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Unbalanced vortex stretching in nonstationary turbulence
ROBERT RUBINSTEIN, NASA Langley Research Center — An important implication of Kolmogorov's theory is that at high enough Reynolds number, the large scales of motion become independent of viscosity. Associated to this idea is the famous observation of Tennekes and Lumley: if the enstrophy balance in a turbulent flow is to be independent of viscosity, then enstrophy generation by vortex stretching and enstrophy destruction by vorticity, both of order $Re^{1/2}$, must cancel, leaving an $O(Re^0)$ remainder. Some issues associated with this balance have recently been reconsidered by Tsinober. The failure of any number of theoretical investigations to justify this balance led Speziale and Bernard to investigate the possibility of 'unbalanced vortex stretching' in turbulence, leading to novel predictions for decaying turbulence and homogeneous shear flow. We will show that unbalanced vortex stretching occurs in transient turbulence dynamics, but that in self-similar turbulent flows, the Tennekes-Lumley balance is recovered. This analysis implies that whereas the Kolmogorov theory does indeed represent a statistical *attractor* for the small scales of motion, it is not a permanent feature. Implications of unbalanced vortex stretching for modeling transient flows will be considered.

Robert Rubinstein
NASA Langley Research Center

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