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# Microscopic model for a granular solid-liquid-like phase transition

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## Résumé

Forced granular matter in confined geometries presents phase transitions and coexistence. Depending on the system and forcing parameters, liquid-vapor and liquid-solid co-existing states are possible. For the solid-liquid coexistence that is observed in quasi-two-dimensional vibrated systems, both first- and second-order transitions have been reported. Experiments show that particles in the solid cluster move collectively, synchronized with the cell's vibration, in a similar way to the collect-and-collide regime observed in granular dampers. Here, we present a model that proposes a microscopic origin of this granular phase transition and co-existence. Imposing synchronicity, we model the solid cluster as an effective particle of zero restitution coefficient. In addition, we use the mechanical equilibrium between the two phases, with an equation of state validated for hard spheres relating the horizontal velocities in each phase. Balancing energy input and dissipation per unit time we obtain a global power equation, which relates the characteristic vertical and horizontal velocities to the microscopic relevant parameters (geometric and dissipation coefficients) as well as to the vibration amplitude and solid cluster's size. The predictions of the model compare quite well with our experimental results and with the experimental and dynamic simulation results reported elsewhere.

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