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Long-term behaviour of granular chains held between walls is really equilibrium.

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Granular chains have been the focus of a number of studies, in part due to their numerous applications, ranging from shock absorption and vibration reduction to energy localization. Force impulses to an unloaded granular chain result in a propagating solitary wave (SW), analogous to a soliton of the Korteweg-de Vries equation. When SWs collide with a boundary or another SW, secondary solitary waves (SSWs) are produced as grains break contact. A consequence of this process is the transition from a non-ergodic, SW dominant, phase to the stable "quasi-equilibrium" (QEQ) phase, thought to be distinct from true thermodynamic equilibrium due to the absence of equipartitioning of energy. We show that, in the absence of energy dissipation, when granular systems are allowed to evolve to extremely long times, the number of SSWs becomes sufficiently large that the system actually approaches a true equilibrium phase. In this extreme-time limit, energy in fact becomes equipartitioned among all grains, and we illustrate how the specific heat and kinetic energy fluctuations can be predicted by the generalized equipartition theorem, regardless of the degree of the interaction potential. This opens up the possibility that granular systems should be treated by equilibrium statistical mechanics.

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