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Ferromagnetic and antiferromagnetic order in bacterial vortex lattices HUGO WIOLAND, FRANCIS G. WOODHOUSE, JÖRN DUNKEL, RAYMOND E. GOLDSTEIN, Department of Applied Mathematics and Theoretical Physics, Centre for Mathematical Sciences, University of Cambridge, GOLDSTEIN LAB TEAM — In conventional electronic materials, spins can organize into ordered phases that give rise to ferromagnetic or antiferromagnetic behavior. Here, we report similar observations in a completely different system: a suspension of swimming bacteria. When a dense *Bacillus subtilis* suspension is confined to a small circular chamber, it can spontaneously form a stable vortex ("spin") state that can persist for several minutes [Wioland et al., PRL **110**, 268102 (2013)]. By coupling up to 100 such chambers in microfluidic devices, we are able to realize bacterial spin lattices of different geometries. Depending on that geometry and the effective coupling strength between neighboring vortices, we observe the formation of stable "antiferromagnetic" and "ferromagnetic" bacterial vortex states, that appear to be controlled by the subtle competition between bacterial boundary layer flows and bulk dynamics.

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