Ken Alexander: Polymer Depinning Transitions with Loop Exponent One

We consider a polymer with configuration modeled by the trajectory of a Markov chain, interacting with a potential of form $u + V_n$ when it visits a particular state 0 at time n, with V_n representing i.i.d. quenched disorder. There is a critical value of u above which the polymer is pinned by the potential. Typically the probability of an excursion of length n for the underlying Markov chain is taken to decay as a power of n (called the loop exponent), perhaps with a slowly varying correction. A particular case not covered in a number of previous studies is that of loop exponent one, which includes simple random walk in two dimensions. We show that in this case, at all temperatures, the critical values of u in the quenched and annealed models are equal, in contrast to all other loop exponents, for which these critical values are known to differ at least at low temperatures. The work is joint with N. Zygouras.

Anne-Laure Basdevant: Multi-excited random walks on trees

Excitedrandom walksare random walks whose transition probabilities depend on the number of previous visits to its actual site. This class of processes has been particularly studied in the lattice case, Z and Z^d. Here, we consider a similar model on a tree. We show that the walk may be recurrence or transient depending on the parameters of the model. Moreover, we study the existence of a positive speed and a CLT in the transient case. The main tool for this study is the construction of a branching Markov chain related to the local time of the walk.

Gerard Ben Arous: Randomly Trapped Brownian Motions

Randomly Trapped Random Walks describe a general mechanism of trapping and slowing down. They include the natural models as CTRW of Montroll and Weiss, and the Bouchaud trap models. They also include more complex models like the random walk along the backbone of an incipient critical Galton Watson tree. I give a general scaling limit theorem for these models in dimension 1, and describe their scaling limits, the Randomly Trapped Brownian Motions. These scaling limits contain Fractional Kinetics as well as the Fontes Isopi Newman singular diffusion. This is joint work with Roman Royfman and Jiri Cerny.

Anton Bovier: Metastability in the Random Field Curie-Weiss model

A classical idea in the theory of metastability is the replacement of the long-term dynamics of a high-dimensional system by an effective diffusion process in a one-dimensional effective potential. In simple mean-field models this can be made rigorous by exploiting symmetries. The random field Curie-Weiss model is one of the simplest models where no such symmetries are present. We use a coarse graining proceedure and variational methods to compute precise asymptotics of metastable exit times which are seen to differ by a multiplicative constant from what if given by the naive one-dimensional approximation.

(joint work with Alessandra Bianchi and Dima Ioffe)

Jiri Cerny: Convergence to Fractional Kinetics for random walk among unbounded conductances.

It has been shown that the random walk among bounded random conductances converges after rescaling to a Brownian motion. In my talk I will show that this ceases to be true if the distribution of conductances has infinite expectation and polynomial tail. Here the limit is a Fractional-Kinetics process - that is the time change of a d-dimensional Brownian motion by the inverse of an independent alpha-stable subordinator.

Francis Comets: Diffusivity of Knudsen stochastic billiard in a random tube

Consider a random tube which stretches to infinity in the direction of the first coordinate, and which is stationary and ergodic, and also well-behaved in some sense. When strictly inside the tube, the particle ("ball") moves straight with constant speed. Upon hitting the boundary, it is reflected randomly: the density of the outgoing direction is proportional to the cosine of the angle between this direction and the normal vector. We also consider the discrete-time random walk formed by the particle's positions when hitting the boundary.

Under the condition of existence of the second moment of the projected jump length with respect to the stationary measure for the environment seen from the particle, we prove the quenched invariance principles for the projected trajectories of the random walk and the stochastic billiard.

Joint work with S.Popov, G.Schütz and M. Vachkovskaia.

Jean-Dominique Deuschel: Invariance principle for the random conductance model with unbounded conductances

We study a continuous time random walk X in an environment of i.i.d. random conductances $\mu_e \in [1, \infty)$. We obtain heat kernel bounds and prove a quenched invariance principle for X. This holds even when $E\mu_e = \infty$.

Giambattista Giacomin: Wetting and pinning models: disorder relevance at marginality

Recently the renormalization group predictions on the effect of disorder on wetting and pinning models have been put on mathematical grounds. The picture is particularly complete if the disorder is 'relevant' or 'irrelevant' in the Harris criterion sense: the question addressed is whether quenched disorder leads to a critical behavior which is different from the one observed in the pure, i.e. annealed, system. The Harris criterion prediction is based on the sign of the specific heat exponent of the pure system, but it yields no prediction in the case of vanishing exponent. This case is called 'marginal', and the physical literature is divided on what one should observe for marginal disorder, notably there is no agreement on whether a small amount of disorder leads or not to a difference between the critical point of the quenched system and the one for the pure system. We have been able to show that quenched and annealed critical points do differ for arbitrarily weak disorder at marginality. I will report on this result, which is work in collaboration with Hubert Lacoin and Fabio Toninelli.

