Bielefeld University

Stochastics and
Real World Models

International Graduate College

Stochastics and Real World Models 2011

Annual joint workshop of the International Graduate College
"Stochastics and Real World Models"
Beijing – Bielefeld

Universität Bielefeld
Lecture Hall H6
July 18–22, 2011

Spokesmen of the IGK:
Zhi-Ming Ma (Beijing), Michael Röckner (Bielefeld)

Organizers:
Moritz Kassmann (Bielefeld), Ante Mimica (Bielefeld)

SFB 701

Universität Bielefeld

General Information

The university building

The university is located in one large building. There is one main hall in the middle connecting all parts of the building. These are labelled by letters. The main hall is on level 0 and it houses shops (books, stationaries, grocery), a post office, and several restaurants and coffee shops. All rooms in the university are labelled like **V3-201**. This means the room is in **part V, 3rd floor and has number 201**.

Main lectures will take place in lecture hall **H6**. Parallel sessions will be organized in lecture hall **H6** and seminar rooms **V3-201** and **V3-204**.

Restaurants in the university building

Westend, opening hours: Mo – Fr 11:00 – 16:00, Sat 11 – 14:30
Located next to the swimming pool at one end of the main hall.
Serves full meals but also cakes and salads. Self-service.

Mensa, opening hours: Mo – Fr 11:30 – 14:00
The Salad bar is a part of the Mensa offering various types of salads (surprise) and some warm food. Here you can pay with cash. The Mensa offers also 2-4 fixed menus. If you want one of the fixed menus, you cannot pay with cash. You need to decide about the menu and buy a "ticket" beforehhand at the counter next to the display.

Univarza–Restaurant, opening hours: Mo – Fr 10:00 – 24:00
Serves full meals, but also pizzas, salads, or just coffee or tea.
Besides the restaurant, there is also a snack bar.

Cafeteria, opening hours: Mo – Fr 8:00 – 20:00, Sat 9:00-14:30
Between the main entrance and the Mensa. Serves full meals, sandwiches and light meals as well as cakes, salads, or just coffee or tea.

Furthermore, there are small coffee shops on the ground and first floor of the main hall.

Internet

During the conference you can use your personal guest-account. Just connect to to **WLAN-Network "guest"**. When you open your web browser you will be asked the username and password which you can find in your registration folder. After authen-

tication, you can use the WLAN connection with any software as usual (e.g. Email, Skype, SSH). You might need to re-authenticate e.g. after waking up your computer from sleep/suspend mode.

Library

On the first floor, around the whole building. Math books and journals are in **part V1**. Entrances to the library are from the first floor of the main hall. To go to the mathematics part use the entrances in part L1 or M1.
Opening hours:

Entrance L1: Mo – Fr 8:00 – 1:00 am, Sat – Sun 9:00 – 22:00.

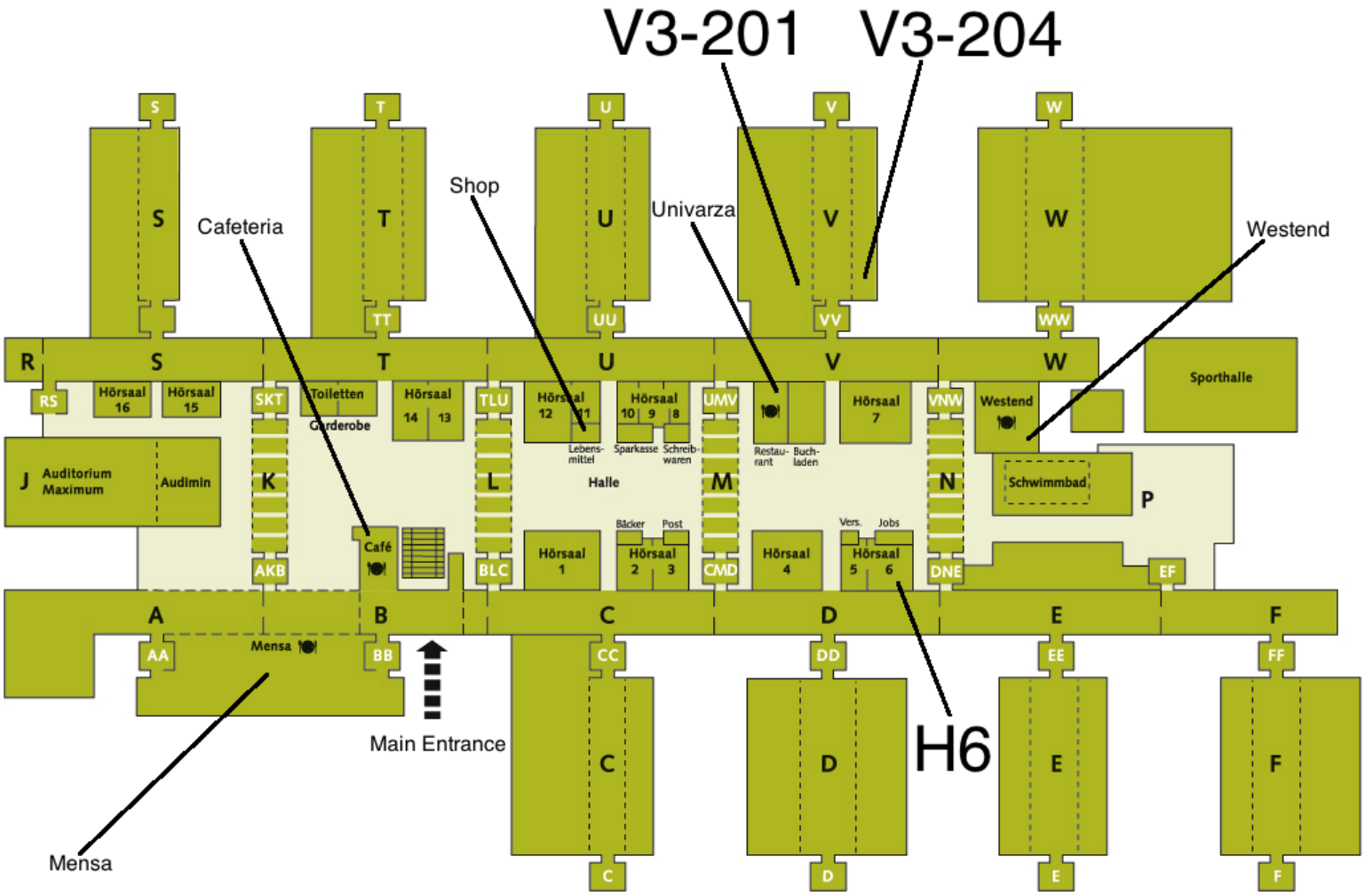
Entrance M1: Mo – Fr 9:00 – 16:00.

