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Phenomenological higher-order PDE models for active suspensions[1]

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A common characteristic of many active fluids, from bacterial suspensions to ATP-driven microtubule networks, is the emergence of turbulent flow structures that exhibit a preferred vortex scale. Although the biophysical origins of this self-organized length scale selection are not yet well understood, the existence of a dominant wavelength suggests that these systems can be efficiently described through phenomenological higher-order PDE models. In this talk, I will first outline how one can derive such PDEs from stochastic micro-swimmer models. Subsequently, we will consider two specific examples: a fourth-order Q-tensor model for active microtubule bundles (New J Phys 18: 093006, 2016), and a generalized Navier-Stokes model for the solvent flow in active suspensions (arXiv:1608.01757 and 1611.08075). Our discussion will focus on the comparison with recent experiments and on specific model predictions, such as the possibility of a helicity-driven inverse cascade in 3D active fluids.

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