M3D-C1 ZOOM Meeting

11/01/2021

Announcements

CS Issues

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

Physics Studies

1. Mesh adaptation to allow $S=10^8$ in center for SBL studies
2. Update on EAST – Yao Zhou

In attendance

Steve Jardin

Adelle Wright

Jin Chen

Andreas Kleiner

Cesar Clauser

Brendan Lyons

Chang Liu

Hank Strauss

Chen Zhao

Nate Ferraro

Mark Shephard

Seegyoung Seol

Usman Riaz

Morteza Siboni

Sam William

Yang Liu

Announcements

- Meeting with Tokamak Energy (UK) this Friday
  - Michele Romanelli to organize

- Presentation to Mandrekas posted on CTTS.PPPL.GOV/talks

- APS Nov 8-12
  - Meeting will be IN PERSON with virtual option.
    - No in-person CTTS meeting at APS
    - No M3D-C1 Meeting next week (Nov 8)

- EPS 6/27 – 7/1 2022 in Maastricht, Netherlands

LBL Report

- Nan Ding and Sherry Li unavailable

- Sam Williams presentation to DOE posted ctts.pppl.gov/Talks

- LBL updates to follow

- Last line of S. Willliams presentation:
  - Development of GPU-friendly sparse linear solvers for ill-conditioned problems

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

- Draft paper will be posted.   Jin: Do you want to add to shared folder that Bill Dorland set up?

Mesh adaptation update

Morteza PPPL account on hold (nationality).   However, issued a PU account on stellar

NERSC Time

mp288

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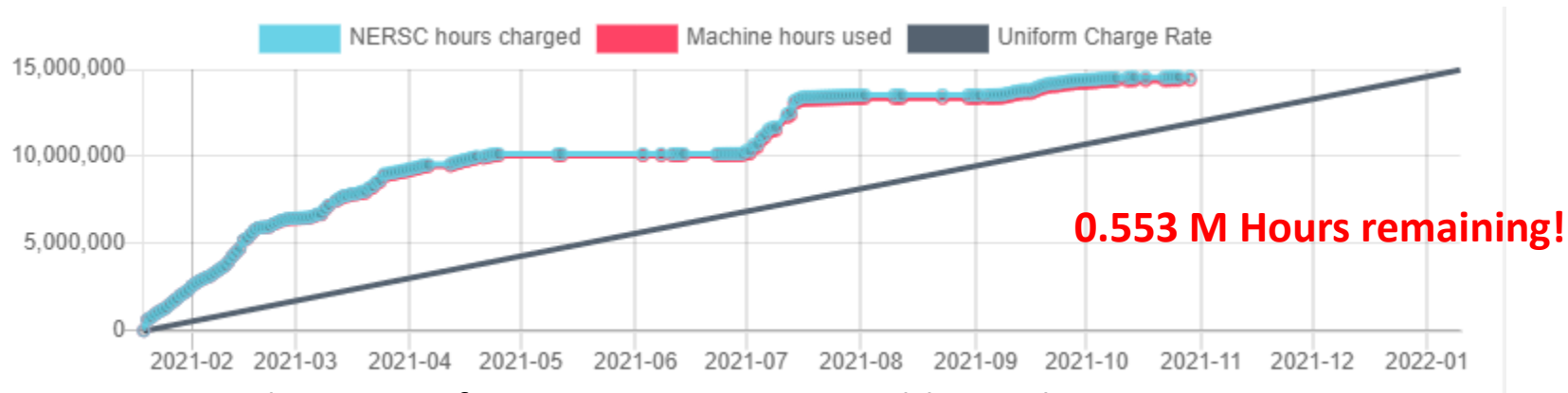
- mp288 received 10M Hrs for CY 2021, + 5M Hrs additional
- Pearlmutter time will not be charged for this FY
- We are NESAP Tier 2. . Phase-I w GPUs   We have been given a repo m3984
- N9ES-N2 M3D-C1:   J. Chen , C. Liu, S. Seol are early users

Changes to github master since 10/17/21

SeegYoung Seol:
10/18/21: adding ENABLE_ZOLTAN in configuration and removing fields in mesh export
10/20/21: fixing some minor errors
              updating SCORECDIR for centos7
10/31/21: adding makefile/readme for stellar-openmpi & traverse-nvhpc

Local Systems

- PPPL centos7(10/31/21)
  - All jobs **FAILED**
  - Error partitioning mesh
- PPPL greene (10/31/21)
  - All jobs **FAILED**
  - Error partitioning mesh
- STELLAR (10/31/21)
  - 6 regression tests **PASSED** on stellar
  - adapt **FAILED** C1ke file was blank "could not find ts0-adapted.smb"
- TRAVERSE(10/31/21)
  - 6 regression tests **PASSED**
  - adapt **FAILED** C1ke file was blank "could not find ts0-adapted.smb"