Public Transport

The tram **Stadtbahn Linie 4** connects the University to the city center.

- Stop **"Hauptbahnhof"** for hotels **"Mövenpick"** and **"Comfort Garni Hotel 'Stadt Bremen' "** ,
- Stop **"Jahnplatz"** for hotel **"Altstadt Hotel Bielefeld"**,
- Stop **"Rathaus"** for hotel **"Tulip"**.

Tickets for one or four trips can be obtained from the machines at each station. You need tickets **"Preisstufe 1"**, single trip 2.10 Euro, 4 trips 7.00 Euro. Make sure to validate your ticket at the stamp machines inside the tram when boarding.


V3-201
V3-204
Shop
Cafeteria
Univarza
Westend
Mensa
Main Entrance
H6
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RS
Hörsaal 16
Hörsaal 15
SKT
Toiletten
Garderobe
Hörsaal 14
13
TLU
Hörsaal 12
11
Lebens-mittel
Hörsaal 10
9
8
Sparkasse
Schreib-waren
UMV
Restau-rant
Buch-laden
Hörsaal 7
VNW
Westend
Sporthalle
J
Auditorium Maximum
Audimin
K
L
Halle
M
N
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Café
AKB
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Monday

8:30–8:50 — *Registration* —

8:50–9:00 — *Opening* —

9:00–9:40 *Invariance properties of solutions of some stochastic partial differential equations*
Giuseppe Da Prato

9:45–10:25 *Web Markov skeleton processes and their applications*
Zhi-Ming Ma

10:30–11:00 — *Coffee Break* —

11:00–11:40 *On the local structure of the population inside the propagating front*
Stanislav Molchanov

11:45–12:25 *Dirichlet forms and diffusions on rough spaces*
Alexander Teplyaev

12:30–13:10 *Energy measures,* 1*-forms and coverings*
Michael Hinz

13:15–14:15 — *Lunch Break* —

14:15–14:55 *Symmetries of stochastic interest rate models*
Paul Lescot

15:00–15:40 *Free Kawasaki dynamics with heavy tail Lévy-jump distributions*
Tobias Kuna

15:45–16:15 — *Coffee Break* —

16:15–16:55 *On an EVI curve characterization of Hilbert spaces*
Jonas Tölle

17:00–17:40 *Characteristic functions of Feller processes and their applications*
Jian Wang

17:45-18:25 *Slow subordinate Brownian motions*
Ante Mimica

Notes

Venue. Main venue is the lecture hall H6, which can be entered from the main hall.

Coffee Breaks take place in front of the lecture hall H6.

Tuesday

9:00–9:40 *Equilibrium pricing in incomplete markets under translation invariant preferences*
Patrick Cheridito

9:45–10:25 *Finance without probability*
Frank Riedel

10:30–11:00 *— Coffee Break —*

11:00–11:40 *From good-deal bounds and hedging to backward SDEs and back*
Dirk Becherer

11:45–12:25 *Gambling contests and Skorokhod embeddings in bounded time*
Stefan Ankirchner

12:30–13:10 *The (im)possibility of collective risk measurement: Aggregation theory for variational preferences*
Frederik Herzberg

13:15–14:15 *— Lunch Break —*

14:15–14:55 *Quenched invariance principle for a balanced, non-elliptic, random walk in balanced random environment*
Jean-Dominique Deuschel

15:00–15:40 *Non-intersecting random walks in the neighborhood of a symmetric tacnode*
Patrik Ferrari

15:45–16:15 *— Coffee Break —*

16:15–17:40 *Parallel Sessions - next page*

Wednesday

9:00–9:40 *Diffusions on thin networks and applications*
Sergio Albeverio

9:45–10:25 *A pathwise approach to parabolic SPDE with fractional noise in measure spaces*
Martina Zähle

10:30–11:00 *— Coffee Break —*

11:00–11:40 *Derivative formula and Harnack inequality for jump processes*
Feng-Yu Wang

11:45–12:25 *Coupling of Lévy processes*
René Schilling

12:30–13:10 *A resolvent approach for measure-valued branching processes and a nonlinear Dirichlet problem*
Lucian Beznea

13:15–14:00 *— Lunch Break —*

14:00–22:30 *— Excursion to Bückeburg —*

— Discussion of joint future research activities and collaboration —

— Conference Dinner —

Sessions on Tuesday Afternoon

Time	**Session 1** H6	**Session 2** V3-201 (Common Room)	**Session 3** V3-204 (Blauer Salon)
16:15–16:40	*Random attractors for stochastic porous media equations perturbed by space-time linear multiplicative noise* Benjamin Gess	*The Feynman-Kac formula* Marina Setić	*Globally coupled phase oscillators driven by ballistic noise source* Julio Rodgriguez
16:45–17:10	*BSDE and generalized Dirichlet forms* Rongchan Zhu	*Gibbs measures in lattice random systems* Diana-Camelia Puţan	*A necessary and sufficient condition for the equivalence of distributions of infinite dimensional Lévy processes and its application* Yulin Song
17:10–17:20	— *Pause* —		
17:20–17:45	*Uniqueness of solutions to Fokker-Planck equations related to singular SPDE driven by Lévy noise* Sven Wiesinger	*Invariant measures of the nearest-neighbour ASEP* Peter Nejjar	*Geometric measure of quantum discord* Shuangshuang Fu
17:50–18:15	*Stochastic evolution equations in weighted L^2 spaces with Lévy noise* Simon Michel	*BV functions in a Gelfand triple and the stochastic reflection problem on a convex set of a Hilbert space* Xiangchan Zhu	*Gibbs measures related to a Gamma measure over the cone of (positive) discrete Radon measures* Dennis Hagedorn
18:20–18:45	*Functional inequalities on Poisson spaces* Changsong Deng		

