

# M3D-C1 ZOOM Meeting

7/20/2020

## Agenda

1. Announcements
2. CS Issues
  1. Local systems
  2. New system benchmark status – Jin Chen
  3. NERSC Time
  4. Changes to GIT master since last meeting
  5. Errors along MPI boundaries with gmres – Yao Zhou
3. Physics Studies
  1. Runaways with sources Chen Z./S. Jardin
  2. M3D-C1 Carbon Mitigation and coupling to KORC: Clauser
  3. Summary: Vessel Forces from a VDE in ITER – S. Jardin
  4. Other

# Announcements

- Laboratory closed unless authorized
  - Once authorized, need to get single access code at <http://rtw-screen.pppl.gov>
- IAEA Technical Meeting on Disruptions and their mitigation
  - “Consequences Section” held this morning
- SciDAC PI meeting scheduled for July 28-30 July 2020 is *cancelled*
  - Replaced by a half-day remote panel session on July 29
- ITPA MHD Meeting October 14-16 2020
  - Fully Remote
- IAEA Fusion Energy Conference postponed to May 2021

# Local Systems

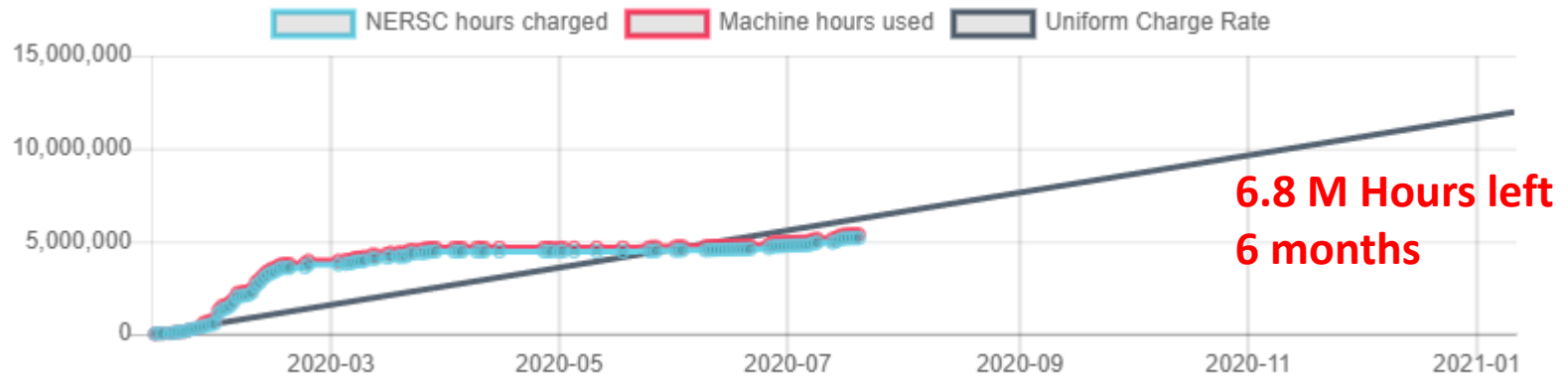
- PPPL
  - Problem with writing to /p/m3dc1 -- resolved!
  - New modules—see README/readme.centos7
  - m3dc1 partition of greene to move to centos7 Tomorrow July 21
  - Change readme.centso7 → readme.m3dc1 ??
  - Reg\_tests
    - KPRAD\_2d, kprad\_restart,RMP,RMP\_nonlin,pellet
    - adapt failed
- EDDY
  - New modules – see README/readme.eddy
  - Reg\_tests
    - Reg tests KPRAD\_2D, KPRAD\_restart failed
    - Reg tests pellet, RMP, RMP\_nonlin passed

# New system benchmark status

Jin Chen ?

# NERSC

MP288



M3163

Has not been updated.

- We will get SOME new M3163 time, but not as much as last year
- Should be enough mp288 time to last until new PU computer arrives in the fall
- Do not waste time!

