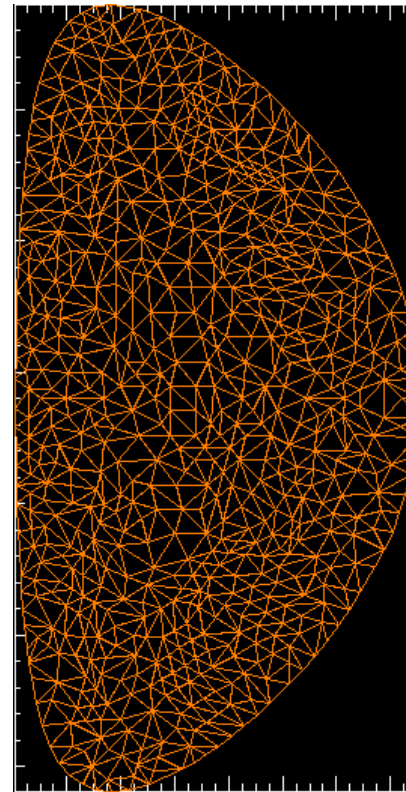
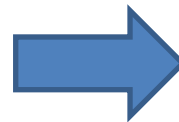
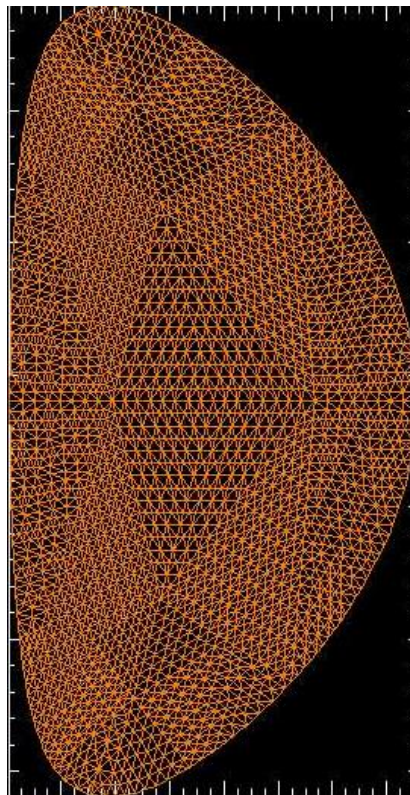
- John Mandrekas requested a 90 min presentation from all SciDACs
 - CTTS now scheduled for Oct 22 at 1:00 PM ET
 - Jardin, Shephard, Williams will make presentations
 - DRAFT presentations posted on [CTTS.PPPL.GOV/talks](https://ctts.pppl.gov/talks)
- APS Nov 8-12
 - Meeting will be IN PERSON with virtual option. Will DOE allow travel?
 - No in-person CTTS meeting at APS
- EPS 6/27 – 7/1 2022 in Maastricht, Netherlands
 - Nominate invited speakers by 29 October 2021

Mesh adaptation update

.smb mesh files now increase in size after adaptation (see next slide)

Morteza PPPL account on hold (nationality)

Case 1: /p/tsc/m3dnl/NSTX/G46



Adapted mesh is coarser:

time_nnn.h5 hdf5 files reduced from 51 mb to 11 mb: size reduced to 21%
16 .smb files **INCREASED** from 26 kB to 40 kB: size **increased** by 53%

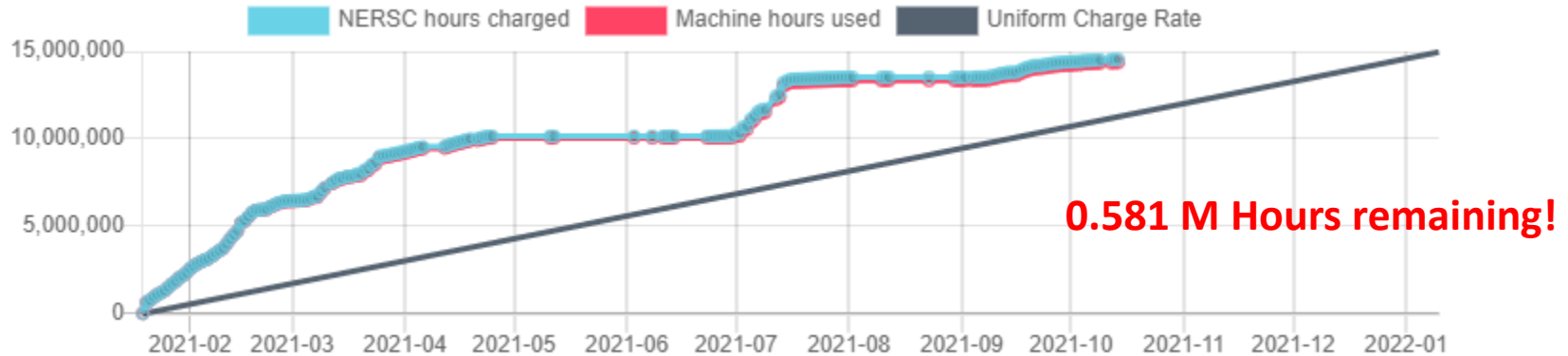
RPI Long Term Plans

Mark sent an email on 10/16 to gauge our interest in the following

1. Replace PUMI/MeshAdapt with Omega
 1. GPU friendly, being developed at RPI and Sandia
2. Provide a high performance M3DC1 driven PIC capability
 1. PUMIPic uses Omega for the mesh
 2. This mesh-based approach may complement Chang Liu's particle-based approach
3. Provide technologies for code-to-code coupling
 1. Intermediate code to couple two existing codes

