Jean-Dominique Deuschel Andreas Greven (Eds.)

## Interacting Stochastic Systems

With 17 Figures



## Table of Contents

	Jean-Dominique Deuschel, Andreas Greven ferences	8	
Pa	Part I Stochastic Methods in Statistical Physics		
Co	parse-Graining Techniques for (Random) Kac Models Anton Bovier, Christof Külske		
1	Introduction	11	
$\overline{2}$	Translation-Invariant Long-Range Models	14	
	2.1 $1/\gamma$ -Contour Model Representation	14	
3	Random Short Range Models and Coarse-Grainings	18	
	3.1 The Random Field Ising Model	18	
	3.2 The Continuous Spin Random Field Model	21	
4	The Random Field Kac Ising Model	23	
	4.1 $1/\gamma$ -Contour Model Representation	24	
	4.2 <i>LR</i> -Blocking	25	
Re	ferences	26	
	nclidean Gibbs Measures of Quantum Crystals: xistence, Uniqueness and a Priori Estimates		
	Sergio Albeverio, Yuri Kondratiev, Tatiana Pasurek, Michael Röckner		
1	Introduction	29	
2	A Simple Model of Quantum Anharmonic Crystal	31	
3	Definition of Euclidean Gibbs Measures	35	
4	Formulation of the Main Results	38	
	4.1 Existence, Uniqueness and a Priori Estimates for Euclidean		
	Gibbs Measures	39	
	4.2 Flow and Integration by Parts Characterization of Euclidean		
	Gibbs Measures	41	
5	Possible Generalizations of QLS Model I	43	
6 D-	Comments on Theorems 1–6	46	

So	me Jump Processes in Quantum Field Theory
	Roderich Tumulka, Hans-Otto Georgii
1	Introduction
2	Jump Rates Induced by Schrödinger Equations 57
3	Bohmian Mechanics and Bell-Type QFT 60
4	Global Existence of Bell's Jump Process
5	Other Global Existence Questions
6	Deterministic Jumps and Boundaries in Configuration Space 68
Rei	ferences
Gi	bbs Measures on Brownian Paths:
$\mathbf{Th}$	eory and Applications
	Volker Betz, József Lőrinczi, Herbert Spohn
1	Introduction
2	Gibbs Measures
	2.1 The Case of External Potential
	2.2 Weak Pair Potential: Cluster Expansion
	2.3 Existence for Pair Potential of Arbitrary Strength 88
	2.4 Phase Transition
3	A Central Limit Theorem 92
4	Applications and Open Problems
Re	ferences
$\mathbf{Sp}$	ectral Theory for Nonstationary Random Potentials
	Stefan Böcker, Werner Kirsch, Peter Stollmann
1	Introduction: Leaving Stationarity
2	Sparse Random Potentials
3	Sparse Random Potentials
	and the Integrated Density of States
4	Random Surface Models
5	The Density of Surface States
6	Lifshitz Tails & Localization
Re	ferences
$\mathbf{A}$	Survey of Rigorous Results on Random Schrödinger
Op	perators for Amorphous Solids
	Hajo Leschke, Peter Müller, Simone Warzel
1	Introduction
	1.1 Motivation and Models
	1.2 Interesting Quantities and Basic Questions
	1.3 Random Landau Hamiltonian and Its Single-Band
	Approximation
2	Self-averaging and Uniqueness
	of the Integrated Density of States
2	Populta in Case of Coursian Bandom Potentials 196

