Omar Abuzzahab (Penn)

Perfect squares in random sequences

A problem related to modern methods of prime factorization is finding a subset of a random sequence of integers where the product of integers in the subset is a perfect square. Assuming the random integers are distributed uniformly between 1 and $N$, there is a threshold phenomena where the existence of such a subset transitions from being very unlikely to very likely once the size parameter $N$ attains a critical value. This threshold informs us about the expected runtime of the prime factorization algorithm, and it is conjectured there is a sharp threshold.

Elisabeth Bauernschubert (Tübingen)

Excited random walks and branching processes

Excited random walks are non-Markovian random walks whose transition probabilities depend on the local time of the walk at its current position. In recent years a well-known relationship between one-dimensional random walk paths and random trees has been used to derive results for excited random walks from results about branching processes with migration. We apply this method to a new class of excited random walks.

Iddo Ben-Ari (Connecticut)

Some recent developments on the Bak–Sneppen Model

The Bak–Sneppen model for biological evolution is a discrete-time Markov process defined as follows. A finite population of species is arranged on a circle. Initially, each species is assigned a “fitness,” the fitnesses being IID and uniform on $[0, 1]$. At each unit of time, the least fit species and its two immediate neighbors are eliminated and are replaced by three new species with independent fitnesses which are uniform on $[0, 1]$, keeping the size of the population fixed. Bak and Sneppen observed through numerical simulations that for large population sizes the stationary distribution of the fitnesses approaches a uniform law on $[h_c, 1]$, where the numerical value of $h_c$ is close to 0.667. Mathematically, this is an open problem. I will present the known results, most of which due to Ronald Meester and his collaborators, as well as some new results I have recently obtained.

Daniela Bertacchi (Milano–Bicocca)

The small world effect on the meeting time of random walks

A small world is obtained from the $d$-dimensional torus of size $2L$ adding randomly chosen connections between sites, in a way such that each site has exactly one random neighbour in addition to its deterministic neighbours. We study the asymptotic behaviour of the meeting time $T_L$ of two random walks moving on this small world and compare it with
the result on the torus. On the torus, $T_L$ behaves as $cL^2$ if $d = 1$, as $cL^2 \log L$ if $d = 2$ and as $cL^d$ if $d \geq 3$ ($c$ being a constant which depends on $d$). We prove that on the small world $T_L$ behaves as $CL^d$ (where $C$ depends on $d$) and identify the constant $C$. Thus the walkers always meet faster on the small world than on the torus if $d \leq 2$, while if $d \geq 3$ the comparison depends on the probability of moving along the random connection.

**Michael Damron (Princeton)**

**Limit shapes outside the percolation cone**

First-passage percolation deals with the large-scale geometry of the randomly weighted graph obtained by placing i.i.d. non-negative weights on the edges of the standard nearest-neighbor graph on the square lattice. The “shape theorem” of Durrett and Liggett states that under mild conditions, if $B(r)$ is the ball of radius $r$ about the origin in the weighted graph metric, then with probability one, $B(r)/r$ converges uniformly to a deterministic compact convex set $C$. In joint work with Mike Hochman and more recent work with Tuca Auffinger, we investigate the limiting shape for a broad class of distributions for which there is a coupling with an underlying oriented percolation model. We can show that in these cases the limit shape must be non-polygonal. I will explain this theorem and its various consequences, relating to shape fluctuations and, if time permits, growth and competition models.

**Shawn Drenning (Chicago)**

**Loewner equations and SLE in finitely connected domains**

I will discuss a probabilistic proof of a Loewner equation in a canonical class of multiply connected domains. If time permits, I will also discuss recent work on defining SLE in multiply connected domains.

**Wilfried Huss (Siegen)**

**Internal aggregation models on the comb lattice**

Internal diffusion limited aggregation (IDLA) and rotor-router aggregation are two related growth models in which particles perform walks on a graph (independent random walks resp. deterministic rotor-router walks) until they reach a previously unoccupied vertex. This way a growing cluster of vertices is obtained. We will present some results on the shape of these clusters on the comb lattice, which is the spanning tree of the two dimensional Euclidean lattice obtained by deleting all horizontal edges, except the ones at the $x$-axis.

**Jonathan Kariv (Penn)**

**Skryms games**

Skryms games are a kind of stochastic signalling process. Although they are heavily stochastic they do evolve towards efficient signaling in some cases (not in others). It is an open problem to determine when they evolve to something nice. In this talk we will discuss some of the known results and conjectures.