Ben Hambly: Diffusion on critical random clusters of the diamond hierarchical lattice

The diamond hierarchical lattice is a recursively constructed graph. Starting with a graph consisting of one edge and two vertices a sequence of graphs is constructed where at each stage each edge is replaced by a diamond, two parallel pairs of two edges in series. This gives a structure which has similar dimension properties to the two dimensional lattice but naturally quite different connectivity. We analyse the critical random cluster measure on this sequence of graphs and show that the scaling limits of critical clusters from the random cluster measure can be described by random recursive graph directed fractals. The analytic exponents, such as the spectral and walk dimensions can be calculated explicitly and are a continuous function of q, the cluster weighting parameter, when the associated Dirichlet form is a resistance form. As q goes to 0 we obtain the uniform spanning tree measure and in this limit the Alexander-Orbach conjecture holds.

Frank den Hollander: Random walk in dynamic random environment

We consider a one-dimensional simple symmetric exclusion process on the integer lattice in equilibrium at a fixed density, constituting a dynamic random environment, together with a nearest-neighbor random walk that on occupied sites has a local drift to the right but on vacant sites has a local drift to the left. We establish a large deviation principle for the empirical speed of the random walk, both annealed and quenched w.r.t. the exclusion process. We exhibit the main properties of the associated rate functions, including the presence of an interval of zeroes representing a slow-down phenomenon. For static random environments with local drifts that point in both directions, it is well known that slow-down occurs because of the occurrence of long strings of sites pushing the walk in opposite directions. In our dynamic environment slow-down survives because the exclusion process suffers "traffic jams", i.e., long strings of occupied and vacant sites having a substantial probability to survive for a long time.

This is joint work with Luca Avena and Frank Redig.

Rick Kenyon: Loops and bundles

We generalize the classical matrix-tree theorem. Given a line bundle (or, more generally, a 2-plane bundle with $SL_2(C)$ connection) on a graph we give a combinatorial interpretation of the Laplacian determinant in terms of cycle-rooted spanning forests (CRSFs). Corresponding to this is a generalization of Wilson's algorithm for generating random spanning trees to an algorithm for generating random CRSFs.

Wolfgang Koenig: Confinement Property in the Parabolic Anderson Model

We consider the parabolic Anderson model, the Cauchy problem for the heat equation with random potential in Z^d. We use i.i.d. potentials $\xi : Z^d \to R$ in the third universality class, namely the class of almost bounded potentials, in the classification of van der Hofstad, König and Mörters [HKM06]. This class consists of potentials whose logarithmic moment generating function is regularly varying with parameter gamma=1, but do not belong to the class of so-called double-exponentially distributed potentials studied by Gärtner and Molchanov [GM98].

In [HKM06] the asymptotics of the expected total mass was identified in terms of a variational problem that is closely connected to the well-known logarithmic Sobolev inequality and whose solution, unique up to spatial shifts, is a perfect parabola. In the present talk we show that those potentials whose shape (after appropriate vertical shifting and spatial rescaling) is away from that parabola contribute only negligibly to the total mass. The topology used is the strong L^1-topology on compacts for the exponentials of the potential. In the course of the proof, we show that any sequence of approximate minimisers of the above variational formula approaches some spatial shift of the minimiser, the parabola.

(joint work with Gabriela Groeninger)

Takashi Kumagai: Convergence of discrete Markov chains to jump processes

In this talk, we will discuss general criteria on tightness and weak convergence of discrete Markov chains to symmetric jump processes on metric measure spaces under mild conditions. As an application, we investigate convergence of Markov chains with random conductances to symmetric jump processes. This is a on-going join work with Z.Q. Chen (Seattle) and P. Kim (Seoul).

Greg Lawler: Multifractal analysis of the Schramm-Loewner evolution

The Schramm-Loewner evolution (SLE) is a conformally invariant process invented by Oded Schramm as a candidate for the scaling limit of planar lattice models in two-dimensional statistical physics. It gives a random fractal curve. To understand the evolution of the curve at time t, one needs to study the derivative near the tip of the path of the conformal map that sends the slit domain to the upper half plane. I will discuss the behavior of this derivative using the reverse-time Loewner flow and give results that can be proved from this analysis, e.g.,

An alternative proof of Beffara's theorem on the Hausdorff dimension of the paths

A parametrization of the curve in a way that matches the fractal structure and should be the limit of the natural parametrization on discrete objects (joint work with Scott Sheffield)

The exact Holder continuity of the paths in the capacity parametrization and a multifractal spectrum relating to the local derivatives (joint work with Fredrik Johansson).

