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Discussion of NSTX Contributions to ITER-ITPA: Macroscopic Stability

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Macroscopic Stability Topical Science Group Meeting

September 24th, 2008

PPPL

College W&M
Colorado Sch Mines
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LANL
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Old Dominion U
ORNL
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Princeton U
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Think Tank, Inc.
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UC Irvine
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UCSD
U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin

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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
KBSI
KAIST
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

NSTX to Provide Input to ITER through the ITPA

- Define specific contributions from NSTX Macro Stability
  - To be discussed further for completeness by the NSTX Team (9/29)
  - To be shown at the next ITPA MHD topical group meeting
    - Lausanne, Switzerland, October 20-22
- ITPA members from NSTX in all areas
  - Sabbagh new member of ITPA MHD group
- ITPA Meeting structured by topics

Action for today's meeting:

1) Discuss topics – experimental / theoretical / modeling perspectives
2) Suggest priority given resources
3) Identify personnel as responsible NSTX contacts

Strawman list: topical areas of contribution from NSTX

- Suggested List of Topics (new group leader: A. Sen)
  - Current high priority research tasks for ITER, including
    - Disruptions and disruption mitigation (vessel forces, runaway electrons, power deposition, etc.)
    - Plasma control requirements (vertical stability, shape and position control, characterization of noise and disturbances, etc.)
  - Magnetic diagnostics for ITER
  - Other MHD topics for ITER, including
    - NTM control
    - RWM control
    - Error field control
  - "Update the list of high priority research topics for our group, guided by the discussion of the topics listed above"
    - "Guided" = above list is not exclusive
    - Suggest additional topics we believe are important

October 2008 ITPA MHD Group Meeting Guidance (II)

- Cross-cutting elements logically suggest joint research
- Provide update on list of joint experiments for MHD group
  - "This must be presented at the meeting on Implementation of the ITPA Coordinated Research Recommendations in December"…
- Possible joint sessions with other topical groups on
  - Energetic particles (Alfven eigenmodes, ripple loss effects, etc.)
  - Integrated operation scenarios (stability and control at high beta, during rampup and rampdown, etc.)
  - Also, joint ELM / RWM / Vertical stability tied through proposed internal control coil set for ITER

Collected thoughts on areas NSTX can address

- List of Topics
  - Disruption characteristics, mitigation
    - Halo currents, peaking, power deposition, vessel forces, etc.
    - Plans for possible use of CT injection for mitigation (Raman, et al.)
  - Disruption avoidance - mode control
    - NTM mitigation, avoidance of mode locking, role of error fields
      - Stability physics vs. ε, marginal island width, ρ^* effects, V_ϕ, V_ϕ shear
    - RWM passive stabilization and active control – focus on low V_ϕ?
    - Resonant field amplification / error field reduction (IPEC vs. vacuum)
    - ELM control (NTM/RWM seeding?, effect on V_ϕ, joint w/ boundary group)
  - Rotation damping; control
    - Effects of 3-D fields, effects of modes (NTV vs. collisionality, ExB, etc.)
  - Plasma control requirements (vertical stability, shape and position)
    - Joint with ISD group?
    - Magnetic diagnostics for ITER?

Joint experiments NSTX Macro group can address

NSTX contact identified

- MHD group
  - MDC-2: Joint Experiments on RWM Physics (SAS)
  - MDC-4: NTM Physics – aspect ratio comparison (EF)
  - ?? MDC-5 Comparison of sawtooth control methods for NTM suppression (none)
  - MDC-12: Non-resonant magnetic braking (SAS)
  - MDC-13: Vertical Stability Physics/performance limits in highly elongated plasmas (DG)
  - MDC-14: V_ϕ effects on NTMs (SAS)
- Other areas of potential interest
  - Many in Steady-State Ops group
    - SSO-2.2: MHD in hybrid scenarios and effects on q-profile (Kessel)
    - SSO-2.3: Rho* dependence on confinement/stability in hybrid scenarios

High Priority IO Research Tasks 2008-2009 of interest

- From Draft document (on website folder for this meeting)
  - Understand effect of ELMs/disruptions on divertor/first wall
    - NSTX XP suggest by S. Gerhardt
  - Assess vertical stabilization options for ITER
  - Develop ITER applicable disruption mitigation techniques
  - Continue development of disruption DB to include pre-disruptive energy loss and halo current data
    - S. Gerhardt has data, waiting on IO to prescribe format
  - Study NTMs in Hybrid Scenarios, effect of plasma rotation
    - NSTX should be able to contribute strongly here
  - RWM
    - Understand mode damping particularly at V_ϕ
    - Continue benchmark test of theory models (for feedback)
    - Experimentally study feedback control at low V_ϕ (diagnostics?)
    - Study coil systems for RWM control in ITER; specify diagnostics
  - Quantify effects of non-resonant error fields
    - multi-mode error correction, error field thresholds
  - ELMs?

Discussion (I)