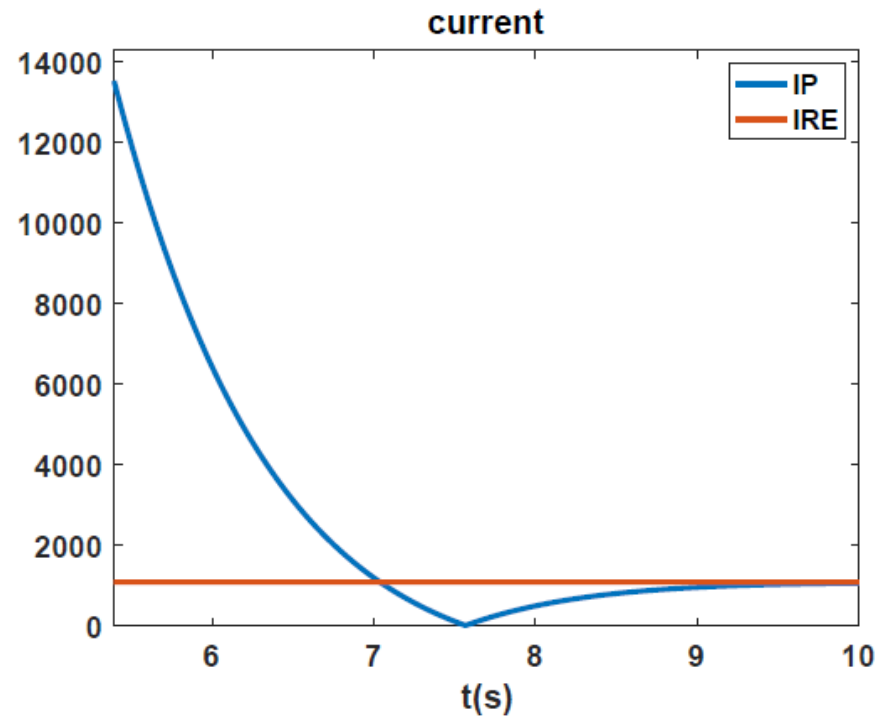
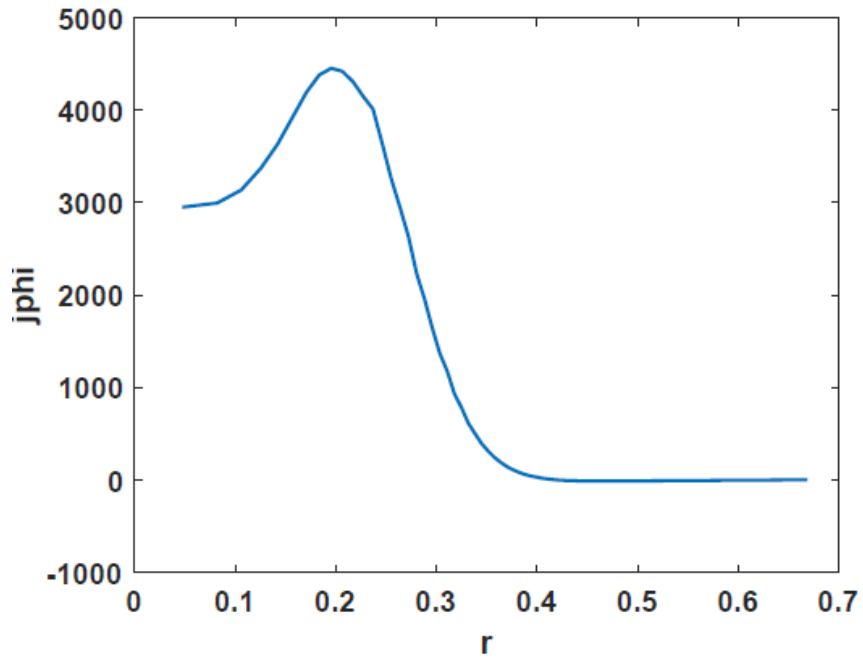
# Changes to github master since last week

