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Generation of large-scale magnetic fields by small-scale dynamo in shear flows[1]

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A novel large-scale dynamo mechanism, the magnetic shear-current effect, is discussed and explored. The effect relies on the interaction of magnetic fluctuations with a mean shear flow, meaning the saturated state of the small-scale dynamo can drive a large-scale dynamo – in some sense the inverse of dynamo quenching. The dynamo is nonhelical, with the mean-field alpha coefficient zero, and is caused by the interaction between an off-diagonal component of the turbulent resistivity and stretching of the large-scale field by shear flow. In this talk, a variety of computational and analytic studies of this mechanism are discussed, which have been carried out both in regimes where magnetic fluctuations arise self-consistently through the small-scale dynamo and at lower Reynolds numbers. In addition, an heuristic description of the effect is presented, which illustrates the fundamental role played by the pressure response of the fluid and helps explain why the magnetic effect is stronger than its kinematic cousin. As well as being interesting for its applications to general high Reynolds number astrophysical turbulence, where strong small-scale magnetic fluctuations are expected to be prevalent, the magnetic shear-current effect is a likely candidate for large-scale dynamo in the unstratified regions of ionized accretion disks.

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