

Verification and Validation: V & V

D. D. Schnack

V & V

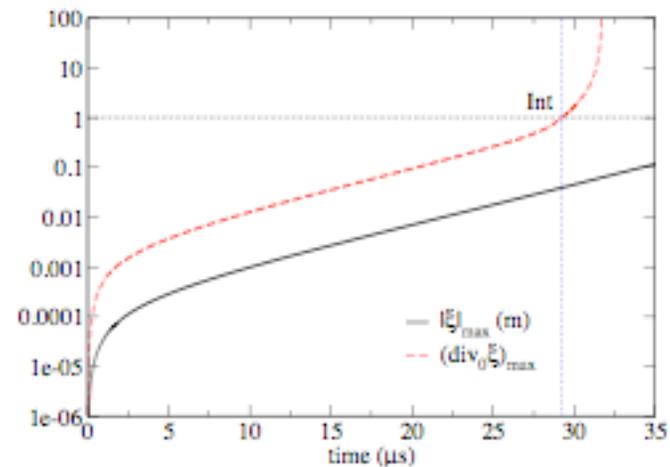
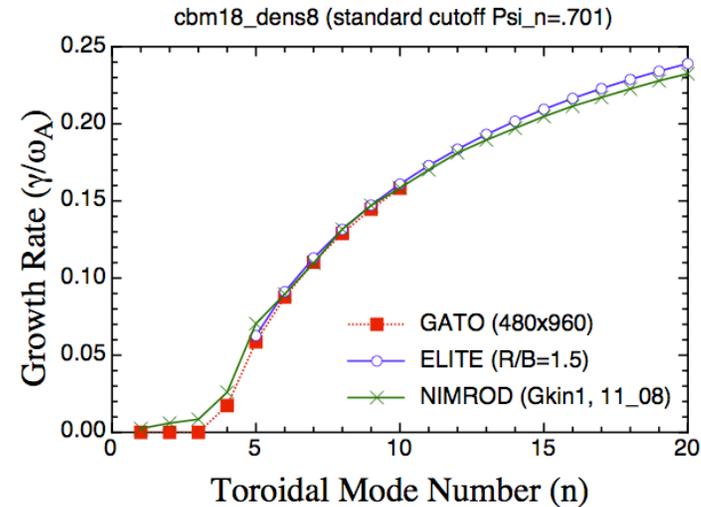
- Verification:
 - Are the equations being solved correctly?
- Validation:
 - Direct comparison between the solutions and experiment

Topics for V & V

- MHD (ideal and resistive)
- Two-fluid physics
- FLR (gyro-viscosity, etc.)
- Energetic ions
- Kinetic closures

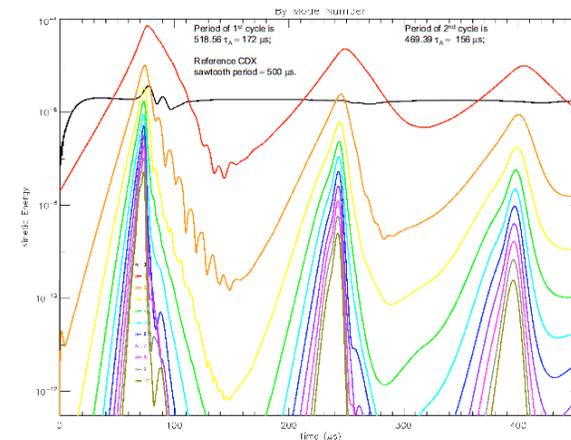
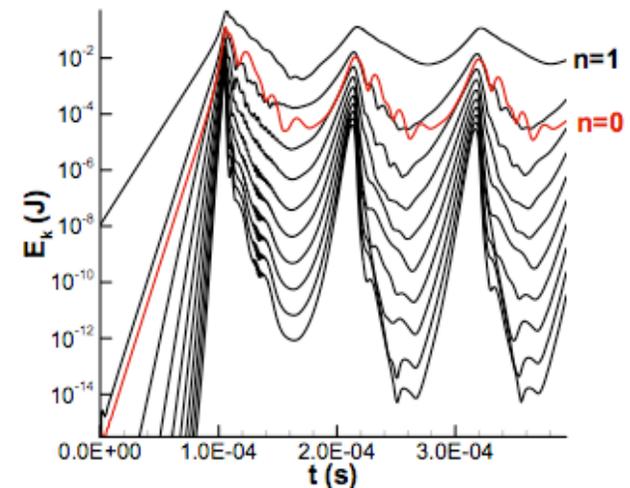
Verification: MHD

- Linear MHD: *CEMM* codes have been verified on “all” relevant linear MHD problems
- Nonlinear MHD: Comparison with “early nonlinear” analytic solutions (NIMROD)



