

On the dynamical origin of the vorticity alignment in homogeneous and isotropic turbulence

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Since the 1980s it has been known that in incompressible homogeneous and isotropic turbulence the vorticity vector tends to align with one of the eigen-directions of the rate-of-strain tensor, specifically the one associated with its intermediate (second largest) eigenvalue. Despite extensive studies, the underlying mechanism of the preferential alignment is not fully understood. In this work, making use of a three-dimensional polar representation of the equation for the velocity gradient tensor obtained before, we explore the alignment mechanism theoretically and numerically combined with the direct numerical simulation of the Navier–Stokes equations.

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