**Jeffrey Kuan (Harvard)**

**Interlacing particle systems and the Gaussian Free Field**

We analyze the fluctuations in the height function of an interlacing system of particles in the two-dimensional lattice. The main result is that these fluctuations converge to the Gaussian Free Field. This model has connections to the Anisotropic Kardar–Parisi–Zhang universality class and to the representation theory of Lie groups.
**Mickaël Launay (Provence)**

**Interacting urn models**

The aim of this talk is to study the asymptotic behavior of strongly reinforced interacting urns with partial memory sharing. The reinforcement mechanism considered is as follows: draw at each step and for each urn a white or black ball from either all the urns combined (with probability $p$) or the urn alone (with probability $1 - p$) and add a new ball of the same color to this urn. The probability of drawing a ball of a certain color is proportional to $w_k$ where $k$ is the number of balls of this color. The higher the $p$, the more memory is shared between the urns. The main results can be informally stated as follows: in the exponential case $w_k = \rho^k$, if $p \geq 1/2$ then all the urns draw the same color after a finite time, and if $p < 1/2$ then some urns fixate on a unique color and others keep drawing both black and white balls.

**Mikhail Malioutov (Northeastern)**

**Compression based homogeneity testing**

We study nonparametric compression-based homogeneity tests pioneered by J. Ziv (1988). The Ziv’s test computationally intensive evaluation of empirical entropy rate and has the same Large Deviation Exponent (LDE) as the most powerful Likelihood Ratio (LR) in homogeneity testing, if the size of the training test exceeds constant times the size of the query test. No analysis of the Ziv’s test performance in the ‘normal range’ was done. To analyze strings approximated by Markov Chains of high order $d$ ($d$-MC) and limited length of training string, applying Ziv’s test is problematic. Even more so is its application for the on line simultaneous testing thousands of parallel strings.

Our CCC test of using average of several compressed concatenated string increments is computationally feasible in applications listed above. Its Asymptotic Normality (AN) and identity of LDE with that of the LR and Ziv’s test is established in full generality for all universal compressors and general stationary ergodic sources under the assumption that the length of the query slice is such that the increments of the compressed concatenated string differ infinitesimally from those with infinite training string. Our AN proof uses the unexpectedly interesting ‘Geometry’ properties of the compressed files in contrast to the previous artificial and technically very involved methods of Szpankowski et al, Aldous and Shields, which could do only the case of LZ-78 compressor and IID sources.

**Roland Markó (Bonn)**

**Allocation of Lebesgue measure to Poisson points**

The allocation problem for a Poisson point process is to find a way to partition the space to parts of equal size, and assign the parts to the configuration points in a measurable, deterministic (equivariant) way. The goal is to make the diameter of the part assigned to a configuration point have fast decay. We present an algorithm for $d \geq 3$, that achieves an $O(\exp(-cR^d))$ tail, which is optimal up to $c$. This improves the best previously known allocation rule, the gravitational allocation, which has $\exp(-cR^{d+o(1)})$ tail.

**Makato Nakashima (Kyoto)**

**On the behavior of the population density for branching random walks in random environment**

We consider a branching process with spatial motion, branching random walks in random environment. In this talk, random environment means that offspring distributions are given as i.i.d. random variables in space and time. We can define the population density which is a random probability measure on $\mathbb{Z}^d$ when the process survives. If branching process satisfies some assumptions, then the properly scaled population density weakly converges to Gaussian measure, almost surely on survival event. On the other hand, localization happens if the environment is random enough.
Michele Salvi (TU Berlin)

**A large deviation principle for a RWRC in a box**

After a review of the basics of Large Deviations Theory, the model of *Random Walk among Random Conductances* (RWRC) on $\mathbb{Z}^d$ is introduced. The process is driven by a randomly perturbed Laplace operator depending on i.i.d. conductances on the bonds, which we assume to be positive, but possibly arbitrarily small. We formulate an annealed large deviation statement for the normalized local times of the RWRC forced to stay in a finite box and give heuristics for its proof. Joint work with Wolfgang König and Tilman Wolff.

Ecaterina Sava (TU Graz, Austria)

**Lamplighter random walks**

In this talk we give an introduction to lamplighter random walks. Given an infinite connected graph $G$, a vertex of the lamplighter graph $L \wr G$ consists of a 0-1 labeling of the vertices of $G$, and a marked vertex of $G$. Each vertex has a lamp, the marked vertex indicates the position of a lamplighter and the labeling at any time indicates the on-off status of each lamp (vertex). The lamplighter random walk on $G$ corresponds to the lamplighter performing a random walk on $G$, while randomizing the status of each lamp, as he/she visits the corresponding vertex. Various aspects of such random walks received considerable attention recently. We will summarize some facts and results about the behaviour of such random walks.

