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Dispersion in Non-homogeneous Intermittent Flows

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One of the most important roles of Stratification and Rotation in environmental turbulence, and in general of all body forces, including magnetic fields; is to modify the slope of the spectral energy cascade.

Another experimental and numerical observation is that while the anisotropy of the Reynolds stresses is oviously linked with the non-homogeneity taking the vertical axis (in stratified flows) and the rotation axis (in rotating flows) (It is not that clear for a magnetic field); Scalar behaviour in such flows has non-linear mixing properties Redondo (2002). There are similar effects that depart from Kolmogorov's K41 and also for K62 theories, not just in second order structure functions (and related spectra) for spatial non-homogeneity, for anisotropy and for spatial and temporal intermittency.

The directions of gravity, rotation axis and magnetic field act as principal axes and play dominant roles in the two dimensionalization due to body forces this forces a dominance of the enstrophy cascade over the direct energy cascade, but it is important to realize that both direct and inverse cascades may not be in equilibrium at the same time. The intermittency coupled with the non-homogeneity and anisotropy act indistinguishably to modify the dispersion within the flow, here the role of coherent structures is also relevant as described in Babiano (2002).

Using Kinematic Simulation (KS) for a variety of pseudo-turbulent flows in which the Energy spectra of the turbulence is varied with logarithmic spectral slopes between 1 (white noise) and 6 (flows dominated by a few large vortices) and using also Extended Self Similarity (Mahjoub et al. 1998,2000a,b) to investigate the diferences in structure between KS and Direct Numerical Simulations (DNS), the relationship between dispersion and spectral slope is cast as a Generalised Richardson's Law valid for even strongly non-local flows with steep spectral slopes that may or may not be in equilibrium (Castilla 2000).

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