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# Princeton Plasma Physics Laboratory

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## Special Issue on the 20<sup>th</sup> Workshop on MHD Stability Control

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# Special Issue on the 20th Workshop on MHD Stability Control

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The 20th workshop on magnetohydrodynamic (MHD) stability control took place November 22-24, 2015, in Princeton Plasma Physics Laboratory (PPPL), following the American Physical Society - Division of Plasma Physics annual meeting on November 16-20 in Savannah, GA. The purpose of this workshop is to stimulate in depth discussion and motivate future research in the areas of MHD stability physics and control of magnetically confined plasmas. The workshop was organized jointly by Auburn University, Columbia University, General Atomics, Princeton Plasma Physics Laboratory, University of Wisconsin-Madison, and the Los Alamos National Laboratory, and under the auspices of the US/Japan Collaboration.

The theme of the 20th workshop is *Non-linear phenomena and MHD control for ITER and beyond* as non-linear processes are crucial frontiers of MHD in the realistic control of magnetically confined fusion plasmas. This workshop included leading edge theoretical and experimental research across linear and non-linear regimes, ideal and non-ideal stability physics and control, studied in various devices including NSTX, NSTX-U, DIII-D, KSTAR, EAST, HBT-EP, TCV, EXTRAP-T2R, RFX-mod, LHD, TFTR, and ITER. There were 10 sessions in this workshop, with 14 invited talks and 32 contributed talks, with about 60 participants from US, EU, eastern to western Asian countries, and ITER Organization. The full agenda and presentations can be found on the web site (<https://fusion.gat.com/conferences/mhd15/>).

The workshop began with the session “Non-linear MHD Control in Fusion Devices” which highlighted the lessons learned from TFTR and discussed the research needs for ITER. The session “Real-time 3D and MHD Control” highlighted real-time and advanced control schemes developed for kinetic profiles, sawtooth and tearing/neoclassical tearing modes (TM/NTM), and for disruption avoidance in multiple machines. The following session “Non-linear/non-ideal Processes in TM/NTM” focused on new theoretical and numerical models to predict linear and non-linear TM/NTM stability and mode evolution. The session “Nonlinear and Extended” introduced recent improvements in understanding on plasma response and stability modification induced by non-axisymmetric (3D) field applications in tokamaks, including edge localized mode (ELM) suppression by resonant magnetic perturbation (RMP). It was followed by “3D Field Physics in Long Pulse Operation”, devoted to discuss the successful 3D field

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5 applications of controlling stability in superconducting tokamaks as well as 3D modeling  
6 for advanced scenarios. More general 3D MHD physics was also discussed in the session  
7 “Non-linear MHD in Stellarators/RFP” through the use of simulations and experiments  
8 in heliotrons/stellarators and also reversed field pinch (RFP). The session “Non-  
9 linear/Kinetic RWM and Wall Effects” showed various advanced and novel concepts and  
10 techniques to control linear/non-linear resistive wall mode (RWM) or MHD instability  
11 in liquid metal wall. A number of recent and important theory, simulation, and  
12 experimental accomplishments towards systematic disruption avoidance and mitigation  
13 were reported in the two sessions “Disruption processes and dynamics” and “Disruption  
14 Mitigation”. The workshop ended with the session “Kinetic Effects in MHD”, to  
15 introduce new and extended MHD physics research including kinetic particle effects.  
16 During the workshop, a brief update from ITPA MHD topical group was also provided,  
17 to emphasize the importance of internationally integrated research collaborations on  
18 MHD stability control for ITER and beyond.  
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21 This special issue on the 20th workshop includes 6 peer-reviewed papers, on the  
22 topic of 3D non-linear physics, control of TM/NTM, RWM, sawtooth, and ELM control,  
23 neoclassical kinetic effects on MHD, liquid metal walls, as presented and discussed  
24 during the workshop. The workshop program committee would like to thank PPCF  
25 for their continuing support of this special issue, and thank especially Dean Williams,  
26 Alice Malhador, Yasmin McGlashan for their kind cooperations and coordination in the  
27 review process. Note that these papers are only the samples of the extensive body of  
28 presentations made in the workshop, as some of talks were topical overviews or rapid  
29 progress reports, and thus published elsewhere already or will be published in the future.  
30 Anyone interested in further information on presentations not published in this special  
31 issue are encouraged to either contact the authors directly or contact Jong-Kyu Park  
32 (at [jpark@pppl.gov](mailto:jpark@pppl.gov)).  
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35  
36 The workshop program committee also would like to thank Prof. Egemen  
37 Kolemen (Princeton University), Michio Okabayashi, Richard Hawyluk, Marylin  
38 Hondrop (PPPL), Matthew Lanctot, Liz Coviello (GA) for organizing and hosting  
39 the meeting in PPPL. Next year is the 21th workshop on MHD Stability Control,  
40 with the theme *Prediction and Forecasting of Transient Events* on November 7-  
41 9, 2016 at General Atomics. Further information can be found on the website  
42 (<https://fusion.gat.com/conferences/mhd16>).  
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