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Soft Modes and Deformations of Three-Dimensional Isostatic Periodic Lattices ANTON SOUSLOV, Georgia Institute of Technology, T.C. LUBENSKY, University of Pennsylvania — Each particle in a three-dimensional isostatic lattice is connected by springs on average to six nearest neighbors, a condition obtained by J.C. Maxwell for marginal stability. The cubic and pyrochlore lattices satisfy this condition. By calculating the dispersion relations and the density of states for phonons in these lattices, we expand on previous studies of isostatic periodic structures [1], which have largely been focused on the simpler two-dimensional cases. The low energy phonon spectrum of these lattices exhibits features common to isostatic systems in any dimension, such as the presence of floppy modes and the scaling of a divergent length and a vanishing critical frequency. However, the allowed symmetries of an elasticity theory and the number of floppy modes depend on dimension and play a crucial role in the structure of the low-frequency response. We relate these findings to the isostatic transition in systems of close-packed athermal spheres and look at an analogy with three-dimensional crystals with zeolite structure.

[1] A. Souslov, A. J. Liu, and T. C. Lubensky, Phys. Rev. Lett. 103, 205503 (2009)

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