Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Scaling theory for the jamming transition CARL GOODRICH, Harvard University, ANDREA LIU, University of Pennsylvania, JAMES SETHNA, Cornell University — We propose a scaling ansatz for the elastic energy of a system near the critical jamming transition in terms of three relevant fields: the compressive strain $\Delta\phi$ relative to the critical jammed state, the shear strain ϵ, and the inverse system size $1/N$. We also use ΔZ, the number of contacts relative to the minimum required at jamming, as an underlying control parameter. Our scaling theory predicts new exponents, exponent equalities and scaling collapses for energy, pressure and shear stress that we verify with numerical simulations of jammed packings of soft spheres. It also yields new insight into why the shear and bulk moduli exhibit different scalings; the difference arises because the shear stress vanishes as $1/\sqrt{N}$ while the pressure approaches a constant in the thermodynamic limit. The success of the scaling ansatz implies that the jamming transition exhibits an emergent scale invariance, and that it should be possible to develop a renormalization-group theory for jamming.

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Date submitted: 03 Nov 2015 Electronic form version 1.4