- Ferraro:
  - 07/13/20: Revoved superfluous ARCH from readme.eddy  
Added eddy module to unstructured/modules  
Added pppl-centos7 to unstructured/modules  
Reorganized unstructured/modules  
Added devel-1.10.3 and devel 4.0.1 modules for pppl
  - 07/14/20: Minor updates to eddy and pppl devel modules  
Added devel-knl and devel-haswell modules for cori  
Updated cori and eddy readme files  
Fixed viscosity normalization in m3dc1\_units.sh to use ion mass instead of proton mass
- Jin Chen
  - 07/13/20: regtest fix on marconi
  - 07/14/20: regtest fix on marconi 2,3
- Clauser
  - 07/18/20: pellet phi position in idl
- Lyons
  - 07/15/20: add pellet regtest for centos7
  - 07/16/20: add ipellet=15, same as 11 but with pellet\_var\_tor a constant angle instead of constant scale length

# Errors along MPI boundaries with gmres

Yao Zhou

# Runaways with Sources

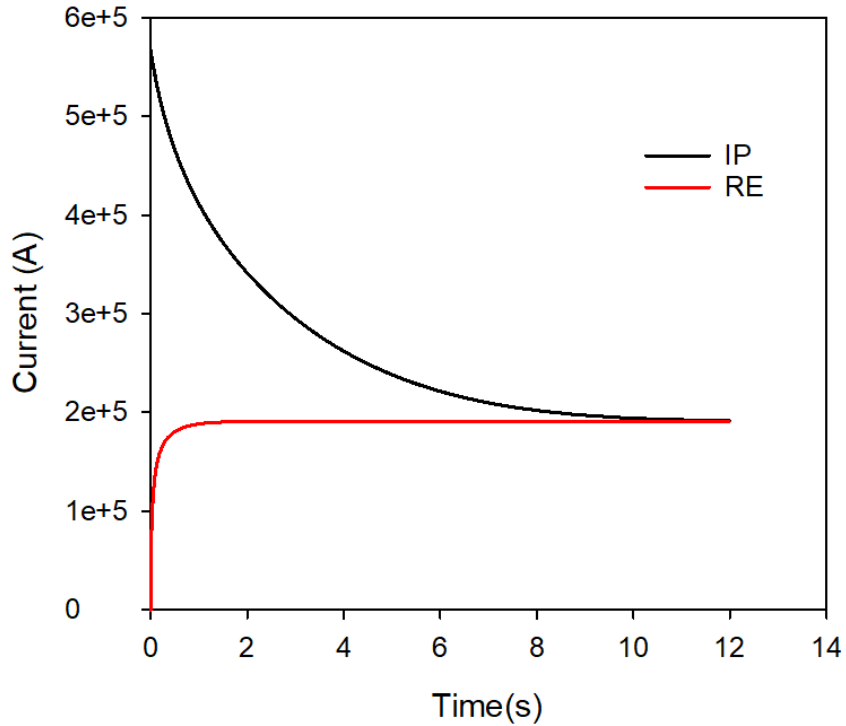


Chen Zhao

Ne=1.e19, a=0.7, R0=1.7



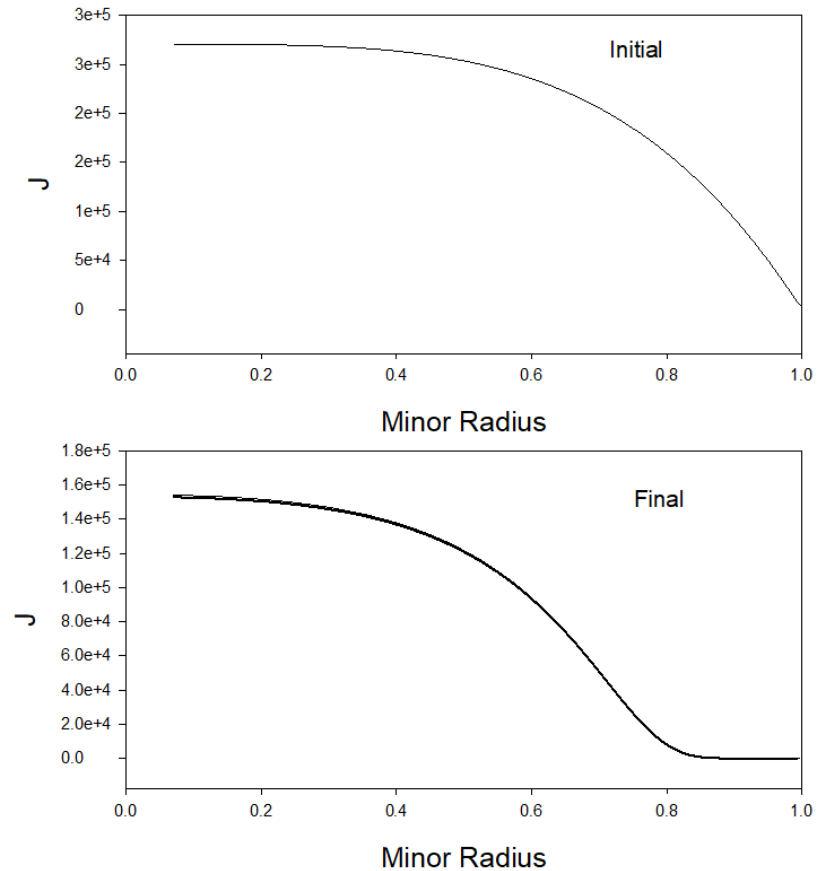
# 1D Fortran Program



ne=0.5 E18

Te: 1keV → 500 eV

scj



