

# **Emergent Hydrodynamic Phenomena in a Bacterial Carpet**

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The present study is motivated by recent experiments on bacterial carpets, which are systems in which bacteria such as *E. coli* are immobilized on a substrate by their heads with their flagella sticking out towards the bulk in a hydrodynamically active state. We model this system as an array of rotors on a substrate that are coupled by hydrodynamic interaction. Each rotor, which is modeled by an effective rigid body, is driven by an internal torque and exerts an active force on the surrounding fluid. The long-ranged nature of the hydrodynamic interaction between the rotors causes a rich pattern of dynamical behaviors including synchronization, phase ordering, and selfproliferating spiral waves. Our results suggest strategies for designing controllable microfluidic mixers using the emergent behavior of hydrodynamically coupled active components.