

Final Scientific Report: *DoE Plasma Center for Momentum Transport and Flow Self-Organization in Plasmas: Non-linear Emergent Structure Formation in magnetized Plasmas and Rotating Magnetofluids*

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Executive Summary and Report

This report covers the UW-Madison activities that took place within a larger DoE Center Administered and directed by Professor George Tynan at the University of California, San Diego. The work at Wisconsin will also be covered in the final reporting for the entire center, which will be submitted by UCSD.

There were two main activities, one experimental and one that was theoretical in nature, as part of the Center activities at the University of Wisconsin, Madison. First, the Center supported a experimentally focused postdoc (Chris Cooper) to carry out fundamental studies of momentum transport in rotating and weakly magnetized plasma. His experimental work was done on the Plasma Couette Experiment, a cylindrical plasma confinement device, with a plasma flow created through electromagnetically stirring plasma at the plasma edge facilitated by arrays of permanent magnets. Coopers work involved developing optical techniques to measure the ion temperature and plasma flow through Doppler shifted line radiation from the plasma Argon ions. This included passive emission measurements and development of a novel ring summing Fabry-Perot spectroscopy system, and the active system involved using a diode laser to induce fluorescence.

On the theoretical side, CMTFO supported a postdoc (Johannes Pueschel) to carry out a gyrokinetic extension of residual zonal flow theory to the case with magnetic fluctuations, showing that magnetic stochasticity disrupts zonal flows. The work included a successful comparison with gyrokinetic simulations. This work and its connection to the broader CMTFO will be covered more thoroughly in the final CMTFO report from Professor Tynan.