Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Onset of motion of a particle attached to a wall in a linearly sheared fluid flow[1] ARSHAD KUDROLLI, DAVID SCHEFF, BENJAMIN ALLEN, Department of Physics, Clark University — We examine the onset of motion of particle on a bumpy surface which is exposed to a linear shear fluid flow by means of moving a top surface parallel to the bottom surface on which the particle rests with a prescribed shear rate. This system can be considered as a particularly simple limit of a granular bed exposed to a fluid flow, where forces and torques acting on the particles can be clearly determined. The control parameters available to us include the relative size of the particle to the bumps, the relative size of the particle to the gap thickness, and the flow Reynolds number controlled by the density of the particle and the viscosity of the fluid. Further, the degree of exposure of the particle to the fluid flow is measured by means of adding tracer particles to the fluid and measuring the flow field around the particle. By measuring the critical shear rate at onset of motion as a function of control parameters, we estimate the relative magnitude of forces and torques acting due to drag, lift, and gravitational forces on the particle. We contrast the torque balance and force balance conditions obtained using analytical expressions and numerical simulations with those observed in our experiments.

[1]Supported by NSF Grant Number CBET 1335928

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Date submitted: 13 Nov 2014 Electronic form version 1.4