Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Microscopic origin and macroscopic implications of lane formation in mixtures of oppositely-driven particles[1] STEPHEN WHITELAM, Lawrence Berkeley National Lab — Colloidal particles of two types, driven in opposite directions, can segregate into lanes [Vissers et al. Soft Matter 7, 2352 (2011); Dzubiella et al. Phys. Rev. E 65, 021402 (2002)]. I will describe some results on this phenomenon obtained by simple physical arguments and computer simulations [Klymko, Geissler, Whitelam, Phys. Rev. E94, 022608 (2016)]. Laning results from rectification of diffusion on the scale of a particle diameter: oppositely-driven particles must, in the time taken to encounter each other in the direction of the drive, diffuse in the perpendicular direction by about one particle diameter. This geometric constraint implies that the diffusion constant of a particle, in the presence of those of the opposite type, grows approximately linearly with Peclet number, a prediction confirmed by our numerics. Such environment-dependent diffusion is statistically similar to an effective interparticle attraction; consistent with this observation, we find that oppositely-driven colloids display features characteristic of the simplest model system possessing both interparticle attractions and persistent motion, the driven Ising lattice gas [Katz, Leibowitz, Spohn, J. Stat. Phys. 34, 497 (1984)].

[1]Office of Science, Office of Basic Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02–05CH11231

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Date submitted: 21 Oct 2016 Electronic form version 1.4