NERSC Time

mp288



- mp288 received 10M Hrs for CY 2021, + 5M Hrs additional
- Pearlmuter 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 and C. Liu are early users

Changes to github master since 10/03/21

Nate Ferraro:

10/04/21: Updated regtest batch scripts on greene to use split.smb

S. Jardin:

10/05/21: re-baselined adapt regtest so it passes on most platforms

Brendan Lyons:

10/05/21: add ipellet=16 option for poloidal gaussian with 1/R weighting

10/05/21: ivisfunc=4 change viscosity within a certain distance to the wall

SeegYoung Seol:

10/06/21: adding makefile for SCOREC RHEL6

10/07/21: fixing compilation error with PETSC 3.0 or lower

10/12/21: fixing error with split.smb arg sanity check

Local Systems

- PPPL centos7(10/17/21)
 - 7 regression tests **PASSED** on centos7
- PPPL greene (10/17/21)
 - 5 regression tests **PASSED** on centos7
- STELLAR (10/17/21)
 - 6 regression tests **PASSED** on stellar
 - adapt **FAILED**
- TRAVERSE(10/17/21)
 - 6 regression tests **PASSED**
 - adapt **FAILED**

Other Systems

- Cori-KNL (10/17/2021)
 - 7 regression tests **PASSED** on KNL
- Cori-Haswell (10/17/2021)
 - 7 regression tests **PASSED** on cori
- MARCONI
 - All regression tests PASSED on MARCONI (J. Chen, 9/04/20)

Discussion of queues on Stellar

- Presently, jobs up to 42 nodes are allowed (out of 96?) for 24hr
 - Slows down queue when next to run and when running
 - Should the max # nodes be smaller? 24? 16?
- 2 21 node jobs could be running for 7day limit
 - Do we really need 7day jobs?

Update on EAST (10/15 Yao Zhou)

I met with Liqing last week in Hefei and discussed the EAST (1,1) modes at negative loop voltage. Here are some updates:

—Regarding how loop voltage is controlled: the EAST current feedback control system keeps the total current (Ohmic + LHCD) constant. In these experiments, Liqing did not control the loop voltage directly, but changed the LHCD so that Vloop would adjust accordingly. For example, he would turn up LHCD during a shot so that Vloop would decrease and change sign from positive to negative. This is my understanding and Liqing could correct me if I am wrong.

—Regarding q profiles: see attached figure from Liqing with both negative and positive Vloop cases. In both cases q_0 is significantly below 1. In the negative Vloop case q_0 is lower like you projected. **Liqing did mention that the q_0 values may not be quite trustworthy though.**

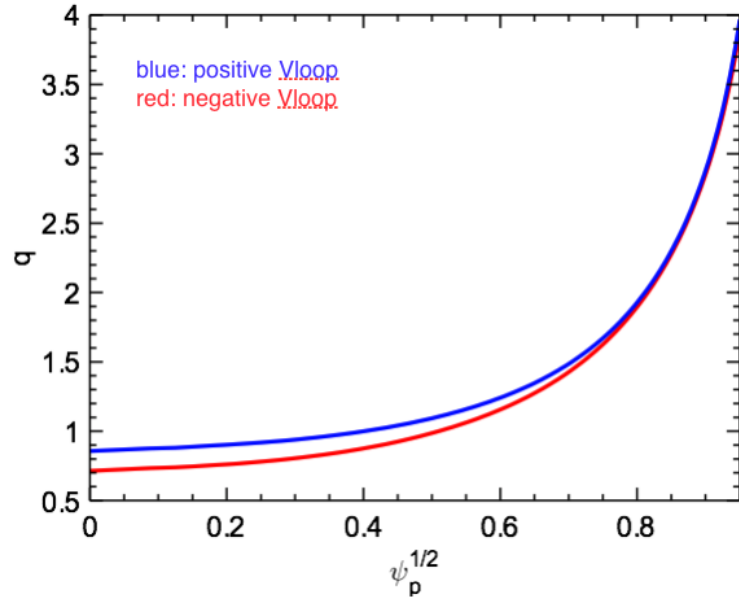
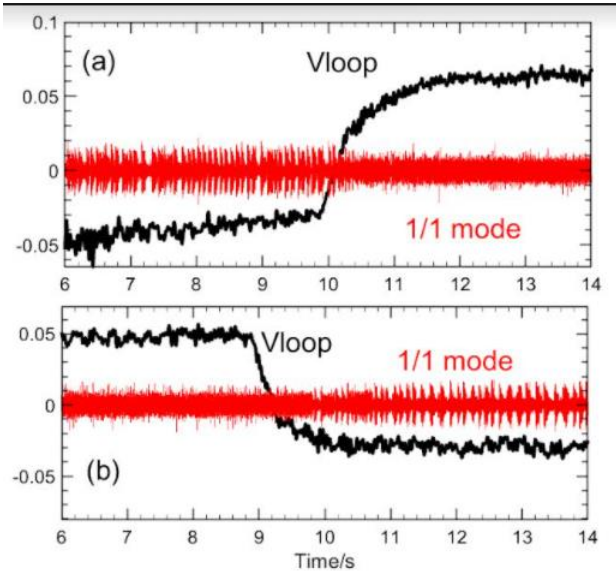
—Regarding equilibrium reconstruction: Liqing gave me EFIT files for both cases and I ran linear M3DC1 simulations, which you could find on stellar at

