Intermittency layers associated to turbulent interfaces

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In this study we focus on the transport across an interface which separates two regions with homogeneous and isotropic turbulence in absence of a mean shear. The turbulent transport resulting presents an internal structure. Indeed, in the case of turbulent self-diffusion, both experiments[1,2,3] and simulations[4,5,6,7,8] show that the fluid velocity field is marked by a high intermittency front located aside the interface, which is the source of turbulent bursts penetrating the low turbulence region. The presence of an inner structure inside a layer of turbulence self-transport highlights the different nature of the turbulent transport with respect to the Gaussian diffusion. By including other effects, for instance a passive scalar transport or a mass transport in presence of a density stratification, the phenomenology is much enriched. For instance, our preliminary numerical experiments on the passive scalar transport reveals the presence of two intermittency fronts, one on each side of the interface.

As can be seen if the figure below, the intermittency level in the fronts is high. This is true both for the scalar and the scalr derivative statistics. A gradual decay in time is observed while they propagate toward the lateral isotropic regions of the flow. In the presence of a kinetic energy gradient across the interface, the locations and intensity of the intermittency fronts are no more symmetric to respect to the interface. The front on the high energy side of the mixing region penetrates deeper and exhibits stronger intermittency. Analogous features are observed also in two dimensions.

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[1]S.Veeravalli, Z.Warhaft, *J.Fluid Mech.* **207** (1989)
[2]Z.Warhaft, X.Shen, *Phys. Fluids* **13**, 1532 (2001).
[3]S.Gerashchenko et al. *J. Fluid Mech.* **668** (2011).
[4]D.Tordella, M.Iovieno *J. Fluid Mech.* **549**, 429 (2006).
[5]H.S.Kang, C.Meneveau, *Phys.Fluids* **20** (2008).
[6]D.Tordella, M.Iovieno, P.R.Bailey *Phys.Rev. E* **77**, 016309 (2008).
[7]D.Tordella, M.Iovieno, *Phys.Rev.Lett.* **107**, 194501 (2011).
[8]D.Tordella, M.Iovieno, *Physica D* **142**, 178 (2012).

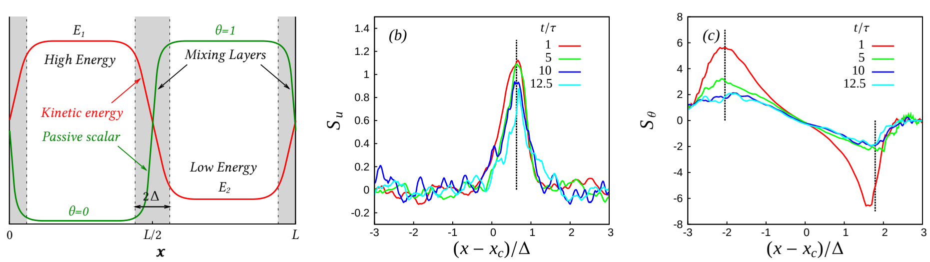

Figure 1: (a) Scheme of the flow. Due to the use of periodic boundary conditions, two mixing layers are included in the computational domain along the x direction, which is the direction where the nonhomogeneoity takes places. (b-c) Spatial distributions of the skewness of the velocity component in the inhomogoenous direction and of the passive scalar skewness. Simulation with $Re_\lambda = 150$ and initial energy ratio $E_1/E_2 = 6.7$, $Sc = 1$. The position is normalized with the interaction layer thickness Δ.