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Rotating bacteria aggregate into active crystals ALEXANDER PETROFF, The Rockefeller University, XIAO-LUN WU, University of Pittsburgh, ALBERT LIBCHABER, The Rockefeller University — The dynamics of many microbial ecosystems are determined not only by the response of individual bacteria to their chemical and physical environments but also the dynamics that emerge from interactions between cells. Here we investigate the collective dynamics displayed by communities of Thiovulum majus, one of the fastest known bacteria. We observe that when these bacteria swim close to a microscope cover slip, the cells spontaneously aggregate into a visually-striking two-dimensional hexagonal lattice of rotating cells. Each cell in an aggregate rotates its flagella, exerting a force that pushes the cell into the cover slip and a torque that causes the cell to rotate. As cells rotate against their neighbors, they exert forces and torques on the aggregate that cause the crystal to move and cells to hop to new positions in the lattice. We show how these dynamics arises from hydrodynamic and surface forces between cells. We derive the equations of motion for an aggregate, show that this model reproduces many aspects of the observed dynamics, and discuss the stability of these and similar active crystals. Finally, we discuss the ecological significance of this behavior to understand how the ability to aggregate into these communities may have evolved.

Alexander Petroff
The Rockefeller University

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