Other Systems

- Cori-KNL (10/31/2021)
  - 5 regression tests **PASSED** on KNL
  - Adapt **FAILED** C1ke file was blank
  - NCSX **FAILED** – velocities differed in 3rd decimal place after 5 steps
- Cori-Haswell (10/31/2021)
  - 6 regression tests **PASSED** on cori
  - Adapt **FAILED** C1ke file was blank
- 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
```

Did Yao respond to this?

GLOBUS Update (from Jin Chen)

Here is the helpdesk documentation
https://ppplprod.service-now.com/nav_to.do?uri=%2Fkb_view.do%3Fsysparm_article%3DKB0011010%26sysparm_rank%3D1%26sysparm_tsqueryId%3Dbbd579651b93b0d0dfa3ff3f034bcb46

to walk you through from account creation on   https://www.globusid.org/create

to use the newly created account login to   https://www.globus.org   to start data transfer.

Please use the following document to link your Princeton University Identity:
https://researchcomputing.princeton.edu/services/data-transfer-networking/data-transfer-globus

As for data transfer, Here are the data nodes:
PPPL: PPPL DTN-SRV1
NERSC: NERSC Cori
PU: Princeton Traverse/Stellar Scratch DTN

Mesh Adaptation

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.
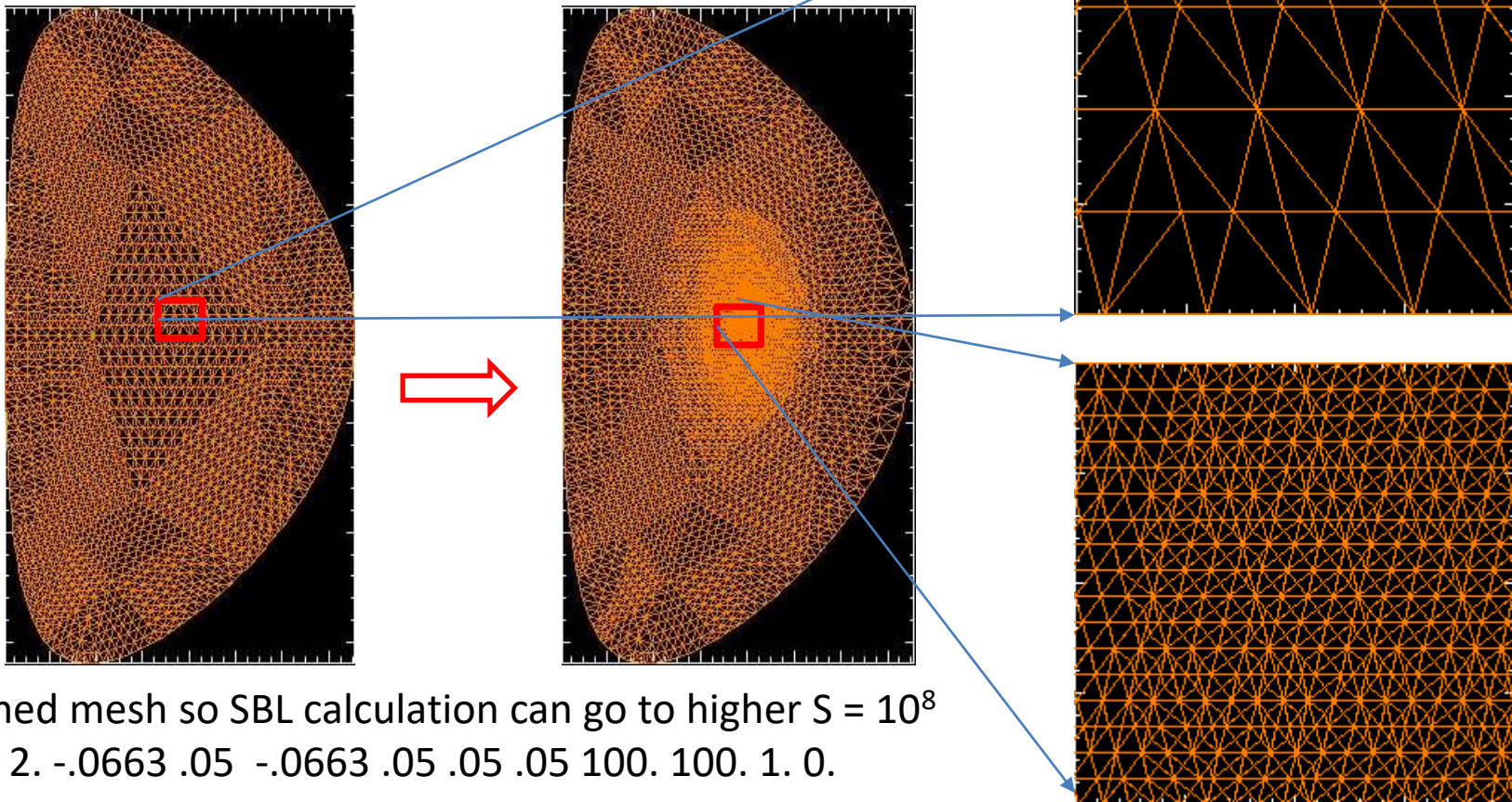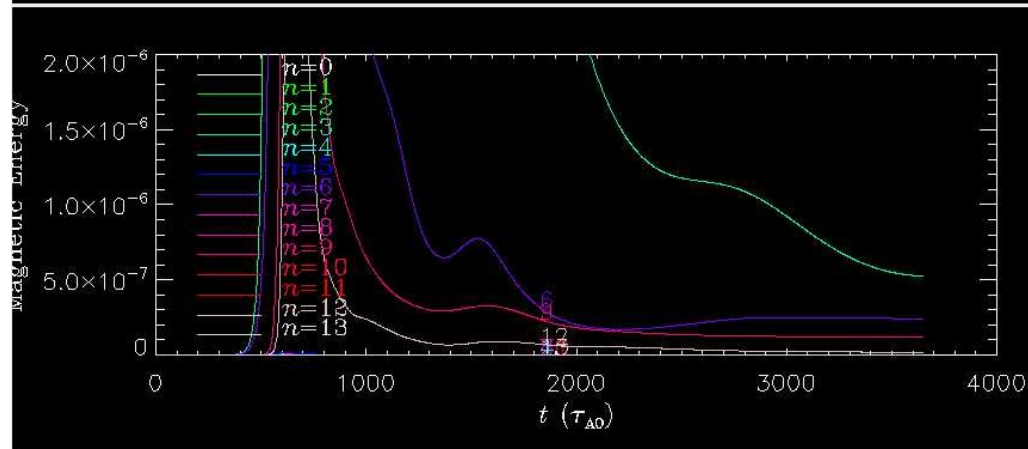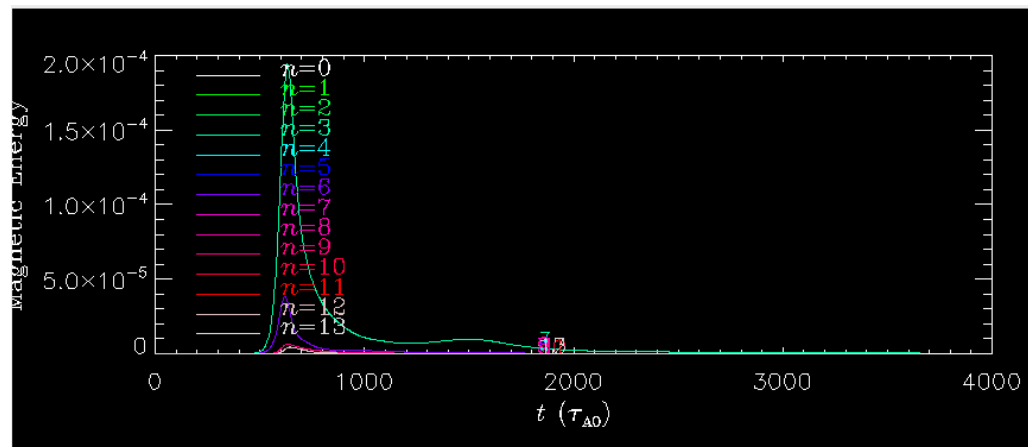
