Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Nonlinear instability and convection in a vertically vibrated granular bed PRIYANKA SHUKLA, Department of Mathematics, IIT Madras, Chennai, India, I.H. ANSARI, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur PO, Bangalore 560064, India, D. VAN DER MEER, DETLEF LOHSE, POF Group, University of Twente, Enschede, The Netherlands, MEHEBOOB ALAM, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur PO, Bangalore 560064, India — The nonlinear instability of the density-inverted granular Leidenfrost state and the resulting convective motion in strongly shaken granular matter are analysed via a weakly nonlinear analysis. Under a quasi-steady ansatz, the base state temperature decreases with increasing height away from from the vibrating plate, but the density profile consists of three distinct regions: (i) a collisional dilute layer at the bottom, (ii) a levitated dense layer at some intermediate height and (iii) a ballistic dilute layer at the top of the granular bed. For the nonlinear stability analysis, the nonlinearities up-to cubic order in perturbation amplitude are retained, leading to the Landau equation. The genesis of granular convection is shown to be tied to a supercritical pitchfork bifurcation from the Leidenfrost state. Near the bifurcation point the equilibrium amplitude is found to follow a square-root scaling law, $A_e \sim \sqrt{\triangle}$, with the distance $\triangle$ from bifurcation point. The strength of convection is maximal at some intermediate value of the shaking strength, with weaker convection both at weaker and stronger shaking. Our theory predicts a novel *floating-convection* state at very strong shaking [Shukla etal, JFM (2014), vol. 761, p. 123-167].

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

Date submitted: 01 Aug 2015 Electronic form version 1.4