## 1D Runaway Electron Formation

$$\dot{\psi} = \frac{\eta}{\mu_0} \left[ \frac{1}{r} \frac{\partial}{\partial r} r \frac{\partial \psi}{\partial r} - \mu_0 R J_{RE} \right] \quad y = r^2 \quad \dot{\psi} = \frac{\eta}{\mu_0} \left[ 4 \frac{\partial}{\partial y} y \frac{\partial \psi}{\partial y} - \mu_0 R J_{RE} \right]$$

$$\frac{dn_r}{dt} = n_e v_{ee} E^{-3(1+Z)/16} \exp \left[ -1 / (4E) - \sqrt{(1+Z) / E} \right] \quad v_{ee} = n_e e^4 \ln \Lambda / 4\pi \epsilon_0^2 m_e^2 v_{th}^3 \quad v_{th} = \sqrt{2T_e / m_e}$$

$$E = (T_e / m_e c^2) (E_{EF} / E_c) \quad E_c = n_e e^3 \ln \Lambda / 4\pi \epsilon_0^2 m_e c^2 \quad E_{EF} = \frac{\eta}{\mu_0} \left[ \frac{4}{R} \frac{\partial}{\partial y} y \frac{\partial \psi}{\partial y} - \mu_0 J_{RE} \right]$$

$$T_e = 10^3 \text{ eV} \quad n_e = 10^{20} \text{ m}^{-3}$$

$$v_{th} = \left[ \frac{T_e \times 2 \times 1.1604 \times 10^4 \text{ K} \times 1.3807 \times 10^{-23} \text{ J / K}}{9.1094 \times 10^{-31} \text{ kg}} \right]^{1/2} = 5.93 \times 10^5 \sqrt{T_e} \text{ ms}^{-1}$$

$$v_{ee} = \frac{n_0 \text{ m}^{-3} \times (1.6022 \times 10^{-19} \text{ C})^4 \times 20}{4\pi (8.8542 \times 10^{-12} \text{ Fm}^{-1})^2 (9.1094 \times 10^{-31} \text{ kg})^2 (5.93 \times 10^5 \sqrt{T_e} \text{ ms}^{-1})^3} = 7.731 \times 10^{-11} n_0 T_e^{-3/2} \text{ s}^{-1}$$

