TITLE: Granular fluids: a proving ground for Nonequilibrium Statistical Mechanics.

TYPE OF ACTIVITY: workshop

LOCATION AND DATES: University of Sevilla (Mexican Pavillion), Sevilla (Spain), 26-29 September (2007)

Organizing Committee: Maria J. Ruiz-Montero (majose@us.es, U. Sevilla, Spain), James W. Dufty (dufty@phys.ufl.edu, U. Florida, USA), Miguel Rubi (mrubi@ub.edu, U. Barcelona, Spain).

Local Committee: Luis F. Rull, Antonio Prados, Francisco Moreno (University of Sevilla)

International Committee: (alphabetical order): J. Robert Dorfman (U. Maryland, USA), Matthieu Ernst (U. Utrecht, The Netherlands), Isaac Goldhirsch (Tel Aviv U., Israel), V. Kumaran (Indian Inst. Science, India), S. Luding (TU Delft, The Netherlands), Cristina Marchetti (U. Syracuse, USA), Michel Mareschal (U. Libre de Bruxelles, Belgium), J. Marro (U. Granada, Spain), Thorsten Poeschel, (U. Charite, Germany), Robert Zwanzig (Nat. Inst. Health, USA).

SCIENTIFIC BACKGROUND The Physics of granular flows is a very active field where new problems and phenomena are continuously appearing. From a fundamental point of view, granular systems present some intrinsic difficulties, as the lack of temporal and spatial scale separation, that imply the reformulation of many of the ideas that apply for molecular fluids. Besides, these systems are of great technological importance due to their ubiquity in Nature and industry (typical examples ranging from the Saturn rings to sand dunes). The objective of this workshop was to bring together some of the more active and acknowledged researches on granular flows so they can present and discuss their latest ideas and results.

Nonequilibrium Statistical Mechanics encompasses a wide scope of many-body phenomena, with methods of application ranging from particle simulations to kinetic theory. New challenges for existing approaches and opportunities for novel developments are provided by its application to the study of granular fluids. In fact, the application of the ideas and methods of Nonequilibrium Statistical Physics has produced a significant advance in the knowledge of granular fluids in the last years. Phenomena as the existence of new transport mechanisms not present in molecular fluids, new instabilities as the transversal and cluster instabilities, lack of energy equipartition, or segregation under vibration, have been found by applying Nonequilibrium Statistical Mechanics to

granular flows. This Workshop addresses the current status of attempts to understand these inherently nonequilibium mesoscopic systems in their fluidized state.

SUMMARY: The Workshop consisted in twenty six 30-minute talks, followed by 10 minute discussion. Sessions were organized around specific topics (kinetic theory of granular gases, experiments on rapid granular flows, instabilities in granular flows, correlations, and so on). The participants were asked to participate actively in the discussions, which they did, as well as to give their ideas in the perspective and possibilities of the problems discussed. There was also an introductory Conference by Prof. James W. Dufty in which the current status of the physics of granular flows was presented. On Thursday 27th there was a poster session in which 15 posters were presented, giving another chance to share results and discuss open problems, methods, and alternatives.

INVITED SPEAKERS:

- Aparna Bhaskaran (U. Syracuse, USA): em Applying non-equilibrium statistical mechanics to active nematics.
- Luis L. Bonilla (U. Carlos III, Spain): *Ideas from granular gases in the kinetic theory of semiconductor nanoestructures.*
- Ricardo Brito (U. Complutense, Madrid): *Segregarion in a vertically vibrated granular mixture.*
- Eric Clement (U. Pierre-Marie Curie, France): *Fluctuations and motion synchronization in a dense vibrated granular packing.*
- Patricio Cordero (U. Chile, Chile): *Solid-gas coexistence in thin granular systems.*
- Vicente Garzo (U. Extremadura, Spain): *Dense fluid transport for granular mixtures of inelastic hard spheres.*
- Isaac Goldhirsch (Tel Aviv U., Israel): *Computer-aided solutions of the Boltzmann equation.*
- Christine Hrenya (U. Colorado, USA): *Agglomeration of wetted particulates.*
- David Jou (U. A. Barcelona, Spain): *Temperature in non-equilibrium granular thermodynamics: granular fluids and other systems.*
- Arshad Kudrolli (U. Clark, USA): *Particle shape and dynamics of granular matter: swarming to swirling.*
- Stefan Luding (TU Delft, The Netherlands):*From dilute to dense, frictional granular gases*
- Jim Lutsko (U. Libre Bruxelles, Belgium): *Velocity correlations in granular fluids compared to sheared elastic fluids.*

- Critina Marchetti (U. Syracuse, USA): *Hydrodynamics and rheology of soft active matter.*
- U. Marini Bettolo Marconi (U. Camerino, Italy): *Theory of thermostated inhomogeneous granular fluids: a self-consistent density functional description.*
- Diego Maza (U. Navarra, Spain): *Experimental analysis of the stochastic particle displacements in granular flows.*
- Baruch Meerson (U. Jerusalem, Israel): *Formation and evaluation of density singularities in ideal hydrodynamics of granular gas.*
- I. Pagonabarraga (U. Barcelona, Spain): *Collision induced fragmentation kinetics.*
- Jaroslaw Piasecki (U. Warsaw, Poland): *Stationary states in systems with dissipative collisions.*
- Thorsten Poeschel (U. Charite, Germany): *Coupling of translational and rotational motion in granular gases.*
- Antonio Prados (U. Sevilla, Spain): *Fluctuations and linear response in a closed model for tapped granular media.*
- Andres Santos (U. Extremadura, Spain): *Aging, rheology, and overpopulated tails in sheared granular gases.*
- Jan V. Sengers (U. Maryland, USA): *Mesoscopic fluctuations in nonequilibrium fluids.*
- Rodrigo Soto (U. Chile, Chile): *Casimir forces in a confined granular geometry.*
- Emmanuel Trizac (U. Paris-Sud, France): *Collisional statistics of the hard spehere gas.*

RESULTS AND IMPACT: The Conference has provided a forum to present and discuss the current status of the Physics of granular flows. The quality of the participant speakers, which are among the most active in the field, their knowledge of the problems presented in the talks, and their different points of view on them, resulted in interesting discussions in which the more polemic points were not avoided. It was important that there was a significant period for discussion after each talk, so the topics could be thoroughly debated. Also, interaction during coffebreaks and lunches (that were provided by the organization for all participants at the conference hotel) was very useful to continue discussion and for the establishment of future collaborations. In fact, the possibility of new actions in the field were widely discussed and a great interest was shown by the participants. The last session was a more general one in which experts on other fields on Nonequilibrium Statistical mechanics

(fluctuations in fluids, patter formation in biological systems, meaning of temperature in out of equilibrium states,...) presented results and methods that could be useful for the future development of the field.

TIMETABLE: see document.

PARTICIPANTS: see document.

CONFERENCE WEBPAGE: www.granfl07.us.es

FUNDING INSTITUTIONS:

1. Ministerio de Educación y Ciencia
2. European Science Foundation
3. Universidad de Sevilla
4. Diputación de Sevilla.