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Numerical and similarity analysis of the turbulent energy and scale mixing

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Numerical experiment on the interaction between different decaying homogeneous and isotropic turbulence fields are described. In the absence of kinetic energy production, the intermediate asymptotics of the turbulent shear-free mixing layer is observed. A first observation is that the mixing is always highly intermittent. For decaying homogeneous isotropic interacting flows with kinetic-energy ratios far from unity, this result is in contrast to the surmised existence of a Gaussian asymptotic state. The homogeneity of the integral length across the shearless layer – associated to the absence of turbulent energy production – is not a sufficient condition to obtain the Gaussian asymptotic state[1]. If the macroscale gradient is suppressed by considering turbulence with similar spectra, it is apparent that the intermittency increases with the energy gradient. This increase and the related intermittency behaviour is discussed by varying the kinetic energy ratio between the two turbulence fields in the range $[1, \infty]$. A scaling law for velocity skewness can be determined[1].

A second observation is that the intermittency increases/decreases when the kinetic-energy gradients and integral-scale gradients are aligned/opposite. This is found by independently varying the initial energy level and distribution over the wavenumbers of the two turbulence fields. Moreover, by means of a theoretical analysis based on the use of the one and two-point lateral correlation equations and their intermediate-similarity solutions[2], we discuss these two results for which a verification indipendent of the numerical experiments has been obtained.

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[1] Tordella and Iovieno, *J. Fluid Mech.*, to appear (2006)
[2] Tordella and Iovieno, *APS-DFD*, 58^{th} *Annual Meeting*, November 20-22, 2005, Chicago, IL.