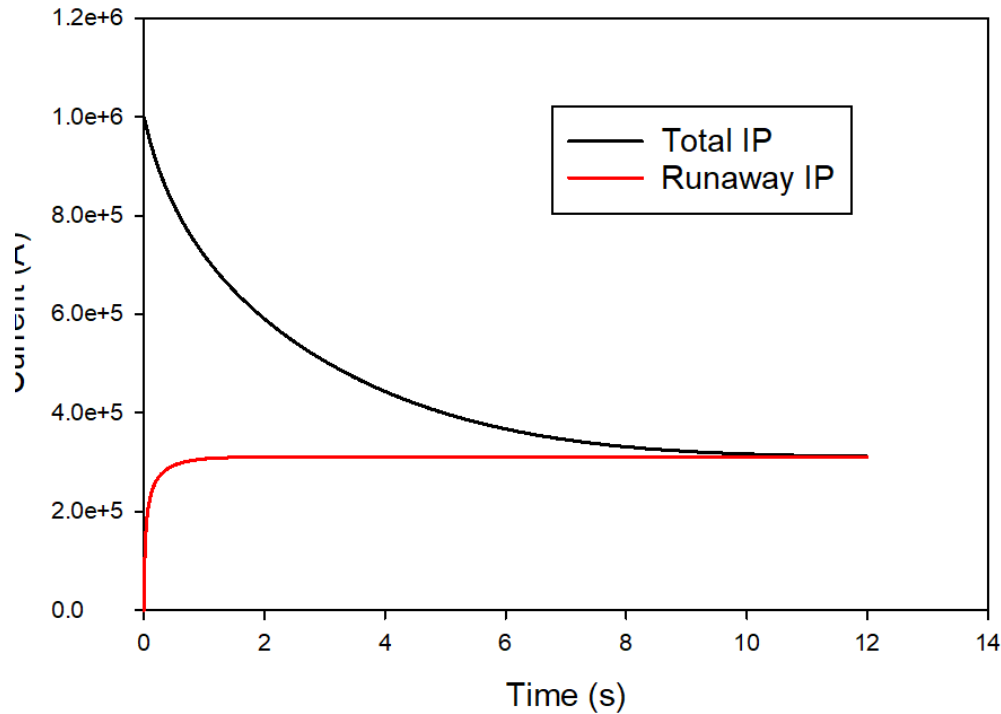
$$E_c = \frac{n_0 \text{ m}^{-3} \times (1.6022 \times 10^{-19} \text{ C})^3 \times 20}{4\pi (8.8542 \times 10^{-12} \text{ Fm}^{-1})^2 (9.1094 \times 10^{-31} \text{ kg}) (3.0 \times 10^8 \text{ ms}^{-1})^2} = 1.018 \times 10^{-21} n_0 \text{ Vm}^{-1}$$

$$E = \frac{T_e \times 1.1604 \times 10^4 \text{ K} \times 1.3807 \times 10^{-23} \text{ J / K}}{(9.1094 \times 10^{-31} \text{ kg}) (3.0 \times 10^8 \text{ ms}^{-1})^2} (E_{EF} / E_c) = 1.95 \times 10^{-6} T_e (E_{EF} / E_c)$$

$$\eta = 1.03 \times 10^{-4} \times 20 \times T_e^{-3/2} \Omega \text{ m} = 2.06 \times 10^{-3} T_e^{-3/2} \Omega \text{ m} \quad \eta / \mu_0 = \frac{2.06 \times 10^{-3} T_e^{-3/2}}{4\pi \times 10^{-7}} = 1.639 \times 10^3 T_e^{-3/2} \text{ m}^2 \text{ s}^{-1}$$

