Nonequilibrium phase transitions in active matter

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While ordinary materials are typically composed of inert "passive" particles, active matter comprises objects or agents which possess an intrinsic propulsion. Examples are living systems like schools of fish, swarms of birds, pedestrians and swimming microbes but also artificial particles equipped with an internal motor such as robots and colloidal Janus particles. In this talk the statistical mechanics of synthetic artificial self-propelled colloidal particles [1] and possible nonequilibrium phase transitions are discussed and the importance of inertia is highlighted [2,3]. Finally, quantum active matter [4] and its thermodynamic consequences will be proposed. The latter describes ultracold atoms in space-time correlated optical fields.

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[3] L. Hecht, S. Mandal, H. Löwen, B. Liebchen, Phys. Rev. Letters 129, 178001 (2022).

[4] Y. J. Zheng, H. Löwen, arXiv:2305.16131