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Shear induced self-diffusion in 3-D sheared dense granular flows
ASHISH ORPE, ARSHAD KUDROLLI, Department of Physics, Clark University, Worcester, MA 01610 — We measure the dynamics of a 3-dimensional gravity driven sheared granular flow using a fluorescent refractive index matched interstitial fluid. The particle positions are identified and tracked over long durations to obtain particle diffusivities, mean-squared displacements and probability distributions of particle displacements. The mean-squared displacements in the velocity-vorticity direction exhibit a crossover from sub-ballistic flow at short time scales (mean flow less than a particle diameter) to diffusive flow when the mean distance traveled is more than a particle diameter. The measured diffusivities show a systematic decrease with decreasing shear rates. The probability distributions at short times show fat tails compared to a Gaussian indicating large fluctuations in particle displacements and possible cage breaking. Preliminary molecular-dynamics simulations for dry dense granular flows in a similar system are in qualitative agreement with the experimental results. Further work will be carried out to measure the full diffusion tensor and to determine the dependence of the individual components on the studied shear rates.

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