Measurements of T_e fluctuations and linear gyrokinetic modeling in the I-mode and L-mode edge at ASDEX Upgrade

R. Bielajew[1], G. D. Conway[2], T. Happel[2], A.E. Hubbard[1], P. A. Molina Cabrera[1], P. Rodriguez-Fernandez[1], D. Silvagni[2], A. E. White[1], C. Yoo[1], and the ASDEX Upgrade team

[1]MIT Plasma Science and Fusion Center, Cambridge, USA

[2]Max Planck Institute for Plasma Physics, Garching, Germany

The I-mode confinement regime is a promising operational regime for future fusion reactors because it features high energy confinement without high particle confinement [1]. The edge-localized Weakly Coherent Mode (WCM) in I-mode is often used to contrast I-mode and L-modes, however there has been observation of WCM precursors in L-modes preceding I-modes [2]. The nature of the edge and pedestal turbulence in I-mode plasmas is still under investigation, and open questions exist about the role of the turbulence in determining the transport of I-mode. In this work we explore the role of collisionality and electron and ion temperature coupling in determining the turbulence in the L-mode/I-mode edge with a combination of experiment and modeling at ASDEX Upgrade. Electron temperature fluctuation ($\tilde{T}_e/T_e$) measurements in the plasma outer core and pedestal ($\rho_{pol} = 0.85 - 1.0$) are taken with a 24-channel high radial resolution Correlation Electron Cyclotron Emission radiometer [3]. The WCM in I-mode is located in the pedestal region and is measured in optically thick plasmas with $\tilde{T}_e/T_e = 2 - 4\%$. A lower frequency and more coherent WCM-like feature also appears in the L-mode phase of these discharges. The quality of the confinement of the discharge phases is found to be independent of the presence and $\tilde{T}_e/T_e$ amplitude of the WCM or WCM-like feature, but inversely dependent on pedestal density and collisionality. In conjunction with fluctuation measurements, linear gyrokinetic analysis was performed with the CGYRO code. Preliminary modeling suggests that dominant turbulent modes in the outer core are electrostatic and ion directed while the edge and pedestal modes are electron directed and electromagnetic in nature.

References

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