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Spectral responses in granular compaction[1] LING-NAN ZOU, The James Franck Institute and Department of Physics, the University of Chicago — I study the compaction of a granular pack under periodic tapping. The magnitude of acceleration Γ at each tap is modulated with frequency ω and amplitude $\delta\Gamma$: $\Gamma(t) = \Gamma_{\rm DC} + \delta\Gamma \sin(\omega t)$, where t is time measured by the number of taps. From the temporal modulation δv in packing volume v, frequency- locked to the modulated tapping input, we can define the real and imaginary volume susceptibilities $\chi'_v = (\delta v/\delta\Gamma)\cos\theta$ and $\chi''_v = (\delta v/\delta\Gamma)\sin\theta$; here θ is the phase lag between $\Gamma(t)$ and $v(t)$. As a function of $\Gamma_{\rm DC}$, χ'_v, χ''_v are peaked at low $\Gamma_{\rm DC}$, a behavior reminiscent of the temperature-dependent susceptibilities in dielectric and spin glasses. For the packing of small particles ($d = 0.5$ mm) in ambient pressure, χ'_v exhibits memory and rejuvenation effects under $\Gamma_{\rm DC}$ cycling, similar to that seen in the magnetic susceptibility of spin glasses when subjected to thermal cycling [1]. However this memory effect is suppressed for the packing of larger particles and in vacuum. The measurement of volume susceptibilities shows promise as a new way to study the packing of granular materials, and as an avenue to explore analogies between jammed grains and molecular and spin glasses.

[1] K. Jonason *et al.*, Phys. Rev. Lett. **81**, 3243 (1998).

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