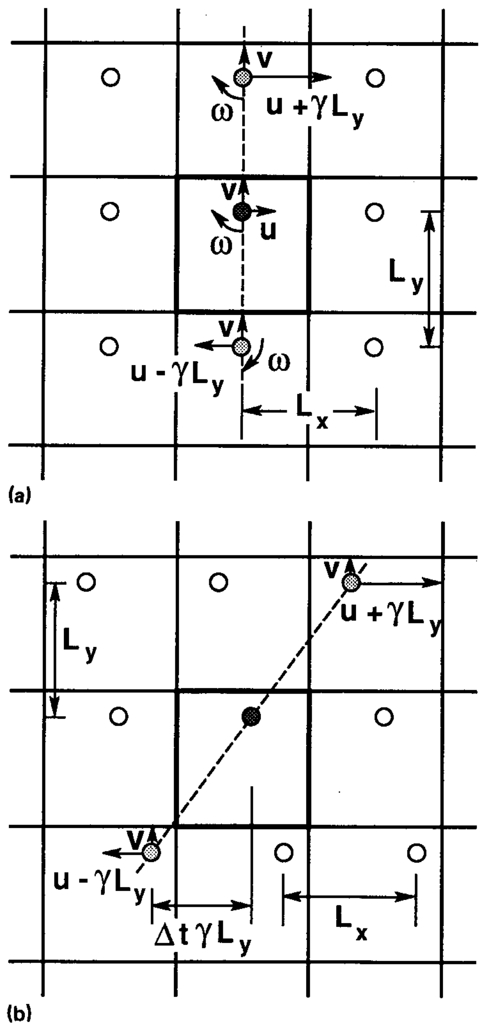
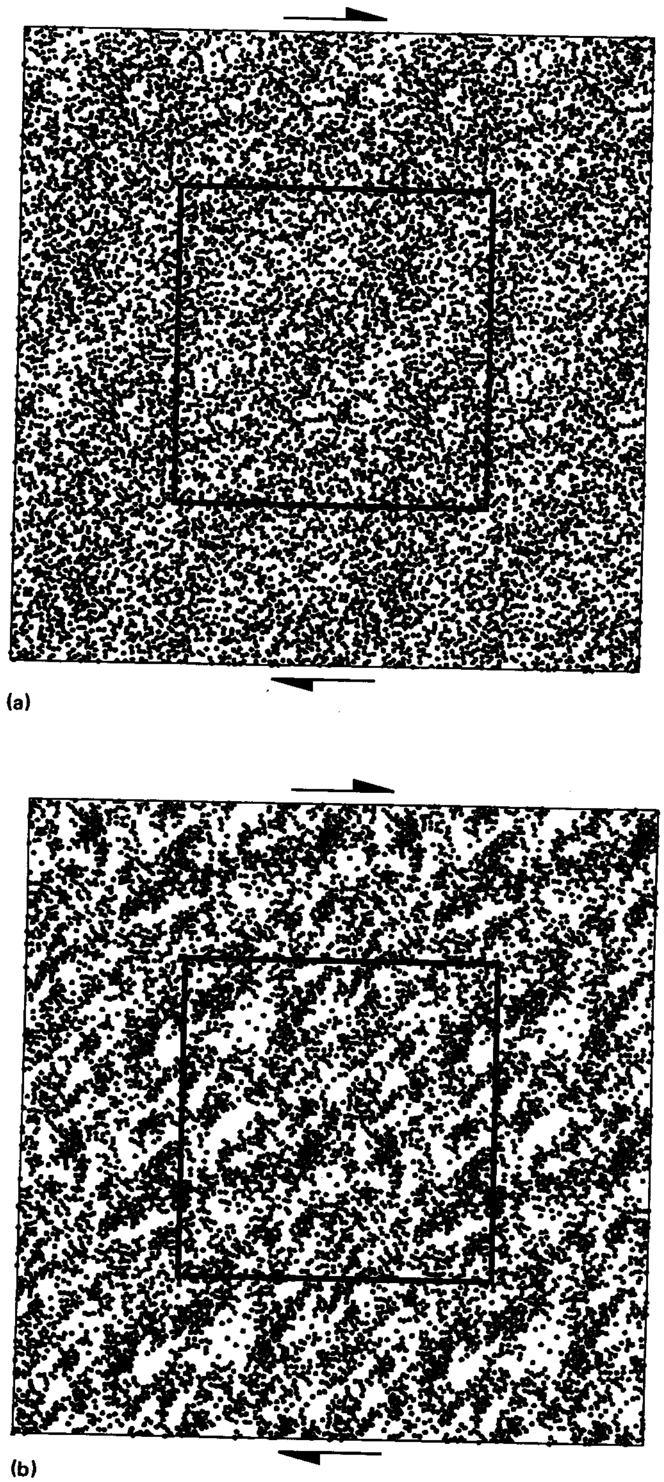
Hopkins, M.A. and Louge M.: "Inelastic Microstructure in Rapid Granular Flows of Smooth Disks," *Phys. Fluids A* **3**(1), 47-57 (1991).

