DY 21: Granular Matter/Contact Dynamics

Time: Wednesday 14:30–17:15 Location: MA 144

DY 21.1 Wed 14:30 MA 144

Coefficient of restitution for wet impacts — Frank Gollwitzer[1], Christof Kruelle[2], Ingo Rehberg[1], and •Kai Huang[1] — [1]Experimentalphysik V, Universitaet Bayreuth, 95440 Bayreuth, Germany — [2]Maschinenbau und Mechatronik, Hochschule Karlsruhe - Technik und Wirtschaft, D-76133 Karlsruhe, Germany

As the experience of playing football in the rain may tell, wetting could influence the coefficient of restitution (COR) dramatically. This is due to the extra energy dissipation from the wetting liquid, for instance viscous damping. To unveil the underlying mechanisms accounting for the influence, we study experimentally the COR by tracing free falling particles bouncing on a wet surface. The dependance of the COR on the impact velocity, various particle and liquid properties will be presented and discussed in terms of dimensionless numbers that characterize the interplay between inertia, viscous and surface forces.

DY 21.2 Wed 14:45 MA 144

Exploring the 'no man's land' inbetween a granular and a colloidal suspension — •Welm Pätzold[1,2], Christoph Gögelein[1], and Matthias Schröter[1] — [1]Max Planck Institute for Dynamics and Self-organisation, Göttingen — [2]Georg-August-Universität Göttingen

The packing fraction in a liquid-fluidized bed depends on the suspension's viscosity. A number of empirical theories predict relations between the packing fraction and the necessary fluid velocity to obtain said packing fraction. We used a fluidized bed to investigate the fluidization and sedimentation processes of monodisperse glass spheres in the lower limits of the granular regime (down to 20 microns in diameter). We'll present data on the packing fraction versus the flow rate and test the above mentioned models.

DY 21.3 Wed 15:00 MA 144

Electrostatic precursors to granular slip events — •N Nirmal Thyagu[1,2] and Troy Shinbrot[1] — [1]Rutgers University, Piscataway, NJ 08854, USA — [2]MPI-DS, Goettingen, Germany

For at least the past 40 years, reports have repeatedly appeared of atmospheric lightning and related effects preceding major earthquakes. Many of these reports are anecdotal and of uncertain reliability, while others appear to have been substantiated by more recent scientific electric field measurements. In this work, we describe laboratory experiments that appear to exhibit sporadic, but statistically significant, electrical precursors to granular slip events. The cause of this phenomenon is unclear: the materials used are neither piezoelectric nor triboluminescent. We speculate that the electrical signals may be related to other electrical phenomena known to be associated with material failures in other contexts, for example in crack formation and in tape peeling.

DY 21.4 Wed 15:15 MA 144

Granular Gases of Anisometric Particles: A Microgravity Experiment — •Kirsten Harth[1], Torsten Trittel[1], Ulrike Kornek[1], Stephan Höme[2], Ulrike Strachauer[1], Karl Will[3], and Ralf Stannarius[1] — [1]Institut für Experimentelle Physik, Otto-von-Guericke Universität Magdeburg — [2]Institut für Automatisierungstechnik, Otto-von-Guericke Universität Magdeburg — [3]Institut für Elektronik, Otto-von-Guericke Universität Magdeburg

Although granular materials are widespread in nature and technological processes, a comprehensive dynamic theory is lacking. Depending on the type and strength of excitation, granulates display different aggregate states similar to thermodynamic states of matter. Granular gases represent dilute ensembles of grains interacting through inelastic collisions. At present, there is a vast amount of analytical or numerical predictions of physical properties of such gases, but only few experiments.

We investigate a granular gas of rodlike particles in microgravity on a sounding rocket. Videos are recorded from two stereoscopic perspectives during flight. Individual rods are tracked in consecutive frames. We analyse classical statistical quantities such as the distribution of energy on different degrees of freedom, orientation, velocity and density distributions. Two different excitation strengths and the cooling of the granular gas after change of the excitation parameters are investigated.

DY 21.5 Wed 15:30 MA 144

A local view on dilatancy onset in sheared granular media — •Annika Döring[1], Jean-François Métayer[1], Mario Scheel[2], and Matthias Schröter[1] — [1]Max Planck Institute for Dynamics and Self-organization, Göttingen, Germany — [2]European Synchrotron Radiation Facility Beamline ID15, Grenoble, France

A recent study on slowly sheared granular media has shown a change in the behaviour of the yield shear stress as a function of packing fraction Φ [1]: for packing fractions below 0.595 the shear stress depends weakly on phi whereas above this value the dependence on Φ is much stronger. It was suggested that this change is the signature of dilatancy.

In order to verify this hypothesis we made tomographies of a slowly sheared granular bed at the ESRF synchrotron in Grenoble.

Using Voronoi tessellation and particle tracking we have been able to access the local variation of the packing fraction and the individual displacement of grains while the bed is sheared. We present these quantities as a function of the initial packing fraction (before the bed is sheared) and test how it is related to the transition shown in [1].

[1] J-F. Métayer, D. Suntrup, C. Radin, H. Swinney, and M. Schröter, EPL 93 (2011) 64003

DY 21.6 Wed 15:45 MA 144

A two-species continuum model of aeolian sand transport — •Marc Lämmel, Daniel Rings, and Klaus Kroy — Institut für Theoretische Physik, Leipzig, Germany

Wind-driven sand transport is the dominant process shaping the geomorphology of arid regions on Earth, Mars and elsewhere. It is responsible for the spontaneous creation of a whole hierarchy of self-organized dynamic structures from ripples over isolated dunes to devastating fields of shifting sands. Provided that the wind is strong enough, you can even experience this transport process—called saltation—just by taking a walk on the beach, where sand clouds pass by, and every single grain tickles your ankles.

