DY 14: Focused Session: 50 years DY: Trends in dynamics and statistical physics

Time: Wednesday 9:30–12:30 Location: HÜL 386

Opening address **Wed 9:30 HÜL 386**

Invited Talk DY 14.1 Wed 9:45 HÜL 386
Turbulent convective transport - news and challenges — •Siegfried Grossmann — Fachbereich Physik, Philipps-Universität Marburg, Renthof 6, 35032 Marburg

Recent progress in our understanding of turbulent transport is reviewed, especially of heat convection in Rayleigh-Bénard geometry and of azimuthal momentum transport in Taylor-Couette geometry of concentrically rotating cylinders. The respective Nusselt numbers and convection amplitudes (Reynolds numbers) are analysed as functions of the control parameters Rayleigh and Prandtl number or Taylor number and gapwidth. Non-Oberbeck-Boussinesq effects, the flow structure and its dynamics, and the dominating role of the boundary layers are addressed. Finally a brief discussion of the most urging challenges for future research in this field is offered.

Work was done in cooperation with Detlef Lohse, Guenter Ahlers, Bruno Eckhardt, Enrico Calzavarini, Kazuyasu Sugiyama, Francisco Fontenele Araujo, Eric Brown, and Denis Funfschilling.

Topical Talk DY 14.2 Wed 10:15 HÜL 386
What's up in quantum chaos? — •Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden

Many fundamental quantum signatures of chaos have been established in recent years, partly based on a deeper understanding of classical dynamics. This talk will review some of these highlights, like the universal properties of energy spectra when the classical limit shows fully chaotic dynamics. For typical systems, where regular and chaotic phase-space regions coexist, we can say now whether or not quantum eigenstates will respect these regions and a quantitative understanding of tunneling between them is on the way. Future challenges will be addressed throughout the talk.

15 min. break.

Topical Talk DY 14.3 Wed 11:00 HÜL 386
Non-equilibrium work and fluctuation theorems — •Andreas Engel — Institut für Physik, Carl-von-Ossietzky-Universität Oldenburg

The general theoretical description of systems driven violently away from thermal equilibrium is still an open problem. Whereas equilibrium situations are comprehensively characterized by a small number of general principles, and near-equilibrium processes can be modeled within the framework of linear-response theory the extreme diversity of phenomena occuring far from equilibrium has precluded a coherent theoretical description up to now.

Nevertheless, some simple, exact and general relations have been established recently which apply to systems driven arbitrarily far from equilibrium. These relations are by now referred to as fluctuation and work theorems respectively, and are in particular relevant for small systems with typical energy changes of the order of the thermal energy $k_B T$. They offer a fresh view on some classical problems in non-equilibrium statistical mechanics, open interesting possibilities for further research, and have motivated new experimental techniques and numerical algorithms.

The talk gives a general introduction into the field of non-equilibrium work and fluctuation theorems and discusses some results and applications.

Topical Talk DY 14.4 Wed 11:30 HÜL 386
Computational Statistical Physics — •Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig

One line of computational statistical physics focuses on providing precise numerical data for testing and complementing analytical predictions for well-controlled model systems. After a brief overview of recent progress in Monte Carlo computer simulation methodologies, the current level of interplay between analytical and numerical considerations will be illustrated in more detail for one selected example application.

Invited Talk DY 14.5 Wed 12:00 HÜL 386
Towards a quantum Church-Turing Theorem — •Reinhard F. Werner — Inst. Math.Physik, TU Braunschweig, Germany

The Church-Turing Thesis states that any reasonable computational process can be simulated by a standard computational model, e.g., the Turing machine. In the quantum case this amounts to the question, whether we have actually found the most general ways to make quanta compute: can every conceivable computational model, which can be formulated within quantum mechanics, be simulated efficiently by one of the equivalent quantum computational models we know, e.g., the gate model, the one-way quantum computer, or adiabatic quantum computing?

We present some partial results, and discuss the relation to the broader question whether Nature is (quantum) computable.