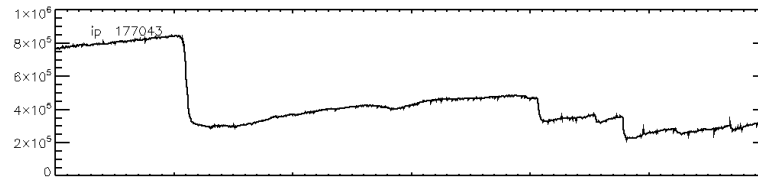
# Initial Condition

$$\frac{\partial}{\partial y} y \frac{\partial \psi}{\partial y} = \frac{1}{4} R J_0 \left[ 1 - \left( \frac{y}{a^2} \right)^2 \right], \quad \psi = \frac{1}{4} R J_0 \left[ y - \frac{y^3}{9a^4} \right]$$

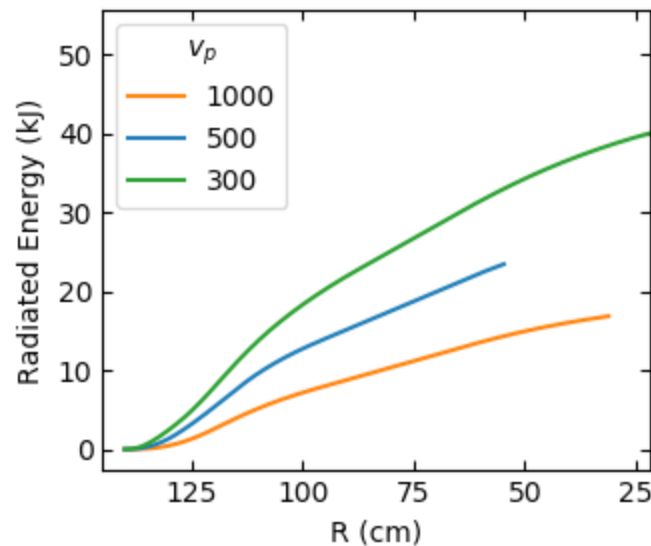


# M3D-C1 coupling to RE code KORC

- Plan to target DIII-D shot 177043 after Chen has a full simulation with fluid runaway electrons

