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From cell extracts to fish schools to granular layers: the universal hydrodynamics of self-driven systems[1]

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Collections of self-driven or "active" particles are now recognised as a distinct kind of nonequilibrium matter, and an understanding of their phases, hydrodynamics, mechanical response, and correlations is a vital and rapidly developing part of the statistical physics of soft-matter systems far from equilibrium. My talk will review our recent results, from theory, simulation and experiment, on order, fluctuations, and flow instabilities in collections of active particles, in suspension or on a solid surface. Our work, which began by adapting theories of flocking to include the hydrodynamics of the ambient fluid, provides the theoretical framework for understanding active matter in all its diversity: contractile filaments in cell extracts, crawling or dividing cells, collectively swimming bacteria, fish schools, and agitated monolayers of orientable granular particles.

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