

Experimental Techniques at Alcator C-Mod and ASDEX Upgrade for Validation of Gyrokinetic Simulations

A.J. Creely¹, G.D. Conway², S.J. Freethy^{1,2}, T. Görler², T. Happel², A.E. White¹ and the ASDEX Upgrade Team²

¹ *Massachusetts Institute of Technology, Plasma Science and Fusion Center, Cambridge, MA 02139, USA*

² *Max Planck Institute for Plasma Physics, 85748 Garching, Germany*

New hardware and new experimental analysis techniques are developed at ASDEX Upgrade in order to facilitate future validation studies of the gyrokinetic code GENE [1]. In light of recent results on Alcator C-Mod, indicating that ion-scale gyrokinetic simulations may inadequately describe L- and I-mode plasmas in some circumstances [2, 3], the development of thorough validation metrics on other machines has become all the more important. In addition to comparisons of experimental and simulated heat fluxes, validation of gyrokinetic codes also typically involves more stringent validation metrics, such as turbulence levels and the plasma perturbative thermal diffusivity [2, 3, 4]. In order to facilitate such studies on ASDEX Upgrade, additional turbulence measurement diagnostics and experimental analysis techniques have been developed. The correlation electron cyclotron emission (CECE) diagnostic described in [5] has recently been significantly upgraded from six to thirty channels, enabling a far wider range of simultaneous turbulence measurements. In addition, the technique of measuring the plasma perturbative thermal diffusivity (which is related to profile stiffness) based on the propagation of partial sawtooth-generated heat pulses [6], has been applied to ASDEX Upgrade plasmas for the first time. The combination of significantly improved turbulence measurements and the ability to passively measure perturbative thermal diffusivity in ASDEX Upgrade enables far more stringent validation of gyrokinetic codes.

- [1] F. Jenko et al., *Phys. Plasmas* 7, 1904 (2000).
- [2] N.T. Howard et al., *Phys. Plasmas* 23, 056109 (2016).
- [3] A.J. Creely et al., *Phys. Plasmas*, Accepted (2017).
- [4] A. Casati et al., *Phys. Rev. Lett.* 102, 165005 (2009).
- [5] S.J. Freethy et al., *Rev. Sci. Instrum.*, 87, 11E102 (2016).
- [6] A.J. Creely et al., *Nucl. Fusion* 56, 036003 (2016).

Preference: Poster

This work is supported by the US DOE under grant DE-SC0006419 and by the US DOD under the NDSEG Fellowship.