Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Periodic Lattices Near Isostaticity ANTON SOUSLOV, T.C. LUBENSKY, Dept. of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA 19104 — Lattices in d dimensions with with an average of $z = 2d$ contacts per site are at the verge of mechanical stability and are called isostatic. Common isostatic lattices include the two-dimensional square and Kagome lattices as well as the three-dimensional cubic lattice with nearest-neighbor sites connected by central-force springs of spring constant k and randomly packed spheres at random close packing at what is called point J. We calculate the phonon response functions and spectra of nearly isostatic square, cubic, and Kagome lattices in which springs of spring constant k' connect next-nearest-neighbor sites. These lattices exhibit highly anisotropic modes at $k' = 0$, among which are soft modes with one-dimensional dispersion in wavenumber, giving rise to a flat density of states as a function of frequency ω. In the square lattice, these modes are shear acoustic phonons, whereas in the Kagome lattice, they are optical phonons. When $k' > 0$, the low-energy modes crossover from acoustic phonons of the appropriate lattice symmetry for $\omega < \omega^* \sim \sqrt{k'}$ to the soft isostatic-like modes for $\omega > \omega^*$, and the density of states crosses over from Debye-like to flat. Static phonon response functions exhibit correlation lengths $\xi \sim 1/\sqrt{k'}$. We discuss the relation of these results to those for jammed systems near point J.

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Date submitted: 02 Dec 2008 Electronic form version 1.4