

Plans and related needs for theory/modeling support – Columbia University group

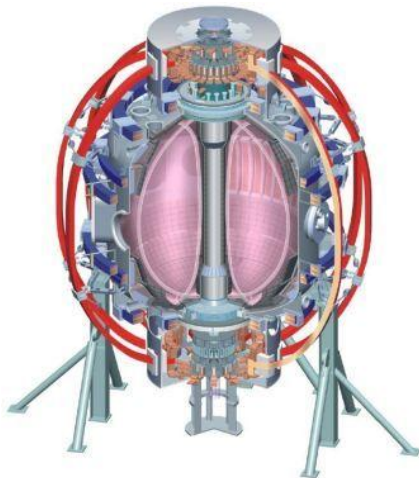
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NSTX-U Theory/Simulation Meeting - Macro-stability
February 14th, 2012



PPPL



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Needs for theory/simulation plans follow Columbia U. NSTX-U grant proposal research plans

- ❑ Physics research areas on NSTX-U
 - ❑ Global MHD mode stabilization physics
 - ❑ Global MHD mode active control
 - ❑ Plasma rotation alteration / modeling / control
 - ❑ ELM mitigation / stabilization physics

- ❑ Related/coordinated research on KSTAR
 - ❑ Aimed at long-pulse, high beta
 - ❑ Higher aspect ratio of KSTAR provides opportunity for comparison to NSTX-U to determine role of A

- ❑ Quantitative analysis on ITER cases, future devices
 - ❑ Continue present publication results; device/code benchmarking
 - ❑ Support of ST-FNSF (e.g. PPPL LDRD effort, ORNL target), etc.

Planned analysis builds from present capabilities and collaborative work

□ Equilibrium

- Free-boundary: NSTX EFIT
- Fixed boundary: CHEASE (w/Liu), JSOLVER, etc.

□ Stability

- DCON, PEST: ideal stability analysis
- MISK (w/R. Betti): kinetic RWM stability analysis
- M3D-C¹ (w/S. Jardin, N. Ferraro): linear/non-linear stability
- NIMROD (w/S. Kruger): recent collaboration started - NSTX cases being run

□ 3D Physics

- NTV analysis: New code, starting tests, planned comparison with JK Park
- TRIP3D (w/T. Evans): ELM mitigation – used for KSTAR
- M3D-C¹ (w/S. Jardin, N. Ferraro): effect of 3D field on stability
- V3FIT: (w/J. Hanson): started discussion - 3D field impact on equilibria

□ Control

- VALEN: RWM / dynamic error field control analysis
- Multi-mode VALEN: Unstable MHD mode spectrum and control
- RWMSC: State-space RWM analysis / feedback control

- Both a control program and an analysis tool

Analysis expansion driven by proposed research and device needs

□ Equilibrium

- NSTX EFIT: expand diagnostics/model, NSTX-U: begin w/simulations
- CHEASE: (w/Liu), JSOLVER, etc.: eq. refinement / eq. exchange

□ Stability

- DCON, PEST: ideal stability analysis
- MISK: continued development driven by XP data (see J. Berkery talk)
- M3D-C¹: resistive wall available soon / desire for kinetic effects (~ MISK)
- NIMROD: resistive wall / kinetic effects available – collaborative development

□ 3D Physics

- NTV analysis: continued development driven by XP data
- TRIP3D: ELM mitigation – use for NSTX-U as desired
- M3D-C¹ (Jardin, Ferraro): desire wall/kinetic/expanded 3D field spectrum input
- V3FIT: start analysis - determine 3D field impact on eq. Plan for NSTX-U ops.

□ Control

- VALEN: continue NSTX-U RWM control analysis
- Multi-mode VALEN: multi-mode spectrum NSTX-U, active control w/RWMSC
- RWMSC: $n > 1$ modeling + upgrades, control simulator w/expanded inputs
 - Inputs: Device data, vacuum field, code results (VALEN, M3D-C¹, etc.)