Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Directed transport of active magnetotactic bacteria in porous media flow[1] NICOLAS WAISBORD, AMIN DEHKHARGHANI, THOMAS COONS, JEFFREY S. GUASTO, Tufts University — Swimming cell migration through porous media is a topic of ecological and technical relevance for understanding sediment ecosystems and bioremediation of soil for decontamination. We focus on magnetotactic bacteria – which align passively with Earth's magnetic field and migrate in such sediment environments – as a model system. The transport properties of magnetotactic bacteria are measured in a 2D microfluidic porous medium as a function of the porous microstructure geometry and under a variety of environmental conditions. In a quiescent fluid and in the absence of an external, guiding magnetic field, the effective diffusion of cells' random walk is unsurprisingly hindered with decreasing porosity due to cell-surface interactions. When guided by a magnetic field, cell trajectories acquire a net direction and form lanes, a behavior that is enhanced with increasing magnetic field. When the directed motility is coupled with an opposing fluid flow through the porous medium, convective cells form and locally trap the swimming bacteria. These results, which are corroborated by Langevin Simulations are an important step toward understanding magnetotactic bacterial ecology as well as for the magnetic guidance of microrobots in complex environments.

[1]Supported by NSF Grant CBET-1511340

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Date submitted: 28 Jul 2017 Electronic form version 1.4