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Fast chemical reactions in chaotic flows: predicting the product growth rate[1] YUE-KIN TSANG, Scripps Institution of Oceanography, UCSD — We consider the fast irreversible bimolecular reaction in a two-dimensional chaotic flow. Simulations show that the reactant concentration decays exponentially with rate λ, and then crosses over to the algebraic law of chemical kinetics in the final stage of the reaction. We estimate the crossover time from the reaction rate constant and the flow parameters. The exponential decay phase of the reaction can be described in terms of an equivalent passive scalar problem, allowing us to predict λ using the theory of passive scalar advection. Depending on the flow configuration, λ is either related to the distribution of the finite-time Lyapunov exponent of the flow, or given in terms of an effective diffusivity. For the former case, we suggest an optimal choice of flow parameters at which λ is maximum.

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