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Soft active matter : a contemporary example of Edwardsian statistical mechanics[1]

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Colonies of swimming bacteria, algae or spermatozoa are examples of active systems composed of interacting units that consume energy and collectively generate motion and mechanical stresses. Due to the anisotropy of their interactions, these active particles can exhibit orientational order at high concentrations and have been called living liquid crystals". Biology at the cellular and multicellular scale provides numerous examples of these active systems. They provide a novel class of experimentally accessible system far from equilibrium. Their rich collective behaviour includes non-equilibrium phase transitions and pattern formation on mesoscopic scales. Interestingly however, some of the theoretical insights gained from field theories applied to equilibrium soft matter systems can be used to explain aspects of their behaviour, but with a number of surprising new twists. I will describe and summarise recent theoretical results characterising the behaviour of such soft active systems highlighting in particular the effects of their internal dynamics on their macroscopic behaviour.

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