Stochastische Prozesse in der Physik
Sommersemester 2016

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Lehrveranstaltung Nr. 12637
(2 SWS V + 2 SWS Ü)
im Rahmen des Studiengangs *Bachelor in Physik*
und
des Studiengang *Lehramts an Gymnasien in Physik*

V: Dienstag 7.30 bis 9.00 Uhr, IfPh, Albert-Einstein-Str. 24, HS 2
Ü: Freitag 7.30 bis 9.00 Uhr, IfPh, Albert-Einstein-Str. 24, SR 1
Übungsleiter: MSc. Sebastian Rosmej

Physics of Stochastic Processes
In addition, everyone (studying in first or second cycle)
from other faculties of Rostock University or from abroard
who likes to learn model-driven approaches rather
than purely statistical ones is welcome.

Die Lehrveranstaltung begann mit der ersten Vorlesung am
Dienstag, d. 05.04.2016 um 7.30 Uhr im Physik-Lehrgebäude
im Hörsaal 2.

The Importance of Being Noisy – Stochasticity in Science

Why stochastic tools? When you asked alumni graduated from European universities moving into nonacademic jobs in society and industry what they actually need in their business, you found that most of them did stochastic things like time series analysis, data processing etc., but that had never appeared in detail in university courses.

Aim The general aim is to provide stochastic tools for understanding of random events in many beautiful applications of different disciplines ranging from econophysics up to sociology which can be used multidisciplinary.

State of the art General problem under consideration is the theoretical modeling of complex systems, i. e. many–particle systems with nondeterministic behavior. In contrast to established classical deterministic approach based on trajectories we develop and investigate probabilistic dynamics by stochastic tools such as stochastic differential equation, Fokker–Planck and master equation to get probability density distribution. The stochastic apparatus provides more understandable and exact background for describing complex systems. The idea goes back to Einstein's work on Brownian motion in 1905 which explains diffusion process as fluctuation problem by Gaussian law as a special case of Fokker–Planck equation.

Textbooks

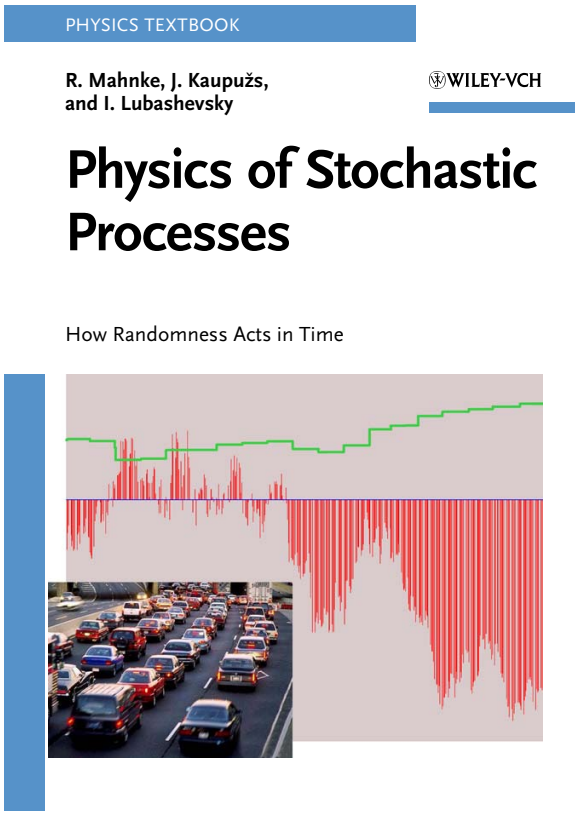

Fig. 1: R. Mahnke, J. Kaupužs and I. Lubashevsky: *Physics of Stochastic Processes*, Wiley-VCH, Weinheim, 2009.

Literatur:

• H. Risken: The Fokker-Planck Equation, Springer, 1984
• W. Paul, J. Baschnagel: Stochastic Processes, Springer, 1999
• C. W. Gardiner: Handbook of Stochastic Methods, Springer, 2004
• V. S. Anishchenko et. al: Nonlinear Dynamics of Chaotic and Stochastic Systems, Springer, 2007
• M. Ullah, O. Wolkenhauer: Stochastic Approaches for Systems Biology, Springer, 2011
• T. Tome, M. J. de Oliveira: Stochastic Dynamics and Irreversibility, Springer, 2015

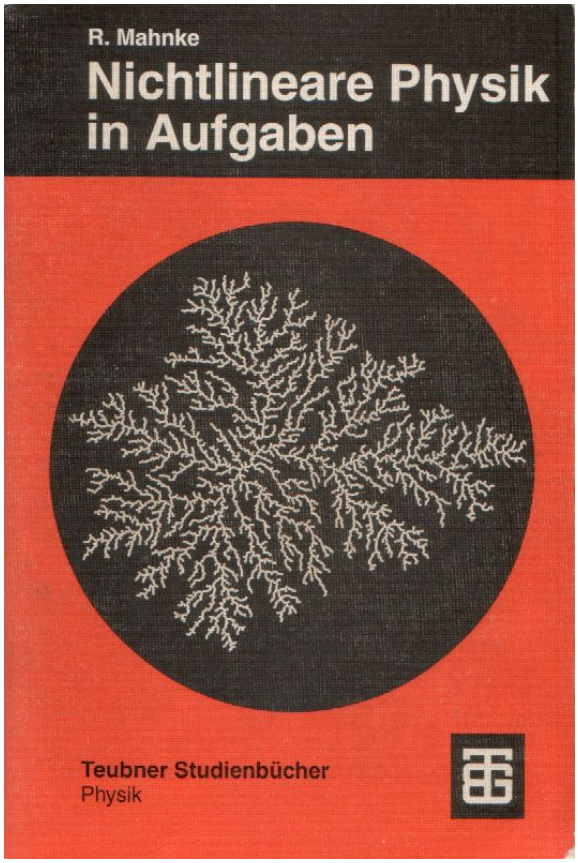

Fig. 2: R. Mahnke: *Nichtlineare Physik in Aufgaben*, Teubner–Studienbücher, Stuttgart, 1994.

Literatur:

• Henry D. I. Abarbanel et. al: Introduction to Nonlinear Dynamics for Physicists, World Scientific, Singapore, 1993

• F. Verhulst: Nonlinear Differential Equations and Dynamical Systems, Springer, Berlin, 1990

• H. G. Schuster: Deterministic Chaos, VCH, Weinheim, 1989

Inhaltsverzeichnis

Einschreibung für das Sommersemester 2016

1 Das mathematische Pendel (14. & 15. KW)

1.1 Deterministische Dynamik: Schwingung und Rotation

Wikipedia: Das math. Pendel ohne Anregung

`https://en.wikipedia.org/wiki/Pendulum_(mathematics)`

1.2 Deterministische Dynamik mit Anregung: Stabilisierung bei parametrischer Resonanz

Wikipedia: Das invertierte math. Pendel mit Anregunmg

`https://en.wikipedia.org/wiki/Inverted_pendulum`

Here are pretty cool clips and easy demonstrations:

`https://www.youtube.com/watch?v=5oGYCxkgnHQ`

`https://www.youtube.com/watch?v=gnn21smGVrQ`