Contribution ID: **366** Type: **Oral**

Advances in physics and performance of the I-mode regime over an expanded operating space on Alcator C-Mod

Wednesday, 19 October 2016 14:00 (20 minutes)

Significant progress has been made on Alcator C-Mod in expanding the configurations and conditions for which the I-mode regime can be accessed and maintained and understanding the physics which underlies the transport improvement. An important result from multidevice studies is that the power threshold for I-mode has only a weak dependence on BT, while the upper power limit increases with BT, making I-modes more robust at higher field [1]. Experiments in 2015 have extended this trend, achieving clear I-modes at up to 8.0 T. The I-mode regime is naturally stable to ELMs, and combines high tauE with low particle confinement [2]. This has benefits for fusion reactors, eliminating damaging ELM heat pulses and avoiding impurity accumulation.

TauE in I-mode is in the H-mode range and has weak power degradation ˜P-0.3. ELITE analysis shows the pedestal to be stable, consistent with this lack of saturation and the absence of ELMs. Nonlinear GYRO simulations show that I-mode core Ti and Te profiles are stiffer than in L-mode, resembling H-mode with regards to marginal ITG stability. I-mode pedestal physics is also advancing, through measurements of fluctuations and flows and using simulations. Both a GAM and a high frequency fluctuation termed the Weakly Coherent Mode are present and strongly interact. Nonlinear BOUT++ simulations agree with many observed features of the WCM.

The C-Mod team has been exploring prospects for extrapolation of I-mode to larger fusion devices. We predict ITER would need about 70 MW to enter I-mode. It should be possible to remain in I-mode and to produce high fusion power, provided that density can be sufficiently increased. Accessibility for compact, high B fusion reactors such as ARC is even more favorable. We are also investigating integration with divertor solutions. Mitigating heat flux using low-Z impurity seeding has been demonstrated, and we have begun to investigate divertor detachment strategies. While robust I-mode operation is typically achieved with ion B×∇B drift away from the X-point, new experiments show that after the L-I transition, the regime can be maintained in a DN configuration. This may help to reduce peak heat flux. Further I-mode experiments will be a priority in the 2016 campaign.
[1] HUBBARD, A.E. et al, IAEA FEC 2014. [2] WHYTE, D. G., et al, Nucl. Fus. 50 (2010).
Work supported by U.S. DoE.

Paper Number

EX/3-1

Country or International Organization

USA

Primary author: Dr HUBBARD, Amanda (Massachusetts Institute of Technology, Plasma Science and Fusion Center)

Co-authors: Prof. WHITE, Anne (Massachusetts Inst of Tech, Plasma Science and Fusion Center); Mr SORBOM, Brandon (Massachusetts Inst of Technology, Plasma Science and Fusion Center); Dr LABOMBARD, Brian (MIT Plasma Science and Fusion Center); Dr BRUNNER, Dan (MIT PSFC); Prof. WHYTE, Dennis (MIT Plasma Science Fusion Center); Dr MARMAR, Earl (Mass. Inst. of Technology); Dr EDLUND, Eric (Massachusetts Institute of Technology); Dr CZIEGLER, Istvan (York Plasma Institute, University of York); Dr TERRY, James (MIT-PSFC); HUGHES, Jerry (MIT PSFC); Dr RICE, John (MIT PSFC); Dr WALK, John (Massachusetts Inst of Technology, Plasma Science and Fusion Center); Dr REINKE, Matthew (Oak Ridge National Laboratory); Dr WOLFE, Stephen (Massachusetts Inst of Tech, Plasma Science and Fusion Center); WUKITCH, Stephen (MIT PSFC); XU, Xueqiao (Lawrence Livermore National Laboratory); Dr LIN, Yijun (MIT Plasma Science and Fusion Center); Dr LIU, Zixi (Institute of Plasma Physics, Chinese Academy of Sciences)

Presenter: Dr HUBBARD, Amanda (Massachusetts Institute of Technology, Plasma Science and Fusion Center)

Session Classification: Pedestal & ELM Physics

Track Classification: EXC - Magnetic Confinement Experiments: Confinement