`/scratch/gpfs/yaozhou/east/positive`
`/scratch/gpfs/yaozhou/east/negative`

Both cases show typical ideal (1,1) kink modes (not surprisingly) and the growth rate is ~50% larger in the positive Vloop case.

So this is where things are and we have not decided how to proceed yet. Your suggestions are welcome.

From EAST



If both $q(\psi)$ plots had $q(0)$ increased by about 0.3, it would make sense that a non-resonant (1,1) mode is excited in the Neg V_{loop} case, but not the pos V_{loop} one

Pellet toroidal distribution

Is the NIMROD source (in real space) much different than the M3D-C1 one? Let us see what the NIMROD source would be in real space

$$\sum_{n=0}^N a_n \cos(n\varphi) = \exp(\cos(\varphi) / V_t^2)$$

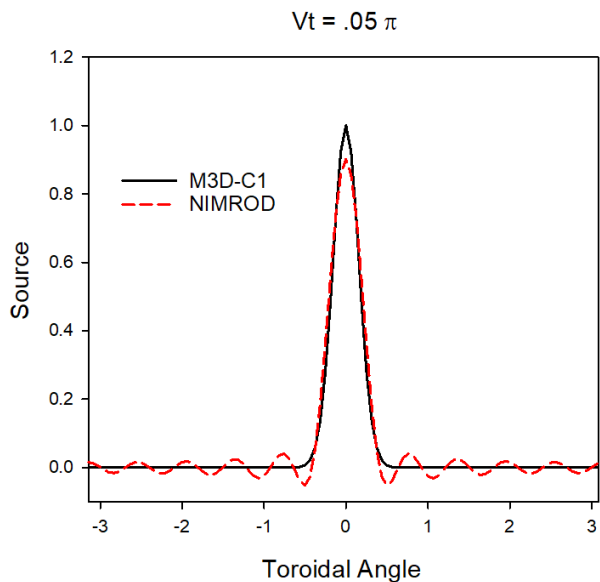
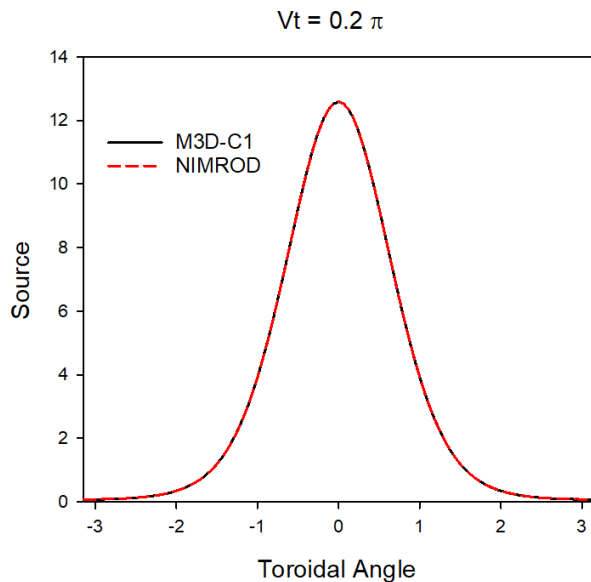
$$\sum_{n=0}^N a_n \int_0^{2\pi} \cos(m\varphi) \cos(n\varphi) d\varphi = \int_0^{2\pi} \cos(m\varphi) \exp(\cos(\varphi) / V_t^2) d\varphi$$

$$\frac{1}{2} \sum_{n=0}^N a_n \int_0^{2\pi} [\cos((m-n)\varphi) + \cos((m+n)\varphi)] d\varphi = \int_0^{2\pi} \cos(m\varphi) \exp(\cos(\varphi) / V_t^2) d\varphi$$

$$n \neq 0 \quad a_m = \frac{1}{\pi} \int_0^{2\pi} \cos(m\varphi) \exp(\cos(\varphi) / V_t^2) d\varphi$$

