Abstract Submitted
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Propulsion of a bacterial phalanx[1] JOHN O. KESSLER, University of Arizona, RICARDO CORTEZ, Tulane University, LUIS CISNEROS, University of Arizona, RAYMOND E. GOLDSTEIN, University of Cambridge, CHRISTOPHER DOMBROWSKI, UC Davis — Concentrated populations of swimming rod-shaped bacteria spontaneously form domains. Within a domain the bacteria are nearly close-packed; they all swim in the same direction. A propagating domain is a phalanx. The forward members of the domain push fluid forward, the flagella of the rear rows push fluid backwards, yielding propulsion. In the transverse direction fluid flows both in and out, but there is little net flow within a phalanx. The bacterial cell bodies and the flagella that surround them (emerging from preceding cell bodies) exert opposite stresses on the interstitial fluid. Using slender body theory, in the Reynolds number $<<1$ regime, a cylindrical phalanx is propelled by the flagella emerging from its rear. Dimensional analysis yields a collective propagation velocity of the same order as that of individual swimmers, even though a large population of swimmers is propelled by only a small number of bacteria, proportional to volume fraction to the 2/3 power.

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