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Magnetohydrodynamic channel flow with Braginskii's anistropic viscosities[1] PAUL DELLAR, University of Oxford — We study the channel flow of a fluid obeying Braginskii's magnetohydrodynamics, in which the viscosity parallel to the magnetic field lines greatly exceeds the viscosity in perpendicular directions. This reflects a weakly collisional regime where particles interact primarily through coupling to the magnetic field, rather than directly through inter-particle collisions. Contrary to the conclusion of a recent study, there is no well-defined limit as the ratio of perpendicular to parallel viscosities tends to zero. The maximum velocity grows as the minus one-quarter power of the (small) viscosity ratio $(\mu_\perp/\mu_\|)^{-1/4}$, due to large shears that develop across boundary layers at the walls. The width of these boundary layers scales as the three-quarters power of the viscosity ratio. They thus lie inside analogs of the usual Hartmann layers, and the Lorentz force does not enter their leading-order force balance. The long-time behavior of computations using lattice Boltzmann magnetohydrodynamics, which is readily adapted for anisotropic viscosities, is in excellent agreement with these asymptotic solutions.

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