Central mesh density doubled again for convergence check
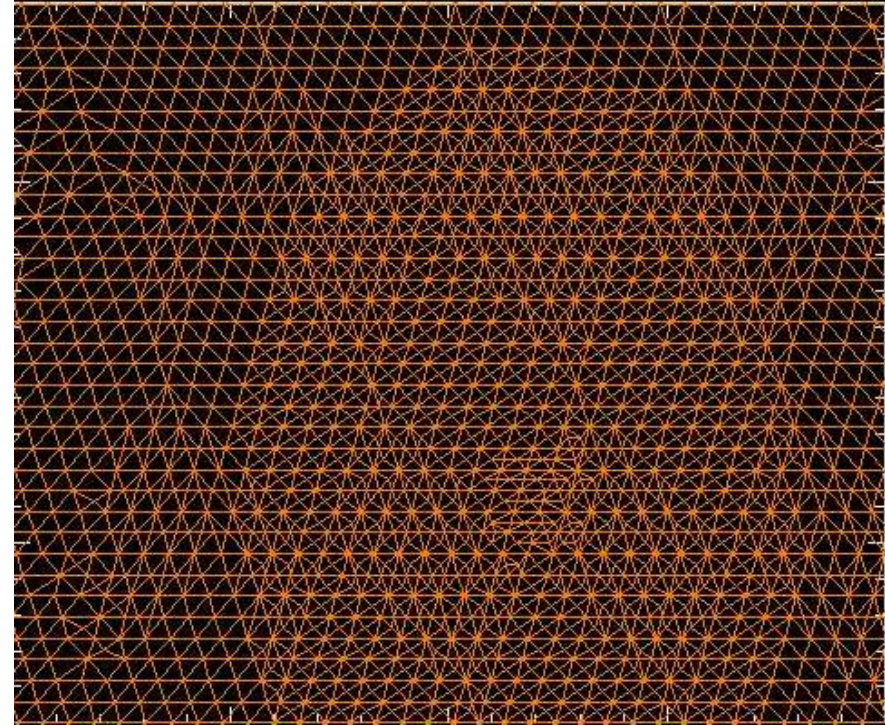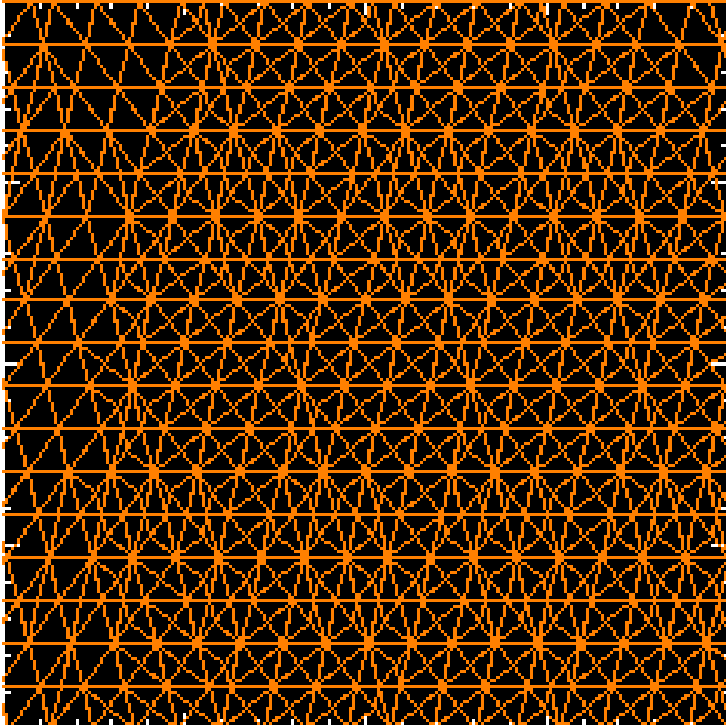
1. 2. 2. -0.07277 .05 -0.07277 .05 .05 .05 100. 100. 1. 0.

Will initially unstable equilibrium return to axisymmetry?
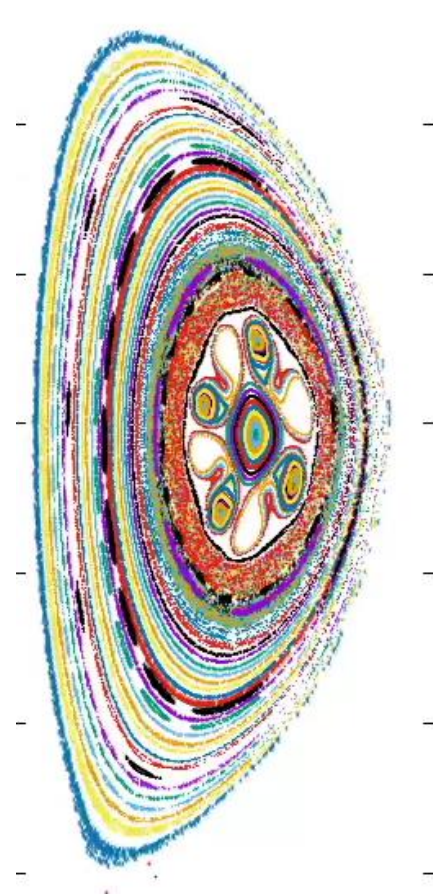
From EAST (11/1/21 via Yao)

 The q profiles I sent you last time were incorrectly labeled. q0 is higher at negative Vloop, not lower. :

1. The current profile is more peaked (slide 3) such that q0 is lower at positive Vloop. LHCD appears to contribute more to the off-axis current such that the current profile is broader at negative Vloop.