Thursday

9:00–9:40 *Gradient vector fields on based path space*
David Elworthy

9:45–10:25 *On the uniqueness of the Wasserstein diffusion*
Wilhelm Stannat

10:30–11:00 — *Coffee Break* —

11:00–11:40 *Markov dynamics and kinetic equations in continuum: generating functionals approach*
Yuri Kondratiev

11:45–12:25 *Martingale solutions and Markov selection for stochastic 3D Navier-Stokes equations*
Zhao Dong

12:30–13:10 *Stochastic calculus via regularizations in Banach spaces and applications*
Francesco Russo

13:15–14:15 — *Lunch Break* —

14:15–14:55 *On a random scaled porous media equation*
Michael Röckner

15:00–15:40 *Stochastic partial differential equations via non-time-homogeneous evolution systems*
Martin Grothaus

15:45–16:15 — *Coffee Break* —

16:15–16:55 *Functional inequalities in infinite dimensions*
Masha Gordina

17:00–17:40 *Some recent results on SPDE within variational framework*
Wei Liu

17:45–18:25 *Existence and uniqueness of strong solution for the stochastic nonlinear diffusion equation of plasma*
Ioana Ciotir

Friday

9:00–9:40 *Global estimates for Green's functions and the conditional gauge*
Igor Verbitsky

9:45–10:25 *Upper estimates of heat kernels of Dirichlet forms on metric measure spaces*
Jiaxin Hu

10:30–11:00 — *Coffee Break* —

11:00–11:40 *The balanced pantograph equation revisited*
Leonid Bogachev

11:45–12:25 *Integrable structure of evolution of complex shapes*
Alexander Vasiliev

12:30–13:10 *Quantum correlations*
Shunlog Luo

13:10–13:15 — *Closing* —

Abstracts

(sorted alphabetically by the family names of the speakers)

Sergio ALBEVERIO

Diffusions on thin networks and applications

We present some recent results on the construction of diffusion processes on networks of thin tubes with different boundary conditions including the study of limiting behavior. Applications include quantum graphs and biological neural networks.

Stefan ANKIRCHNER

Gambling contests and Skorokhod embeddings in bounded time

This talk deals with the Skorokhod embedding problem in bounded time for the Brownian motion with drift $X_t = \kappa t + W_t$: Given a probability measure μ we aim at finding a stopping time τ such that the law of X_τ is μ, and τ is almost surely smaller then some given time horizon $T > 0$. We provide necessary and suffcient conditions on the distribution of μ for the existence of such bounded stopping times. The problem is a particular economic interest because it arises naturally in the context of mixed strategy Nash equilibria in dynamic games without observability. The talk is based on joint work with Philipp Strack.

Dirk BECHERER

From good-deal bounds and hedging to backward SDEs and back

Good-deal bounds have been introduced as a way to obtain valuation bounds for derivative assets which are tighter than the arbitrage bounds. This is achieved by ruling out not only those prices that violate no-arbitrage restrictions but also trading opportunities that are 'too good'. We show how the analysis of good deal bounds leads to BSDEs. We discuss suitable notions of hedging and consequences of model uncertainty about market prices of risk.

Lucian BEZNEA

A resolvent approach for measure-valued branching processes and a nonlinear Dirichlet problem

A Dirichlet problem associated with the operator $\Delta u + u^2$ is solved, using a branching process on the space of finite configurations. We follow the pioneering works of M. Nagasawa, S. Watanabe, M.L. Silverstein, and the approach of E.B. Dynkin.

Leonid BOGACHEV

The balanced pantograph equation revisited

In our earlier paper [1], we have shown that the functional-differential equation with rescaling $y'(x) + y(x) = \sum_j p_j\, y(a_j x)$ with $a_j > 0$, $p_j > 0$, $\sum_j p_j = 1$ (called the *balanced pantograph equation*) has no nontrivial (i.e., nonconstant) bounded solutions $y(x)$ ($x \in \mathbf{R}$) if and only if $\sum_j p_j \ln a_j \leq 0$. In the present talk, we report similar results for a

more general equation $y(x) = \iint y(\alpha x + \beta)\, \mu(\mathrm{d}\alpha, \mathrm{d}\beta)$, where μ is a probability measure on $\mathbf{R}_+ \times \mathbf{R}$. Particular cases specified by a suitable choice of the measure μ include (i) the functional equation $y(x) = \sum_j p_j\, y(a_j x + b_j)$ and (ii) the balanced pantograph equation $y'(x) + y(x) = \sum_j p_j\, y(a_j x + b_j)$ and its higher-order generalizations. Joint work with G. Derfel (Ben Gurion), S. Molchanov (UNC-Charlotte) and J. Ockendon (Oxford).

[1] L. Bogachev, G. Derfel, S. Molchanov and J. Ockendon. On bounded solutions of the balanced generalized pantograph equation. In: *Topics in Stochastic Analysis and Nonparametric Estimation* (P.-L. Chow et al., eds.), IMA Volumes in Mathematics and its Applications **145**, pp. 29–49. Springer, New York, 2008.

Patrick CHERIDITO

Equilibrium pricing in incomplete markets under translation invariant preferences

We provide results on the existence and uniqueness of equilibrium in dynamically incomplete financial markets in discrete time. Our framework allows for heterogeneous agents, unspanned random endowments and convex trading constraints. In the special case where all agents have preferences of the same type and all random endowments are replicable by trading in the financial market we show that a one-fund theorem holds and give an explicit expression for the equilibrium pricing kernel. If the underlying noise is generated by finitely many Bernoulli random walks, the equilibrium dynamics can be described by a system of coupled backward stochastic difference equations, which in the continuous-time limit becomes a multi-dimensional backward stochastic differential equation. If the market is complete in equilibrium, the system of equations decouples, but if not, one needs to keep track of the prices and continuation values of all agents to solve it. As an example we simulate option prices in the presence of stochastic volatility, demand pressure and short-selling constraints.

