

ITPA – Topical Group on MHD Stability

Ted Strait

**Presented at the
15th Workshop on MHD Stability Control
Madison, Wisconsin**

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The ITPA Operates under the Auspices of the ITER-IO

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 program organized around scientific issues**

Advisory role with respect to the ITER-IO

[excerpts from the ITPA charter]

Scope of the MHD Topical Group

- **MHD instabilities and active control**
 - Sawteeth, NTMs, RWMs
- **Disruptions and disruption mitigation**
 - Disruption database, disruption characterization
 - Prediction, avoidance, and mitigation of disruptions
- **Plasma magnetic control**
 - Control of plasma current, position and shape
 - Control and reduction of error fields
- **Diagnostic issues related to the above**

MHD Stability Topical Group

- **Leaders**

A. Sen (chair)

E. Strait (deputy)

Y. Gribov (deputy)

- **US members**

E. Strait (coordinator)

R. Granetz (deputy)

J. Harris

V. Izzo

S. Jardin

S. Sabbagh

F. Waelbroeck

J. Wesley

Post-IAEA Topical Group Meeting

- **Seoul National University, October 18-20, 2010**
 - Approximately 40 participants
 - Included joint sessions with topical groups on
 - Energetic Particles
 - Divertor-SOL
 - Pedestal
- **The agenda included sessions on**
 - ITER needs (by Y. Gribov and M. Sugihara)
 - Small number of contributed talks
 - Activities of joint experiments and working groups

Joint Experiments

Primary contact

MDC-1 Disruption mitigation by massive gas jets

M. Lehnen

- Optimal disruption mitigation schemes to avoid large local heat loads, halo currents, and runaway avalanche generation

MDC-2 Joint experiments on resistive wall mode physics **S. Sabbagh ('11)**

- Benchmark and validate kinetic RWM stability models

MDC-4 NTM physics - aspect ratio comparison

M. Maraschek

- Analysis of MAST $\leftrightarrow$ AUG and DIII-D $\leftrightarrow$ NSTX data sets
- Expected to close in 2011

MDC-5 Sawtooth control methods for NTM suppression **I. Chapman**

- Improve NTM β -limits by controlling fast ion-stabilized sawteeth

MDC-8 Current drive prevention/stabilisation of NTMs **R. La Haye**

- Develop real-time control including benefits of ECCD modulation
- Provide multi-machine data on power requirements for extrapolation to ITER

Joint Experiments

Primary contact

MDC-12 Non-resonant magnetic braking

T. Hender

- Comparison of magnetic braking from externally applied $n=2$ or 3 fields
- Experiment closed (2010), analysis continuing

MDC-14 Rotation effects on NTMs

R. Buttery

- Error field sensitivity of medium β_N low rotation plasmas
- Resolve other governing physics for the 2/1 NTM β_N limit

MDC-15 Disruption database development

J. Wesley

- Halo currents: complete the entry of multi-machine data
- Shutdowns by massive gas injection: define variables, begin data entry

MDC-16 Runaway electron generation, confinement, loss

R. Granetz

- Develop and improve radial and vertical position control of the RE beam
- Explore dissipation of the RE beam by injection of impurity gas or pellets
- Continue investigation of runaway suppression by 3-D fields

MDC-17 Active disruption avoidance

M. Maraschek

- Direct ECH heating of magnetic islands: joint scaling of power required

Working Groups Address Short-term Issues for ITER

- **Response to requests from ITER-IO for recommendations on specific issues**
- **Short time scale (1-2 years)**
- **Recommendations to be based on modeling, analysis of existing data**
 - New experiments not envisioned due to short deadlines

Working Groups — Ongoing

- WG-1** Waveforms of current in error field correction coils **A. Garofalo**
- For design of the coil power supplies and analysis of ac losses in these superconducting coil
 - Preliminary report June 2010
- WG-2** Guideline for optimization of distribution of ferritic inserts **M. Schaffer**
- Trade-off between TF ripple and low n error fields caused by ferromagnetic inserts of irregular sectors
 - Report Dec. 2010
- WG-3** Power requirements for ECRH & ICRF control of sawteeth **I. Chapman**
- Sawtooth stabilization by fast ions, destabilization by local H&CD, sawtooth period to avoid triggering NTMs

Working Groups — Ongoing

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|-------------|---|--------------------|
| WG-4 | Diagnostic requirements for MHD stability control | J. Lister |
| | <ul style="list-style-type: none">– For control or avoidance of vertical instability, RWM, error fields, NTM, sawtooth, ELM, AE, disruption– Draft report in preparation | |
| WG-5 | Halo currents caused by disruptions | V. Riccardo |
| | <ul style="list-style-type: none">– Halo current fraction and toroidal peaking, halo current width, rotation of halo current asymmetry | |
| WG-6 | Sideways forces on vacuum vessel and magnets caused by disruptions | T. Hender |
| | <ul style="list-style-type: none">– Assessment of models and measurements for horizontal forces on vacuum vessel, PFC, and magnets | |

New Working Groups for 2011 – Being Defined

WG-7 Resistive wall mode feedback control

- Assess capability of ITER ELM coils to stabilize RWMs

WG-8 Radiation asymmetry during MGI

M. Lehnert

- Recommendation on the minimum number of ports for MGI

WG-9 Criteria for error field correction

- Limits on low n error fields for avoidance of locked modes (at low and high β_N) for resonant and non-resonant magnetic fields

Please Participate!

- Help needed with joint experiments, working groups, and other activities
- You do not need to be an “official” member to attend meetings and participate in other ways
- Next MHD group meetings (tentatively):
 - March 1-4, 2011 - Gandhinagar, India
 - October 2011 - Padova, Italy
- Web sites
 - <http://itpa.ipp.mpg.de/> (old)
 - <http://www.iter.org/org/team/fst/itpa/> (new)