Yuval Peres: Random walks on critical percolation clusters in finite graphs

After reviewing several alternative definitions of the critical parameter p_c on finite graphs, I will describe the behavior of simple random walk on critical clusters; the cubic scaling of sphere hitting times was verified first on trees (by Kesten) and then on oriented percolation clusters, on the complete graph, on typical d-regular graphs and most recently in high dimensional lattices (Kozma-Nachmias). The next natural challenge, of interpolating between the critical and supercritical behaviors, leads to a new set of problems- I will present progress for the mean-field case. The talk is based on joint works with A. Nachmias and with J. Ding, E.Lubetzky and J. H. Kim; it will also survey works of many others.

Jon Peterson: Current fluctuations for a system of one-dimensional

random walks in a common random environment For a system of independent on-dimensional random walks, Seppalainen and Kumar have shown that the current process, scaled by $n^{1/4}$ converges to a mean-zero Gaussian process. Moreover, if the system is started from the stationary distribution, the current process converges to fractional Brownian motion with Hurst parameter 1/4. In this talk, I will consider the current fluctuations of a system of independent random walks in a common random environment. It turns out that the randomness of the environment substantially changes the current fluctuations. Under certain conditions on the law of the environment, the quenched mean of the current, scaled by $n^{1/2}$, converges to Brownian motion, while the deviations from the quenched mean, when scaled by $n^{1/4}$ converge to a mean-zero process which is different from the limiting process for classical random walks.

Firas Rassoul-Agha: Quenched level-3 large deviations for random walk in random environment

We consider a finite step size random walk in an ergodic elliptic random environment. We prove a process level quenched large deviation principle with rate function equal to a certain entropy. The proof is an extension of the homogenization machinery introduced by Kosygina, Rezakhanlou, and Varadhan in the context of diffusion in random media, and adapted later by Rosenbluth and Yilmaz to random walk in random environment. This is joint work with Timo Seppalainen.

Christophe Sabot: Random walks in Dirichlet random environment in dimension $d > 2$

Random walks in Dirichlet random environments are obtained by picking independently at each site the transition probabilities as Dirichlet random variables. They are parametrized by 2d reals (one for each direction) and have the remarkable property that their annealed law is the law of an edge reinforced random walk. I will prove that these walks are transient in dimension d¿2 and caracterize the integrable moments of the Green function. It shows in particular that there are no stronger trapps than the finite ones which come from the non-uniform ellipticity of the environment.

Pierre Tarres: Brownian polymers

We consider a process $X_t \in R^d$, $t \geq 0$, introduced by Durrett and Rogers in 1992 in order to model the shape of a growing polymer; it undergoes a drift which depends on its past trajectory, and a Brownian increment. Our work concerns two conjectures by these authors (1992), concerning repulsive interaction functions f in dimension 1 ($\forall x \in R$, $xf(x) \geq 0$).

We showed the first one with T. Mountford (AIHP, 2008), for certain functions f with heavy tails, leading to transience to $+\infty$ or $-\infty$ with probability 1/2. We partially proved the second one with B. Tóth (preprint), for rapidly decreasing functions f, through a study of the local time environment viewed from the particule: we explicitly display an associated invariant measure, which enables us to prove under certain initial conditions that $X_t/t \to_{t\to\infty} 0$ a.s., and that the process is at least diffusive asymptotically.

Fabio Toninelli: On the mixing time of the 2D Ising model with + boundary conditions

The equilibration time T_mix for the Glauber dynamics of the Ising model at low temperature is known to depend crucially on dimension $D \geq 2$ and on boundary conditions (b.c.). When the b.c. are free, T_mix behaves like $\exp(L^{D-1})$, while when b.c. are homogeneous (say, +), one expects that $T_m^+ix \sim L^2$, but the best known upper bound is of the order $\exp(\sqrt{L})$ for $D = 2$ and $\exp(L)$ for $D = 3$. In 2D, we considerably improve such bound by showing that $T_m^+ix \leq \exp(c(a)L^a)$ for every given $a > 0$. Joint work with F. Martinelli

Atilla Yilmaz: A recent result on the equality of the quenched and averaged large deviation rate functions for RWRE

Consider large deviations for nearest-neighbor random walk in a uniformly elliptic i.i.d. environment. It is easy to see that the quenched and averaged rate functions are not identically equal. When the dimension is at least four and Sznitman's transience condition (T) is satisfied, I recently proved that these rate functions are finite and equal on a closed set whose interior contains every nonzero velocity at which the rate functions vanish. In this talk, I will present this result and briefly sketch the proof.

Martin Zerner: Lyapunov exponents of Green's functions for random potentials tending to zero.

We consider quenched and annealed Lyapunov exponents for the Green's function of the simple symmetric random walk among non-negative i.i.d. random potentials gamma*V(x) on the d-dimensional lattice Z^d, where $\gamma > 0$ is a scalar. We present a probabilistic proof that both Lyapunov exponents scale like $c\sqrt{\gamma}$ as γ tends to 0. Here the constant c is the same for the quenched as for the annealed exponent and is computed explicitly. This improves results obtained previously by Wei-Min Wang. (Joint work with E. Kosygina and T. Mountford.)