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**Kinetic Theory of Tokamak Zonal Flow Dynamics**[1] F.L. HINTON, M.N. ROSENBLUTH, General Atomics, P.H. DIAMOND, University of California, San Diego, L. CHEN, University of California, Irvine — The nonlinear interaction of drift wave turbulence with axisymmetric potentials (sheared $E \times B$ or "zonal" flows) is investigated. Starting with the gyrokinetic equation in toroidal geometry, the axisymmetric linear response is determined, including both geodesic acoustic modes and collisionally damped residual flows. These flows are driven nonlinearly by the drift wave turbulence. An equation for the drift wave potentials is derived by using a simple ion fluid closure and assuming adiabatic electrons. For ion gyroradius much smaller than the wavelength, this is equivalent to a polarization drift nonlinearity. An electron nonlinearity also exists because the electron response, to the axisymmetric potentials, is not adiabatic. The electron nonlinearity is essential for energy conservation in the coupled equations for the potentials. Weak turbulence theory is used to derive equations for the drift wave and zonal flow intensities.

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