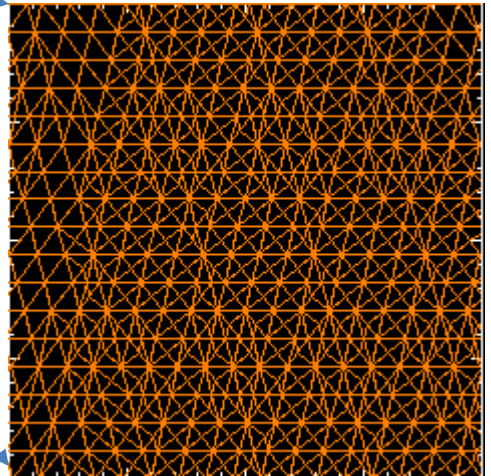
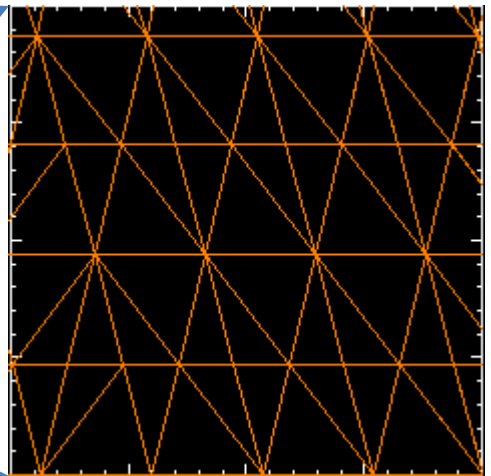
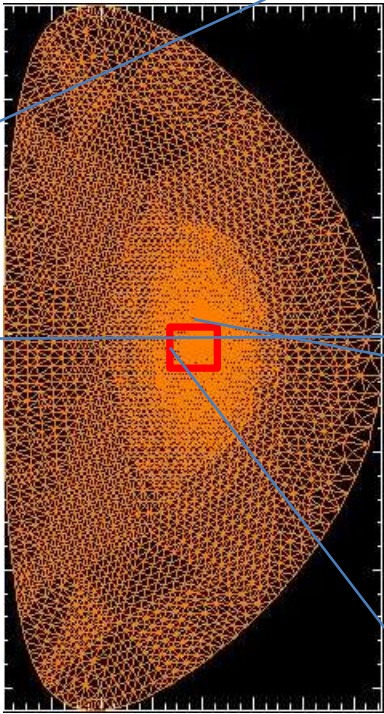
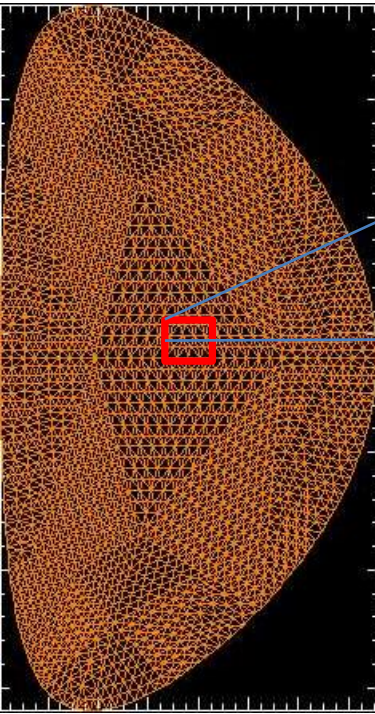
$$n = 0 \quad a_0 = \frac{1}{2\pi} \int_0^{2\pi} \exp(\cos(\varphi) / V_t^2) d\varphi$$

Compare NIMROD & M3D-C1 for $n=10$ harmonics



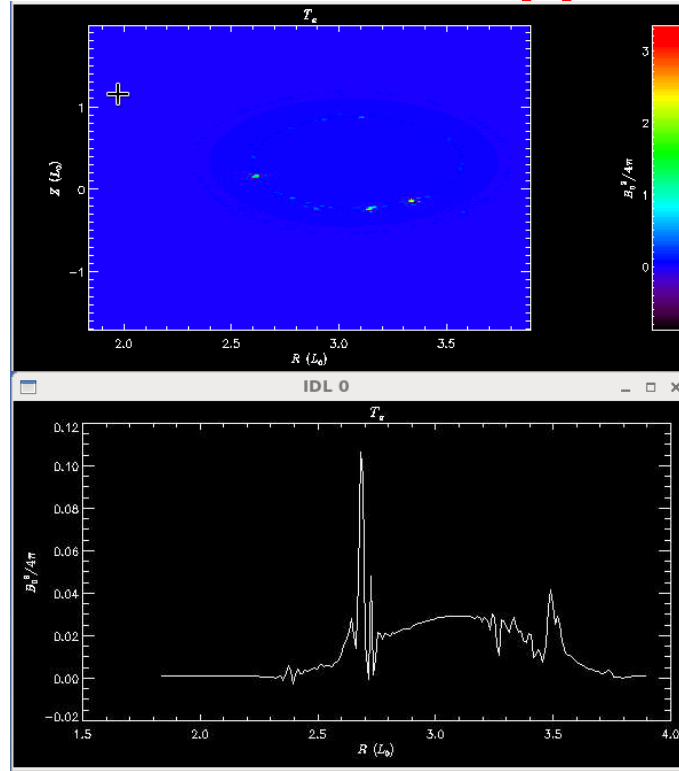
- Almost identical for $Vt = 0.2 \pi$
- Some small oscillations (few %) for $Vt = 0.05 \pi$

Mesh Adaptation



Refined mesh so SBL calculation can go to higher S
1. 2. 2. -.0663.05 -.0663 .05 .05 .05 100. 100. 1. 0.

