

DY 31 Nonlinear Stochastic Systems I

Zeit: Montag 10:30–12:45

Raum: TU H2032

DY 31.1 Mo 10:30 TU H2032

Fluctuation-dissipation theorems and second order statistics of many-body systems described by means of nonlinear Fokker-Planck equations and Vlasov-Fokker-Planck equations — ●TILL DANIEL FRANK — Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany

In line with mean field theory, we study stochastic properties of many-body systems in terms of nonlinear Fokker-Planck equations, in general, and Vlasov-Fokker-Planck equations, in particular. We show that the first order statistics of these models can be embedded into second and higher order statistics defined by self-consistent Langevin equations. We exploit this approach to derive exact analytical expressions for two-time point joint probability densities for some benchmark models and to address the fluctuation-dissipation theorem. In addition, we derive analytical expressions for short-time correlation functions and show how to determine time correlation functions in general in terms of hierarchies of coupled differential equations.

M. Shiino: Phys. Rev. A 36 (1987) 2393; M. Hütter and H. C. Öttinger: Phys. Rev. E 54 (1996) 2526

T.D. Frank: Phys. Lett. A, 319 (2003) 173; Physica A, 331 (2004) 391; Eur. Phys. Journal B 37 (2004) 139; Phys. Lett. A, 329 (2004) 475-485

DY 31.2 Mo 10:45 TU H2032

Estimation of Drift and Diffusion Functions of Stochastic Processes — ●DAVID KLEINHANS and RUDOLF FRIEDRICH — Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

We present a general method to extract drift and diffusion functions from experimental time series. This is based on a procedure recently published by Siegert et al[1]. However, our approach does not perform any limiting procedure regarding the sampling rate.

Drift and diffusion coefficients are embedded into families of functions depending on a set of parameters σ . A first estimate is given by the evaluation of drift and diffusion using the smallest available time increment[1]. An optimal set of parameters is obtained by an iteration procedure minimizing the Kullback-Leibler distance between the measured and the calculated two point joined pdf. This pdf is obtained either by a simulation of the langevin equation of a numerical solution of the corresponding Fokker-Planck equation for the parameter set σ .

For unidimensional data our method substantially can be simplified to analyse processes containing additive and multiplicative noise terms.

[1] S. Siegert et al., Physics Letters A **234**, 275-280 (1998)

DY 31.3 Mo 11:00 TU H2032

Response of stochastic and chaotic systems to weak sinusoidal and rectangular modulation — ●THOMAS STEMLER¹, JOHANNES WERNER¹, ANDRZEJ KRAWIECKI², and HARTMUT BENNER¹ — ¹Institut für Festkörperphysik, TU-Darmstadt — ²Faculty of Physics, Warsaw University of Technology, Poland

We investigate stochastic resonance in a Schmitt trigger driven by white Gaussian noise and a circuit showing chaos-chaos intermittency. In the chaotic circuit at some critical control parameter R_c a merging crisis occurs. For higher control parameter values $R > R_c$ the system jumps intermittently between two dynamical states. The time series containing only state information filtered from the output signal of this circuit has a residence time distribution comparable to that of the stochastically driven Schmitt trigger. The mean value of this distribution can be changed by variation of the control parameter R like the Kramers time by variation of the noise intensity D . We focus on the question how the stochastic resonance behaviour of both systems is influenced by the kind of weak modulation applied. Therefore we test two different types of modulation, a sinusoidal and a rectangular one and analyse the cross-correlation function between the response of the system and the drive. In addition the measured experimental data will be compared with approximated cross-correlations derived from linear response theory.

DY 31.4 Mo 11:15 TU H2032

Control of noise-induced oscillations in superlattices — ●JOHANNES HIZANIDIS, ALEXANDER BALANOV, ANDREAS AMANN, and ECKEHARD SCHÖLL — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, 10623 Berlin

Superlattices are spatially extended systems with complex dynamics of interacting fronts [1]. We consider noise-induced dynamics of a superlattice below the Hopf bifurcation, where in the absence of noise the system exhibits a fixed point. We show that delayed feedback control that was previously used for manipulation of noise-induced oscillations in systems *without spatial degrees of freedom* [2], can not only enhance or deteriorate the regularity of stochastic *spatio-temporal* motion but also allows the manipulation of the system's timescales with varying time delay.

[1] A. Wacker, Phys. Rep. 357, 1-111 (2002)

[2] N. B. Janson, A. G. Balanov, and E. Schöll, Phys. Rev. Lett. 93, 010601 (2004)

DY 31.5 Mo 11:30 TU H2032

Kritisches Verhalten und Universalität bei rauschgetriebenen Nichtgleichgewichts-Phasenübergängen — ●ULRICH BEHN und JENS PRZYBILLA — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10, 04109 Leipzig

Für ein System global gekoppelter Stratonovich-Modelle wurde kürzlich ein kontinuierlicher Nichtgleichgewichts-Phasenübergang beschrieben [1], bei dem der kritische Exponent des Ordnungsparameters mit ansteigendem Verhältnis von Rauschstärke zu räumlicher Kopplungsstärke einen Übergang vom 'klassischen' Wert 1/2 zu einem kontinuierlich von diesem Verhältnis abhängendem Verlauf zeigt.

