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Nonlocal pressure and viscous contributions to the velocity gradient statistics based on Gaussian random fields[1] MICHAEL WILCZEK, CHARLES MENEVEAU, Johns Hopkins University — The velocity gradient tensor characterizes the small scales of fully developed turbulence comprehensively. The challenge in understanding its statistical properties in terms of exact statistical evolution equations lies in specifying the nonlocal pressure and viscous effects. Based on the assumption of incompressible Gaussian velocity fields, these statistically unclosed terms are evaluated analytically, and the dynamics of this Gaussian closure and generalizations thereof are discussed and compared to data from direct numerical simulations. The results help to explain how nonlocal pressure Hessian contributions prevent the restricted Euler singularity, and yield insights into the origin of the velocity gradient skewness related to a breaking of the time-reversal symmetry.

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