Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Rectified Motion of Microparticles: Generalizing Streaming and Radiation Forces DAVID RAJU, SIDDHANSH AGARWAL, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, BHARGAV RALLABANDI, Mechanical and Aerospace Engineering, Princeton University, SASCHA HILGENFELDT, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — It is well known that a wide variety of oscillating flows gives rise to steady streaming, i.e., rectified motion of fluid elements. Small spherical particles introduced into such a flow have been shown to experience an additional lift force that ultimately leads to particle trajectories that differ systematically from the fluid element pathlines. We demonstrate a systematic derivation of this differential particle motion on the steady streaming time scale, so that time-averaged particle trajectories can be directly predicted without computation on the fast, oscillatory time scale. The resulting dynamics can be interpreted as a generalization of streaming flow, while the closed-form lift force provides a generalization of the secondary radiation force, to which it reduces in appropriate limiting cases. These very general results are validated by comparison with experiments in the context of bubble streaming, but apply to a large class of other flows as well.

Sascha Hilgenfeldt
University of Illinois at Urbana-Champaign

Date submitted: 01 Aug 2016 Electronic form version 1.4