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Front dynamics and macroscopic diffusion in buoyant mixing in a tilted tube J.-P. HULIN, T. SÉON, J. ZNAIEN, D. SALIN, Laboratoire FAST, Bâtiment 502, 91405 Orsay (France), B. PERRIN, LPA-ENS, UMR 8551, 75231 Paris 5 (France), E.J. HINCH, DAMTP-CMS, CB3-OWA, Cambridge (UK) — The buoyancy driven interpenetration of two fluids of different densities has been studied in a long tilted tube in the strong mixing regime for which the mean concentration profile along the tube length satisfies a macroscopic diffusion equation. Variations of the corresponding macroscopic diffusion coefficient D and of the front velocity V_f are studied as a function of the Atwood number At, the viscosity ν, the tube diameter d and the tilt angle θ. Introducing the characteristic inertial velocity V_t and the Reynolds number Re_t, the normalized front velocity V_f/V_t and dispersion coefficient $D/(V_t d)$ are observed to scale respectively as $Re_t^{-3/4}$ and $Re_t^{-3/2}$ for $Re_t \lesssim 1000$. Also, V_f increases linearly with $\tan\theta$ and the ratio (D/V_f^2) remains of the order of $(35 \pm 10)d/V_t$ in a wide range of values of the tilt angle and of the other control parameters. This close relation observed between the variations of D and V_f^2 will be discussed in terms of the characteristic time for transverse mixing across the flow channel.

J.-P. Hulin
Laboratoire FAST, Bâtiment 502, 91405 Orsay (France)

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