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The Role of Walls in Chaotic Mixing: Experimental Results

We report on experiments of chaotic mixing in a closed vessel, in which a highly viscous fluid is stirred by a moving rod. We analyze quantitatively how the concentration field of a low-diffusivity dye relaxes towards homogeneity, and observe a slow algebraic decay, at odds with the exponential decay predicted by most previous studies. Visual observations reveal the dominant role of the vessel wall, which strongly influences the concentration field in the entire domain and causes the anomalous scaling. A simplified 1-D model supports our experimental results. Quantitative analysis of the concentration pattern leads to scalings for the distributions and the variance of the concentration field consistent with experimental and numerical results. We also discuss possible ways of avoiding the limiting role of walls.

This is joint work with Emmanuelle Gouillart, Olivier Dauchot, and Stephane Roux.