Classical Disordered Ground States: Super-Ideal Gases, Stealth and Equi-Luminous Materials

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Poster (2:20 PM)

Using a collective coordinate numerical optimization procedure, we construct ground-state configurations of interacting particle systems in various space dimensions so that the scattering of radiation exactly matches a prescribed pattern for a set of wave vectors [1]. We show that the constructed ground states are, counter intuitively, disordered (i.e., possess no long-range order) in the infinite-volume limit. We focus on three classes of configurations with unique radiation scattering characteristics: (i) "stealth" materials, which are transparent to incident radiation at certain wavelengths; (ii) "super-ideal" gases, which scatter radiation identically to that of an ensemble of ideal gas configurations for a selected set of wave vectors; and (iii) "equi-luminous" materials, which scatter radiation equally intensely for a selected set of wave vectors. We find that ground-state configurations have an increased tendency to contain clusters of particles as one increases the prescribed luminosity. Limitations and consequences of this procedure are detailed.

[1] R.D. Batten, F.H. Stillinger, S. Torquato, *Journal of Applied Physics* 104, 033504 (2008).