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Simulation Insights into Chiral Active Matter

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Abstract:

Active matter represents a wide range of physical systems in which individual constituents can perform mechanical work in terms of self-propulsion or self-spinning. This type of dissipative systems can give rise to rich collective dynamics phenomena that are promising for emergent applications in, for example, photonics, drug delivery, and autonomous materials systems. Many biological active matter systems are chiral. Chirality can give rise to even richer phenomena that are under studied to date. Here we discuss the physics of two types of chirality. In one system, active chiral particles can exhibit circular motion, and a combination of granular experiments and simulation show that active particles moving in an obstacle lattice are sensitive to the geometry of the lattice, a feature that can be used to sense the environment. In another scenario, we study how +1/2 disclinations self-propel in a thin-film active chiral nematic liquid crystal. Our theory and simulation find that these defects can acquire an active angular velocity in certain conditions. Taken together, our study reveals the intriguing physics of chirality in active matter, paving the way towards better understanding and control of biological active matter.

Reference:

Wang, Ren and Zhang, PRL (2024).

Chan et al., Nat. Commun. (2024).