Strauss test of ikapparfunc=1



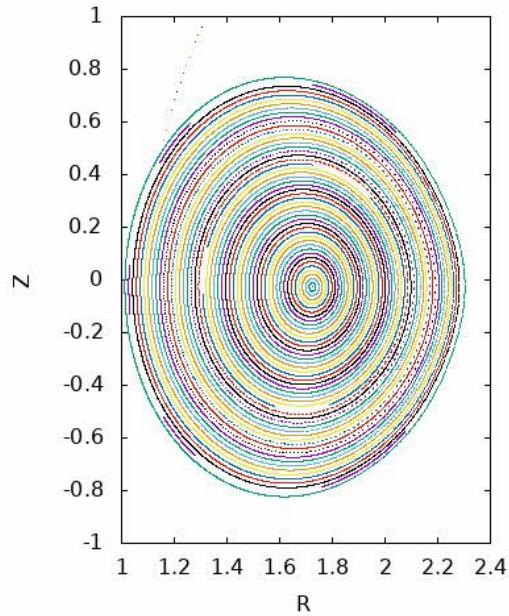
Initial temperature profiles is unphysically jagged, goes negative

Pellet with RE

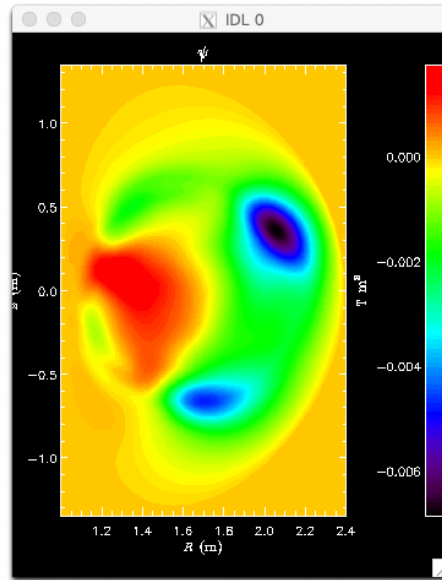
10/12/21

Chen Zhao

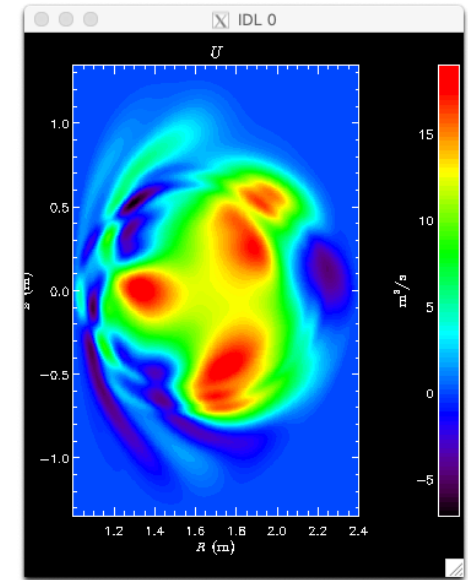
Poincare plot 0ms – 1.2ms



$\delta\psi$ at 1.2ms

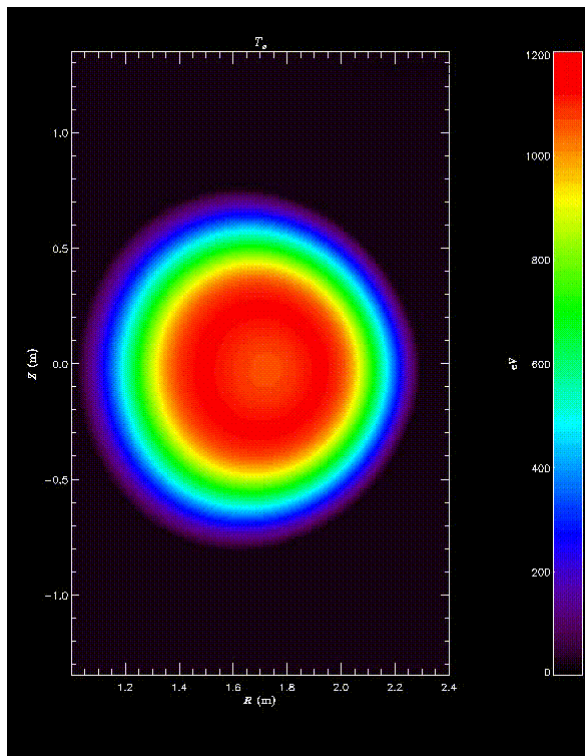


U at 1.2ms

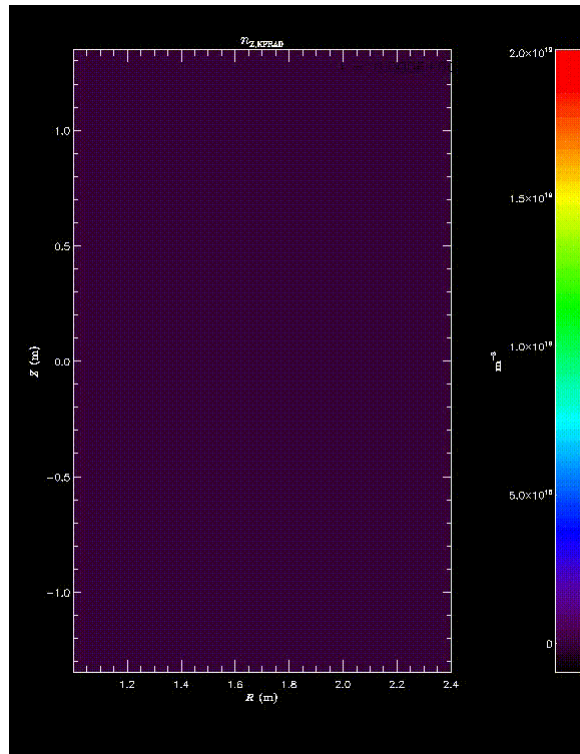


It seems that there is a $n \sim 3$ island at 1.2ms during the pellet injection.

