Abstract Submitted
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Dynamics of Gas-Fluidized Bipolar Rods L. DANIELS, D. DURIAN, U. Penn — We study a driven, non-equilibrium two-dimensional system consisting of bipolar rods in a gas-fluidized bed. The rods have an aspect ratio of 4 and occupy an area fraction of 42%, chosen both to minimize the effects of ordering as well as to ensure a uniform density of particles across the system. We are able to track the position and orientation of the particles as a function of time. From this, we measure the dynamics of the system with the advantage that our temporal resolution allows us to observe ballistic motion at the shortest time scales. We calculate the mean squared displacement (MSD) in both the lab frame and the particle's frame in which displacements are measured as either perpendicular or parallel to the rod's long axis. In contrast to a comparable system of isotropic particles in which the dynamics are thermal, our system exhibits distinctly athermal behavior. Specifically, the effective temperature along the parallel direction is greater than that along the perpendicular direction. Furthermore, the parallel MSD remains superdiffusive at the longest time scales we are able to measure before the particles have reached the wall whereas the perpendicular component experiences cross-over to diffusive motion. This is emphasized by the power law decay of the velocity autocorrelation function (VAF). In comparison to a thermal fluid, the parallel VAF decays much more slowly whereas the perpendicular VAF decays more rapidly. With these characteristics in mind, ours is a simple experimental system that could be used to compare to biological models of active particles as well as to generalize the framework of statistical mechanics to non-equilibrium, athermal systems.

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