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Enhanced Mixing by Vortices

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The advection of a passive scalar blob in the deformation field of an axisymmetric vortex is a simple mixing protocol for which the advection–diffusion problem is amenable to a near-exact description. It is investigated here both experimentally and theoretically. The blob rolls-up in a spiral which ultimately fades away in the diluting medium. The complete transient concentration field in the spiral is accessible from the Fourier equations in a properly chosen frame. The concentration histogram of the scalar wrapped in the spiral presents unexpected singular transient features and its long time properties are discussed in connection with mixtures from the real world. The merging of two vortices will also be addressed and compared to the mixing properties of two-dimensional turbulence.

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