	Table of Contents	VII
	3.1 Lifshits Tails	. 132
	3.2 Existence of the Density of States	
	3.3 Spectral and Dynamical Localization	
4	Results in Case of Poissonian Random Potentials	
-	4.1 Lifshits Tails	
	4.2 Existence of the Density of States and Spectral Localization	
5	Some Open Problems	
	erences	
$\mathbf{T}\mathbf{h}$	Parabolic Anderson Model	
	lürgen Gärtner, Wolfgang König	
1	Introduction and Heuristics	153
	1.1 Evolution of Spatially Distributed Systems in Random Medi-	
	1.2 The PAM with Time-Independent Potential	
	1.3 Intermittency	
	1.4 Annealed Second Order Asymptotics	
	1.5 Quenched Second Order Asymptotics	
	1.6 Geometric Picture of Intermittency	
2	Examples of Potentials	163
	2.1 Double-exponential Distributions	163
	2.2 Survival Probabilities	164
	2.3 General Fields Bounded from Above	165
	2.4 Gaussian Fields and Poisson Shot Noise	166
3	Results for the Double-exponential Case	166
	3.1 Annealed Asymptotics	167
	3.2 Quenched Asymptotics	168
	3.3 Geometry of Intermittency	170
4	Universality	171
5	Time-Dependent Random Potentials	173
Re	erences	177
Ra	ndom Spectral Distributions	
	Friedrich Götze, Franz Merkl	
1	Asymptotic Approximation of Random Spectra	
	1.1 Wigner and GUE Ensembles	
	1.2 Universality in the Wigner Ensemble of Matrices	
	1.3 Laguerre Ensembles and Universality	
2	Eigenvalues of CUE-Ensembles	
	2.1 Correlation Functions for CUE	
	2.2 Fock Space	
	2.3 Proof of the Combinatorial Lemma	
Re	erences	202

## Part II Stochastic in Population Models

		nalization and Universality	
юг		ltitype Population Models reas Greven	
1		eus Greven	ഹവ
1			
	1.1	Background and Motivation	
0	1.2	The Models	
2	-	litative Properties of the Population Models	
	2.1	The Longtime Behavior	
	2.2	Continuum Limit	
	2.3	Historical Processes	219
3		ormalization Analysis	
		Hierarchical Mean-Field Limit	220
	3.1	Multiple Space-Time Rescaling	
		and the Hierarchical Mean-Field Limit	
	3.2	Background on the Hierarchical Mean-Field Limit	
4		llysis of the Limiting Renormalized System	
	4.1	The Dichotomy Stability versus Clustering	
	4.2	Cluster Formation	
5		versality	
	5.1	A Nonlinear Map and Its Orbit	
	5.2	Fixed Points, Fixed Shapes and Their Domain of Attraction $$ .	
6		rarchical Mean-Field Continuum Limit	
	6.1	Hierarchical Mean-Field Continuum Limit	
	6.2	Dichotomy for the Continuum Limit	
	6.3	Hot Spot Formation	
	6.4	Universality	243
Re	eferenc	ces	244
		stic Insertion-Deletion Processes and Statistical	
Se	-	ce Alignment	
_		Metzler, Roland Fleißner, Anton Wakolbinger, Arndt von Haesel	
1		oduction	247
2	_	uence Evolution Models	
		Insertion and Deletion	
	2.1	Stochastic Indel Dynamics	
	2.2	TKF Bridges	
	2.3	A Genealogy of Positions	
	2.4	Reading an Indel Forest from Left to Right	
	2.5	A Fragment Insertion-Deletion Model	
3	Tree	e Indexed Indel Processes	
	3.1	Multiple TKF Bridges	
	3.2	Decomposing a Tree Indexed Indel Path into Heirs Lines	256

4 Rei	3.3 Building an Indel History by a Markov Chain of Tree Indexed Heirs Lines and Sets of Active Nodes 2 3.4 Generating Labelled Sequences in the Leaves 2 3.5 Computing Multiple Alignment Likelihoods 2 3.6 Extension to Fragment Insertions and Deletions 2 Indel Models and Tree Reconstruction 2 ferences 2	259 261 263 264
	anching Processes in Random Environment –	
$\mathbf{A}$	View on Critical and Subcritical Cases	
	Matthias Birkner, Jochen Geiger, Götz Kersting	
1	Introduction	
2	A Formula for the Survival Probability	
3	Criticality	
$\frac{4}{5}$	Spatial Branching Processes in Space-Time i.i.d. Random	
	Environment	
Rei	ferences 2	289
Pa	rt III Stochastic Analysis	,
Th	nin Points of Brownian Motion Intersection Local Times  Achim Klenke	
1	Introduction	295
$\overline{2}$	Intersection Local Time	
3	The Multifractal Spectrum	
4	Non-intersection Exponents	
5	Results	
6	Sketches of Proofs	300
Ref	ferences	302
Co	oupling, Regularity and Curvature  Karl-Theodor Sturm	
1	Introduction	305
2	The Space of Probability Measures	308
3	Probability Measures on Metric Spaces	
	of Nonpositive Curvature	
4	Barycenters	
5	Transport Inequalities and Gradient Estimates	316
6	Gradient Flows on Metric Spaces	
_	and Nonlinear Diffusions	
	ferences	1631

