DY 5: Fluid dynamics I

Time: Monday 14:00–16:00 Location: H2

Invited Talk DY 5.1 Mon 14:00 H2

Dynamics of Dunes — •Hans Herrmann — ETH, Zürich, Switzerland

Dunes exist along coasts, in deserts and also on other planets like Mars. They are aerodynamic instabilities formed on free granular surfaces. By formulating a set of equations of motion for the height of the surface, the sand flow and the shear stress of the wind it is possible to describe the formation and evolution of dunes. Using adecuate boundary conditions one gets quantitative agreement with field measurements. Including a further equation for the growth of vegetation one can also calculate dune fixation and observe the transition between croissant-shaped "barchan" dunes and parabolic dunes. Inserting the parameters for Mars also the recently observed shapes of Mars dunes can be reproduced.

DY 5.2 Mon 14:30 H2

Development of a sphere-anemometer for measuring wind velocities in the open air test site — •Bianca Schulte, Michael Hölling, Stephan Barth, and Joachim Peinke — Institut für Physik, Universität Oldenburg

In nature wind rarely occurs in a laminar form, but the wind flow is mostly turbulent. Therefore, it is necessary to use a setup with short response time to measure the current wind velocity. On the other hand the setup has to withstand the harsh conditions of an open air test site. The conventional cup-anemometer often used in an open air situation has the drawback that the response time at increasing and decreasing wind velocity is different. This asymmetric inertia of the anemometer leads to a wrong averaging of the current wind velocity. Conversely the fast responding hot wire anemometer can not be utilized in long term free field measurements because of its aging and vulnerability of the filigree wire.

A new kind of anemometer, the sphere-anemometer, is presented to overcome these problems. This kind of anemometer principle relies on drag acting on a sphere which is fixed to the end of a flexible rod. The deflection of the rod gives a measure for the force acting on the sphere and is measured by means of a light pointer. In wind tunnel measurements we compared the three devices in a wake configuration. The signals taken from the different setups are opposed via statistical methods.

DY 5.3 Mon 14:45 H2

Correlation measurements of temperature and velocity in turbulent flows — •Marino Beenhakker, Michael Hölling, Stephan Barth, Marco Munzel, Joachim Peinke, and Achim Kittel — Institut für Physik, Universität Oldenburg

The knowledge of the statistics of velocity and temperature fluctuations at a certain position in turbulent flow is important for the development of theory on turbulence. Two different sensors are presented to measure flow velocity and temperature of fluids.

A Laser-Cantilever-Anemometer (LCA) detects the flow velocity by means of the deflection of a microscopic cantilever. The measurement principle is predestined to be combined with a temperature measurement because in contrast to a hot wire anemometer the fluid is not heated. The high-speed thermometer used is based on submicrometer-size thermocouples. The thermocouple is formed at the tip of a glass-micropipette with a platinum core and a coating of gold. Both sensors are embedded in waterproof shielded enclosures which both include a preamplification circuit. These type of sensors are able to measure with high spatial and temporal resolution and small crosstalk which is necessary for correlation measurements.

The characterization features of both sensors are discussed and compared with other methods.

DY 5.4 Mon 15:00 H2

Vertically Correlated Signals in Turbulent Windfields — •Thomas Laubrich and Holger Kantz — Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden

The wind velocities at different points in the atmosphere are highly spatial correlated. The understanding of turbulent wind fields and its correlated structures plays an important role for atmospheric applications, e.g. the design of wind turbines. The focus is put on the exchange of spatial-temporal structures in the Prandtl Layer using data collected at a windmast with cup-anemometers installed at different altitudes. Examining the cross-correlation between the wind speeds at different altitudes helps us to gather information about the nature of highly correlated signals.

DY 5.5 Mon 15:15 H2

Beitrag abgesagt — •XXX XXX —

DY 5.6 Mon 15:30 H2

Gas Flow through Nanopores — •Simon Grüner and Patrick Huber — Saarland University, Saarbrücken, Germany

We present gas flow experiments on both narrow capillaries and silicon membranes which are permeated by a bundle of parallel, tubular channels of approx. 10nm diameter. Applying pressures between 1 and 10^{-5}bar this arrangement allows us to study flows of compressible fluids over a wide range of Knudsen numbers, Kn, which refers to the ratio of the mean free path λ to the channel diameter. We find for both helium and argon gas flow the expected breakdown of continuum-like behavior at $Kn \approx 0.45$. At higher Kn, on the other hand, the flow dynamics is in perfect agreement with a Knudsen diffusion-like particle transport. This is confirmed by measurements of temperature and molar mass dependencies of the diffusion coefficient D.

In our latest experiments we've been probing the influence of pore wall modification on the helium gas diffusion through the nanopores via condensing monolayers of argon at $T = 30$K.

DY 5.7 Mon 15:45 H2

On the nonlinear dynamics of a sonoluminescing bubble — •Joachim Holzfuss — Institut für Angewandte Physik, TU Darmstadt, Schlo8gartenstr. 7, 64289 Darmstadt

A bubble in water is driven by ultrasound. In a small parameter region strong nonlinear oscillations are observed that give rise to the emission of ultrashort light pulses, termed sonoluminescence (SBSL). The parameter space is bounded by several instability mechanisms which are discussed in detail. Recent results including period doubled unisotropic emissions, rescaling of stability boundaries and nobel gas - free stable SBSL are reported.