NSTX

Supported by

U.S. DEPARTMENT OF ENERGY | Office of Science

Diagnostics supporting advanced global mode stabilization studies

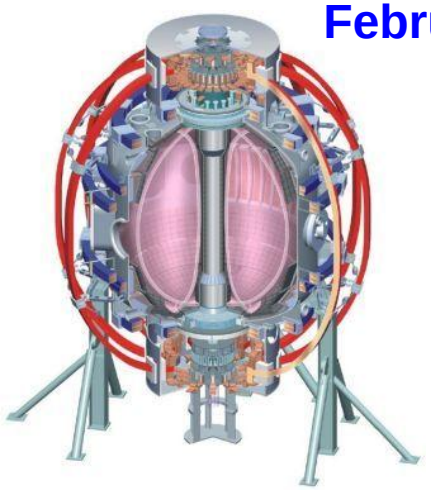
S.A. Sabbagh[1], J.W. Berkery[1] J.M. Bialek[1], T.E. Evans[2], S.P. Gerhardt[3], Y.S. Park[1], K. Tritz[4]

[1]Department of Applied Physics, Columbia University, NY, NY
[2]General Atomics, San Diego, CA
[3]Plasma Physics Laboratory, Princeton University, Princeton, NJ
[4]Johns-Hopkins University, Baltimore, MD

Columbia U
CompX
General Atomics
FIU
INL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
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 Washington
U Wisconsin

Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
NFRI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep

NSTX-U Facility Enhancement Brainstorming Meeting
February 8th, 2012



PPPL

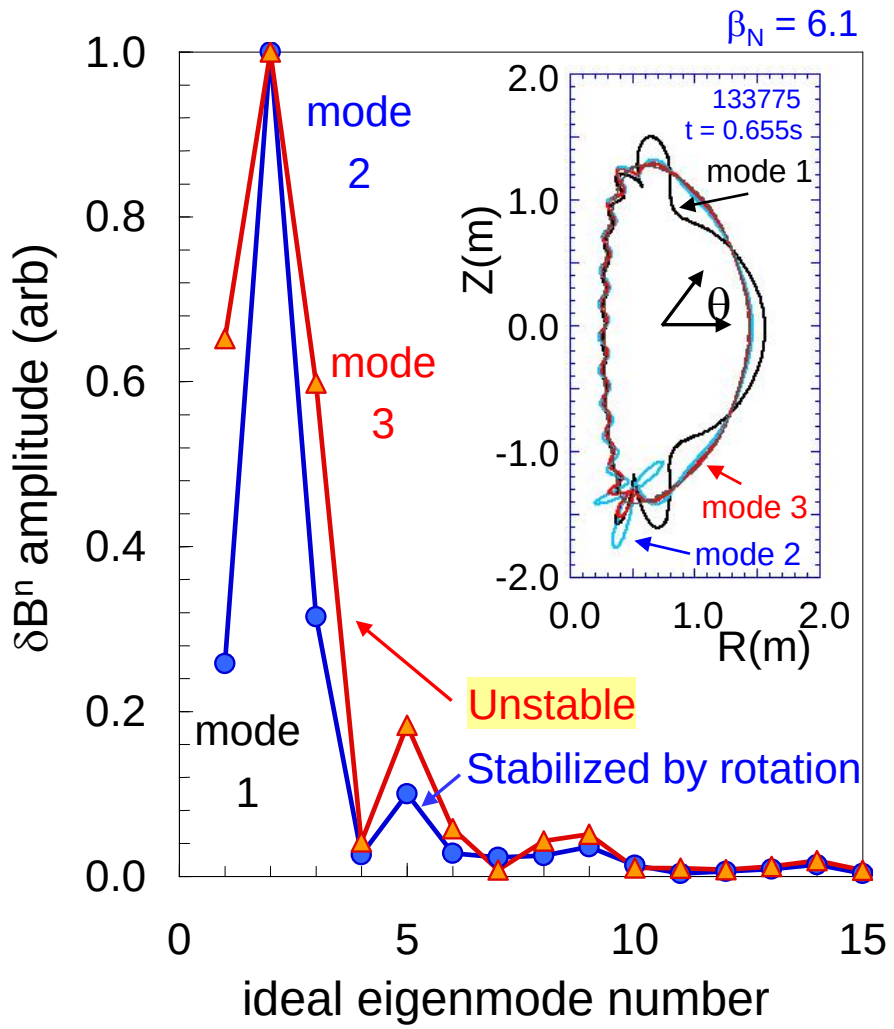
V1.0

Some new diagnostics would significantly enhance proposed MHD stability studies

- Magnetic
  - Low frequency MHD sensors over a wider poloidal range
    - Midplane: for global mode/RWM diagnosis – are our eigenfunction expectations from MHD correct, especially during mode growth? WIll internal sensors show key difference compared to external LMD?
    - Closer to divertor: diagnose, and perhaps feed back upon the “divertor” mode with the NCC
    - Direct use in RWM state space controller: for both physics studies of the observer model, and improved control – defined needs for ITER, etc.
- Kinetic
  - SXR sensors for global mode feedback
    - Magnetic sensors problematic in future high neutron environments
    - Typically aimed at RWM – still a major application. Proposed before for NSTX (JHU), but not funded
    - Also use in real-time to detect internal (global) kinks - using NBI, plasma rotation as actuators to alter mode stability in feedback; disruption detection

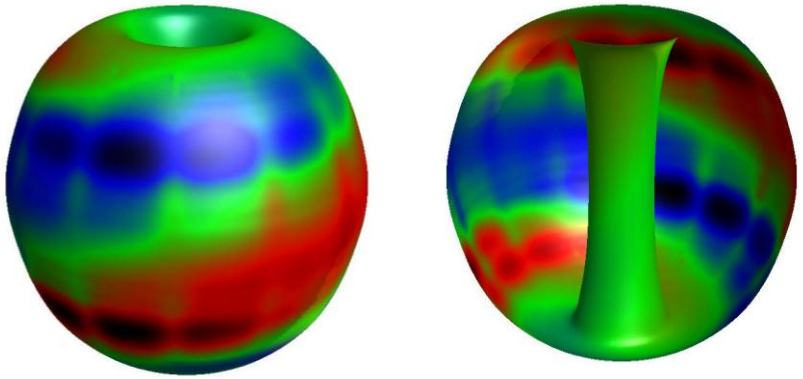
Multi-mode RWM computation shows 2nd eigenmode component has dominant amplitude at high β_N in NSTX stabilizing structure

δB^n RWM multi-mode composition



mmVALEN code

δB^n from wall, multi-mode response



- NSTX RWM not stabilized by ω_ϕ
  - Computed growth time consistent with experiment
  - 2nd eigenmode ("divertor") has larger amplitude than ballooning eigenmode
- NSTX RWM stabilized by ω_ϕ
  - Ballooning eigenmode amplitude decreases relative to "divertor" mode
  - Computed RWM rotation ~ 41 Hz, close to experimental value ~ 30 Hz
- ITER scenario IV multi-mode spectrum
  - Significant spectrum for n = 1 and 2

BP9.00059 J. Bialek, et al.; see poster for detail