Matthew Sedlock (Johns Hopkins)

**A history of percolation thresholds and a method of finding exact site percolation thresholds for a class of lattices**

A brief history of exact solutions for percolation thresholds will be given. Expanding on the recent results of the generalized version of the star-triangle transformation, a method will be presented to find exact percolation thresholds for site models in a certain class. This, in effect, is the generalization of the star-triangle transformation of bond models to apply to site models. This allows us to find the percolation thresholds for some site models that do not arise from a bond to site transformation (by way of line graphs), so we get a wider class of solutions. The main tool used is stochastic ordering on partially ordered sets. In particular, a stochastic ordering of the probability measures on the boundary partitions for a generator of a lattice and for the generator of its matching lattice is obtained, thereby setting up equations whose unique solution in $(0,1)$ is the percolation threshold.

Daisuke Shiraishi (Kyoto)

**Random walk on conditioned two-sided random walk trace is subdiffusive**

Let $S^1, S^2$ be independent simple random walks in $\mathbb{Z}^d$ ($d = 2, 3$) started at the origin. We construct two-sided random walk paths conditioned that $S^1[0, \infty) \cap S^2[1, \infty) = \emptyset$ by showing the existence of the following limit:

$$\lim_{n \to \infty} P(\cdot | S^1[0, \tau^1(n)] \cap S^2[1, \tau^2(n)] = \emptyset) =: P^\#(\cdot),$$

where $\tau(n) = \inf\{k \geq 0 : |S^i(k)| \geq n\}$.

Let $\overline{S}^1, \overline{S}^2$ be the associated two-sided random walks whose probability law is $P^\#$. We consider the trace $\overline{G} = \overline{S}^1[0, \infty) \cup \overline{S}^2[0, \infty)$ to be a random subgraph of $\mathbb{Z}^d$ ($d = 2, 3$) and show that the simple random walk on $\overline{G}$ is subdiffusive.
David Sivakoff (Duke/SAMSI)

The contact process on modular random graphs

We studied the contact process, or SIS epidemic, on weakly coupled Erdős–Rényi random graphs. We show that for certain parameter values, the time that it takes the process to spread to the entire network when it is started at a single vertex converges in distribution. I will compute this distribution and give an outline of the proof.

Alessio Troiani (Leiden)

Metastability for Kawasaki dynamics with two types of particles

A system is metastable when, for a given choice of the parameters, it is in a point of quasi-equilibrium (a local minimum of some potential) but not in the stable state (the global minimum of the potential). The system will stay in the vicinity of the local minimum (the metastable state) for a long time before undergoing a sharp transition towards the global minimum. We study the metastable behavior of a lattice gas with two types of particles subject to Kawasaki dynamics. We identify the region of parameters for which the system is metastable, compute the transition time from the metastable to the stable state and give a characterization of the “critical” configurations.

Florian Völlering (Leiden)

Random walks in fast mixing dynamic environments

Random walks in random environment are random walks whose jump rates are influenced by a random environment. I will focus on the situation where the environment is given by a Markov process which has sufficiently high decay of correlations in time. Then results like a law of large numbers or a central limit theorem for the random walk hold. The method is a coupling argument to lift the decay of correlations in time from the original environment to the environment as seen from the walker.

Tilman Wolff (Weierstrass Institute, Berlin)

The parabolic Anderson model from the perspective of a moving catalyst

We consider the solution \( u : \mathbb{R}_+ \times \mathbb{Z}^d \to \mathbb{R}_+ \) to the parabolic Anderson model (PAM), where the potential is given by \((t, x) \to \gamma \delta_0(x - Y_t)\) with \(Y\) a simple symmetric random walk on \(\mathbb{Z}^d\). Depending upon the parameter \(\gamma > 0\), the potential is interpreted as a randomly moving catalyst. In particular, we analyse the solution \(u\) from the perspective of the catalyst, i.e., the expression \(u(t, Y_t + x)\). Focusing on the cases where moments grow exponentially fast (that is, sufficiently large), we aim at describing the leading-order moment asymptotics of the expression above. Here, it is crucial to prove the existence of a principal eigenfunction of the corresponding Hamilton operator. While this is well-established for the first moment, we have found an extension to the second one. An analogous result for higher moments holds under further assumptions on the model parameters. A paper including these results has recently been accepted for publication. The final version of this joint work with A. Schnitzler, TU Berlin, is available under “preprints and reports” at my personal page at Weierstrass Institute, www.wias-berlin.de/~wolff.