Hier werden diese Untersuchungen auf Modelle mit nichtlinearen Termen höherer Ordnung ausgedehnt und daneben die kritischen Exponenten der Suszeptibilität und der Varianz des Ordnungsparameters analytisch und numerisch bestimmt sowie Universalitätsklassen diskutiert. Weiterhin beschreiben wir den Einfluss eines zusätzlichen additiven Rauschens.

[1] T. Birner, K. Lippert, R. Müller, A. Kühnel, U. Behn, Phys. Rev. E 65, 046110 (2002).

DY 31.6 Mo 11:45 TU H2032

Controlling Traffic Breakdowns — ●REINHARD MAHNKE¹, REINHART KÜHNE², and IHOR LUBASHEVSKY³ — ¹Inst. of Physics, Univ. Rostock, D-18051 Rostock — ²Inst. Transport. Res., DLR, D-12489 Berlin — ³Physics Inst., Russian Acad. Sc., Moscow, Russia

A stochastic description of traffic flow, called probabilistic traffic flow theory, is developed.

Traffic breakdowns are described by a balance equation that models the dynamics of jam formation by two contributions: a discharge rate depending on the length of the congestion, and an adhesion rate mainly depending on the traffic volume of the considered road section. With this balance equation it is feasible to calculate the dynamics of traffic pattern formation especially the first passage time for a transition from free flow condition to congested traffic including the influence of the parameters affecting the discharge and adhesion rates.

Starting with the cumulative probability for breakdowns the change in the incident duration distribution is calculated and qualitatively given. The contribution concludes with recommendations for a comprehensive operation improvement and provides necessary steps for a long lasting stabilization of traffic for a given traffic flow time series pattern.

[1] R. Kühne, R. Mahnke, I. Lubashevsky, Phys. Rev. E **65**, 066125 (2002)

DY 31.7 Mo 12:00 TU H2032

Alterungsphänomene ohne detailliertes Gleichgewicht: der Kontaktprozess — ●MALTE HENKEL¹, TILMAN ENSS², ALAN PICONE¹, MARIA AUGUSTA SANTOS³, CONSTANTINO DA SILVA SANTOS³, ULRICH SCHOLLWÖCK⁴ und JOSÉ RAMASCO³ — ¹LPM, Université Nancy I, B.P. 239, F - 54506 Vandœuvre les Nancy, Frankreich — ²MPI Festkörperforschung, 70569 Stuttgart — ³Departamento de Física, Universidade do Porto, Portugal — ⁴Institut Theoretische Physik C, RWTH Aachen

Das Langzeitverhalten des Kontaktprozesses in $(1+1)$ und $(2+1)$ Dimensionen wird numerisch mit Hilfe von Monte-Carlo Simulationen [1] und der Dichtematrixrenormierungsgruppe [2] untersucht. Wir finden in diesem System ohne detailliertes Gleichgewicht an seinem kritischen Punkt eine große Analogie zu alternden magnetischen Systemen, deren Dynamiken das detaillierte Gleichgewicht erfüllen. Unsere numerische Daten lassen sich durch einen dynamischen Skalenansatz beschreiben. Dagegen sind die Autokorrelations- und Selbstantwortexponenten b

und a im Kontaktprozeß verschieden, so daß eine Definition eines nicht-trivialen Fluktuations-Dissipationsverhältnisses nicht mehr möglich ist. Insbesondere können wir so zeigen, daß die von Sastre et al. [3] anhand des Wählermodells vorgeschlagene Definition einer Nichtgleichgewichtstemperatur nicht auf den Kontaktprozeß übertragbar ist.

[1] JJ Ramasco, M Henkel, MA Santos und CA da Silva Santos, J. Phys. **A37**, 10497 (2004). [2] T Enss, M Henkel, A Picone und U Schollwöck, J. Phys. **A37**, 10479 (2004). [3] F Sastre, I Dornic und H Chaté, Phys. Rev. Lett. **91**, 267205 (2003).

DY 31.8 Mo 12:15 TU H2032

Non-monotonic Velocity Dependence of Atomic Friction —
•PETER REIMANN and MYKHAYLO EVSTIGNEEV — Universität Bielefeld

We propose a theoretical model for friction force microscopy experiments with special emphasis on the realistic description of dissipation and inertia effects. Its main prediction is a non-monotonic dependence of the friction force upon the sliding velocity of the AFM-tip relative to an atomically flat surface.

DY 31.9 Mo 12:30 TU H2032

Analysis of the Dynamics of Dissipative Solitons using Stochastic Data Analysis — •HANS-GEORG PURWINS¹, HENDRIK U. BÖDEKER¹, and ANDREAS W. LIEHR^{1,2} — ¹Institut für Angewandte Physik, WWU Münster, Corrensstr. 2/4, 48149 Münster — ²Freiburger Materialforschungszentrum, Stefan-Meier-Str. 21, 79104 Freiburg

In this talk, we focus on the dynamics of solitary particle-like structures in nonlinear dissipative systems referred to as dissipative solitons (DSs). We consider theoretical prediction like intrinsic propagation, interaction and formation of molecules or clusters. The theoretical predictions are compared to experimental results obtained from planar gas-discharge systems. As strong fluctuations are present in the experimental system, the dynamics has to be modeled by stochastic differential equations in the form of a Langevin equation. On this background methods of stochastic data analysis are developed that allow for a quantitative separation of the deterministic and the stochastic part of the dynamics. Processing experimental data by this method, theoretical predictions with respect to the transition from a stationary to intrinsically propagating DSs and their interaction law can be verified. The latter is consistent with the locking distances of DSs in the observed molecules.