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Nematic long-range ordering of topological defects in active liquid crystals JORN DUNKEL, MIT, ANAND OZA, Courant Institute — Identifying the ordering principles of intracellular matter is key to understanding the physics of microbiological systems. Recent experiments demonstrated that ATP-driven microtubule-kinesin bundles can self-assemble into two-dimensional active liquid crystals that exhibit a rich creation and annihilation dynamics of topological defects, reminiscent of particle-pair production processes in quantum systems. This remarkable discovery has sparked considerable theoretical and experimental interest, yet a satisfactory mathematical description remains elusive. Here, we present and validate a continuum theory for this new class of active matter systems by merging universality ideas with the classical Landau-de Gennes theory. The resulting model agrees quantitatively with recently published data and, in particular, predicts correctly a previously unexplained regime of long-range nematic ordering of defects observed in experiments. Our analysis implies that active liquid crystals are governed by the same generic ordering principles that determine the non-equilibrium dynamics of dense bacterial suspensions and elastic bilayer materials. Moreover, the theory suggests an energetic analogy with strongly interacting quantum gases.

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