Ioana CIOTIR

Existence and uniqueness of strong solution for the stochastic nonlinear diffusion equation of plasma

In this paper we are concerned with the stochastic partial differential equations of super fast diffusion processes describing behavior of plasma, in a bounded open subset of

R, with additive noise. We define a strong solution adequate to the properties of the natural logarithm and we prove the corresponding existence and uniqueness result.

Giuseppe DA PRATO

Invariance properties of solutions of some stochastic partial differential equations

We are concerned with a stochastic differential equation in a Hilbert space H of the form

$$\begin{cases} dX = (A + b(X))dt + \sigma(X)dW(t), \\ X(0) = x \in H, \end{cases}$$

under different assumptions on A, b, σ.

DENG Changsong

Functional inequalities on Poisson spaces

I shall present some new results on functional inequalities on Poisson spaces. Especially, the L^1 log-Sobolev inequality for second quantization Dirichlet form is well described by the base Dirichlet form. Moreover, Poincaré type inequalities for mixed Poisson measures are also discussed. This talk is based on joint work with Prof. Feng-Yu Wang.

Jean-Dominique DEUSCHEL

Quenched invariance principle for a balanced, non-elliptic, random walk in balanced random environment

Let M^d be all probability measures on $\{\pm e_i\}_{i=1}^d$ An **environment** is a point $\omega \in \Omega = \left(M^d\right)^{\mathbb{Z}^d}$

$$\omega = \{\omega(x, \pm e_i), i = 1, ..., d\}_{x \in \mathbb{Z}^d}$$

The law of environment P is an i.i.d. measure, i.e.

$$P = \mu^{\mathbb{Z}^d}$$

for some distribution μ on M^d.

For an environment $\omega \in \Omega$, the *Random Walk* on ω is a time-homogenous Markov chain with transition kernel

$$P_\omega \left(X_{n+1} = z + e | \, X_n = z \right) = \omega(z, e).$$

The **quenched law** P_ω^z is defined to be the law on $\left(\mathbb{Z}^d\right)^{\mathbb{N}}$ induced by the kernel P_ω and $P_\omega^z(X_0 = z) = 1$. An environment ω is said to be *balanced* if for every $z \in \mathbb{Z}^d$ and neighbor e of the origin, $\omega(z, e) = \omega(z, -e)$.

An environment ω is said to be *genuinely d-dimensional* if for every neighbor e of the origin, there exists $z \in \mathbb{Z}^d$ such that $\omega(z,e) > 0$.

Throughout this paper we make the following assumption. P-almost surely, ω is balanced and genuinely d-dimensional.

Set

$$X_t^N = \frac{1}{\sqrt{N}} X_{[tN]} + \frac{tN - [tN]}{\sqrt{N}} \big(X_{[tN]+1} - X_{[tN]}\big), \quad t \geq 0.$$

The **quenched invariance principle holds** if for P a.a. ω the law of $\{X_t^N\}_{t\geq 0}$ under P_ω^0 converges weakly to a Brownian motion with deterministic non-degenerate matrix.

Theorem Let $d \geq 2$ and assume that the environment is i.i.d., genuinely d-dimensional and balanced, then the quenched invariance principle holds with non-degenerate limiting covariance matrix.

Lawler showed in [L] the quenched invariance principle for ergodic uniformly elliptic environments: that is, if there exits $\epsilon_0 > 0$ with

$$P(\forall i = 1, ..., d,\ \omega(z, e_i) > \epsilon_0) = 1.$$

Guo and Zeitouni showed in [GZ] the quenched invariance principle for i.i.d elliptic environments

$$P(\forall i = 1, ..., d,\ \omega(z, e_i) > 0) = 1.$$

and for ergodic environments under the moment condition

$$E[\big(\prod_{i=1}^{d} \omega(x, e_i)\big)^{-p/d}] < \infty \quad \text{for some } \ p > d$$

One can find an example of ergodic elliptic balanced environment, where the invariance principle fails.

Note that, due to the balanced environment, $\{X_n\}$ is a martingale.

Let $\{\bar{\omega}_n\}_{n\in\mathbb{N}}$ be the environment viewed from the point of view of the particle:

$$\bar{\omega}_n = \tau_{X_n}\omega,$$

where τ is the shift on Ω This is a Markov chain on Ω under P with transition kernel

$$M(\omega', d\omega) = \sum_{i=1}^{d} \left[\omega'(0, e_i)\delta_{\tau_{e_i}\omega'} + \omega'(0, -e_i)\delta_{\tau_{-e_i}\omega'}\right]$$

The quenched invariant principle follows once we can find a probability measure $Q \ll P$ which is an invariant ergodic measure for $\{\bar{\omega}_n\}$ and such that P-almost surely, after some finite time the shifted environment is in the support of Q.

Note that in the elliptic case it follows immediately when $Q \ll P$ that $P \ll Q$, but in our case it is possible to have $Q \ll P$ but $P \not\ll Q$. Thus we need to be more careful.

Our proof is based on analytical methods, in particular on the maximum principle which we have to adapt to the non-elliptic setting. The estimates are based on the rescaled random walk, obtained from the original walk stopped after each coordinate

has been upgraded. The maximum inequality allows us to control for $p > 1$ the L^p-norm of the density of the invariant measure of the walk on the reflected-periodized cube of size N, uniformly in large N. From this we get the existence of an invariant measure $Q \ll P$, however due to the non-ellipticity of the walk, the proof of the ergodicity of Q, which is related to the uniqueness of a maximal strongly connected component, is more delicate. In the 2 dimensional case a simple coupling argument is applicable, while in higher dimensions we need to adapt the Burton-Keane argument [BK], to our setting, where we only have a weak version of the finite energy condition. We compensate for the weaker finite energy condition by using density bounds on the support of the invariant measure.

[BK89] R. M. Burton and M. Keane, Density and uniqueness in percolation *Comm. Math. Phys.* Vol. 121, 501-505, (1989),

[GZ10] Xiaoqin Guo and Ofer Zeitouni. Quenched invariance principle for random walks in balanced random environment. *to appear Prob. Theo Rel. Fields*, 2011.

[KT90] Hung Ju Kuo and Neil S. Trudinger. Linear elliptic difference inequalities with random coefficients. *Math. Comp.*, 55(191):37–53, 1990.