Here, we present a mathematical description of aeolian sand transport based on the successful continuum saltation model introduced in Ref. [1]. We show that a systematically improved version of this model can be derived by considering two species of trajectories, low-energy reptating grains and high-energy saltating grains—similar to what has been proposed in Ref. [2]. The resulting predictions are in remarkable agreement with flux data from various wind tunnel measurements.

[1] Sauermann, G., Kroy, K., Herrmann, H.J., 2001. Continuum saltation model for sand dunes. Phys. Rev. E 64, 031305.

[2] Andreotti, B., 2004. A two-species model of aeolian sand transport. Journal of Fluid Mechanics 510, 4770.

DY 21.7 Wed 16:00 MA 144

Jamming and glassy dynamics in driven particulate systems — •Claus Heussinger — Institute for theoretical physics, University Göttingen

The jamming paradigm aims at providing a unified view for the elastic and rheological properties of materials as different as foams, emulsions, suspensions or granular media. Apart from the industrial relevance of these materials, there is also a fundamental theoretical interest in the (athermal) jamming transition: as a new paradigm for structural arrest its relation to the (thermal) glass transition, the characterization of common and distinguishing features, remain to be elucidated.

By comparing different computational models we will discuss the question of universality on the macroscopic level of rheological observables as well as on the microscopic level of single particle trajectories and collective particle motion. We will show how small changes in the particle nteractions may lead to large changes in the response of the system. The goal is to delineate genuine aspects of a universal jamming transition from system-specific properties that depend on microscopic details, the driving mechanism or the preparation protocol.

DY 21.8 Wed 16:15 MA 144

Sorting of sand grains inside migrating dunes — Christopher Groh[1], Ingo Rehberg[1], and •Christof A. Krülle[1,2] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth, Germany — [2]Maschinenbau und Mechatronik, Hochschule Karlsruhe - Technik und Wirtschaft, D-76133 Karlsruhe, Germany

In general, agitated granular matter is known to show de-mixing whenever particles differ in size, shape or density. For example, inside natural sand dunes grain sorting phenomena are well-known features for geomorphologists coined reverse grading, when larger particles are found on top of smaller ones. Already in 1993 Anderson & Bunas demonstrated the effect of size segregation in a migrating dune by modeling the trajectories of large and small particles with a stochastic cellular automaton. Larger, and therefore heavier, grains travel in small jumps of the order of a few grain diameters, while smaller particles are able to leap over the crest far down into the shadow zone. Consequently, smaller particles end up being buried by larger ones at the toe of a dune. In addition, Makse (2000) showed that this size segregation due to different hopping lengths in the wake of a dune competes with a so-called shape segregation during transport and rolling of particles with different roughness along the dune's surface. Here we report results of an experimental investigation where the particles inside a downscaled model dune differ not in size or shape but in density, revealing that also denser particles accumulate on top of lighter ones and will finally end up close to the crest of a migrating dune [1].

[1] C. Groh, I. Rehberg, C.A. Kruelle, PRE 84, 050301(R) (2011).

DY 21.9 Wed 16:30 MA 144

Jamming and Random Close Packing of Ellipsoids — •Fabian M. Schaller[1], Gary W. Delaney[2], Max Neudecker[3], Sebastian C. Kapfer[1], Klaus Mecke[1], Matthias Schröter[3], and Gerd E. Schröder-Turk[1] — [1]Institut für Theoretische Physik, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen, Germany — [2]CSIRO Mathematics, Informatics and Statistics, Clayton South, VIC 3169, Australia — [3]Max-Planck-Institut für Dynamik und Selbstorganisation, Am Fassberg 17, 37077 Göttingen, Germany

Disordered packings of ellipsoidal particles are a generalization of disordered sphere packings that can shed light on geometric features of random close packings and structural transitions in granular matter. Here we report the structure of ellipsoid packings in terms of contact numbers and Voronoi cell shapes, for several aspect ratios. Discrete approximations of generalized Voronoi diagrams are extracted from a large number of tomographic data of ellipsoid configurations, obtained by vertical shaking. Additionally, we performed DEM simulations of random ellipsoid packings. Their shape is quantified by isotropy indices $\beta_\nu^{r,s}$ based on Minkowski tensors[1,2]. These structural data contribute to a geometric understanding why the maximal random packing fractions of ellipsoids exceed that of monodisperse spheres.

[1] G.E. Schröder-Turk *et al.*, Disordered spherical bead packs are anisotropic, Europhys. Lett. **90**, 34001 (2010)
[2] G.E. Schröder-Turk *et al.*, Minkowski Tensor Shape Analysis of Cellular, Granular and Porous Structures, Adv. Mater. **23**, 2535 (2011)

Topical Talk DY 21.10 Wed 16:45 MA 144

Algorithms in statistical physics: Percolation — •Stephan Mertens[1,2] and Cristopher Moore[2,3] — [1]Otto-von-Guericke Universität, Magdeburg, Germany — [2]Santa Fe Institute, USA — [3]University of New Mexico, Albuquerque, USA

Statistical physics is a field rich in algorithmic challenges. In this contribution we discuss algorithms for the percolation problem. In particular we present a simple algorithm for generating percolating clusters. The algorithm works on lattices as well as in continuous systems, in arbitrary dimensions and even for heterogeneous objects. Despite its simplicity and versatility, the algorithm runs in linear time, which is the optimum for algorithms that explicitly construct percolating clusters. We use the algorithm to compute values of the percolation thresholds for various continuous systems with unprecedented accuracy.