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Progress Toward Understanding Turbulence and Transport in I-mode Plasmas

Fusion is a tremendously promising energy source for mitigating and adapting to climate change. The tokamak is a toroidal plasma confinement system, where a fusion plasma is confined by a magnetic field. The magnetic fields produced by the plasma and external electromagnets also provide the equilibrium conditions necessary for achieving a steady, electricity producing system. There is a grand challenge for optimizing fusion power plants: understanding small-scale turbulent fluctuations and their contributions to transport of heat, particles and momentum in the fusion plasma. This talk will introduce high-performance modes of operation in tokamaks. Especially, the I-mode confinement regime is promising for future reactor operation due to high energy confinement without high impurity particle confinement. However, the role of edge turbulence in creating I-mode's beneficial transport properties is still not fully understood. New measurements of edge turbulence in I-modes at low and high densities at ASDEX Upgrade will be presented. A high radial resolution correlation electron cyclotron emission radiometer measures broadband turbulence. Linear gyrokinetic simulations of the edge turbulence indicate that while the dominant turbulent modes in the outer core are ion directed and electrostatic, the turbulence becomes increasingly electron directed and electromagnetic with increasing radius. This talk will also discuss next steps for understanding high performance operation modes via detailed turbulence measurements.

About the Speaker: Anne E. White is the head of the Nuclear Science and Engineering Department at MIT and MIT School of Engineering Distinguished Professor of Engineering. She received her PhD in experimental plasma physics in 2008 from UCLA and was a DOE Fusion Energy Sciences ORISE postdoctoral fellow before becoming an assistant professor at MIT in 2009. White performs fusion energy research at the Plasma Science and Fusion Center (PSFC) at MIT and in involved in research collaborations at tokamaks in the US and around the world. Prof. White is active in the fusion community, is a member of American Physical Society and American Nuclear Society, and has served on the executive committees and program committees of many workshops and conferences. She currently serves on the US DOE Fusion Energy Sciences Advisory Committee (FESAC). She has won numerous awards for her research, teaching and service to MIT and to the fusion community, and is an APS Fellow.