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Shear transport in far-from-equilibrium isotropization of supersymmetric Yang-Mills plasma

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We holographically study the far-from-equilibrium isotropization dynamics of the strongly coupled $\mathcal{N} = 4$ supersymmetric Yang-Mills plasma. The dual gravitational background is driven to be out of equilibrium and anisotropic by a time-dependent change in boundary conditions. At late times, the system relaxes and asymptotically approaches a static configuration. The large initial energy densities accelerate the isotropization significantly compared to the initial geometry corresponding to the supersymmetric Yang-Mills vacuum. We analyze shear transport during isotropization by directly computing the time-dependent stress tensor, which is now a nonlinear function of the shear rate. The shear viscosity far from equilibrium displays much richer dynamics than its near-equilibrium counterpart. Moreover, we uncover that the equilibrium viscosity-to-entropy ratio at late times depends on the details of the quench function and the initial data, which could be due to a resummation of the hydrodynamic description. In particular, this ratio can be parametrically smaller than the Kovtun-Son-Starinets bound calculated from linear response theory.

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