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Observation of Zonal Flow Formation in a Cylindrical Magnetized Plasma JONATHAN H. YU, CHRISTOPHER HOLLAND, GEORGE R. TYNAN, UCSD, MICHAEL J. BURIN, Princeton University — An azimuthally symmetric sheared flow is observed to spontaneously develop in a turbulent cylindrical magnetized plasma, with no apparent source of external angular momentum. The shear layer is maintained against ion-ion viscosity and ion-neutral flow damping by electrostatic Reynolds stress, which is due to collisional drift turbulence. Measurements show that as the magnetic field is increased, the shear layer develops near the radial edge of the plasma. Simultaneously, collisional drift turbulence is produced from coherent drift eigenmodes due to harmonic generation and three wave interactions. An inverse energy transfer from turbulent, small spatial scales to large spatial scales drives the zonal flow, and this energy transfer rate will be measured in future work. Simulations of collisional drift turbulence demonstrate zonal flow formation via merging of tilted vortices, and the resulting azimuthal velocity profile is consistent with Mach probe measurements and time-delay velocity estimates. This set of measurements may provide insight into the structure formation process of zonal flows that are often observed in the edge of tokamaks.

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