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Dynamics of Random Packings in Granular Flow CHRIS H. RYCROFT, MARTIN Z. BAZANT, Massachusetts Institute of Technology, JAMES W. LANDRY, BAE Systems, GARY S. GREST, Sandia National Laboratories —
How do random packings flow? Dilute "packings" (gases) flow by the accumulated effect of independent, random collisions. Dense, ordered packings (crystals) flow collectively via the motion of defects, such as vacancies, interstitials, and dislocations. Similarly, existing theories of the dense, disordered packings in granular drainage are based on either gas-like inelastic collisions or crystal-like void diffusion, but experiments show that a fundamentally different approach is needed. Here, we propose that dense random packings flow co-operatively in response to diffusing "spots" of free volume. The Spot Model is very simple to simulate and may be analyzed in the continuum limit (via a non-local stochastic differential equation). With only a few fitting parameters, it predicts the mean flow, spatial velocity correlations, cage breaking, diffusion, and packing structure, in good agreement with experiments and molecular dynamics simulations. The results suggest that flowing random packings have universal structural features.

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