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Experimental Studies of the Effects of Mixing on Reacting Systems[1]

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Experimental studies of the effects of mixing on reacting systems are presented. The experiments can be divided into two classifications: (1) the effects of chaotic mixing on front propagation and (2) synchronization via superdiffusive mixing in an extended, fluid system. The front propagation studies are conducted in an oscillating vortex chain flow. The velocities of the propagating fronts are measured as a function of the frequency and amplitude of the external forcing. In the absence of mixing the Fisher-Kolmogorov result correctly predicts the front velocity; however these experiments show that this result is not extendable to chaotically mixed systems. Instead, the fronts are shown to mode-lock onto the external forcing, propagating an integer number of vortices in an integer number of drive periods. The flow used in the synchronization studies is an oscillating/drifting vortex chain, which may be used to produce both enhanced diffusion and superdiffusion. We show that the key to synchronization in an extended, fluid system is superdiffusive transport produced by Lévy flights, where tracers undergo rapid jumps between distant regions of the flow.

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