[Law83] Gregory F. Lawler. Weak convergence of a random walk in a random environment. *Comm. Math. Phys.*, 87(1):81–87, 1982/83.

DONG Zhao

Martingale solutions and Markov selection for stochastic 3D Navier-Stokes equations

In this talk, we will show that there exists a martingale solutions and Markov selection for stochastic 3D Navier-Stokes equations.

David ELWORTHY

Gradient vector fields on based path space

The main result described can be considered as giving necessary and sufficient conditions for an H-vector field, V, which is in L^2 to be the gradient of an L^2 function. The vector fields considered are on on the spaces $C_{x_0}M$ of continuous based paths on compact Riemannian manifolds M, with Brownian motion measure. As in finite dimensions it is natural to rephrase the question in terms of the corresponding differential form, $V^\sharp$, and the expected condition would be vanishing of its exterior derivative.

However the notion of H-vector field, or H-one -form is based on the Bismut tangent bundle of "admissible directions". This is not usually integrable and problems arise in defining a closed exterior derivative operator, see [3]. In work with Xue-Mei Li a proposal was made to modify the definition of q-forms. For q=1 this was done by perturbing their domains by the curvature of M and the theory was worked out in [1].

After describing this set up, work with Yuxin Yang will be described which proves vanishing of the resulting first L^2 cohomology group, and so of L^2 harmonic one-forms.

This proof demonstrates a pleasing interplay between the differential geometry of the Bismut tangent spaces and the temporal structure of the underlying path space. It extends the result for symmetric spaces given in [2]. The proof, together with the unsurprising vanishing, might be considered to justify the definition of exterior derivative proposed in the earlier work with Xue-Mei Li.

Patrik FERRARI

Non-intersecting random walks in the neighborhood of a symmetric tacnode

Consider a continuous time random walk in Z with independent and exponentially distributed jumps ± 1. The model in this paper consists in an infinite number of such random walks starting from the complement of $\{-m, -m+1, ..., m-1, m\}$ at time $-t$, returning to the same starting positions at time t, and conditioned not to intersect. This yields a determinantal process, whose gap probabilities are given by the Fredholm determinant of a kernel. Thus this model consists of two groups of random walks, which are contained into two ellipses which, with the choice $m = 2t$ to leading order, just touch: so we have a *tacnode*. We determine the new limit extended kernel under the scaling $m = 2t + \sigma t^{1/3}$, where parameter σ controls the strength of interaction between the two groups of random walkers.

FU Shuangshuang

Geometric measure of quantum discord

In this talk, I am going to talk something about quantum correlations, especially a quantity called geometric measure of quantum discord.

Benjamin GESS

Random attractors for stochastic porous media equations perturbed by space-time linear multiplicative noise

Unique existence of solutions to porous media equations driven by continuous linear multiplicative space-time rough signals is proven for initial data in $L^1(\mathcal{O})$. The generation of an order-preserving random dynamical system on $L^1(\mathcal{O})$ and the existence of a "small" random attractor for stochastic porous media equations perturbed by linear multiplicative noise in *space and time* is obtained. Uniform L^∞ bounds and uniform space-time continuity of solutions is shown. General noise including fractional Brownian Motion for all Hurst parameters is contained. A pathwise Wong-Zakai result for driving noise given by a continuous semimartingale is obtained.

Masha GORDINA

Functional inequalities in infinite dimensions

We will discuss various functional inequalities on infinite-dimensional groups, and how they can be used to prove quasi-invariant properties of heat kernel measures.

Martin GROTHAUS

Stochastic partial differential equations via non-time-homogeneous evolution systems

An existence and uniqueness result for stochastic partial differential equations via non-time-homogeneous evolution systems is presented. The studies are motivated by a non-linear stochastic partial differential algebraic equation arising in industrial mathematics.

Dennis HAGEDORN

Gibbs measures related to a Gamma measure over the cone of (positive) discrete Radon measures

A Gamma measure $\mathcal{G}_\theta$, $\theta > 0$ being a shape parameter, can be regarded as the 'free' case of a Gibbs measure because the involved potential is zero. Vershik, Gel'fand and Graev introduced the Gamma measure $\mathcal{G}_\theta$ in the context of the representation theory in 1975. It can be seen as a "marked" Poisson measure with an (infinite) Levy measure λ_θ on the marks.

We construct a Gibbs measure that corresponds to a (possibly negative,) non-symmetric potential with infinite interaction range and the to $\mathcal{G}_\theta$ associated "marked" Poisson measure.

Frederik HERZBERG

The (im)possibility of collective risk measurement: Aggregation theory for variational preferences

This paper studies collective decision making with regard to convex risk measures: It addresses the question whether there exist non-dictatorial aggregation functions of convex risk measures satisfying Arrow-type rationality axioms (weak universality, systematicity, Pareto principle). Herein, convex risk measures are identified with variational preferences on account of the Maccheroni–Marinacci–Rustichini (2006) axiomatisation of variational preference relations and the Föllmer–Schied (2002, 2004) representation theorem for concave monetary utility functionals. We prove a variational analogue of

Arrow's impossibility theorem for finite electorates. For infinite electorates, the possibility of rational aggregation depends on a uniform continuity condition for the variational preference profiles; we prove variational analogues of both Campbell's impossibility theorem and Fishburn's possibility theorem. The proof methodology is based on a model-theoretic approach to aggregation theory inspired by Lauwers–Van Liedekerke (1995).

Michael HINZ

Energy measures, 1-forms and coverings

The talk is concerned with substitutes for differential 1-forms on possibly non-smooth spaces which in general do not allow any version of the classical definition. If a suitable energy functional is given, 1-forms may be defined using a certain tensor space endowed with a norm based on the energy measure. This construction is consistent with the classical notions and has interesting algebraic and continuity properties. In connection with open covers it reflects some topological features of the base space.

HU Jiaxin

Upper estimates of heat kernels of Dirichlet forms on metric measure spaces

I will give a brief survey on heat kernel upper estimates for local and non-local regular Dirichlet forms on metric measure spaces. This survey is based on a couple of joint papers with Alexander Grigor'yan and Ka-Sing Lau.