2. There are fairly typical sawtooth crashes at positive Vloop (slides 5&6). In contrast, the (1,1) modes at negative Vloop saturate with coexisting hot and cold cores rather than "complete" crashes. The latter case is more benign and favorable for confinement and that is why Liqing is interested in this regime.

I think a possible way to proceed is to find a pair of equilibria and use M3DC1 to show sawtooth crash in the positive-Vloop case and saturated (1,1) in the negative-Vloop case.

q profiles - New

- New EFIT equilibria with higher q_0 are generated.
- $q_0 < 1$ at **positive** Vloop, $q_0 > 1$ for **negative**.
- Hence a (1,1) kink mode is seen only at positive Vloop in linear M3DC1 simulations.
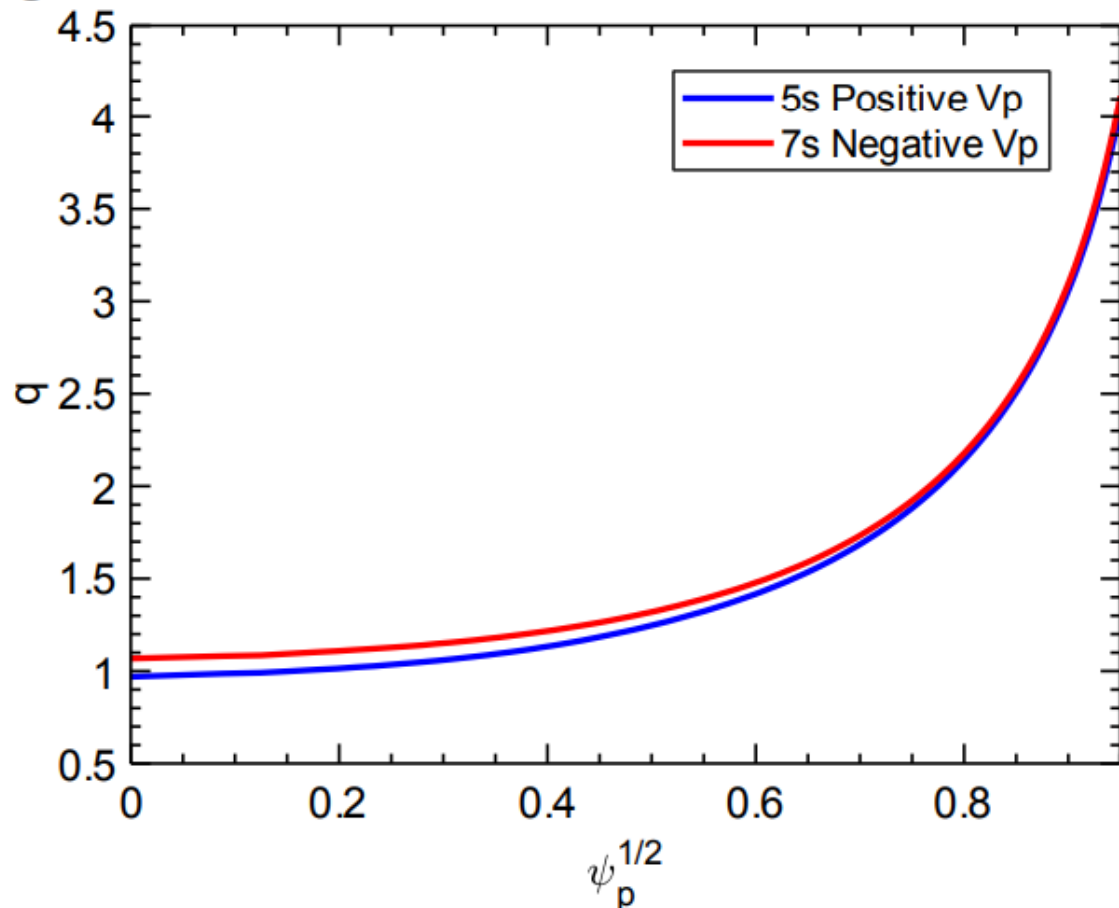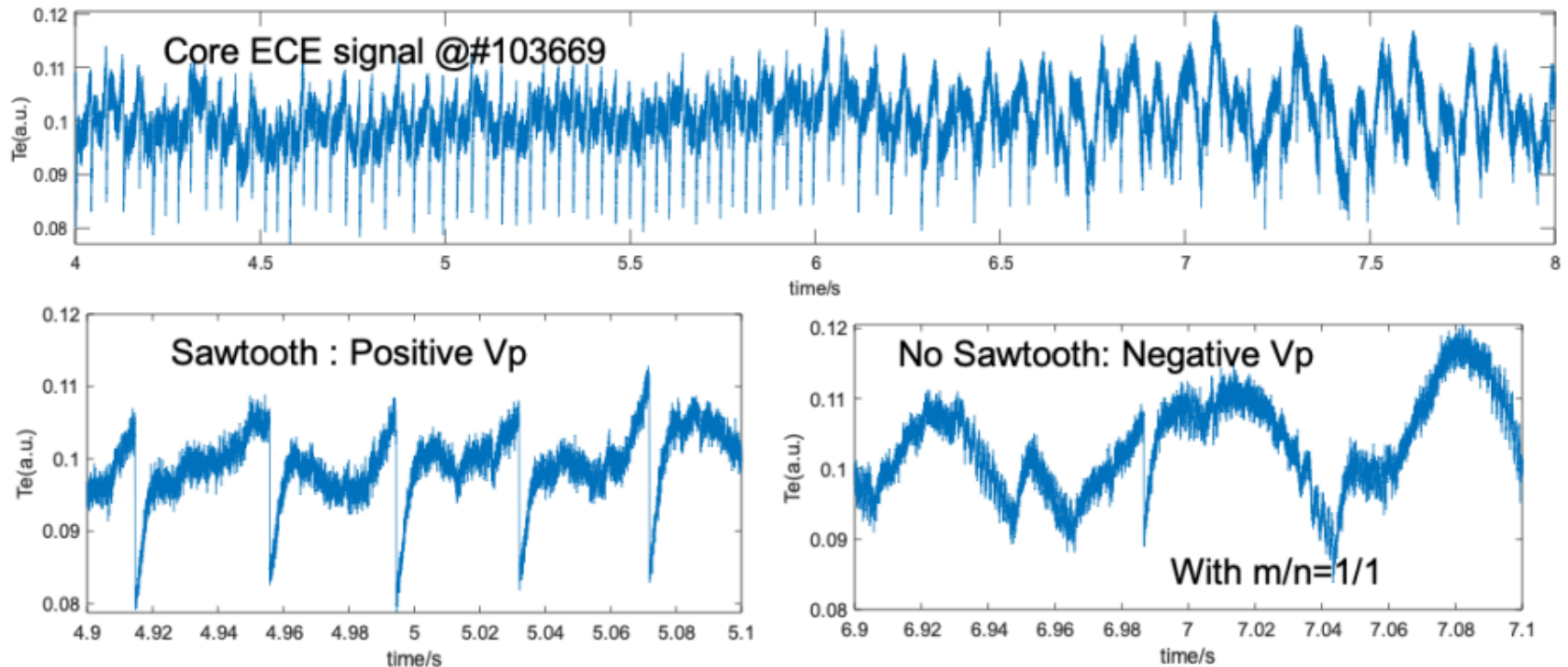
Current profile is more peaked at positive Vloop
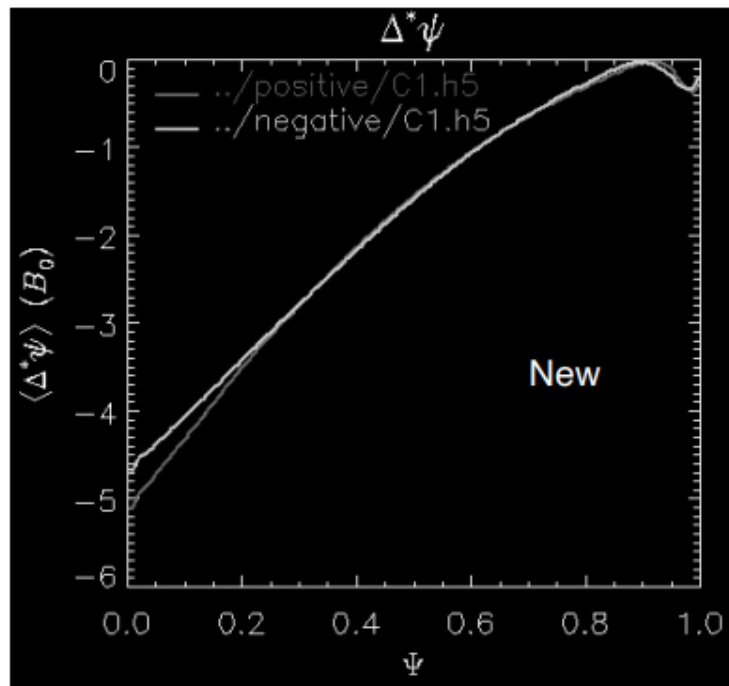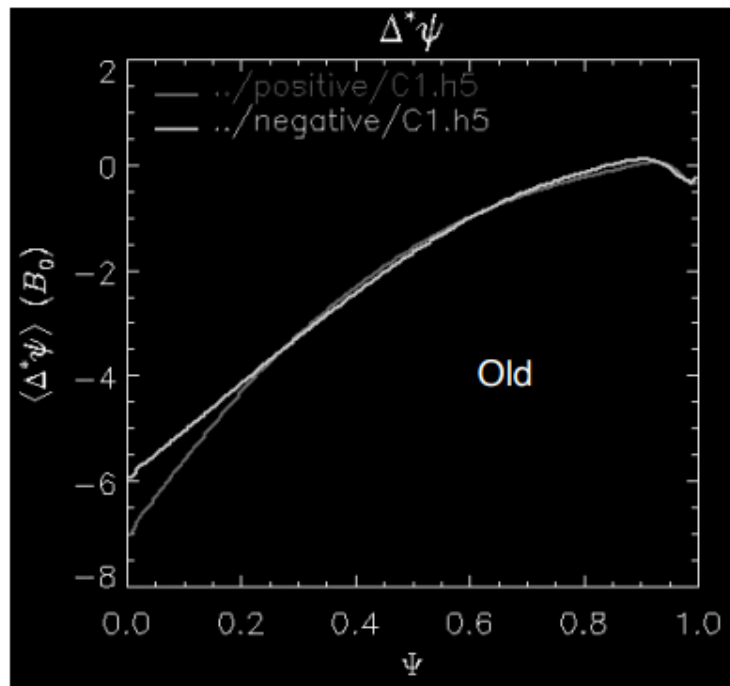
Total current is (almost) the same in all four equilibria

ECE Signal #103669 (ECE measures electron temperature)


The sawtooth is 'humpback', not in a normal shape.

Possible Explanation for different sawtooth behavior

- There are 2 known mechanisms for sawtooth-like behavior

    - $q(0) < 1$ Kadomtsev (1,1) reconnection (current driven)

