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Free shearless multi-material turbulent mixing in the presence and absence of gravity[1] POOYA MOVAHED, ERIC JOHNSEN, University of Michigan, Ann Arbor — Using a novel set-up, we perform direct numerical simulations of free shearless turbulent multi-material mixing starting from an unperturbed material interface between two fluids in an isotropic turbulent velocity field. The energy dissipation rate is matched in each fluid, such that anisotropy in the initial set-up solely comes from the density gradient. At large scales, the mixing region grows self-similarly after an initial transient period; a one-dimensional turbulence-diffusion model in conjunction with Prandtl's mixing length theory is applied to describe the growth of the mixing region. The observed growth exponent tends to 2/7, as expected for Batchelor turbulence based on energy budget arguments for large Reynolds numbers. At small scales, flow isotropy and intermittency are measured. Results suggest that a large density ratio between the two fluids is required to make the velocity field anisotropic at the Taylor microscope, while the flow remains isotropic at the Kolmogorov microscale. Results with gravity in a similar set-up that is Rayleigh-Taylor unstable will also be presented. This novel set-up allows us to investigate the role of gravity and density gradient on flow statistics separately, as opposed to traditional Rayleigh-Taylor studies in which these effects are coupled.

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