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Experimental characterization of microstate probabilities in mechanically stable packing of frictionless disks. M.D. SHATTUCK, Levich Institute and Physics Department, The City College of New York, New York, NY, G.-J. GAO, Department of Mechanical Engineering, Yale University, New Haven, CT, J. BLAWZDZIEWICZ, C.S. O'HERN, Departments of Mechanical Engineering and Physics, Yale University, New Haven, CT — We report on a new experimental technique to produce mechanically stable packings of frictionless disks. The system consists of a quasi-2D vertical cell filled with bi-disperse disks. The disks are vigorously shaken and then allowed to settle under gravity in the presence of high-frequency low-amplitude vibrations to eliminate frictional effects. For a system of 7 particles we find approximately 1000 mechanically stable states. The most probable states occur at least 10^6 times more often than those that are least probable. This is in direct contradiction to the fundamental postulate in statistical mechanics, that all possible microstates are equally probable and calls into question granular theories based on this assumption. We have measured the frequency distribution of the states in the experiments and in corresponding discrete element simulations, and find excellent agreement. We have also examined how the microstate distribution scales with system size and will connect the microstates to macroscopic quantities such as the density to predict the statistics of macroscopic properties.

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