Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Breakdown of effective temperature agreement near jamming
ADAM ABATE, DOUG DURIAN, University of Pennsylvania — The jamming concept may unify a wide class of disparate phenomena. Central to this are the behaviors of effective temperatures as a system falls out of equilibrium. We present experimental measurements of effective temperatures in a granular system as it is gradually brought close to jamming. One effective temperature is based on the Einstein relation and defined in terms of the ratio of diffusion to mobility of a heavy test particle dragged through the system. The others are measures from local single-particle observables: the granular temperature is the average kinetic energy of the grains; the thermometer temperature is the average total mechanical energy of a weighted oscillator placed in the system. In thermal equilibrium and, surprisingly, when this non-equilibrium granular system is driven far from jamming, these effective temperatures agree. As jamming is approached, the Einstein temperature, which depends on system wide relaxation, systematically deviates from the other local measurements of effective temperature. The amount of deviation depends on the system's proximity to jamming and results in qualitative scaling differences of the relaxation timescales. These results suggest that global packing constraints play an important role in the breakdown of the thermal analogy as granular materials jam.

Adam Abate
Harvard University

Date submitted: 02 Dec 2007 Electronic form version 1.4