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Physics behind the role of shear flow in turbulent transport of magnetic fields A. NEWTON, E. KIM, University of Sheffield — Fundamental processes governing the dynamics of coherent structures and their interplay with turbulence in magnetized fluids present some of the most outstanding problems in classical physics. In particular, various observations indicate that typical magnetic activities in astrophysical plasmas must involve the fast transport of magnetic fields on time scales much shorter than the Ohmic diffusion time scale. In this contribution, we report on the first comprehensive direct numerical simulations of 2D sheared MHD turbulence to elucidate fundamental physical processes which accelerate or moderate turbulent transport of magnetic fields [1]. We show (i) that transport quenching by shear flows and resonant interactions are vitally important; (ii) that a shear flow plays a dual role of quenching transport by shearing and enhancing it by resonance and the overlap of resonant layers; (iii) that a strong suppression of transport by shear flow (magnetic fields) occurs when the shearing (Alfvénic) timescale is shortest among all the characteristic timescales. Specifically, without resonance, turbulent magnetic diffusivity η_T is quenched as $\eta_T \propto B_0^{-4}$ for weak shear (Ω) and strong magnetic field (B_0) while $\eta_T \propto \Omega^{-2.7}$ for strong shear and weak magnetic fields. In comparison, η_T is less severely quenched with resonance with the scaling $\eta_T \propto B_0^{-2} \propto \Omega^{-2}$ for strong shear and magnetic fields.

[1] A. Newton and E. Kim, Phys. Rev. Lett., v102, 165002 (2009).

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