Verification: Nonlinear Benchmarking

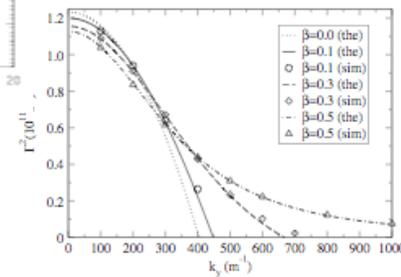
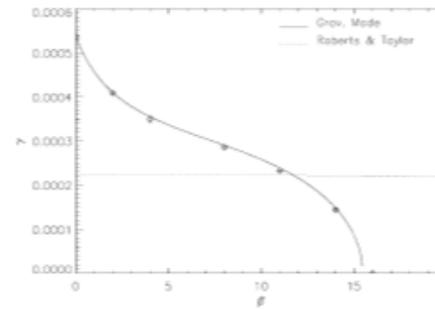
CDXU: Direct comparison
Between NIMROD and
M3D on nonlinear resistive
MHD tokamak problem



Verification: 2-fluid/FLR effects

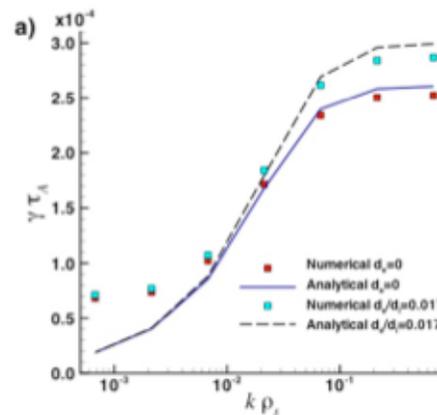
2-fluid and FLR effects on g-mode

(Ferraro & Jardin, Zhu et al.)

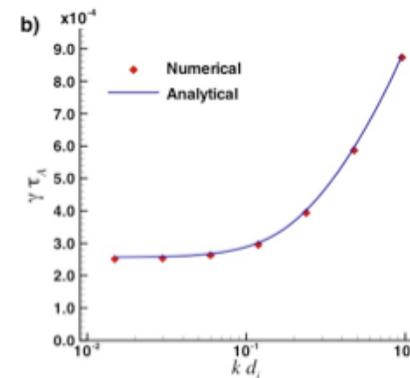


2-fluid tearing mode

Nonlinear 2-fluid sawtooth in cylinder and torus (Not shown)



Mirnov



Ramos

Verification: other issues

- Energetic minority species:
 - NIMROD/M3D benchmark on 2/1 fishbone
- Kinetic closures
 - Test problems for thermal transport across island (in progress)

Validation: Comparison with Experiment

- SSPX: spheromak
- HIT-II: Helicity injection

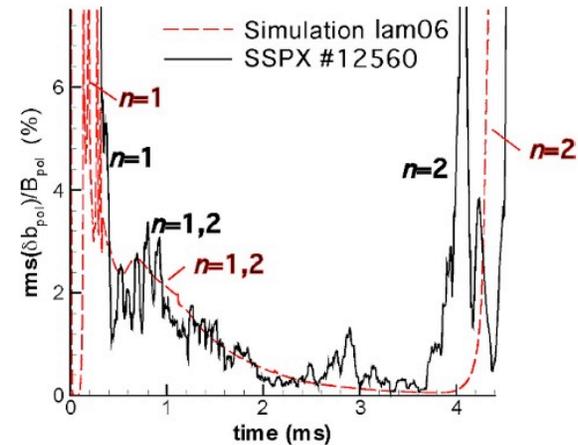
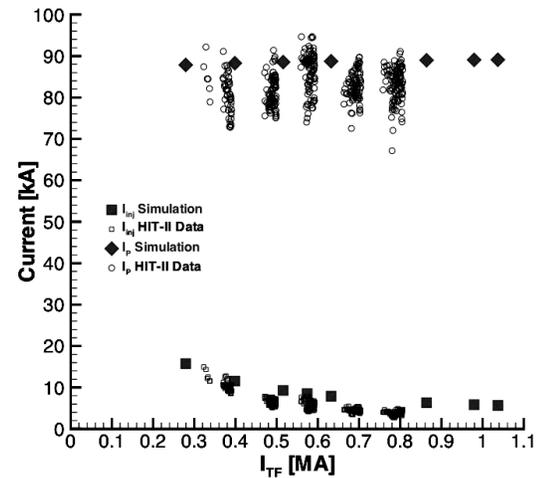
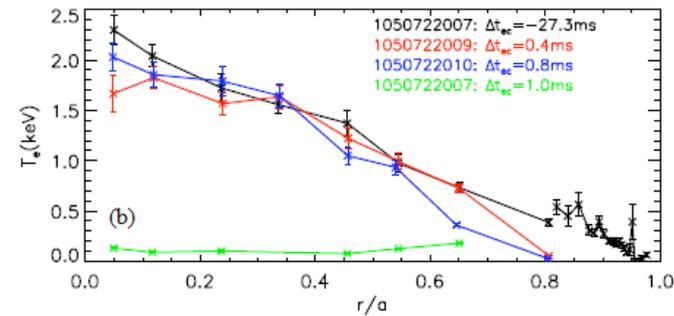
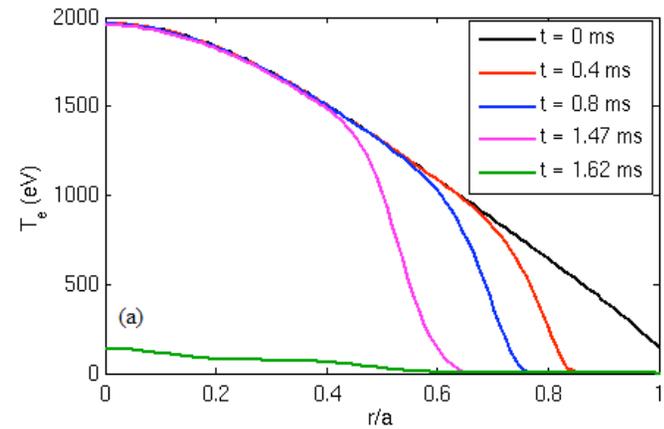