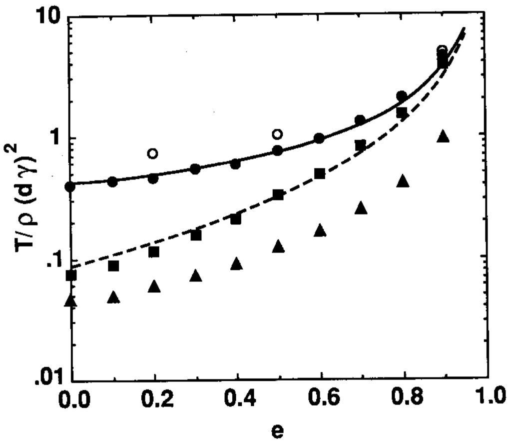
Computer simulations of two-dimensional rapid granular flows of uniform smooth inelastic disks under simple shear reveal a dynamic microstructure characterized by the local, spatially anisotropic agglomeration of disks. A spectral analysis of the concentration field suggests that the formation of this inelastic microstructure is correlated with the magnitude of the total stresses in the flow. The simulations confirm the theoretical results of Jenkins and Richman (1988) for the kinetic stresses in the dilute limit and for the collisional stresses in the dense limit, when the size of the periodic domain used in the simulations is a small multiple of the disk diameter. However the kinetic and, to a lesser extent, collisional stresses both increase significantly with the size of the periodic domain, thus departing from the predictions of the theory that assumes spatial homogeneity and isotropy.



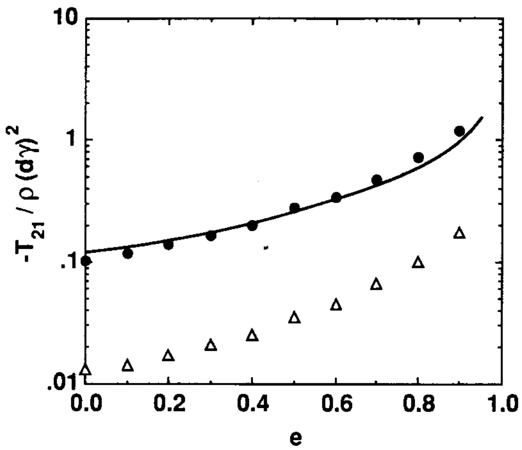
Particle images (a) at a time $t = kL_x/L_y\gamma$ where the images are aligned on the vertical axis, and (b) at an intermediate time $t = (kL_x/L_y\gamma) + \Delta t$. The heavy lines are bounds of the central periodic domain.



