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Three-dimensional Order and Self-Diffusion in a Cyclically Sheared Granular System ANDREEA PANAITESCU, ARSHAD KUDROLLI, Physics Department, Clark University — We investigate the structure and dynamics of a dense granular packing (consisting of one millimeter diameter spherical glass beads) undergoing cyclic shear obtained by smoothly deforming a parallelepiped shaped cell. Using a fluorescent refractive index matched particle tracking technique, we obtain the three dimensional position of particles in the central region of the shear cell as a function of shear cycle. The granular packing is observed to evolve towards crystallization over thousands of shear cycles and the packing fraction is correspondingly observed to increase smoothly from loose packing fraction. We obtain the Voronoi cell volume distributions from the measured positions, and compare them with various models which predict a Gamma-distribution and help us define a regularity factor. Further, we discuss the measured radial distribution and the bond-order parameter Q6 which are widely used to quantify local order in spherical particle systems. We find that the initial self-diffusion of the particles is anisotropic with diffusion greater in the flow direction compared with the velocity gradient direction which in turn is greater than the vorticity direction.

Andreea Panaitescu
Physics Department, Clark University

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