Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Shear-rate Dependent Regime Transition in Homogeneously sheared systems of Frictionless Cohesive Granules[1] ERIC MURPHY, SRIRAM SUNDARARAJAN, SHANKAR SUBRAMANIAM, Iowa State University — We study regime transition behavior in systems of cohesive micron-sized granular particles in the absence of friction via soft sphere discrete element (DEM) simulations. Previous studies[2,3] have identified a shear-rate dependent regime transition, from Bagnold to quasi-static scaling, occurring below jamming volume fractions. The transition of interest is well-described by theories for non-equilibrium phase transitions. Most notably, this regime transition is accompanied by the emergence of a diverging meso-scopic length-scale based on the formation of local contact networks indicative of clustering. We identify the relevant non-dimensional quantities, e.g. ratio of cohesive potential to granular kinetic temperature, which mark the location of the critical transition and show that the fabric tensor may serve as a promising order-parameter. The study of such simple systems has broad implications for the constitutive modeling of other athermal systems, and illuminates the growing need for the modeling of non-local effects in flows of macroscopic particles.

[1]We gratefully acknowledge the support for this work from NSF grant no. 0927660.
[2]Aarons, L. Sundaresan, S. Powder Tech. 169 (2006) 10–21.
[3]Rognon, P.G. et al. J. Fluid Mech. 596 (2008) 21–47.

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Date submitted: 02 Aug 2013 Electronic form version 1.4