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Numerical simulations of turbulent buoyant mixing in tilted tubes
YANNICK HALLEZ, IMFT/INPT, JACQUES MAGNAUDET, IMFT/CNRS, ANR GIMIC COLLABORATION — We study the concentration and velocity distributions in the mixing zone of interpenetrating light and heavy fluids placed in an inclined tube using direct numerical simulation. The results of our simulations agree with the joint experimental work of Znaien et al. showing that when the tilt angle θ increases and the Atwood number At decreases, the flow regime in the mixing region evolves from a turbulent shear flow towards a laminar counterflow with three well-defined layers of different concentrations. The computational results are averaged in time as well as in the streamwise direction to study the variation of the various statistics accross the tube. The transverse distribution of second-order moments is found to differ significantly from that found in a classical pipe flow, with maxima of the second-order diagonal Reynolds stresses reached on the pipe axis. The analysis of the averaged momentum balance reveals that three-dimensional effects related to the presence of inclined streamwise vortices in the flow significantly contribute to the turbulent transfer.

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