Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

**Gradient and Vorticity Banding Phenomena in a Sheared Granular Fluid** MEHEBOOB ALAM, PRIYANKA SHUKLA, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur PO, Bangalore 560064, India — In many complex fluids, including granular systems, the homogeneous shear flow breaks into alternate regions of low and high shear rates (i.e., shear localization), respectively, when the applied shear rate exceeds a critical shear rate and this is known as gradient banding. On the other hand, if the applied shear stress exceeds a critical value, the homogeneous flow separates into bands of different shear stresses (having the same shear rate) along the vorticity (spanwise) direction, leading to "stress localization." Here we outline a Landau-type nonlinear order-parameter theory for both gradient and vorticity banding phenomena in a sheared granular fluid. Our analysis holds for any general constitutive model, but the specific results will be presented for a kinetic-theory constitutive model that holds for rapid granular flows. Our theory predicts that while the vorticity banding [1] can occur via supercritical/subcritical pitchfork and subcritical Hopf bifurcations in dilute and dense flows, respectively, the gradient banding [2] occurs only via pitchfork bifurcations, both resulting in inhomogeneous states.

[1] P. Shukla and M. Alam, (2012, submitted).
[2] J. Fluid Mech. **666**, 203 (2011); Phys. Rev. Lett. **100**, 068001 (2009).

Meheboob Alam
Jawaharlal Nehru Centre for Advanced Scientific Research,
Jakkur PO, Bangalore 560064, India

Date submitted: 09 Aug 2012 Electronic form version 1.4