FIG. 6. Time histories of the edge-probe poloidal magnetic field fluctuation data from SSPX discharge shot 12 560 and simulation lam06.



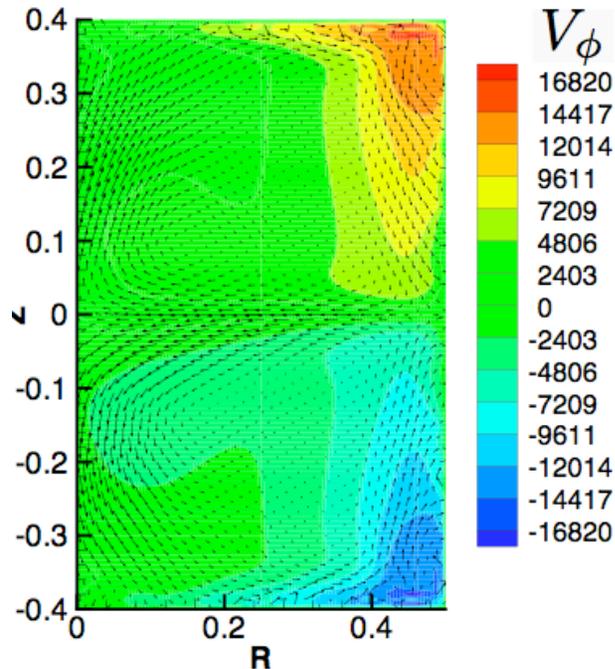
Validation: Tokamak

- Evolution of electron temperature profiles in DIII-D (V. Izzo)

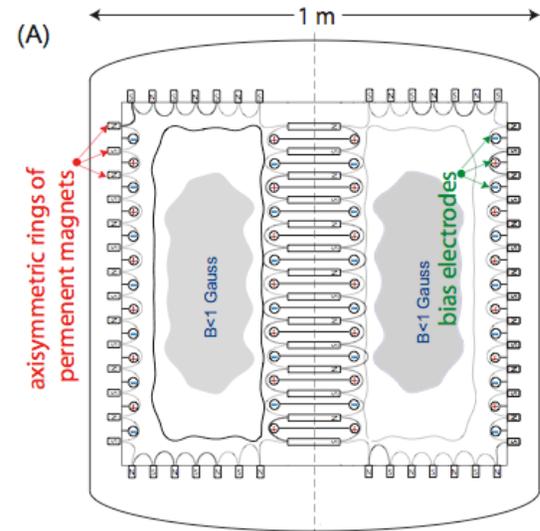


Verification: A new experiment

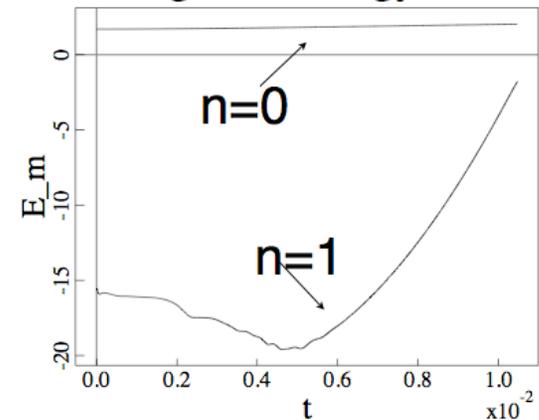
Couette flow/plasma dynamo experiment, C. B. Forrest, UW
Potential for *direct* comparison



NIMROD
simulation of
twisting flow.
Is there a
dynamo?



Magnetic Energy vs. t



Validation: PSI Center

- Much validation work done through PSI Center, U. Washington
(meeting Tuesday afternoon, 5:30)

Discussion.....