Abstract Submitted
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The complex fluid dynamics of simple diffusion.[1] ERIK VOLD, Los Alamos National Laboratory — Diffusion as the mass transport process responsible for mixing fluids at the atomic level is often underestimated in its complexity. An initial discontinuity between two species of different atomic masses exhibits a mass density discontinuity under isothermal pressure equilibrium implying equal species molar densities. The self-consistent kinetic transport processes across such an interface leads to a zero sum of mass flux relative to the center of mass and so diffusion alone cannot relax an initially stationary mass discontinuity nor broaden the density profile at the interface. The diffusive mixing leads to a molar imbalance which drives a center of mass velocity which moves the heavier species toward the lighter species leading to the interfacial density relaxation. Simultaneously, the species non-zero molar flux modifies the pressure profile in a transient wave and in a local perturbation. The resulting center of mass velocity has two components; one, associated with the divergence of the flow, persists in the diffusive mixing region throughout the diffusive mixing process, and two, travelling waves at the front of the pressure perturbations propagate away from the mixing region. The momentum in these waves is necessary to maintain momentum conservation in the center of mass frame. Thus, in a number of ways, the diffusive mixing provides feedback into the small scale advective motions. Numerical methods which diffuse all species assuming P-T equilibrium may not recover the subtle dynamics of mass transport at an interface.

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