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The Role of Kinetic Instabilities in the Collisionless Turbulent Dynamo[1] D. A. ST-ONGE, M. W. KUNZ, Princeton University — Conservation of the first adiabatic invariant μ in a magnetized, collisionless plasma precludes turbulent amplification of the magnetic field. This is because any increase in magnetic-field strength would adiabatically increase the perpendicular pressure, whose growth is stringently limited by the finite free energy in the system. A mechanism is then needed to break μ conservation in order to enable the amplification of a weak, primordial seed magnetic field to dynamically important strengths. Conveniently, amplification of the magnetic field in a high-beta plasma leads to pressure anisotropies large enough to trigger kinetic instabilities at ion-Larmor scales (e.g., firehose, mirror). These instabilities saturate by causing anomalous scattering of particles, breaking μ conservation. This interplay between magnetic-field growth and kinetic instabilities adds a new layer of complexity to the more conventional (and much better understood) magnetohydrodynamic turbulent dynamo. Using self-consistent hybrid-kinetic, particle-in-cell simulations, we investigate the impact of these kinetic instabilities on the turbulent dynamo in a collisionless plasma, with a particular focus on how kinetic effects enable the amplification of magnetic fields and modify their structure.

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