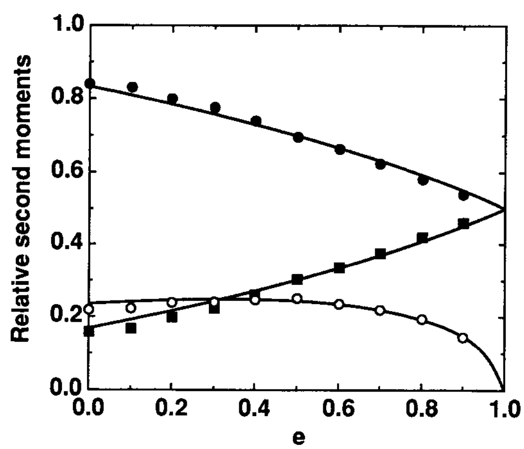
Distribution of disks at specific times for the conditions ν=0.3, L/d = 83 and (a) e=0.9; (b) e=0.2. The square represents the boundary of the central periodic domain. The arrows determine the direction of shear.



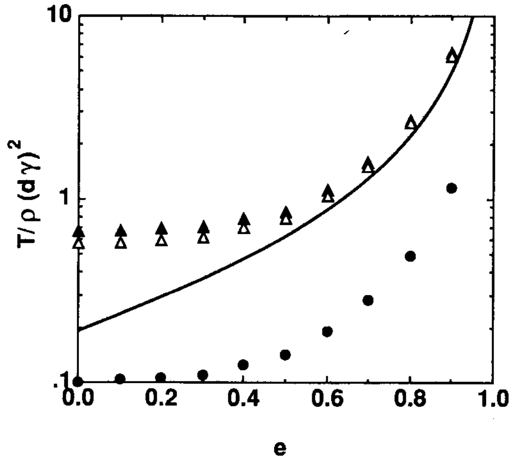
Dimensionless normal stresses for the conditions ν=0.1 and L/d = 21. The solid and dashed lines are the predictions of Jenkins and Richman for T_{11k} and T_{22k} in the dilute limit. The solid circles are T_{11k}, the solid squares T_{22k}, and the solid triangles $T_{11c} \approx T_{22c}$ from the simulation. The open circles are values of T_{11k} obtained with L/d = 167.



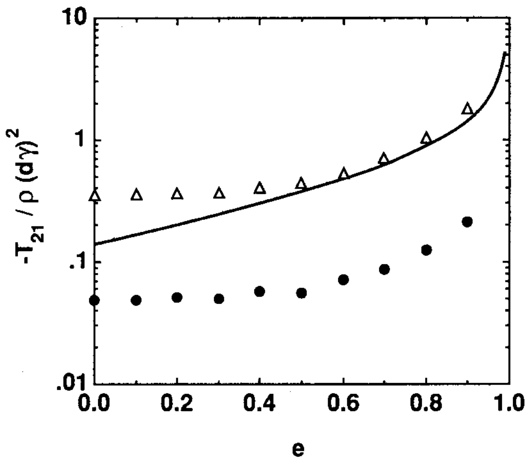
Dimensionless shear stresses for the conditions ν=0.1 and L/d = 21. The solid line is the prediction of Jenkins and Richman for $-T_{21k}$ in the dilute limit. The solid circles are $-T_{21k}$ and the open triangles are $-T_{21c}$ from the simulation.



Anisotropy of the second moment of the velocity fluctuations for the conditions ν=0.1 and L/d=21. The solid lines are the predictions of Jenkins and Richman for the dilute limit. The solid circles represent <uu>/(<uu>+<vv>), the solid squares <vv>/(<uu>+<vv>), and the open circles -<uv>/(<uu>+<vv>) from the simulation.



Dimensionless normal stresses for the conditions ν=0.6 and L/d = 21. The solid line is the prediction of Jenkins and Richman for T_{11c}=T_{22c} in the dense limit. The solid triangles are T_{11c}, the open triangles T_{22c}, and the solid circles are $T_{11k} \approx T_{22k}$ from the simulation.



Dimensionless shear stresses for the conditions ν=0.6 and L/d = 21. The solid line is the prediction of Jenkins and Richman for $-T_{21c}$ in the dense limit. The open triangles are $-T_{21c}$ and the solid circles are $-T_{21k}$ from the simulation.