Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Quantitative kinetic theory of active matter THOMAS IHLE, North Dakota State University, YEN-LIANG CHOU, Max-Planck-Institute for the Physics of Complex Systems — Models of self-driven agents similar to the Vicsek model [Phys. Rev. Lett. 75 (1995) 1226] are studied by means of kinetic theory [1,2]. In these models, particles try to align their travel directions with the average direction of their neighbours. At strong alignment a globally ordered state of collective motion forms. An Enskog-like kinetic theory is derived from the exact Chapman-Kolmogorov equation in phase space using Boltzmann's mean-field approximation of molecular chaos. The kinetic equation is solved numerically by a nonlocal Lattice-Boltzmann-like algorithm. Steep soliton-like waves are observed that lead to an abrupt jump of the global order parameter if the noise level is changed. The shape of the wave is shown to follow a novel scaling law and to quantitatively agree within 3 % with agent-based simulations at large particle speeds. This provides a mean-field mechanism to change the second-order character of the flocking transition to first order. Diagrammatic techniques are used to investigate small particle speeds, where the mean-field assumption of Molecular Chaos is invalid and where correlation effects need to be included. [1] T. Ihle, Phys. Rev. E 83 (2011) 030901; 88 (2013) 040303. [2] Y.L. Chou et al, Phys. Rev. E 86, 021120 (2012).

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Date submitted: 15 Nov 2013

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