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Optimal stretching of fluid for enhancing reaction growth
THOMAS NEVINS, DOUGLAS KELLEY, Univ of Rochester — When a biological or chemical scalar grows in flowing fluid, the resulting reacted region is dependent on both the details of the flow, and the reaction kinetics. We simultaneously film reaction state and flow in a laboratory model of reactive mixing in order to examine reactive mixing in physical, time-dependent flows. Using the excitable Belousov-Zhabotinsky (BZ) reaction, we find an optimal stretching range in which the flow enhances reaction, but larger stretching causes reaction blowout. We observe the transition from flow mostly helping to mostly blowout is not associated with the transition to turbulence, and that stretching fields (closely related to finite-time Lyapunov exponents) inside the optimal range appear to have a large effect on reaction growth rate locally. We also present estimates of the optimal stretching for BZ, and hypothesize that it is a feature exclusive to excitable reactions.

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