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Evidence for Trapped Electron Mode Turbulence in MST Improved Confinement RFP Plasmas

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Drift wave turbulence underlies key transport phenomena in toroidal, magnetically confined plasmas. While long-studied for the tokamak and stellarator configurations, the distinguishing features of the reversed field pinch (RFP) allow further development of gyrokinetic models that build on the RFP's features of high-beta, large magnetic shear (tending to add stability), and relatively weak toroidal field. Since the RFP is poloidal-field-dominated, the role of ballooning is considerably weaker. Standard RFP behavior tends to be governed by tearing magnetic fluctuations driven by the gradient in the current density. However, tokamak-like improved confinement occurs with inductive profile control (PPCD: pulsed poloidal current drive), and large-scale electromagnetic fluctuations are largely suppressed. [1] In this environment, gyro-scale instabilities are anticipated important and could ultimately limit confinement. [2] The role of drift waves is rapidly emerging for the RFP, and this provides a complementary environment to other configurations for exploring basic understanding of turbulent-driven-transport physics and improving confidence in predictive capability for future burning plasmas. Herein we describe detailed measurements of high-frequency density fluctuation spectral features and temporal-spatial dynamics in the MST-RFP. Comparison with modeling results from the gyrokinetic GENE code provide evidence that these fluctuations are consistent with expectations for TEM turbulence and may indeed be playing a role in governing the overall plasma confinement.

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[1] J.S. Sarff, et al., Nuclear Fusion 43,1684-1692 (2003).
[2] D. Carmody, et al., Phys. Plasmas 22, 012594 (2015).

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