A spectral model for unstably stratified homogeneous turbulence

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Unstably Stratified Homogeneous Turbulence (USHT) is an idealized approach for buoyancy driven flows under Boussinesq approximation. This concept is aimed at analysing the properties of turbulent fluctuating quantities developing in Rayleigh- Taylor mixing zones or in turbulent convection. In particular, it is dedicated to investigate the unsteadiness and anisotropy of the flow, while getting rid of inhomogeneity effects. USHT has been explored extensively through numerical simulations and theoretical studies which focus particularly on the self-similar aspects of this flow. These works have shown the fundamental importance of large scales in the time evolution of turbulent quantities. They also have proved the limitations of simulations, due to confinement effects induced by the growth of energetics scales fed by constant injection of potential energy. In order to overcome this difficulty, we develop a spectral model based on an Eddy- Damped Quasi-Normal Markovian method which takes into account energy production by buoyancy terms. This two-point statistical model describes axisymmetric turbulence through a set of velocity-density correlation spectra. In our talk, we will introduce the equations for the model and we will confront its results with high resolution DNS of USHT. Afterwards, we will present two applications of our EDQNM model: (a) the time evolution of turbulent quantities at very large Reynolds number; (b) the study of large-scale dynamics controlling the evolution of self-similar regime.

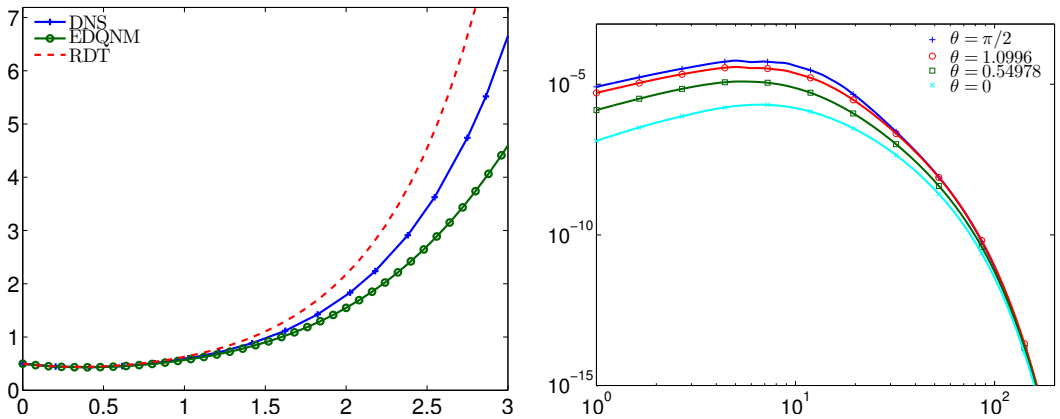

Figure 1: (a) Kinetic energy evolution (ordinate) vs. non-dimensional time (abscissa). (b) Kinetic energy spectrum (ordinate) vs. wavenumber (abscissa) for 4 angles at T*=3.

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