Yuri KONDRATIEV

Markov dynamics and kinetic equations in continuum: generating functionals approach

We propose an approach to the construction of random evolutions for interacting particle systems in continuum. This method is based on the analysis of evolutional equations for generating functionals corresponding to states of considered systems. Using techniques of infinite dimensional complex analysis, we state the convergence of a rescaled dynamics to the solution of a limiting generating functional equation. The latter leads to a non-linear non-local evolutional equation for the particle density of the system.

Tobias KUNA

Free Kawasaki dynamics with heavy tail Lévy-jump distributions

The dynamics of a system of infinite many particles jumping independently is studied. Due to independence, the dynamics can be reduced to an effective one particle dynamics. Because of its effective nature, the one particle dynamics has to be studied in a more general framework as usual. In particular, one looses time ergodicity, this loss corresponds to non-equilibrium regimes of the infinite particle systems. The talk presents our investigation of this richer analytical structure which should give us a better understanding of the difficulties to be expect in the construction of interacting systems.

Paul LESCOT

Symmetries of stochastic interest rate models

One can describe the structure of a one-factor affine interest rate model by means of a Bernstein process. The associated stochastic differential equation is closely related to the (backward) heat equation with potential term $\frac{A}{q^2} + Bq^2$.

The complete symmetry of algebra of the last equation has been determined. Possible generalizations to other models will be discussed.

This is partly joint work with H. Quintard and M. Houda.

LIU Wei

Some recent results on SPDE within variational framework

In this talk we will first recall the classical variational framework for SPDE and review some known results obtained within this framework. Then we will extend this classical framework and present some recent results on the well-posedness of SPDE with locally monotone coefficients driven by Wiener noise or Lévy noise.

LUO Shunlong

Quantum correlations

Quantum correlations (including entanglement) play a fundamental role in quntum information theory. We will present a brief survey and report some recent results on quantum correlations beyong entanglement.

MA Zhi-Ming

Web Markov skeleton processes and their applications

Recently a new class of stochastic processes, Web Markov Skeleton Processes (WMSP), has been found to be very useful in the study of information retrieval on the Web. In our research we found that the framework of WMSP enjoys also many interesting theoretical properties by its own. In this talk I shall briefly review some of our work in this research direction. I shall introduce the notion of WMSP, compare it with the previous notion of Markov skeleton processes introduced and studied by Hou el.al, discuss the relation between WMSP and multivariate point processes, discuss in detail the properties of mirror semi-Markov processes, a new class of processes in WMSP family. At the end of my talk I shall briefly explore the applications of WMSP in modeling user browsing behavior on the web.

Simon MICHEL

Stochastic evolution equations in weighted L^2 spaces with Lévy noise

Stochastic differential equations (SDE's) with Wiener noise are well-studied in the literature, but meanwhile also SDE's with Lévy noise have been treated in general, e.g. in the monograph [PeZa]. In this talk, we consider stochastic evolution equations with polynomial drift and Lipschitz Levy noise coefficient in L^2 spaces with certain polynomial weights. In the special case of Wiener noise, these equations have been treated in [MaZa] and we apply their method of proof to prove our main result.

[PeZa] S.Peszat, J.Zabczyk, Stochastic Differential Equations With Levy Noise, Cambridge University Press , 2007

[MaZa] R.Manthey, T.Zausinger, Stochastic Evolution Equations in $L^{2\nu}_{\rho}$, Stochastics and Stochastic Reports, Volume 66, pp.37-85, 1999

Ante MIMICA

Slow subordinate Brownian motions

We consider a particular class of Lévy processes which can be obtained as a subordinate Brownian motions with slow subordinators. We obtain asymptotic behavior of the Green function and the Lévy density of such processes near the origin. Using this asymptotics it is possible to give apriori regularity estimates of harmonic functions. Geometric stable processes and iterated geometric stable processes are considered as examples of such processes.

Stanislav MOLCHANOV

On the local structure of the population inside the propagating front

For the classical FKPP model, the fluctuating of the local distribution of the particles (inside the front of the population) is studied. We prove the increasing of the intermittency near the propagating front.

Peter NEJJAR

Invariant measures of the nearest-neighbour ASEP

In this talk I will report on recent progress made on the characterisation of the set of invariant measures for the asymmetric simple exclusion process (ASEP) in the nearest neighbour case. In the case of homogeneous transition probabilities this was already done by Liggett in 1976. In the inhomogeneous case, however, Jung described a family of extremal invariant measures only recently (2003) and Chayes and Ligget proved that under the condition of zero flux, all extremal invariant measures belong to this family. We will present these results, discuss some consequences, and adress the question what happens if the assumption of non-zero transition probabilities is dropped.

Diana-Camelia PUȚAN

Gibbs measures in lattice random systems

We will present a survey on Gibbs and generalized Gibbs measures on lattices. First, we are concerned with the necessary and sufficient conditions for a measure to be Gibbsian and the answer will be given by a theorem of Kozlov. In the non-Gibbsian case we are still interested to find nice properties, therefore different notions of generalized Gibbs measures are introduced. We follow the work of R. Fernández, C. Külske, A. Le Ny and F. Redig.

Frank RIEDEL

Finance without probability

We develop the fundamental theorem of asset pricing in a probability-free infinite-dimensional setup. We replace the usual assumption of a prior probability by a certain continuity property in the state variable. Probabilities enter then endogenously as full support martingale measures (instead of equivalent martingale measures). A variant of the Harrison-Kreps-Theorem on viability and no arbitrage is shown. Finally, we show how to embed the superhedging problem in a classical infinite-dimensional linear programming problem.

Michael RÖCKNER

On a random scaled porous media equation

We show that a random scaled porous media equation arising from a stochastic porous media equation with linear multiplicative noise through a random transformation is well-posed in L^∞. In the fast diffusion case we show existence in L^p.

Julio RODRIGUEZ

Globally coupled phase oscillators driven by ballistic noise source

Among the rich collection of noise sources that can be used to drive stochastic differential equations (SDE), we here focus on a Markov process that is function of the standard Brownian motion. This noise source result as lumped versions of a Markov process with an enlarged state space and exhibit ballistic non-Gaussain noise features with long time range correlations. When used as simple additive noise sources in SDE, these ballistic noise source may produce noise induced structures (i.e noise induced transitions), a behavior so far only observed for multiplicative de-correlated noise sources. Our ballistic noise source is then used in a system of all-to-all coupled phase oscillators for which analytic results are derived.

