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Kinetic theory for systems of self-propelled particles YEN-LIANG CHOU, THOMAS IHLE, North Dakota State University — Models of self-driven particles similar to the Vicsek model [Phys. Rev. Lett. 75 (1995) 1226] are studied by means of kinetic theory. In these non-equilibrium models, particles try to align their travel directions with the average direction of their neighbors. At strong alignment a global flocking state forms. The alignment is defined by a stochastic rule, not by a Hamiltonian. The corresponding interactions are non-additive and are typically of genuine multi-body nature. The theory [1] is based on a Master equation in 3N-dimensional phase space, which is made tractable by means of the molecular chaos approximation. The phase diagram for the transition to collective motion is calculated and compared to direct numerical simulations. A stability analysis of a homogeneous ordered state is performed, which reveals a long wave length instability for some of the considered models. The mean-field calculations of one of the models show a tricritical point where the flocking transition changes its character from continuous to discontinuous.

[1] T. Ihle, Phys. Rev. E 83 (2011) 030901

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