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Symmetry Breaking and the Inverse Energy Cascade in a Plasma[1]

MATTHEW WORSTELL, M.S. DAVIS, D. GARNIER, M.E. MAUEL, T.M. ROBERTS, Columbia University, J. KESNER, MIT Plasma Science and Fusion Center — The application of electrostatic bias to high density plasmas with turbulent fluctuations confined by a magnetic dipole are investigated. This research investigates the ap- plication of non-symmetric bias and the influence of broken symmetry on strongly turbulent plasmas. Non-symmetric bias is applied through either point biasing or an equatorial array spanning the device. In both cases, the spatial symmetry of applied bias dramatically effects the plasma fluctuations. With bias applied, the plasma achieves a new equilibrium characterized by amplified low order modes and diminished amplitude of higher order modes. Although the turbulent spectrum changes, the RMS fluctuation level is unchanged by the bias. Bias also causes the turbulent electrostatic fluctuations to coalesce into a quasi- coherent mode and the appearance of increased coherence. The effect of bias configuration is also seen to change the measured levels of non- linear coupling. Non-symmetric biasing increases nonlinear coupling in contrast to symmetric biasing. These results represent the first experi- mental demonstration of symmetry breaking driving the inverse energy cascade in a quasi-two dimensional plasma system.

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Matthew Worstell
Columbia University

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