Continuous descriptions for dry active matter

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We have developed a general method to derive continuous equations for the density and order parameter fields describing the large-scale properties of two-dimensional systems of Vicsek-like active particles, namely overdamped point-like particles with either polar or nematic symmetries. Both the symmetries of motion (self-propelled or diffusive) and of interactions (ferromagnetic or nematic) can be varied. From the study of these different cases, a generic scenario emerges in which the (high-noise) homogeneous isotropic phase and the (low-noise) homogeneous ordered phase are separated, in the noise-density plane, by a rather complex non-homogeneous phase dominated by dynamically evolving non-linear structures. Whether this phase exhibits long-range order in the large size limit depends on the specific symmetries considered.

Boltzmann–Ginzburg–Landau approach for continuous descriptions of generic Vicsek–like models

Large-scale chaos and fluctuations in active nematics

Mesoscopic theory for fluctuating active nematics

Nonlinear field equations for aligning self-propelled rods