Francesco RUSSO

Stochastic calculus via regularizations in Banach spaces and applications

This talk is based on a collaboration with Cristina Di Girolami, Luiss University Rome.
This talk develops some aspects of stochastic calculus via regularization to Banach valued processes. The finite dimensional calculus was first introduced by the speaker and P. Vallois in 1991. Processes with values in a Banach space have rarely the property of finite quadratic variation. An original concept of χ-quadratic variation is introduced, where χ is a subspace of the dual of a tensor product $B \otimes B$ where B is the values space of some process process $\mathbb{X}$. Given $F : [0,T] \times B \to \mathbb{R}$, of class $C^{1,2}$, Itô formulae expanding $Y_t := F(t, \mathbb{X}_t)$ are provided when $\mathbb{X}$ admits a finite χ-quadratic variation. Also we provide natural sufficient conditions on F so that the real process Y is a real finite quadratic variation process.
Particular interest is devoted to the case when B is the space of real continuous functions defined on $[-\tau, 0]$, $\tau > 0$. Attention is deserved to a finite real quadratic variation (for instance Dirichlet, weak Dirichlet) process X. The $C([-\tau,0])$-valued process $\mathbb{X} := X(\cdot)$ defined by $X_t(y) = X_{t+y}$, where $y \in [-\tau, 0]$, is called *window* process associated with X. Indeed, even the window process associated with a classical Brownian motion is not of finite quadratic variation but it has a χ-quadratic variation with respect to some specific spaces χ.
Let $T > 0$. If X is a finite quadratic variation process such that $[X]_t = t$ and $h = H(X_T(\cdot))$ where $H : C([-T,0]) \longrightarrow \mathbb{R}$ has some given regularity, it is possible to

represent h as a sum of a real H_0 plus a forward integral of type $\int_0^T \xi d^- X$ where H_0 and ξ are explicitly given. The representation will be linked to a function $u : [0,T] \times C([-T,0]) \longrightarrow \mathbb{R}$ which in general solves an infinite dimensional partial differential equation with the property $H_0 = u(0, X_0(\cdot))$, $\xi_t = D^{\delta_0} u(t, X_t(\cdot)) := Du(t, X_t(\cdot))(\{0\})$. This decomposition generalizes the Clark-Ocone formula which is true when X is the standard Brownian motion W. This work has a financial perspective: hedging theory of path dependent options without semimartingales.

René SCHILLING

Coupling of Lévy processes

We give conditions which ensure that a Lévy process has the coupling property. We use the successful coupling to derive estimates of the transition density and the gradient of the transition density. (Joint work with Björn Böttcher, Paweł Sztonyk and Jian Wang)

Marina SERTIĆ

The Feynman-Kac formula

In my presentation, I am going to talk about the Feynman–Kac formula, the stochastic representation for the solution of the parabolic partial differential equation

$$\frac{\partial u}{\partial t} + ku = \frac{1}{2}\frac{\partial^2 u}{\partial x^2} + g, \quad (t,x) \in \langle 0, \infty\rangle \times \mathbb{R},$$

subject to the initial condition

$$u\,(0,x) = f\,(x)\,, x \in \mathbb{R},$$

for maps $f : \mathbb{R} \to \mathbb{R}$, $g : [0,\infty\rangle \times \mathbb{R} \to \mathbb{R}$, and $k : \mathbb{R} \to [0,\infty\rangle$.

However, before that, I would like to mention a few Brownian sample path properties (non-differentiability, variations, the law of the iterated logarithm, and Lévy's modulus of continuity).

SONG Yulin

A necessary and sufficient condition for the equivalence of distributions of infinite dimensional Lévy processes and its application

We study the relation between the characteristics and the distributions of Levy Processes valued on Hilbert space, and obtain a necessary and sufficient condition for the equivalence of distributions of Levy processes valued on Hilbert space. Besides, we give an applications of the main result.

Wilhelm STANNAT

On the uniqueness of the Wasserstein diffusion

The Wasserstein diffusion is an Ornstein-Uhlenbeck type process on the set of all probability measures with the Wasserstein metric as intrinsic metric. Sturm and von Renesse constructed this process in the case of probability measures over the unit interval using Dirichlet form theory (cf. AOP 2009). In our talk we prove that certain particle approximations of the process introduced by Andres and von Renesse (cf. JFA 2010) do converge to the Wasserstein diffusion, a question that has been left open in the above cited work. The problem of convergence of particle approximations is related to the uniqueness of the Friedrichs extension of the Wasserstein Dirichlet form, a problem that we will also dicuss.

Alexander TEPLYAEV

Dirichlet forms and diffusions on rough spaces

Up to scalar multiples, there exists only one local regular Dirichlet form on a Sierpinski carpet that is invariant with respect to the local symmetries of the carpet. Consequently for each such fractal the law of the Brownian motion is uniquely determined and the Laplacian is well defined. As a consequence, there are uniquely defined spectral and walk dimensions which determine the behavior of the natural diffusion processes via so called generalized Einstein relation. (These dimensions are not directly related to the well known Hausdorff dimension, which describes the distribution of the mass in a fractal.) These other other recent joint results (joint with Martin Barlow, Richard Bass, Takashi Kumagai, Katheryn Hare, Robert Stichartz, Michael Hinz, Marius Ionescu, Luke Rogers) will be reviewed in the talk.

Jonas TÖLLE

On an EVI curve characterization of Hilbert spaces

It is shown that the existence of a large enough collection of EVI (evolution variational inequality) curves for a lower semi-continuous functional on a Banach space implies that the space is in fact a Hilbert space. The main result is exemplified by the p-Laplacian evolution in Banach space.

Alexander VASILIEV

Integrable structure of evolution of complex shapes

We discuss deterministic and stochastic contour evolution in the space of complex shapes by means of the Loewner-Kufarev equation. The embedding of this evolution

into the universal Grassmannian is given and the tau-function is constructed. The underlying symmetries of this evolution are provided by the Virasoro algebra. Relation to the dispersionless Toda hierarchy is obtained.