Two Mathematical Approaches to Stochastic Resonance
Samuel Herrmann, Peter Imkeller, Ilya Pavlyukevich
1 Introduction
2 Model Reduction and Stochastic Resonance
3 Periodically Switching Potentials
and the Spectral Approach
3.1 The Spectral Gap and the First Eigenfunction
3.2 Asymptotics of the SPA Coefficient
3.3 The 'Effective Dynamics': Two-State Markov Chain
4 Smooth Periodic Potentials and a Robust Resonance Notion 340
4.1 Transition Times for the Markov Chain
4.2 Transition Times for the Diffusion and Robustness 346
References
Continuity Properties of Inertial Manifolds
for Stochastic Retarded Semilinear Parabolic Equations
Igor Chueshov, Michael Scheutzow, Björn Schmalfuß
1 Preliminaries
2 Construction of inertial manifolds
3 Dependence of inertial manifolds on the delay time 368
4 Dependence of the inertial manifold on the intensity of the noise 373
References
References $374$ The Random Walk Representationfor Interacting Diffusion ProcessesJean-Dominique Deuschel $378$ 1 The Random Walk Representation $378$ 2 Estimates for the Correlations $385$
References $374$ The Random Walk Representationfor Interacting Diffusion ProcessesJean-Dominique Deuschel1 The Random Walk Representation $378$ 2 Estimates for the Correlations $382$ 3 Examples $386$
References         374           The Random Walk Representation         for Interacting Diffusion Processes           Jean-Dominique Deuschel         378           1 The Random Walk Representation         378           2 Estimates for the Correlations         385           3 Examples         386           3.1 Parabolic Anderson model         391
References $374$ The Random Walk Representationfor Interacting Diffusion ProcessesJean-Dominique Deuschel1 The Random Walk Representation $378$ 2 Estimates for the Correlations $382$ 3 Examples $386$
References         374           The Random Walk Representation         for Interacting Diffusion Processes           Jean-Dominique Deuschel         378           1 The Random Walk Representation         378           2 Estimates for the Correlations         382           3 Examples         386           3.1 Parabolic Anderson model         391           References         391
References
References         374           The Random Walk Representation         for Interacting Diffusion Processes           Jean-Dominique Deuschel         378           1 The Random Walk Representation         378           2 Estimates for the Correlations         382           3 Examples         386           3.1 Parabolic Anderson model         391           References         391
References

Random Dynamical Systems Methods in Ship Stability:	
A Case Study	
Ludwig Arnold, Igor Chueshov, Gunter Ochs	
1 Introduction	109
2 The Motion of a Ship in Random Seaway	110
2.1 The General Model	411
2.2 The Roll-Heave-Sway Interaction in Beam Sea	412
2.3 The Equation of the Roll Motion	412
3 Random Dynamical Systems Methods:	
A Brief Review	414
3.1 General Setup	414
3.2 Invariant Objects and Random Attractors	415
3.3 Lyapunov Exponents	416
4 The Roll Motion of a Ship: A Case Study	417
4.1 Numerical Studies	
4.2 Existence of a Compact Invariant Set in the White Noise Case	424
References	432
Analysis of Algorithms by the Contraction Method:	
Additive and Max-recursive Sequences	
Ralph Neininger, Ludger Rüschendorf	40 F
1 Introduction to the Contraction Method	
2 Limit Theorem for Divide and Conquer Algorithms	
3 Contraction and Fixed Point Properties with Maxima	
4 Max-recursive Algorithms of Divide and Conquer Type	
References	449