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Chaotic mixing by microswimmers moving on quasiperiodic orbits MIR ABBAS JALALI, Department of Astronomy, University of California, Berkeley, California 94720, USA , ATEFEH KHOSHNOOD, Reservoir Engineering Research Institute, Palo Alto, California 94301, USA, MOHAMMAD-REZA ALAM, Department of Mechanical Engineering, University of California, Berkeley, California 94720, USA — Life on the Earth is strongly dependent upon mixing across a vast range of scales. For example, mixing distributes nutrients for microorganisms in aquatic environments, and balances the spatial energy distribution in the oceans and the atmosphere. From industrial point of view, mixing is essential in many microfluidic processes and lab-on-a-chip operations, polymer engineering, pharmaceutics, food engineering, petroleum engineering, and biotechnology. Efficient mixing, typically characterized by chaotic advection, is hard to achieve in low Reynolds number conditions because of the linear nature of the Stokes equation that governs the motion. We report the first demonstration of chaotic mixing induced by a microswimmer that strokes on quasiperiodic orbits with multi-loop turning paths. Our findings can be utilized to understand the interactions of microorganisms with their environments, and to design autonomous robotic mixers that can sweep and mix an entire volume of complex-geometry containers.

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