Summary of the 10th Meeting of the ITPA Topical Group on MHD and Disruptions

(IPP-Garching, Oct. 10-12, 2007)

Leaders: Tim Hender, Yuri Gribov

Presented by Ted Strait

12th Workshop on MHD Mode Control

Columbia University

Nov. 18-20, 2007

DIII-D NATIONAL FUSION FACILITY

GENERAL ATOMICS

This ITPA meeting had two main focal points:

- **ITER Design Review and related issues**
- **Energetic particle issues for ITER (with IAEA Technical Meeting, Kloster Seeon, Oct. 8-10)**
  - Not discussed in this summary

My personal view
– *NOT that of the ITPA or anyone else*

- **Some important issues remain unresolved so far**
- **Virtually no possibility for significant changes in major components (buildings, PF coils, vacuum vessel)**
  - Unacceptable in terms of schedule and budget
- **Some opportunity remains to change design of auxiliary systems (power supplies, pumps, control systems, …)**
  - Any change must be very strongly motivated
- **Emphasis will soon shift from optimizing the design to optimizing performance with the given design**

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  - Loads due to asymmetric VDEs
  - Disruption mitigation
  - Disruption heat loads

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  DCR-135: Requirements for pellet pacing system

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- **Plasma Control:**
  - Vertical stabilization of ITER plasmas
  - Include circuit VS2 using central solenoid segments
  - Control of start-up scenarios

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- **MHD instability control:**
  - ELM suppression: RMP Coils, pellet pacemaking
  - RWM Control

  DCR-96: Requirements for RMP and RWM coils

Disruptions/ VDEs

- **Safety issues for licensing:**
  - Asymmetric VDEs: Large horizontal forces observed in JET
  - Runaway electron avalanche, deposition
- **Other issues include**
  - Heat loads: toroidal and poloidal symmetry vs. surface melt limits
  - Halo current: amplitude and symmetry
  - Gas jet mitigation: requirements for species, injection symmetry
  - Impact of mitigation gas load on pumping & tritium handling systems
- **New ideas**
  - RMP for runaway suppression
  - Lithium pellet injection by rail gun
- **Disruption database to be extended**
  - Halo currents
  - Pre-disruption energy loss

Plasma control

- **Vertical stability is an issue**
  - High li during startup, rampdown
  - Low li startup demonstrated in DIII-D
- **PF coil maximum voltage and current are limiting factors**
  - low li startup, operation, rampdown
  - Transients of shape and li, H-L transition, etc.
- **Concerns expressed about**
  - Feasibility of VS1 voltage increase, VS2 circuit
  - Robustness of advanced controllers
- **Other proposed solutions:**
  - Passive plates or blanket module connections
  - Subcooling of PF coils to increase max current
  - Improved operating scenarios
  - Active internal coils not an option

ELM suppression

- **Pellet pacing remains the primary planned method**
  - Feasibility at the required ELM frequency
  - Impact on pumping systems and density control
- **Only midplane port plug RMP coils now under consideration**
  - Space requirements
  - Adverse effects on rotation, stability, confinement
  - Can a single row of coils suppress ELMS??
  - Expansion of operating range, extrapolation to ITER
- **G. Janeschitz (at APS conf.) suggests coils inside vacuum vessel wall as another option(?)**

RWM and Error Field Control

- **Midplane port plug coils under consideration for RWM**
  - DCR recently submitted by USBPO
- **Compatibility with RMP for ELM control**
  - Coil specifications
  - Magnetic braking by RMP
- **RWM code benchmarking**
  - Good agreement on growth rates
  - Some discrepancies in feedback results
- **AUG plans to install active coils for ELM and RWM control**

- **Error field issues:**
  - Aliasing of spatial sidebands from correction coils
  - Possible importance of n>1 error correction (NSTX)
  - Bandwidth requirements for error field correction in ITER

Joint experiments

MDC-1 **Disruption mitigation by massive gas jets**

MDC-2 **Joint experiments on resistive wall mode physics**

MDC-3 **Joint experiments on neoclassical tearing modes**

- To be closed and replaced with MDC-14

MDC-4 **Neoclassical tearing mode physics - aspect ratio comparison**

- Possibly to be closed

MDC-5 **Comparison of sawtooth control methods for NTM suppression**

MDC-8 **Current drive prevention/stabilisation of NTMs (modulated ECCD)**

MDC-10 **Measure damping rate of intermediate-n Alfven Eigenmodes**

MDC-11 **Fast Ion Losses and redistribution from localised AEs**

Proposed new joint experiments

MDC-12 **Non-resonant magnetic braking**

MDC-13 **Vertical Stability**

MDC-14 **NTM stability at low rotation**

Future of the ITPA?

- **ITPA to be reorganized in the near future**
  - Likely to be reconstituted under the control of ITER
- **MHD topical group next meeting in Naka, with**
  - US/Japan MHD workshop
  - IEA Large Tokamak workshop on Control of ELMs and RWMs
- **Dates to be determined (tentatively Feb. 25-29, 2008)**