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Preventing or exploiting turbulence during plasma compression[1]
SETH DAVIDOVITS, NATHANIEL J. FISCH, Princeton University — Inertial confinement fusion (ICF) and Z-pinch compressions may be turbulent to varying degrees. The turbulent kinetic energy (TKE) in turbulence undergoing compression can be amplified, if the compression time is fast compared to the dissipation time of the turbulence. By studying the behavior of plasma turbulence under compression, we propose ways of avoiding or exploiting turbulent growth. One possibility for exploiting turbulence during a compression occurs because of a recently discovered "sudden viscous dissipation" mechanism. The TKE, having been amplified during the compression, is suddenly dissipated by viscosity into thermal energy. This is possible in plasmas because of the strong dependence of the viscosity on the temperature, which grows during compression. By intentionally storing energy from the compression partly in TKE, which has different loss mechanisms than the thermal energy, and only converting the TKE into thermal energy late in the compression, energy losses may be reduced. Understanding the behavior of TKE under compression also allows us to predict compression trajectories, in rho-R vs. temperature space, where (bulk) turbulent growth will be suppressed. Contamination of hydrogen plasma with higher Z materials is shown to enhance turbulent growth.

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