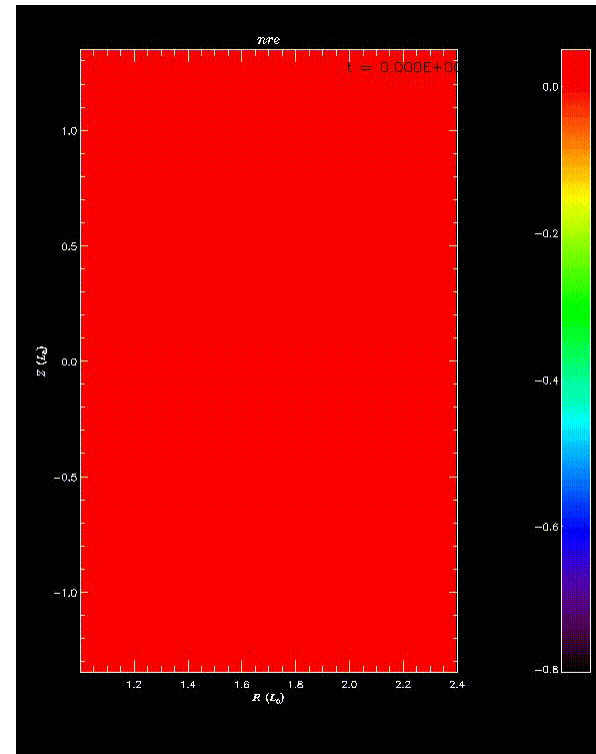
Te 0ms – 1.2ms



n_zpel 0ms – 1.2ms



J_RA 0ms – 1.2ms



That's All I have

Anything Else ?

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`

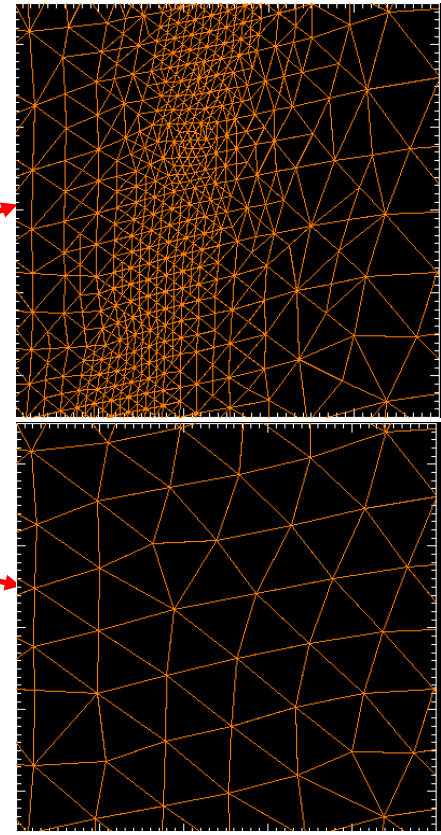
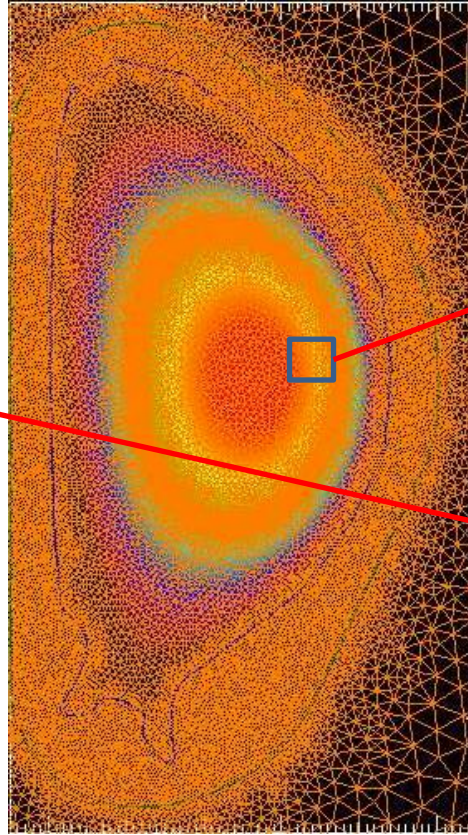
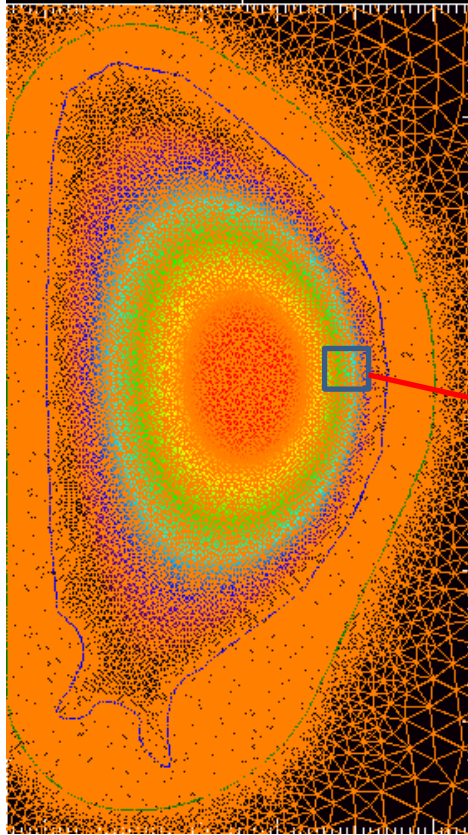
The 14th parameter in `sizefieldParam` (if exists) should be either 0 or 1 and with this change the following behaviours can be expected

