DY 6: Granular Physics 1 - organized by Matthias Sperl (Köln)

Time: Monday 9:30–10:30 Location: DYc

DY 6.1 Mon 9:30 DYc

Flow study for poly-dispersed dense granular suspension in Non-Newtonian media, mimicking concrete flow — •Himanshu P Patel, Peyman Rostami, and Günter K Auernhammer — Leibniz-Institut für Polymerforschung Dresden e. V., Hohe Straße 6, D-01069 Dresden, Germany

The study of internal flow dynamics and associated particle migration for poly-dispersed dense granular suspension, e.g., flowing concrete, still lacks quantification on a single particle level.

We use a macroscopically highly transparent model system for concrete and cement paste [1] that is a dense granular suspension of particles suspended in non-Newtonian media (particle volume fractions of 42% to 48%). The model system mimics the rheology behavior of cement paste (yield stress and plastic viscosity) and is completely index matched. The rheological characteristics of the model system is tunable through its composition of additives.

We analyze gravity-assisted continuous flow for the model system through a cylindrical pipe. Our setup allows tracking of polydisperse tracer particles at different sections of the pipe and near its wall using diffused back-light illumination. The flow analysis revels a flow profile similar to a plug flow and a migration of larger towards the central region of the flow. Sliding and rolling motion of the particles is observable. The lubrication layer thickness is also evaluated in the study.

[1] Auernhammer, Günter K., et al., Materials & Design (2020): 108673.

DY 6.2 Mon 9:50 DYc

Uncertainty relations for mesoscopic coherent light — •Ohad Shpielberg — University of Haifa, Haifa, Israel

Thermodynamic uncertainty relations unveil useful connections between fluctuations in thermal systems and entropy production. This talk extends these ideas to the disparate field of zero temperature quantum mesoscopic physics where fluctuations are due to coherent effects and entropy production is replaced by a cost function defined using a novel disorder reversal operator. A simple expression is obtained for the average cost function, which depends on the dimensionless conductance g and on a geometrical factor B controlled by boundary conditions. Contrary to thermodynamic machines aimed at minimising fluctuations to increase precision, it is desirable in mesoscopic devices to increase coherent effects. The cost function indicates that increasing coherent effects can be achieved by playing with the geometry and boundary conditions through B and not only by decreasing the bulk conductance g.

DY 6.3 Mon 10:10 DYc

Coupling between rotational and translational motions of a vibrated polygonal disk — •Simeon Voelkel[1] and Kai Huang[1,2] — [1]Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth, Germany — [2]Institute of Applied Physical Sciences and Engineering, Division of Natural and Applied Sciences, Duke Kunshan University, No. 8 Duke Avenue, Kunshan, Jiangsu, China 215316

We investigate experimentally the dynamics of a single polygonal disk (regular n-gon with $3 \leq n \leq 8$) under vertical vibrations against gravity. The disks tend to precess continuously upon vibrations, transferring the mechanical energy injection into the rotational as well as the translational degrees of freedom (DoF) spontaneously. An analysis of the velocity distribution functions in both DoF suggests that the mobility in both DoF are coupled with each other with a preferred angular velocity that depends on the confinement, the geometry of the disk as well as the driving condition. The favored angular velocity can be captured with a model considering sustainable precession due to continuous driving. We also find a regime in the parameter space where the kinetic energy in both DoF agree with each other, despite of the strong energy dissipation and fluctuations in the system upon frequent collisions of the disk with the vibrating plates.