Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Continuum equations for dense shallow granular flows VISWANATHAN KUMARAN, Indian Inst of Science — Simplified equations are derived for a granular flow in the 'dense' limit where the volume fraction is close to that for dynamical arrest, and the 'shallow' limit where the stream-wise length for flow development (L) is large compared to the cross-stream height (h). In the dense limit, the equations are simplified by taking advantage of the power-law divergence of the pair distribution function χ proportional to $(\phi_{ad} - \phi)^{-\alpha}$, where ϕ is the volume fraction, and ϕ_{ad} is the volume fraction for arrested dynamics. When the height h is much larger than the conduction length, the energy equation reduces to an algebraic balance between the rates of production and dissipation of energy, and the stress is proportional to the square of the strain rate (Bagnold law). The analysis reveals important differences between granular flows and the flows of Newtonian fluids. One important difference is that the Reynolds number (ratio of inertial and viscous terms) turns out to depend only on the layer height and Bagnold coefficients, and is independent of the flow velocity, because both the inertial terms in the conservation equations and the divergence of the stress depend on the square of the velocity/velocity gradients.

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Date submitted: 01 Aug 2015 Electronic form version 1.4