- (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

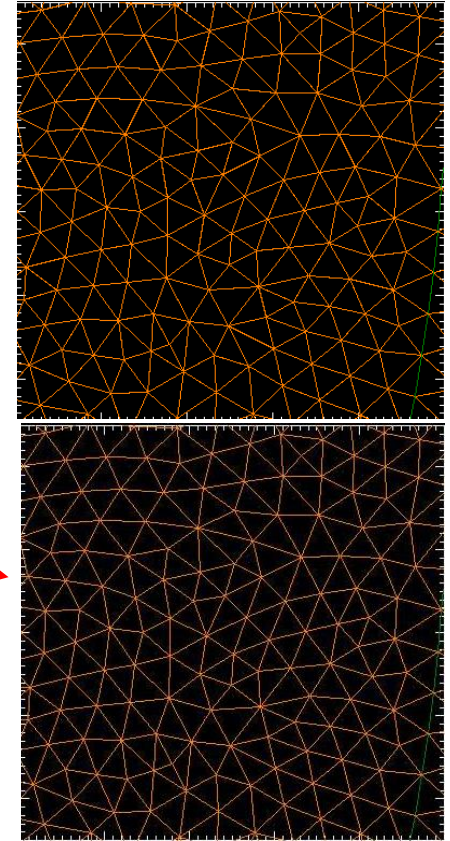
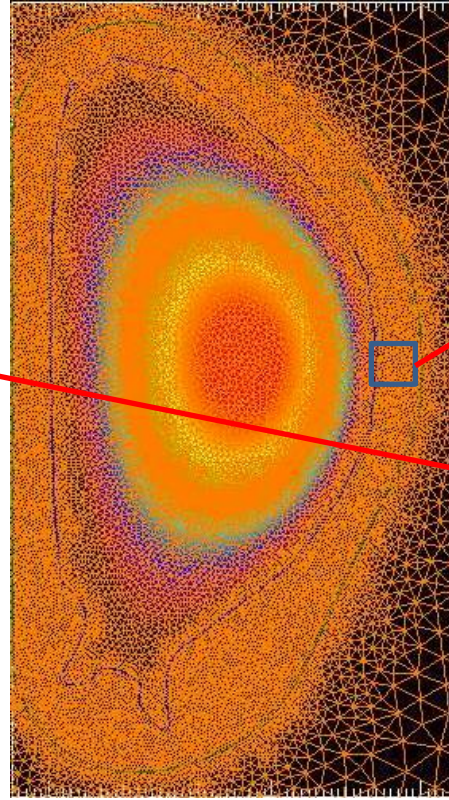
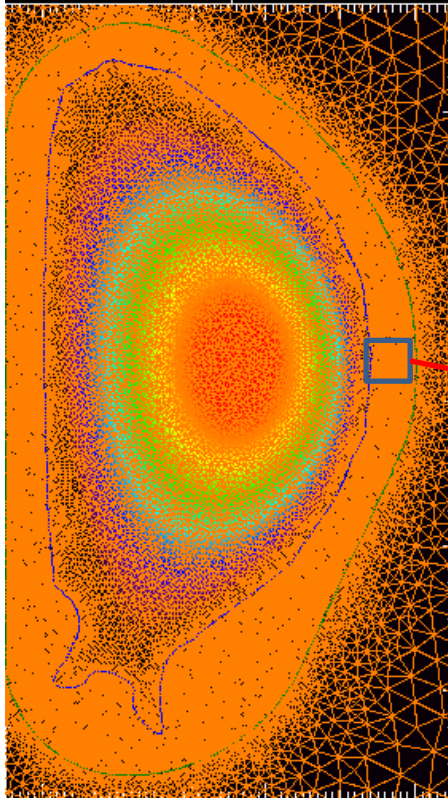


