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Polar patterns in active fluids[1]

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Active fluids are a new class of soft materials composed of interacting units that consume energy and collectively generate motion and mechanical stress. Examples include bacterial suspensions, mixtures of cytoskeletal filaments and motor proteins, and migrating epithelial cell layers. Due to their elongated shape, active particles can exhibit orientational order at high concentration and have been likened to "living liquid crystals", with either nematic or polar symmetry. In this talk I will discuss the spatio-temporal dynamics of continuum models of active fluids in two dimensions, focusing on the case of a system with polar symmetry as relevant to bacterial suspensions. Upon increasing activity, the active fluid displays increasingly complex patterns, including traveling bands, traveling vortices and chaotic behavior. The nonlinear hydrodynamic equations can be mapped onto a diffusion-reaction-convection model, highlighting the connection between the complex dynamics of active system and that of excitable systems.

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