1 Sebastian Andres

Title: Green kernel asymptotics for two-dimensional random walks under random conductances
Abstract: The random conductance model is a well-established model for a random walk in random environment. In recent years the behaviour of the associated heat kernel and Green function has been intensively studied, and in dimension $d \geq 3$ the asymptotics of the Green kernel are meanwhile quite well-understood. In this talk we present precise asymptotics of the potential kernel and the Green function of the walk killed upon exiting balls in dimension $d = 2$. This result holds, for instance, in the case of uniformly elliptic conductances, random walks on supercritical percolation clusters or ergodic degenerate conductances satisfying a moment condition. This talk is based on a joint work with Jean-Dominique Deuschel and Martin Slowik (TU Berlin).

2 Erwin Bolthausen

Title: On two-dimensional random walks in random environments
Abstract: We report about work in progress (with Ofer Zeitouni and Erich Baur). For the standard (non-reversible) random walk in random environment, the dimension 2 is critical. The disorder is not contracting in leading order (as is the case in higher dimensions), but only borderline through the influence of higher order terms in the perturbation expansion. This is not yet a finished work, but we will report about the present status of the project.

3 Paul Dario

Title: Stochastic homogenization and the grad phi model.
Abstract: Recently, there has been a lot of progress in the field of stochastic homogenization. We try to understand if and how this new set of tools and techniques can be adapted to the setting of the grad phi model and what are the main difficulties to overcome.

4 Markus Heydenreich

Title: Lace expansion for the random connection model
Abstract: The random connection model is a random graph whose vertices are given by the points of a Poisson process and whose edges are obtained by randomly connecting pairs of Poisson points in a position dependent but independent way. Under very general conditions, the resulting random graph undergoes a percolation phase transition if the the Poisson density varies, and we are interested in the case of critical percolation. Our main result is an infrared bound for the critical connectivity function if the dimension is sufficiently large or if the pair connection function has sufficiently slow decay. This is achieved through an adaptation of the percolation lace expansion for Poisson processes.

Based on joint work with R. van der Hofstad, G. Last and K. Matzke.

5 Pierre-François Rodriguez

Title: Phase coexistence of Gaussian free field sign clusters
Abstract: We describe the geometry of sign clusters of the Gaussian free field on a large class of transient weighted graphs. An important ingredient is the use of a certain algebraic relation, whose origins can be traced back to early work of Symanzik in field theory, which links the free field to Sznitmans interlacement. As it turns out, the interlacement set can be crucially used as a system of highways that create good local and global connections. Based on joint work with A. Prévost and A. Drewitz.

6 Akira Sakai

Title: Critical two-point function for long-range models with power-law couplings: The marginal case for $d \geq d_c$
Abstract: Consider the long-range models on $\mathbb{Z}^d$ of random walk, self-avoiding walk, percolation and the Ising model, whose translation-invariant 1-step distribution/coupling coefficient decays as $|x|^{-d-\alpha}$ for some $\alpha > 0$. In the previous work with Lung-Chi Chen (Ann. Probab. 43 (2015): 639681), we have shown in a unified fashion for all $\alpha \neq 2$ that, assuming a bound on the "derivative" of the n-step distribution, the critical two-point function decays as $|x|^{\alpha \wedge 2-d}$ above the upper-critical dimension $d_c = (\alpha \wedge 2)m$, where $m = 2$ for self-avoiding walk and the Ising model and $m = 3$ for percolation.

In this talk, I will show in a much simpler way, without assuming a bound on the derivative of the n-step distribution, that the critical two-point function for the marginal case $\alpha = 2$ decays as $|x|^{2-d}/\log|x|$ whenever

$d \geq d_c$ (with a large spread-out parameter). This solves the conjecture in the previous work, extended all the way down to $d = d_c$, and confirms a part of predictions in physics (Brezin, Parisi, Ricci-Tersenghi, J. Stat. Phys. 157 (2014): 855–868). The proof is based on the lace expansion and new convolution bounds on power functions with log corrections.

7 Gordon Slade

Title: Long range models below the upper critical dimension
Abstract: We discuss the computation of critical exponents for long-range ϕ^4 spin models and weakly self-avoiding walk slightly below the upper critical dimension. This is a rigorous version of the epsilon expansion for critical exponents, via a renormalisation group method.

8 Andrew Swan

Title: Supersymmetry and the Vertex Reinforced Jump Process
Abstract: The BFS–Dynkin isomorphism describes the curious connection between Markovian random walks and (supersymmetric) Gaussian free fields, namely, that any observable of the walk can be represented as an observable of the field. With this relation, one can rephrase any question of the walk (recurrence/transience, localisation, etc.) as a question of the GFF, one that is potentially easier to answer due to the additional field theoretical tools which become available.

The focus of this talk, however, will be on a non-Markovian random walk where the usual BFS–Dynkin isomorphism does not apply: the vertex reinforced jump process (VRJP), a history dependent reinforcing random walk. Instead, as I will show, the VRJP is connected to "hyperbolic" field theories by a new BFS–Dynkin isomorphism. By utilising the particular symmetries of the field theoretic representation, we can then construct a Mermin–Wagner theorem which proves that the VRJP is recurrent in two dimensions. Surprisingly, our Mermin–Wagner theorem applies even though the symmetry groups of the model are non-compact.

This talk is based on joint work with Roland Bauerschmidt and Tyler Helmuth.

9 Lorenzo Taggi

Title: Random walks in 'conservative' random environment
Abstract: We consider two systems of interacting particles on an arbitrary graph, 'activated random walks' (ARW) and 'oil and water' (OW), where each particle performs a simple random walk and interacts with the other particles which share the same vertex according to some specific rules. One important property of these systems is that the number of particles is conserved. We discuss under which conditions these systems undergo a phase transition as one varies the particle density. More specifically, for ARW we prove that a phase transition occurs at a critical value of the particle density, i.e. if the particle density is small any particle stops moving eventually a.s., while if the particle density is large the activity is sustained a.s.. A non-trivial characterization of such a critical threshold is provided. For OW, we prove that every particle stops moving eventually a.s., does not matter how large the particle density is.

10 Bálint Tóth

Title: Quenched CLT for random walk in divergence-free random drift field
Abstract: We prove the quenched version of the central limit theorem for the displacement of a random walk in doubly stochastic random environment, under the H_{-1}-condition, with slightly stronger, $L^{2+\epsilon}$ (rather than L^2) integrability condition on the stream tensor. On the way we extend Nash's moment bound to the non-reversible, divergence-free drift case.

11 Andrew Wade

Title: Random walk avoiding its convex hull with finite memory.
Abstract: Consider a random walk in d-dimensional space which remembers its most recent k steps, and at each step takes a jump distributed uniformly on a unit ball, excluding the convex hull of the origin and those k most recent sites. For k = infinity this is a version of the model introduced by Angel et al., which is conjectured to be ballistic (i.e., to have a limiting speed and a limiting direction). We establish ballisticity for the finite-memory case, and comment on some open problems. This is joint work with Francis Comets and Mikhail Menshikov