/p/tsc/m3dnl/ITER/NewMesh/Eq2

and .../Adapted

Refines plasma region ok

Testing on ITER equilibrium -- 2



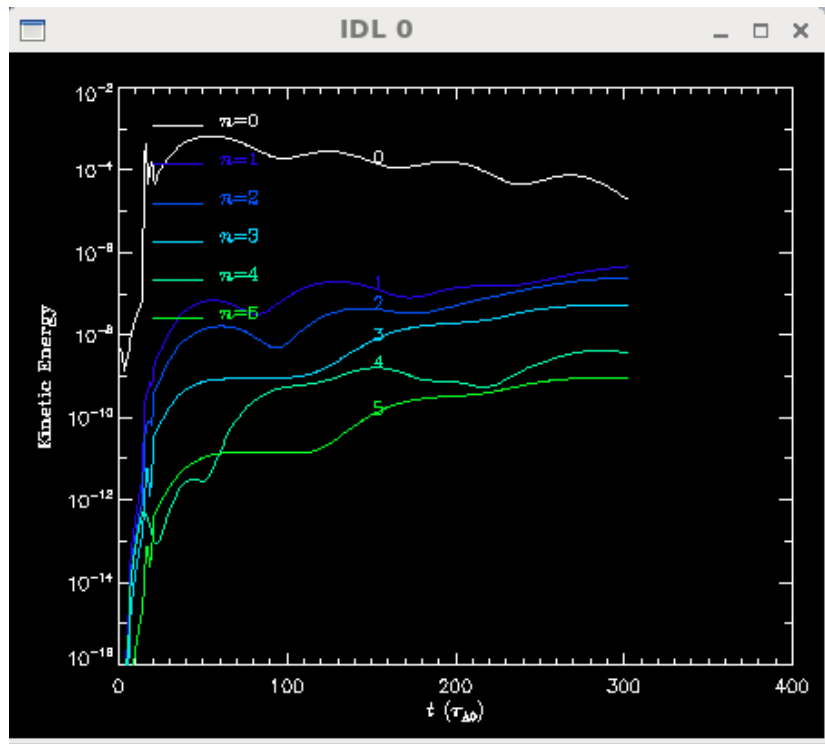
/p/tsc/m3dnl/ITER/NewMesh/Eq2

and .../Adapted

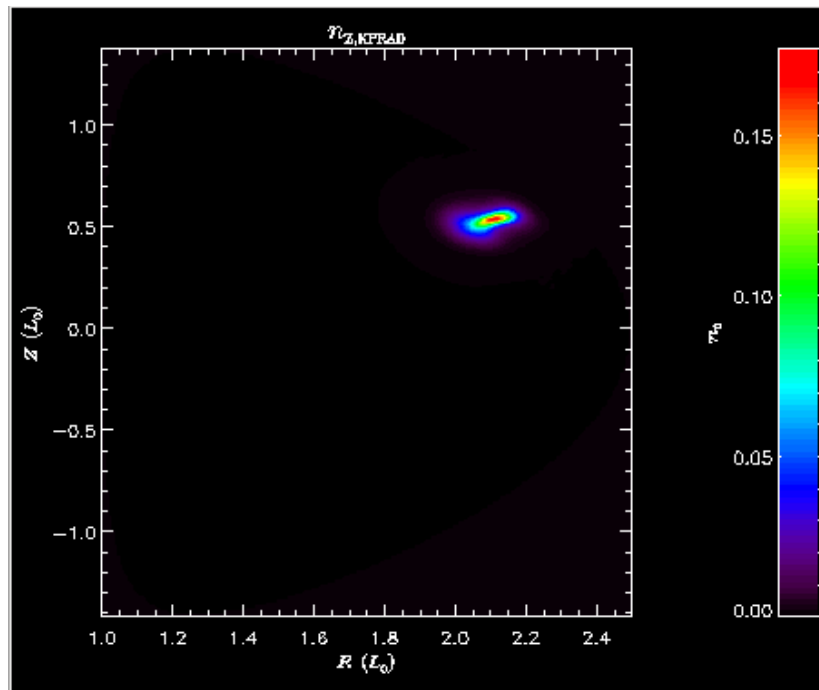
Leaves wall zones untouched!

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

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V. Bandaru³, M. Hoelzl³

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General Atomics, San Diego, CA, United States of America

³ Max Planck Institute for Plasma Physics, Boltzmannstraße, Garching, Germany

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- Now only contains formulation and 2 test problems (1 cylindrical and 1 with JOEKE)
- 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?