BuildMoNa

UNIVERSITÄT LEIPZIG

SCIENTIFIC AND METHOD MODULES

Module name	Theory
Number	2010-M03
Aims	The aim is to illustrate, using elementary examples, the role of probability theory as the inductive logic behind statistical physics, quantum physics and information theory. The concepts of entropy and dissipation will be elucidated.
Basics	Topics covered in Bachelor courses on elementary quantum mechanics and statistical mechanics, elementary probability theory, equilibrium ensembles, entropy, dissipation, detailed balance.
Contents	Bayesian probability theory, the constitutive role of probability in quantum mechanics and statistical physics, information-theoretic measure of irreversibility, notions of entropy, nonequilibrium work theorems, entropy production in nonequilibrium steady-states.
Methods	Methods and concepts dealing with incomplete data, inductive inference, information theory, logics, analytical & numerical techniques.
Type	Two-day block course/ yearly recurrence with modification.
Date (month/year)	10.11. – 11.11.2010
Time	9:30 – 18:00h, 9:30 – 18:00h
Work load	15 hours presence/ 45 hours self-study
Examination	written exam 15.11.2010
Credit points	2
Responsible scientists	Wolfhard Janke / Klaus Kroy
International guest lecturers	Prof. Dr. Herbert Wagner (LMU Munich) Dr. Richard Blythe (The University of Edinburgh)
Recommendations for literature, e-learning	Introductory: E.T. Jaynes, *Clearing up mysteries – The original goal* (1989); E.T. Jaynes, *Probability theory as logic* (1990); L.E. Ballentine, *Probability theory of quantum mechanics*, Am. J. Phys. **54** (1986) 883; R.B. Griffiths, *Probabilities and quantum reality...*, Found. Physics **13** (2003) 1423; C. Bustamante, J. Liphardt, and F. Ritort, *The nonequlibrium thermodynamics of small systems*, Phys. Today **58**:7 (2005) 43; R. Blythe, *An introduction to phase transitions in stochastic dynamical systems*, J. Physics: Conference Series **40** (2006) 1–12. Further Reading: G.D. Agostini, *Bayesian inference in processing experimental data: principles and basic applications*, Rep. Prog. Phys. **66** (2003) 1382; W.T. Grandy Jr., Principles *of maximum entropy and irreversible processes*, Phys. Reports **62** (1980) 175; R. Blythe, *Reversibility, heat dissipation, and the importance of the thermal environment in stochastic models of nonequilibrium steady states*, Phys. Rev. Lett. **100** (2008) 010601. Supplementary & Advanced Reading: E. Sober, *Evidence and Evolution – The Logic Behind Science*, CUP 2009; E.T. Jaynes, *Probability Theory: The Logic of Science*, CUP 2003.

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SCHEDULE Module 2010-M03

Time	Lecturer	Program	Location
Day 1			
09:30-10:00	W. Janke/K. Kroy	Introduction	GrHosSR
10:00-11:00	H. Wagner	Theory I	GrHosSR
11:00-11:30		*Discussions & Coffee Break*	
11.30-12.30	H. Wagner	Theory I	GrHosSR
12:30-14:00		*Lunch*	
14:00-15:00	H. Wagner	Theory I	GrHosSR
15:00-15:30	All Lecturers	Discussions	GrHosSR
15:30-16:30	R. Blythe	Theory II	GrHosSR
16:30-17:00		*Discussions & Coffee Break*	
17:00-18:00	H. Wagner	Practical part/exercises	GrHosSR
Day 2			
09:30-10:00	All Lecturers	Discussions	GrHosSR
10:00-11:00	H. Wagner	Theory I	GrHosSR
11:00-11:30		*Discussions & Coffee Break*	
11:30-12:30	H. Wagner	Theory I	GrHosSR
12:30-14:00		*Lunch*	
14:00-15:00	H. Wagner	Theory I	GrHosSR
15:00-15:30	All Lecturers	Discussions	GrHosSR
15:30-16:30	R. Blythe	Theory II	GrHosSR
16:30-17:00		*Discussions & Coffee Break*	
17:00-18:00	H. Wagner	Practical part/exercises	GrHosSR

Didactic elements:
Lecture, discussions, presentations, exercises

Expected performance:
Active participation in discussions, exercises, and written exam

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