Igor VERBITSKY

Global estimates for Green's functions and the conditional gauge

We intend to discuss global pointwise estimates for kernels of the resolvent $(I-T)^{-1}$ of integral operators $Tf(x) = \int_\Omega K(x,y)f(y)d\omega(y)$ on $L^2(\Omega,\omega)$ for $||T|| < 1$ under the only assumption that $d(x,y) = 1/K(x,y)$ is a quasi-metric. An instructive example is the dyadic kernel $K(x,y) = \sum_{Q\in\mathcal{Q}} c_Q\, \chi_Q(x)\, \chi_Q(y)$ where $\mathcal{Q}$ is the family of all dyadic cubes in $\mathbf{R}^n$, χ_Q is the characteristic function of Q, and $c_Q \geq 0$. As an application, we give sharp bilateral bounds for Green's function and Martin's kernel of the fractional Schrödinger operator $(-\triangle)^{\alpha/2} - q$ with an arbitrary nonnegative potential q (possibly a measure) on $\mathbf{R}^n$ for $0 < \alpha < n$, or a bounded NTA domain Ω for $0 < \alpha \leq 2$. This yields explicit bounds for the conditional gauge:

$$e^{\mathbf{E}_y^x\left[\int_0^\zeta q(X_t)\,dt\right]} \leq \mathbf{E}_y^x\left[e^{\int_0^\zeta q(X_t)\,dt}\right] \leq e^{C\,\mathbf{E}_y^x\left[\int_0^\zeta q(X_t)\,dt\right]},$$

for Brownian motion or α-stable Lévy processes X_t. Here ζ is the lifetime, and $\mathbf{E}_y^x$ the expectation of the conditioned process starting at x and exiting at y. The upper bound is new even in the classical case $\alpha = 2$. Other applications include necessary and sufficient conditions for the existence of weak solutions, along with sharp pointwise estimates of solutions for some nonlinear elliptic equations with natural growth terms.

This is joint work with Michael Frazier and Fedor Nazarov.

WANG Feng-Yu

Derivative formula and Harnack inequality for jump processes

By using lower bound conditions of the Lévy measure, derivative formulae and Harnack inequalities are derived for linear stochastic differential equations driven by Lévy processes. As applications, explicit gradient estimates and heat kernel inequalities are presented. As byproduct, a new Girsanov theorem for Lévy processes is derived.

WANG Jian

Characteristic functions of Feller processes and their applications

We present uniform upper and lower bounds for the characteristic function of a Feller process, which yield sufficient conditions for the ultracontractivity of the associated Feller semigroup, the transience and recurrence of the Feller process and the existence of local times for the Feller process. These conditions are optimal for symmetric Lévy

processes, and they apply to a large class of Feller processes. As a byproduct, we obtain that for a stable-like process on $\mathbb{R}^d$ with smooth variable index $\alpha(x) \in (0,2)$, if $d \geq 2$ or $\sup_{|x|\geq K} \alpha(x) \in (0,1)$ for some constant $K > 0$, then the process is transient; while if $d = 1$ and $\inf_{|x|\geq K} \alpha(x) \in [1,2)$ for some constant $K > 0$, then it is Harris recurrent; moreover, if $d = 1$ and $\inf_{x\in\mathbb{R}} \alpha(x) \in (1,2)$, then the associated process has local times. The work is based on a joint work with René L. Schilling.

Sven WIESINGER

Uniqueness of solutions to Fokker-Planck equations related to singular SPDE driven by Lévy noise

In the case of singular SPDE, which do not necessarily have pathwise solutions, the approach of DiPerna and Lions, to consider instead the question of existence and uniqueness of solutions to the related Fokker-Planck equations, has generated some interest. Several groups of authors have generalized this approach for different types of non-regular coefficients, and towards SPDE in infinite dimensions. However, most of the existing research is focused on the case of SPDE driven by Wiener noise. In this talk, we present some new results concerning uniqueness of solutions to such Fokker-Planck equations related to singular SPDE driven by possibly discontinuous Lévy noise.

Martina ZÄHLE

A pathwise approach to parabolic SPDE with fractional noise in measure spaces

Pathwise defined stochastic parabolic (pseudo) differential equations in σ-finite measure spaces are studied. The spatial operators are given by (fractional powers of) the generators of ultracontractive strongly continuous symmetric Markovian semigroups. Unique solutions are determined in associated Bessel potential spaces, where the spatial noises are elements of certain dual spaces and their time 'derivatives' are realized by means of operator-valued fractional calculus. In particular, we consider fractional heat equations driven by fractional Brownian noises on metric measure spaces. This approach extends former Euclidean versions and can be applied to known classes of fractal sets. (Joint work with Michael Hinz and Elena Issoglio.)

ZHU Rongchan

BSDE and generalized Dirichlet forms

We consider the following quasi-linear parabolic system of backward partial differential equations

$$(\partial_t + L)u + f(\cdot,\cdot,u,\nabla u\sigma) = 0 \text{ on } [0,T]\times\mathbb{R}^d \qquad u_T = \phi,$$

where L is a second order differential operator with measurable coefficients. We solve this system in the framework of generalized Dirichlet forms and employ the stochastic calculus associated to the Markov process with generator L to obtain a probabilistic representation of the solution u by solving the corresponding BSDE. The solution satisfies the mild equation which is equivalent to the generalized solution of the PDE. We generalize the martingale representation theorem using the stochastic calculus associated to the generalized Dirichlet form. The nonlinear term f satisfies a monotonicity condition with respect to u and a Lipschitz condition with respect to ∇u.

ZHU Xiangchan

BV functions in a Gelfand triple and the stochastic reflection problem on a convex set of a Hilbert space

In this paper, we introduce a definition of BV functions in a Gelfand triple which is an extension of the definition of BV functions in [1] by using Dirichlet form theory. By this definition, we can consider the stochastic reflection problem associated with a self-adjoint operator A and a cylindrical Wiener process on a convex set Γ in a Hilbert space H. We prove the existence and uniqueness of a strong solution of this problem when Γ is a regular convex set. The result is also extended to the non-symmetric case. Finally, we extend our results to the case when $\Gamma = K_\alpha$, where $K_\alpha = \{f \in L^2(0,1) | f \geq -\alpha\}, \alpha \geq 0$.

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