DY 12: Granular Matter / Contact Dynamics Part II

Time: Monday 15:30–17:00 Location: BH-N 128

DY 12.1 Mon 15:30 BH-N 128

Dissipation in quasistatically sheared wet and dry sand under confinement — •Maryam Pakpour[1], Jorge E. Fiscina[1,2], Abdoulaye Fall[3], Nicolas Vandewalle[1], Christian Wagner[2], and Daniel Bonn[4,5] — [1]GRASP, Physics Department B5, University of Lièege, B-4000 Lièege, Belgium — [2]Experimental Physics, Saarland University, Saarbrücken Germany — [3]Laboratoire Navier (UMR CNRS 8205), Universitè Paris Est, Champs-sur-Marne, France — [4]Van der waals-Zeeman Istitute, University of Amsterdam, Amsterdam, the Netherlands — [5]Laboratoire de Physique Statistique de l'ENS, 75231 Paris Cedex 05, France

We investigated the stress-strain behavior of granular materials with and without small amounts of liquid near the jamming transition under steady and oscillatory shear. Partially saturated sand has a much higher yield stress and should therefore have a much higher apparent viscosity for slow flows. For this reason, it is commonly believed that dry sand should deform more easily and wet sand shows a larger resistance to flow, i.e., more viscous than dry sand. In this study, using a new technique to quasistatically push the sand through a tube with an enforced parabolic (Poiseuille-like) profile, we minimize the effect of avalanches and shear localization. We observe that the resistance against deformation of the wet (partially saturated) sand is much smaller than that of the dry sand, and that the latter dissipates more energy under flow. This is also observed in large-amplitude oscillatory shear measurements using a rotational rheometer, showing that the effect is robust and holds for different types of flow.

DY 12.2 Mon 15:45 BH-N 128

DWS measurements on fluidized granular media — •Philip Born, Steffen Reinhold, and Matthias Sperl — DLR Institute of Materials Physics in Space, Cologne, Germany

Diffusing wave spectroscopy (DWS) measurements indicate glass-like dynamics in dense, fluidized granular media close to jamming. This suggests fundamental similarities among the jamming transition in granular media and the glass transition in other fluid systems. However, the glass-like dynamics appear as a localization of the mean-squared displacement of the particles on length scales of a few 10 nm. Such length scales are not present in measurements using complementary techniques. In order to confirm the present results, we perform DWS measurements in microgravity, which promises isotropic agitation. Additionally, we tailor particle interactions to test the influence of long-ranges and short-ranged interactions. The results indicate that DWS measurements have to be evaluated with care, as omnipresent particle interactions prevent pure hard-sphere behavior, and incoherent intensity fluctuations put in question the localization interpretation of the intensity fluctuations.

DY 12.3 Mon 16:00 BH-N 128

Flow and clogging of anisometric granular matter in a hopper — •Sandra Wegner[1], Tamás Börzsönyi[2], Balázs Szabó[2], and Ralf Stannarius[1] — [1]Otto-von-Guericke-University, Magdeburg, Germany — [2]Department of Complex Fluids, Wigner RCP SZFI, Budapest, Hungary

Granular matter is processed and stored in many branches of industry. This storage is often done in silos or hoppers. When the granular material is flowing out of a hopper, jamming is a frequent problem. We address this phenomenon by means of a three-dimensional experimental investigation of the jammed state in cylindrical and conical hoppers. We detect the jamming of differently shaped particles with X-ray computed tomography. With the complete three-dimensional information of grain positions and orientations, packing fractions and orientational ordering of the systems can be calculated and compared. We find differences for grains of different shapes and surface properties.

DY 12.4 Mon 16:15 BH-N 128

The Mach number determines the onset of clustering in a dissipative gas — •Mathias Hummel, James Clewett, Stephan Herminghaus, and Marco G. Mazza — Max Planck Institut für Dynamik und Selbstorganisation

We perform direct numerical simulations of granular hydrodynamics to study the clustering of a dissipative gas for constant coefficients of restitution in three dimensions. We demonstrate that clustering appears when the ratio between local bulk velocity and local thermal velocity, that is the Mach number, reaches a threshold value $\mathcal{M}_t \approx 10^{-3}$, independently of the coefficient of restitution. We also find that the local Mach numbers, and not the coefficient of restitution, determine the evolution of the clusters.

DY 12.5 Mon 16:30 BH-N 128

Stabilty of Dune Fields — •Sven Auschra, Marc Lämmel, and Klaus Kroy — University of Leipzig, Institute for Theoretical Physics

Arid regions on Earth and Mars are often covered with vast assemblies of crescent-shaped sand dunes, so-called barchans. The observation that single barchans either shrink or grow indefinitely if fed by a constant homogeneous influx of sand [1], makes the existence and stability of such barchan fields a conundrum [2].

We investigate the steady-state configuration of consecutive barchan dunes interacting by wind-driven sand transport. Based on well-established equations for isolated dunes [1,3] we derive a coarse-grained description of the dominant pair interactions within a field. Sand supplied from the horns of windward dunes to its downwind neighbor initiates a complex response of its shape and mass. Based on a dimensionally reduced description justified by a closeby shape attractor, a fixed point equation for the mass balance of the fed dune is derived and analyzed for stable solutions. We provide evidence that this process is a good candidate for explaining the stabilization of barchan dunes in the field.

[1] Fischer, E., Cates, M. E., Kroy, K., 2008. Dynamic scaling of desert dunes. Phys. Rev. E 77, 031302.

[2] Duran, O. *et al.*, 2011. Size distribution and structure of barchan dune fields. Nonlin. Processes Geophys. 69, 455-467.

[3] Kroy, K., Sauermann, G., Herrmann, H. J., 2002. Minimal Model for Sand Dunes. Phys. Rev. Lett. 88, 5.

DY 12.6 Mon 16:45 BH-N 128

Aeolian sand sorting and megaripple formation — •Marc Lämmel, Anne Meiwald, and Klaus Kroy — Institut für Theoretische Physik, Universität Leipzig, Germany

Turbulent flows drive sand along riverbeds or blow it across beaches and deserts. This seemingly chaotic process creates a whole hierarchy of structures ranging from ripple patterns over dunes to vast wavy sand seas. Moreover, by the very same process, grains are constantly being sorted, because smaller grains advance faster while their heavier companions trail behind. Starting from the grain-scale physics, we model the sorting dynamics by erosion and show how it creates the characteristic bimodal grain size distribution that is a prerequisite for the formation of so-called megaripples [1]. Due to the separation into small and big grains, these structures have a lot in common with their bigger relatives, aeolian sand dunes, whose physics is much better understood. This enables us to adapt a well established dune model [2] to predict formation, morphology, and dynamics of the megarippels. Preliminary tests against field data strongly support our approach, which, moreover, provides a roadmap for future systematic field and laboratory measurements.

[1] Qian, G. et al., Sedimentology 59, 1888 (2012)

[2] Kroy, K. et al., Phys. Rev. Lett. 88, 054301 (2002)