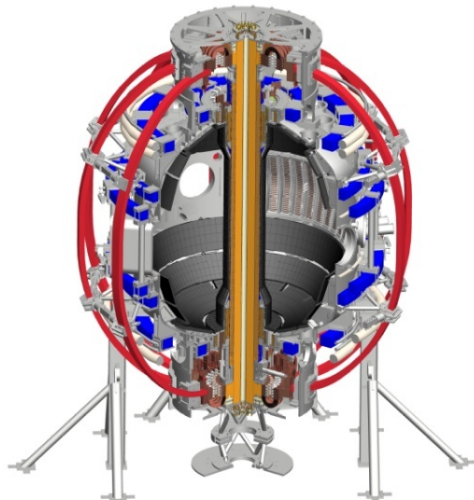


NSTX-U 5 year plan status for Macroscopic Stability (MS)

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B318, PPPL
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Coll of Wm & Mary
Columbia U
CompX
General Atomics
FIU
INL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Lehigh U
Nova Photonics
ORNL
PPPL
Princeton U
Purdue U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Illinois
U Maryland
U Rochester
U Tennessee
U Tulsa
U Washington
U Wisconsin
X Science LLC



Culham Sci Ctr
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Inst for Nucl Res, Kiev
Ioffe Inst
TRINITI
Chonbuk Natl U
NFRI
KAIST
POSTECH
Seoul Natl U
ASIPP
CIEMAT
FOM Inst DIFFER
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep

Summary of high-level research thrusts/goals

- Stability: Understand and advance passive and active feedback control to sustain macroscopic stability
 - Berkery wrote some material, but **need Sabbagh input**
 - Also needs reorganization from subdivision by year to division by topic
- 3D: Understand 3D field effects and provide physics basis for optimizing stability through equilibrium profile control by 3D fields
 - Written by Park. Just needs some editing.
- Disruption: Understand disruption dynamics and develop techniques on disruption detection, mitigation, and avoidance, in high-performance ST plasmas
 - Three subthrusts: one by Gerhardt complete, one by Raman complete, **one by Sabbagh empty.**

2.3 Summary of theory and simulation capabilities

<i>Code</i>	<i>Description</i>	<i>Scope</i>	<i>Improvements</i>
EFIT	Equilibrium reconstruction code	Between-shots equilibrium reconstruction	Higher resolution, auto best level, new diagnostics
DCON	Ideal MHD stability code	Ideal Kink stability analysis with and without the wall up to $n=6$	Resistive layer physics across rational surfaces (Resistive DCON)
IPEC/GPEC	Ideal and general perturbed equilibrium with 3D fields	Plasma response, locking, and NTV studies with 3D fields	General force balance equation including general jump conditions
MISK	Modifications to ideal stability by kinetic effects	Calculation of resistive wall mode stability	Improved model of energetic particle, anisotropy effects
POCA	δf guiding-center orbit code	Calculation of neoclassical transport, perturbed pressures and NTV	Improved numerical scheme to enhance computation speed
VALEN	Models currents in structures with thin shell finite elements	Resistive wall mode active feedback simulation	Multi-mode VALEN
MARS-K	Self-consistent kinetic stability calculation	Calculation of RWM stability and plasma response to perturbation	Inclusion of energy dependent collisionality for NTV calculation
M3D-C ¹	Implicit resistive and 2-fluid MHD code	Linear and nonlinear MHD stability	Neoclassical terms, resistive wall being added
DEGAS-2	Monte Carlo code to compute transport of neutral atoms	Calculation of neutral gas penetration through SOL	Include multiple gas species Use exact NSTX-U SOL conditions from UEDGE

Table 2.3: Summary table of the main codes used for theory-experiment comparison on NSTX-U.

2.4 Summary of diagnostics for macroscopic stability research

- ~ • Magnetic BP and BR RWM sensor refurbishment and upgrade
 - Berkery wrote something – need Sabbagh and Gerhardt to check.
- ✓ • Real-time velocity measurement for successful implementation of rotation control, and disruption detection
 - Podesta sent material, but should be in Masa's chapter. Just a pointer here.
- ✓ • Toroidally displaced multi-energy SXR to study 3D physics including island dynamics, and RWM eigenfunctions
 - Pointer to Masa's chapter.
- ✗ • Core X-ray imaging spectrometer to study rotation effects on error field and early MHD without NBIs
 - Delgado?
- ✗ • Internal magnetic fluctuation measurement for island structures
 - Levinton, Foley?
- ✓ • Real time MSE and MPTS for fast and precise kinetic equilibrium reconstruction
 - Pointer to Masa's chapter.
- ✓ • Diagnostics for disruption mitigation studies
 - Gerhardt described shunt tiles in chapter. Raman and Tritz sent proposed SXR/VUV diagnostic.

2.5 Non-axisymmetric control coil (NCC)

- Motivation and design
 - Park wrote something. Just needs editing.
- RWM active control for significant multi-mode spectrum.
 - Berkery wrote something. Needs work from Sabbagh.
- Rotation control by NTV braking
 - Park wrote something. Needs more description and plots.
- Error field correction and tearing mode stabilization
 - Park wrote something. Needs more on tearing mode stabilization.
- RWM kinetic stabilization
 - Berkery wrote something, not much to it. Not sure this needs it's own subsection.
- ELM control and stabilization
 - Berkery wrote something based on Evans input. Doesn't have any results, just research questions that can be addressed. Needs work from Evans or Park on NSTX-U targets.
- Simultaneous control for rotation, error field, RWM, TM, ELM
 - Berkery wrote something. Needs work.
- Prediction for ITER and FNSF 3D coil capabilities
 - Berkery wrote something. Needs work.