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Numerical simulation of gravity-driven mixing of two fluids in an inclined tube YANNICK HALLEZ, IMFT, JACQUES MAGNAUDET, CNRS/IMFT — The concentration distribution in the mixing zone of interpenetrating light and heavy fluids in an inclined tube is studied using direct numerical simulation as a function of the tilt angle θ from the vertical. Two-dimensional computations first show evidence of the concentration contrast-driven velocity of the front at any θ. However three-dimensional computations carried out in a circular tube reveal how crucial the geometry is. In these simulations,and for small θ, mixing is very efficient and the observed pattern is similar to the 2D one. Increasing θ, a concentration gradient appears across the tube section due to the transverse component of gravity and the concentration contrast at the front can reach that of the pure fluids. At still higher tilt angle, the transverse component of gravity becomes strong enough to set up a stable counterflow driven by viscous dissipation. The difference of behaviour between 2D and 3D cases appears to be due to the structure of the vorticity field, since the 2D vortices are found to be much more coherent than the 3D ones. Hence the pure fluid channel supplying the front is more easily broken by 2D vortices than by 3D ones, which leads to a smaller concentration contrast at the front in the former case.

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