

# ***Center for Extended MHD Modeling***

Santa Fe

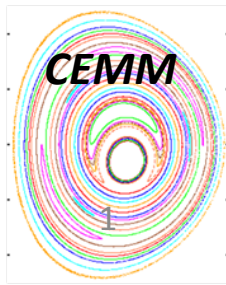
14 April 2013

New Mexico Room, La Fonda Hotel

## **Status and Agenda**

S. C. Jardin

PPPL



# Award Letter: Nov 4, 2010

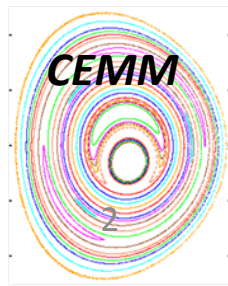
I am pleased to inform you that the five-year proposal entitled “Center for Extended Magnetohydrodynamic Modeling” you submitted to this solicitation, is one of five that have been recommended for funding. FES is planning to allocate \$1,050,000 of FY 2011 funds to continue your current project. Funding beyond the first year is contingent upon the availability of funds, progress of the research, and programmatic needs. Funding for the final two years is contingent upon satisfactory completion of a progress review during the third year of the project.

- FY 2011
- FY 2012
- FY 2013 --- started Oct 1, 2012
- FY 2014 } *satisfactory completion*
- FY 2015 } *of progress review*

**Requested: \$ 1.20 M/yr**

**Awarded: \$ 1.05 M/yr**

**(87.5 %)**



# Proposed Work

## 4.1 ELMs and ELM Control using RMP

- Linear RMP modeling has received high visibility.
  - Can we model a complete non-linear ELM cycle (with XGCO ?)
  - Can we reproduce  $\gamma_{MHD} < \omega_* / 2$ ;
  - Particle transport in RMP fields

## 4.2 Disruption Studies and Mitigation

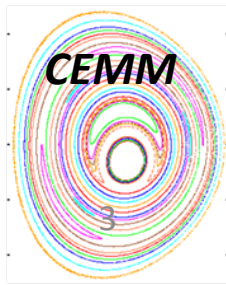
- Present modeling has high visibility (DIII, ITER, ITPA, Theory Milestone)
  - Wall force, boundary conditions, MGI, runaways, DIII-D, NSTX
  - Causes of disruptions? Starting work on NSTX.

## 4.3 Giant Sawteeth Studies

- Will this work continue? Should we shift focus to comparison of sawteeth in Ellipse and Bean

## 4.4 Resistive Wall Mode

- M3D-C1 ... plans to include thick wall. Kinetic effects?
- NIMROD ???



# ***Proposed Work-2***

## 4.5 Neoclassical tearing modes

- Work underway with both NIMROD and M3D-C1
- Ramos working on Two-fluid tearing benchmark (NIMROD, M3D-C1)

## 4.6 Error Fields and 3D Perturbations

- Error fields in the presence of plasma rotation

## 4.7 Model Development – continuum kinetic

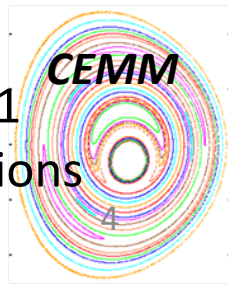
- Held, et al work on NIMROD (reported today)
- Lyons, Ramos, et al work in M3D-C1...plans reported today

## 4.8 Model Development – hybrid kinetic

- Drift-kinetic ion model (from M3D?) into M3D-C1?
- Lorentz ion model into NIMROD

## 4.9 Applied Math and CS

- M3D-C1 development (on schedule)
- Advanced algorithmic development in HiFi then ported to M3D-C1
- NIMROD algorithmic development and comparison of basis functions



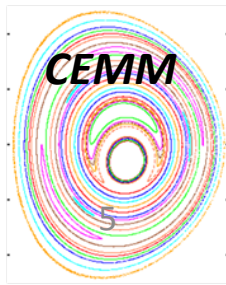
# Verification and Validation Plans

## Code Verification plans:

- Section 4.5: Compare bootstrap current predictions from NIMROD and NEO
  - Done. Will also include M3D-C1
- Section 4.5: Two-fluid tearing mode benchmark
  - M3D-C1 to do new Ramos benchmark, NIMROD Ahedo and Ramos benchmark
- Section 4.6: NIMROD/M3D –C1 comparison of effects of error fields with rotation
  - New benchmark case? Waelbrock interested.
- Section 4.8: Expand the two-fluid tearing mode benchmark to include GEM
  - Scott Parker, et al

## Validation with Experimental Data as discussed in Proposal:

- Section 4.1: ELM modeling in DIII-D, NSTX, and Alcator C-mod
- Section 4.2: Comparison of disruption halo current predicted with NSTX data
- Section 4.2: Comparison of Runaway Electron calculations with CMOD and DIII-D
- Section 4.3: Comparison of Giant Sawtooth simulations with DIII-D
  - Extend this to include simulation of sawteeth in Beans/Ellipses with M3D-C1 ?
- Section 4.4: Comparison of kinetic resistive wall mode with NSTX and DIII-D
  - Could follow from Ramos/Lyons work



# Today's Agenda

- Jardin                   Introductory remarks and CEMM status
- Glasser                 Resistive DCON Status and Plans
- V. Izzo                 MGI Modeling and Runaway Confinement
- King                    Progress towards EHO computations
- Ferraro                RMP modeling
- P. Zhu                 Plasma response to RMP in DIII-D
- → Ferraro            discussion of RMP modeling
- Parker                Implicit kinetic MHD
- J.Obryan             Modeling DC startup in Pegasus
- Sugiyama             Sawteeth and 1/1 modes
- Jardin                 M3D-C1 sawtooth and internal mode modeling and plans
- → Jardin             discussion of sawtooth modeling
- Ramos                 2F tearing modes
- Held                  Plans and progress for coupled kinetic and MHD in NIMROD
- Lyons                 Plans and progress for coupled kinetic and MHD in M3D-C1
- Jenkins               ECCD induced tearing mode stabilization
- → Kruger             discussion of kinetic MHD
- 4:40 PM             Schnack     Kinetic and MHD ITG modes
- Strauss               Toroidal rotation and disruptions

