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A Reduced Model for the Magnetorotational Instability BEN JAMROZ, KEITH JULIEN, University of Colorado at Boulder, EDGAR KNOBLOCH, University of California, Berkeley — The magnetorotational instability is investigated within the shearing box approximation in the large Elsasser number regime. In this regime, which is of fundamental importance to astrophysical accretion disk theory, shear is the dominant source of energy, but the instability itself requires the presence of a weaker vertical magnetic field. Dissipative effects are weaker still. However, they are sufficiently large to permit a nonlinear feedback mechanism whereby the turbulent stresses generated by the MRI act on and modify the local background shear in the angular velocity profile. To date this response has been omitted in shearing box simulations and is captured by a reduced pde model derived here from the global MHD fluid equations using multiscale asymptotic perturbation theory. Results from numerical simulations of the reduced pde model indicate a linear phase of exponential growth followed by a nonlinear adjustment to algebraic growth and decay in the fluctuating quantities. Remarkably, the velocity and magnetic field correlations associated with these algebraic growth and decay laws conspire to achieve saturation of the angular momentum transport. The inclusion of subdominant ohmic dissipation arrests the algebraic growth of the fluctuations on a longer, dissipative time scale.

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