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Cyclic Packing and Unpacking of Spheres by Thermal Convection
BIN LIU, Dept. of Physics, New York University, JUN ZHANG, Dept. of Physics and Courant Inst., NYU — We explore the dynamics of a multi-body interaction that is coupled to the large-scale circulation of a Rayleigh-Benard convection. This system is a collection of freely-moving spheres that sediment at the bottom of the convection cell. Once aggregated, they perturb collectively the convection in the bulk by reducing the local heat flux. As a consequence, the mean wind of circulation will reverse direction, driving the spheres to new positions. As this process continues, it causes the collection of spheres to move back and forth between the two ends of the convection cell along its long side. This system can be seen as a prototype of a self-organized, self-excited oscillating machine, which operates with regularity. The reversal time-scale represents the stochastic characteristic of the repetitive tunneling between the two degenerate "ground states," which correspond to two modes of large-scale circulation.

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