Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Reversible Ratchet Effects and Structural Ordering for Self-Propelled Disks on Quasi-One Dimemsional Asymmetric Substrates DANIELLE MCDERMOTT, Wabash College, CYNTHIA REICHHARDT, CHARLES REICHHARDT, Los Alamos National Laboratory, Theoretical Divsion — When a particle is placed in an asymmetric periodic potential and an ac driving force is applied, it is possible to produce a net dc flow through a ratchet effect. When the particles are active, a net dc particle flow can arise even in the absence of external driving, creating an active ratchet effect as has been observed for bacteria in funnel geometries. Here we examine a 2D assembly of self-propelled disks interacting with an asymmetric 1D substrate. We find that at low density, with few particle collisions, this system exhibits a robust ratchet effect in which the particles undergo a net drift in the easy direction of the substrate asymmetry. At higher densities where particle-particle interactions become important, a reversed ratchet effect can arise with the net flow of particles in the hard direction. These reversals occur due to the formation of commensurate chain-like structures of disks. When there are two or more chains of particles in a one substrate well, the effective substrate potential is inverted. This reversible active ratchet effect could be used to separate different species of particles, cause the shepherding of passive particles, or control the migration of micro-organisms, and should be general to a wide class of self driven interacting particle systems.

Danielle McDermott
Wabash College

Date submitted: 02 Nov 2015 Electronic form version 1.4