



Editorial

Special issue on the 24th workshop on MHD stability control

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The 24th workshop on magnetohydrodynamic (MHD) stability control was held on the Columbia University campus 28–30th October, 2019. The purpose of this annual workshop is to discuss cutting edge results and form future plans for active control of MHD instabilities in magnetic confinement fusion reactor concepts. The program was organized by an international committee of representatives from Auburn University (USA), Columbia University (USA), Massachusetts Institute of Technology (USA), Princeton Plasma Physics Laboratory (USA), Princeton University (USA), Tottori University (Japan), Kyoto Institute of Technology (Japan), National Institute of Radiological Sciences (Japan), National Institute for Fusion Science (Japan), Institutes of Physical Science—Chinese Academy of Sciences (People's Republic of China), and Consiglio Nazionale delle Ricerche (Italian Republic). Dr Gerald Navratil and Columbia University, in particular, were responsible for organizing and hosting the meeting on their beautiful Morningside Heights campus.

This 24th workshop's theme was 'Key MHD Control Issues on the path towards a compact fusion pilot plant.' This theme embraced the focus of the ongoing Community Planning Process, building on the National Academy recommendation that, 'the United States should start a national program of accompanying research and technology leading to the construction of a compact pilot plant that produces electricity from fusion at the lowest possible capital cost'. The key challenges that need to be addressed in the prediction, avoidance and control of MHD instabilities in order to meet this goal were discussed throughout. Cutting edge solutions were proposed, with emphasis placed on collaborations necessary to facilitate rapid forward progress in these areas. This theme, however, did not exclude contributions from other fusion relevant areas of MHD stability and control.

During the two and a half day conference, 38 participants from 12 institutes gave 10 invited and 18 contributed presentations. Seven topical sessions were organized around the topics of MHD control actuators, real-time control systems, MHD equilibrium stability, ideal MHD and locked modes, mode locking and error fields, 3D field stability control, and machine learning applications MHD stability control and four devoted discussion sessions enabled ample group participation in clarifying the impact of the presented material and implications for future reactors. The full agenda and presentations can be found on the web site, <https://fusion.gat.com/conference/event/95>.

This workshop demonstrated the importance of strong international collaboration on this topic and contained an inspiring wave of progress lead by early career scientists. Two sessions in particular emerged as exemplars for this, serving as catalysts for recent progress and critical future opportunities in the field. The first was the 'real-time control systems' session, which contained presentations from the Dutch Institute for Fundamental Energy Research, Swiss Plasma Center EPFL, and Princeton University. Invited speaker Matthijs van Berkel's material on 'system identification and real-time control of, the CIII emission front using MANTIS in TCV' is demonstrative of the many recent advances in this field and

is now published within this special issue. The immense progress in ‘machine learning applications MHD stability control’ warranted six presentations, three of which were invited and two of which are now also published within this special issue. This topic is being driven largely by Herculean efforts of early career physicists and workshop discussion sessions revealed that the fusion community is recognizing these efforts as a critical element of future stability control design.

This special issue of *Plasma Physics and Controlled Fusion* (PPCF) contains material from a selection of workshop presentations that has been peer reviewed according to the usual journal procedures. These articles cover the range of the workshop, including three of the ten invited presentations and spanning six of the seven topical sessions. Many of the workshop presentations not found here contained material that has been published elsewhere or rapid progress reports of results that are not yet in publication. Anyone interested in further information on topics outside of this special issue is encouraged to contact the presenters directly or submit their enquiry through workshop Chairman Nikolas Logan (nlogan@pppl.gov).

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