Abstract Submitted
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Steady-state fluid-flow established by active matter-fluid interaction.[1] ZIJIE QU, DOMINIK SCHILDKNECHT, JIALONG JIANG, ENRIQUE AMAYA, SHAHRIAR SHADKHOO, HEUNJIN LEE, TIFFANY TSOU[2], TOM ROESCHINGER, JACK STELLWAGEN[3], NITZAN RAZIN, ROB PHILLIPS, DAVID VAN VALEN, MATT THOMSON, Caltech, THOMSON LAB COLLABORATION, PHILLIPS LAB COLLABORATION, VAN VALEN LAB COLLABORATION — Biological systems achieve precise control over ambient fluids by self-organizing active protein structures. Active structures consume chemical energy to generate mechanical stresses that induce organized fluid flows. Reconstitution of active matter driven fluid flows in vitro illuminates flow-dominated biological processes. However, the mechanism of flow fields generated by the active structures remains poorly understood. Here, we apply an optically-controlled active matter system composed of microtubule filaments and kinesin motor proteins to analyze the persistent flow fields. We demonstrate that organized fluid flows emerge through dynamic feedback between microtubule network contractions and fluid-driven mass transport. The geometry of active stresses at the vertices of the microtubule network determines the architecture of induced flow-fields allowing prediction of flow architecture given microtubule network geometry. Our work provides a foundation for programming microscopic fluid-flows and could enable the engineering of versatile microfluidic devices.

[1]Rosen Foundation, Packard Foundation, Heritage Medical Research Institute, Search Results Web Result with Site Links National Institutes of Health, National Science Foundation, John Templeton Foundation, The Foundational Questions Institute and Fetzer Franklin Fund, UCSF Center for Systems and Synthetic Biology
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