

ITPA – Topical Group on MHD Stability

**presented by Ted Strait
(for A. Sen)**

**US-Japan Workshop on
MHD Control, Magnetic islands, and Rotation
Austin, Texas
Nov. 23-25, 2008**

Reorganization of the ITPA in 2008

- **The ITPA now operates under the auspices of the ITER-IO**
 - Advisory role with respect to the ITER-IO
- **Topical groups have been reorganized**
 - Energetic particles is now a separate group
 - “MHD, Disruptions, and Control” → “MHD Stability”
- **Topical groups have new leadership.**
Leaders for MHD Stability are:
 - A. Sen (chair)
 - E. Strait (deputy)
 - Y. Gribov (deputy)

Reorganization of the ITPA in 2008

- **Each party now contributes up to 7 members to each topical group**
- **US members of the MHD topical group are:**
 - E. Strait (coordinator)
 - R. Granetz (deputy coordinator)
 - S. Jardin
 - V. Izzo
 - S. Sabbagh
 - F. Waelbroeck
 - J. Wesley

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- **You do not need to be an “official” member to attend meetings and participate in other ways**

Purpose: provide a framework for coordinated physics research activities

- **Develop the physics basis for ITER operation**
- **Integrate the expertise of the international fusion community into ITER**
- **Provide a pathway to exploit the capabilities of existing fusion facilities in support of ITER**
- **Create a common international research programme organized around scientific issues**

[excerpts from the ITPA charter]

Scope of the MHD topical group

- **MHD instabilities and their control**
 - Stability limits (NTMs, external kinks, RWMS),
 - active control of MHD instabilities
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 - tools and recommendations for disruption prediction, avoidance, and mitigation
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- **Plasma magnetic control**
 - feedback and feedforward control of plasma current, position and shape by axisymmetric poloidal fields,
 - control and reduction of error fields,
 - diagnostic issues related to magnetic control
 - development, tests and recommendation on magnetic control used in Plasma Control Simulators.

1st meeting of the MHD Stability Topical Group ...or... 12th meeting of MHD, Disruptions, and Control

- **EPFL-CRPP (Lausanne) October 20-22, 2008**
 - Approximately 40 participants
 - Included joint sessions with topical groups on:
 - Energetic Particles
 - Integrated Operating Scenarios
- **The agenda included sessions on**
 - ITER needs (by Y. Gribov and M. Sugihara)
 - Disruptions and disruption mitigation
 - Plasma control requirements
 - NTMs and the role of flow shear
 - Error field control and locked modes
 - RWM control

ITER Urgent R&D Needs: Disruptions

- **Electromagnetic loads – vertical & horizontal – due to halo currents, disruptions and VDEs**
 - Improve 2D (DINA, TSC) and 3D halo current models
 - Extend ITPA disruption database: focus on halo currents
- **Runaway electrons**
 - Diagnostics for generation, confinement, loss
 - Physics basis for runaway suppression by gas injection, MHD activity, or RMP
- **Requirements for ITER's disruption mitigation system**
 - Experiments and modeling (NIMROD, SOLPS, ...)
 - Gas injection
 - Alternate delivery methods such as pellet injection

ITER Urgent R&D Needs: Plasma Control & Equilibrium

- **Vertical Stability: confirm design of in-vessel coils**
 - Characterize plasma disturbances, e.g. ELMs
 - Effects of noise, disturbances on ITER controllability limits
- **Effects of ferromagnetic steel in Test Blanket Modules: design of correction coils**
 - Potential effects of TBM fields on many aspects of operation, including equilibrium reconstruction
 - Modeling needed to quantify these effects
 - Simulate TBM fields in existing devices?
- **Error Field Correction: design of EFC methods**
 - Criteria for EF tolerance in all operating scenarios
 - EFC methods for ITER: vacuum meas., plasma response
- **Adequacy of magnetic diagnostics**
 - 3D effects of eddy currents, ferromagnetic components

ITER Urgent R&D Needs: Stability control

- **Neoclassical Tearing Modes: requirements for ECRH detection and stabilization**
 - Determine diagnostic requirements for island detection
 - Confirm power requirements
 - Launcher capability for planned operating scenarios
- **Resistive Wall Modes: requirements for control coils and their power supplies**
 - Current, voltage, frequency, toroidal mode requirements for RWM stabilization by
 - * ELM control coils
 - * External EFC coils
 - Effects of noise and plasma disturbances on the control system
- **Sawtooth control: confirm EC requirements**
 - Power requirement in 15 MA scenario

Joint Experiments

Continuing

- MDC-1** Disruption mitigation by massive gas jets
- MDC-2** Joint experiments on resistive wall mode physics
- MDC-3** NTM physics (incl. error field effects) **Closed (2008)**
- MDC-4** NTM physics - aspect ratio comparison
- MDC-5** Sawtooth control methods for NTM suppression
- MDC-8** Current drive prevention/stabilisation of NTMs
- MDC-12** Non-resonant magnetic braking
- MDC-13** Vertical stability physics and performance limits
- MDC-14** Rotation effects on NTMs (+ remainder of MDC-3)

[MDC-10 and MDC-11 transferred to Energetic Particles group]

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New (proposed)

- MDC-15** Disruption database development
- MDC-16** Runaway electron generation, confinement, and loss
- MDC-17** Active disruption avoidance

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Joint Experiments

Primary contact (2008)

| | | |
|---------------|--|-------------------------------------|
| MDC-1 | Disruption mitigation by massive gas jets | M. Lehnert |
| MDC-2 | Joint experiments on resistive wall mode physics | H. Reimerdes |
| MDC-4 | NTM physics - aspect ratio comparison | M. Maraschek |
| MDC-5 | Sawtooth control methods for NTM suppression | R. La Haye |
| MDC-8 | Current drive prevention/stabilisation of NTMs | H. Zohm |
| MDC-12 | Non-resonant magnetic braking | T. Hender |
| MDC-13 | Vertical stability physics and performance limits | D. Humphreys |
| MDC-14 | Rotation effects on NTMs (+ remainder of MDC-3) | R. Buttery |
| MDC-15 | Disruption database development | J. Wesley |
| MDC-16 | Runaway electron generation, confinement, loss | R. Granetz |
| MDC-17 | Active disruption avoidance | M. Maraschek |

Please participate!

- Help needed with joint experiments, modeling, and other activities
- You do not need to be an “official” member to attend meetings and participate in other ways
- Next MHD group meeting (tentatively):
Korea, April 6-10, 2009
- More information at
http://itpa.ipa.mpg.de/mhd_disruption_control/
(needs some updating)