    - $q(0) > 1$ Interchange mode (pressure driven)

- Maybe changing the current profile causes it to alternate between these two types of behavior

That's All I have

Anything Else ?

Soft X-ray diagnostic #103669

Core Soft X-ray signal @#103669

Sawtooth : Positive Vp

No Sawtooth: Negative Vp

With m/n=1/1
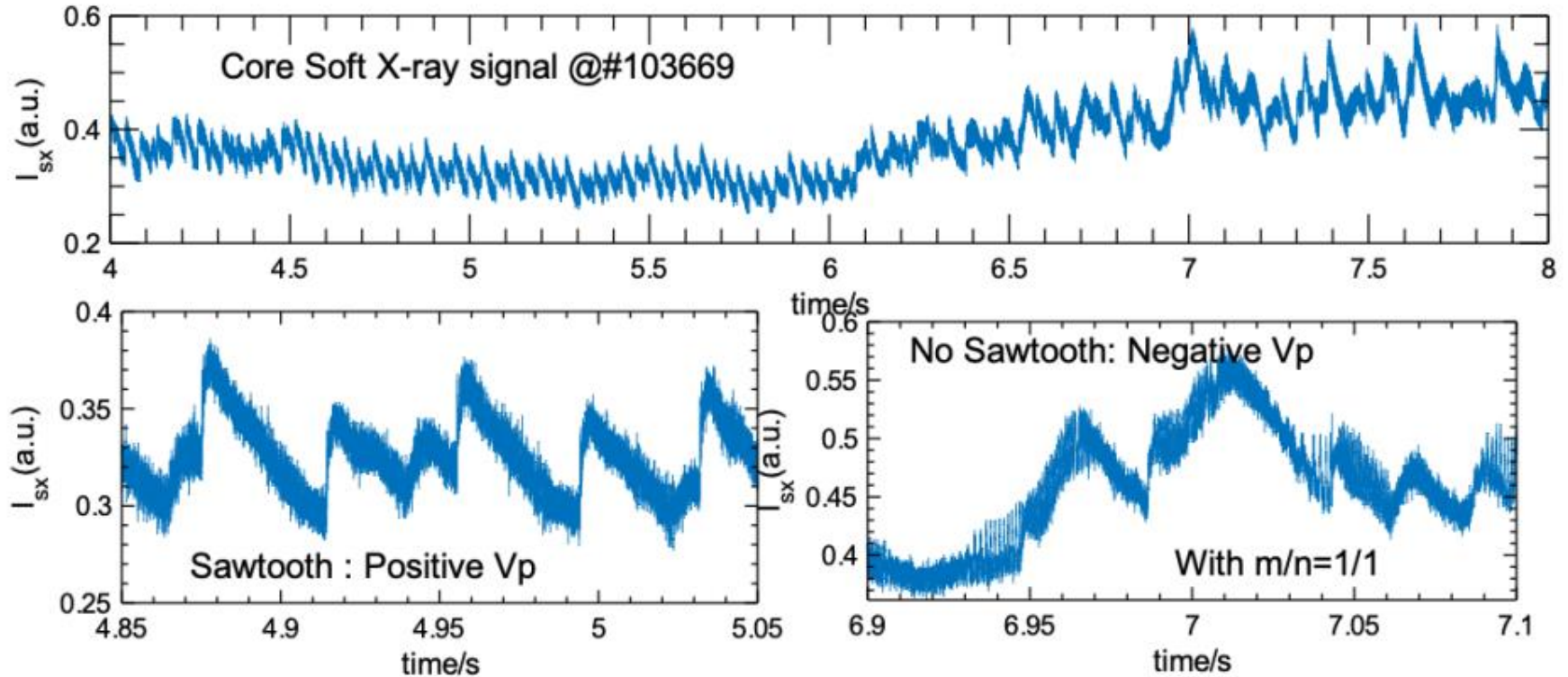
The 'inverted' sawtooth shown in Core SXR signal, is due to the formation of hollow SXR profile.

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
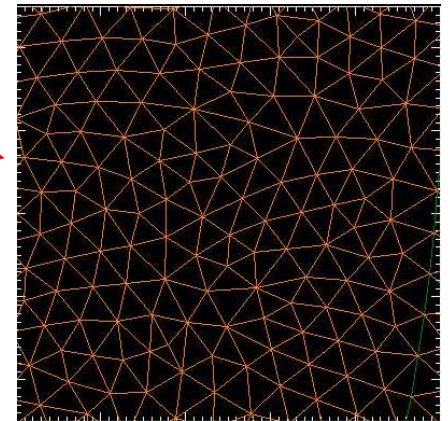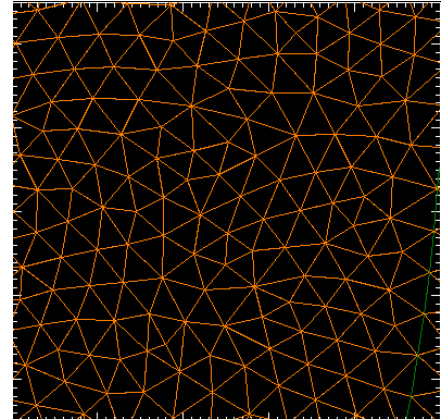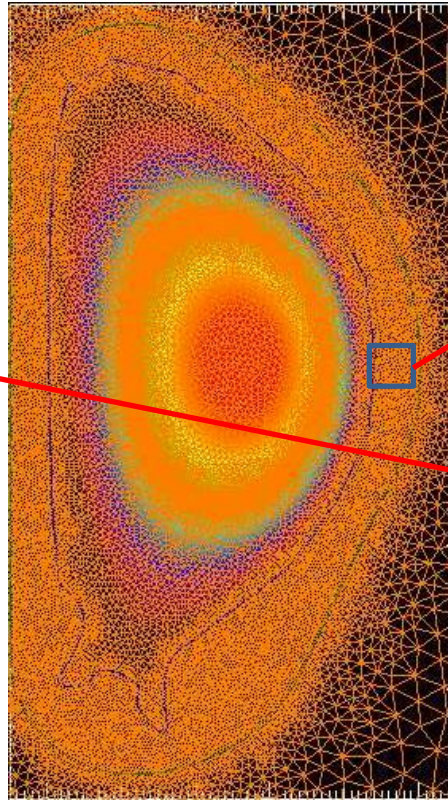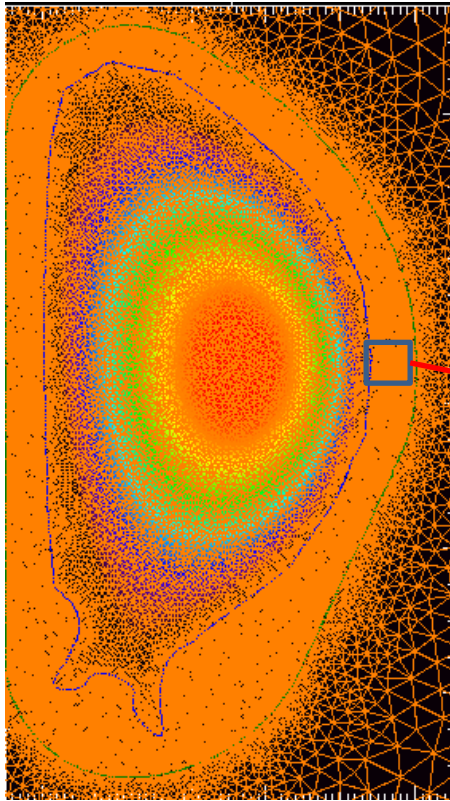