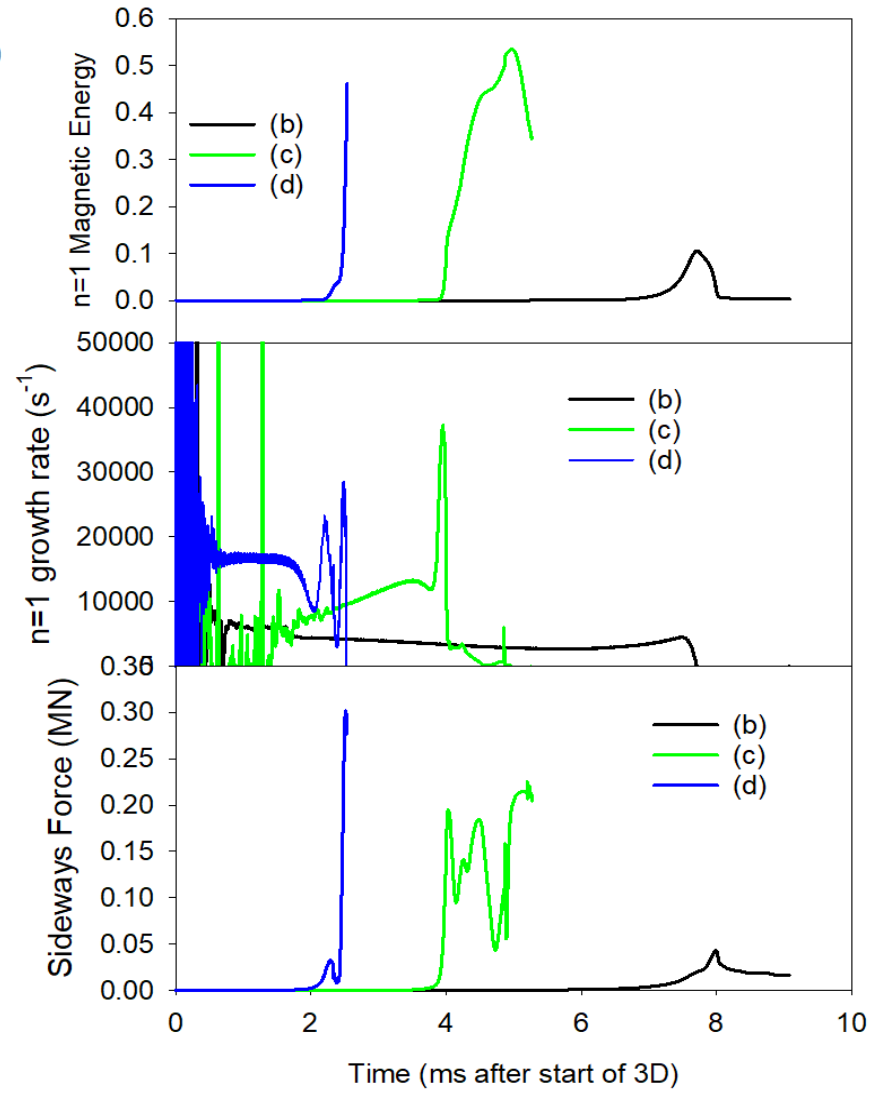
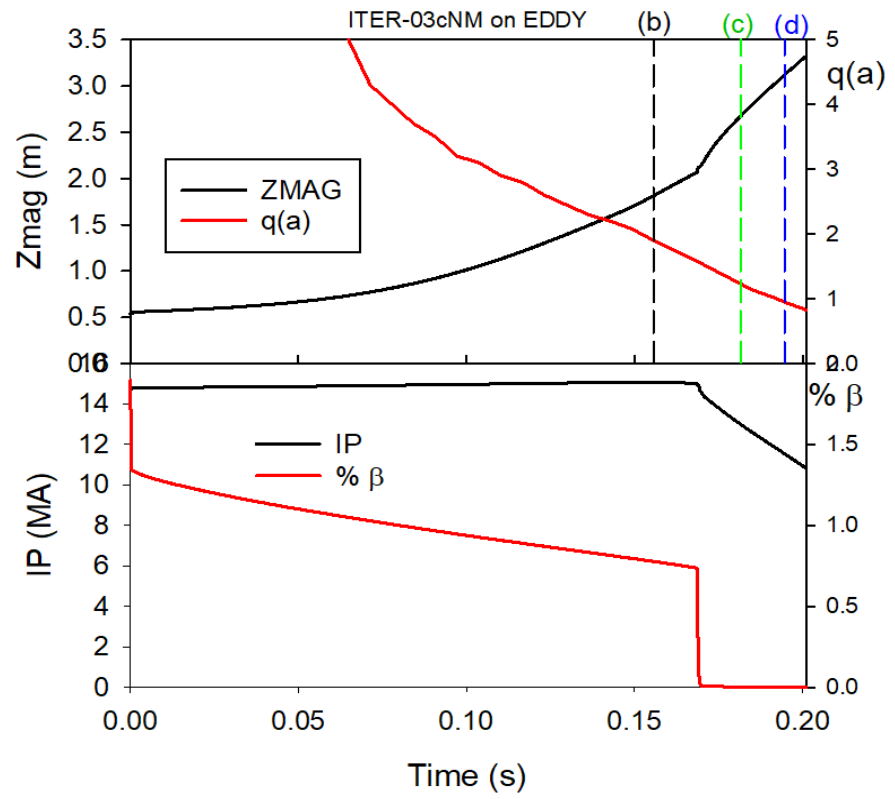


- KORC can now run using fields, densities, and temperatures from M3D-C1 hdf5 files using Nate's Fusion-IO routines
- Cesar trying to increase C-concentration to get stronger TQ and CQ



- Total radiated energy increases as pellet speed decreases
- Try 100 m/s ?
- Also trying uniform distribution in 2D

# Update: Vessel Forces During a Disruption in ITER



That's All I have

Anything Else ?