Testing on ITER equilibrium -- 1
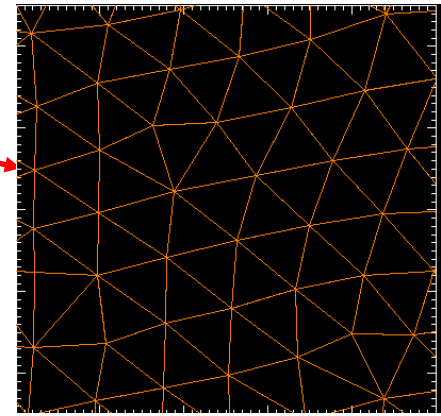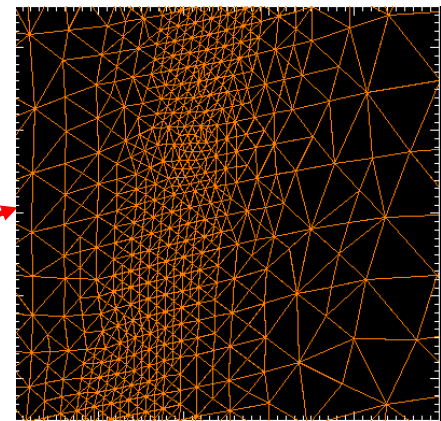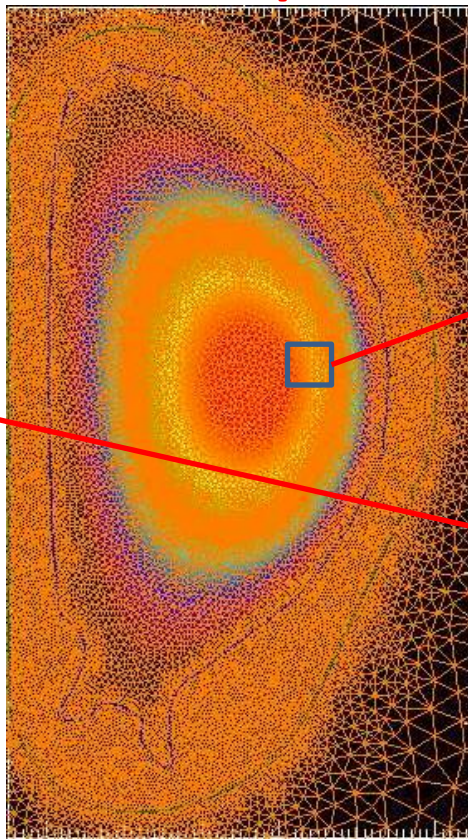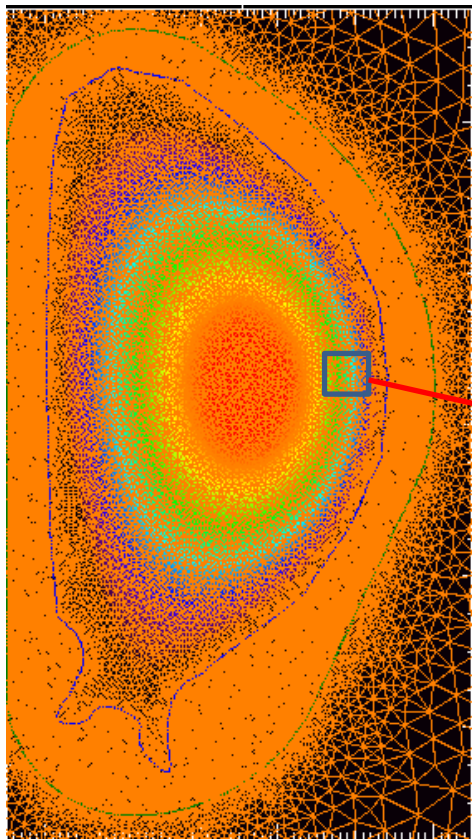
/p/tsc/m3dnl/ITER/NewMesh/Eq2   and …/Adapted   Refines plasma region ok
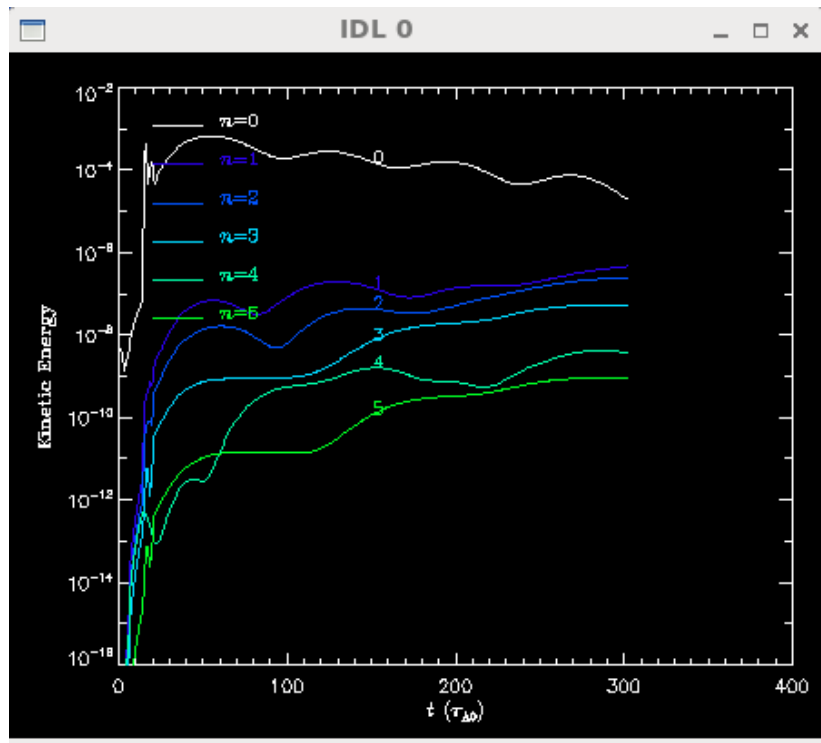
Testing on ITER equilibrium -- 2

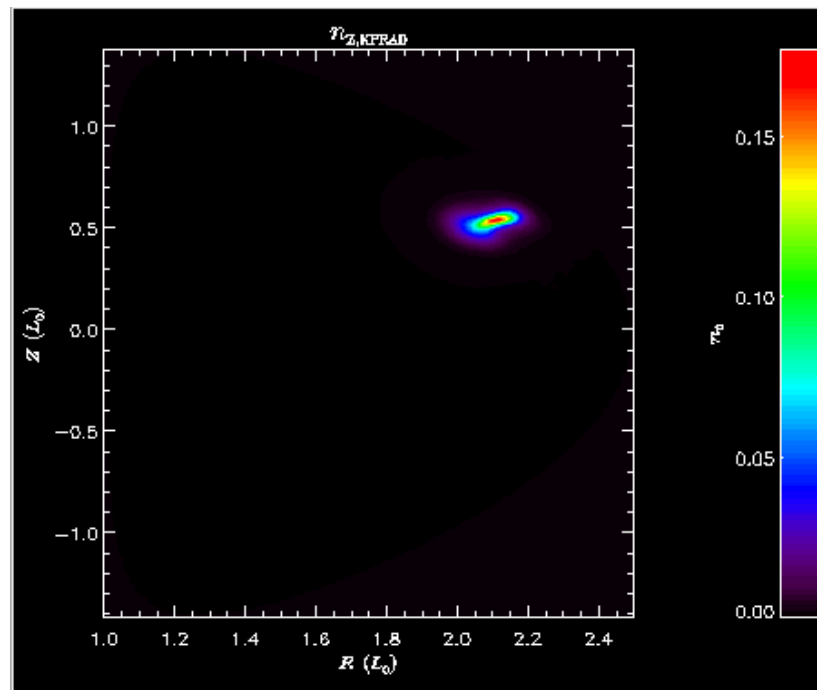/p/tsc/m3dnl/ITER/NewMesh/Eq2   and …/Adapted

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

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- 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?