Michal Bassan. Non-constant ground configurations in the disordered Ising ferromagnet

The disordered Ising ferromagnet is a disordered version of the ferromagnetic Ising model in which the coupling constants are quenched random, chosen independently from a distribution on the non-negative reals. A ground configuration is a configuration of the model in infinite volume whose energy cannot be lowered by finite changes. It has been asked whether the disordered Ising ferromagnet on Z^D admits non-constant ground configurations. It is conjectured that such configurations do not exist in dimension $D = 2$, as their existence is equivalent to the existence of bigeodesics in first-passage percolation. We prove that non-constant ground configurations do exist in dimensions $D \geq 4$ for suitable coupling constant distributions. Joint work with Ron Peled and Shoni Gilboa.

Guillaume Bland. Poissonian colouring of the hypercube.

Let R_0, B_0 and $X_1, X_2, \ldots$ be independent random variables, uniformly distributed in $[0,1]^d$. Picture R_0 (resp. B_0) as an initial red (resp. blue) point, and $X_1, X_2, \ldots$ as points falling consecutively in $[0,1]^d$. Then, for each $n \in \mathbb{N}$, make X_{n+1} take the colour of the closest point already fallen, its nearest neighbour among $R_0, B_0, X_1, \ldots, X_n$. In the limit $n \to \infty$, this yields a colouring of the hypercube, and several interesting questions can be asked about the geometry of the frontier between the red and blue regions. With Anne-Laure Basdevant, Nicolas Curien and Arvind Singh, we show that the Hausdorff dimension of the frontier is strictly between $(d-1)$ and d.

Guy Blachar. Probabilistic Laws on Groups

Suppose a finite group satisfies the following property: if you take two random elements, then with probability bigger than $5/8$ they commute. Then this group is commutative. Starting from this well-known result, it is natural to ask: Do similar results hold for other laws (p-groups, nilpotent groups...)? Are there analogous results for infinite groups? Are there phenomena specific to the infinite setup? We will present some known and new results in this area. New results are joint with Gideon Amir, Maria Gerasimova and Gady Kozma.

Barak Budnick. The distribution of shortest path lengths in subcritical Erdős-Rényi random graphs

The Erdős-Rényi model is one of simplest and most studied models of random graphs. An Erdős-Rényi network consists of N vertices and is generated by including each one of the possible edges with probability p (where no loops or self-edges are aloud). It was found that Erdős-Rényi graphs exhibit a percolation transition at $p = 1/N$, such that, if $p < 1/N$ the graph is composed of small, disconnected tree components, whereas if $p > 1/N$, there exists a connected component whose size scales with N possibly accompanied by some small components. In this talk, we will present analytical results for the distribution of shortest path lengths on the tree components of the subcritical Erdős-Rényi network.

Sahar Diskin. Supercritical percolation on the hypercube - likely properties of the giant component

A random subgraph of the binary d-dimensional hypercube Q^d is one of the most classical and researched models of bond (edge) percolation. In this model, the base graph is the binary hypercube Q^d (vertices are 0/1-vectors with d coordinates, two are adjacent if they differ in exactly one coordinate), and each edge of Q^d is retained independently with probability $p = p(d)$.

It is known since the classical work of Ajtai, Komlos and Szemeredi in 1982 that the model undergoes phase transition at $p = 1/d$, and in the supercritical regime $p = (1 + \epsilon)/d$, $\epsilon > 0$ a small constant, there is typically a unique component of size linear in $|V(Q^d)| = 2^d$, the so-called giant component.

We investigate typical combinatorial properties of the giant component, with an emphasis on, and a key being, its typical expansion. Among the properties we address are: edge- and vertex-expansion, diameter, length of a longest cycle, mixing time of a lazy random walk.

Our methods extend smoothly to the general setup of supercritical percolation on high-dimensional product graphs.

A joint work with Joshua Erde, Mihyun Kang and Michael Krivelevich.

Paul Duncan. Higher Dimensional Percolation

Percolation theory studies the phase transition marked by the appearance of an infinite component in a random graph. Bobrowski and Skraba introduced a topological extension of the notion of percolation to higher dimensional cell complexes marked by the appearance of giant generalized surfaces. We will discuss some generalizations of classical percolation results in this setting, in particular an analogue of the Harris-Kesten theorem.

Chen Idan. Generalization of Shelah and Spencer 0-1 Laws in Multi- Parameter Random Simplicial Complexes

The Erdős-Rényi model, $G(n, p)$, is a random graph on n vertices, where each edge is added independently, with probability $p = p(n)$.

The 0-1 laws of first-order logic properties of graphs are two striking results.

The first 0-1 laws were proven by Glebskiĭ, and later independently by Fagin. They found that when p is constant, every first order logic property of graphs is either true or false w.h.p in $G(n, p)$.

Shelah and Spencer later found similar 0-1 laws: When $\alpha \notin \mathbb{Q}$, every first order logic property of graphs is either true or false w.h.p in $G(n, n^{-\alpha})$.

We will discuss a generalization of such 0-1 laws to random simplicial complexes of arbitrary dimension, and show that analog statements hold. This talk is based on my master's thesis, under the guidance of Ron Rosenthal.

Xaver Kriechbaum. Voting models on branching random walks

Let $T = (V, E, o)$ be a ternary rooted tree and $(X_e)_{e\in E}$ an i.i.d. sequence of random variables. For $v \in V$ let S_v be the sum of the X_e along the path from the root o to v. For a rooted binary subtree (τ, o) of T let $M_{n,\tau} := \max_{v\in\tau,|v|=n} S_v$, where $|v|$ denotes the distance of v to o. What can we say about $M_n := \min_{\tau\subseteq T \text{binary}} M_{n,\tau}$?

The above is an example of a voting model on branching random walks. We will introduce more general voting models on branching random walks and show how they are connected to certain PDEs. After this we will provide some results for the initial example.

This talk is based on joint work with Lenya Ryzhik and Ofer Zeitouni.

René Rühr. On the critical temperature for the Ising model situated on a random lattice.

We parametrize the bond weight variables J in the anisotropic Ising model using Minkowski's successive minima from the geometry of numbers. This makes the critical temperature to be a random variable on the space of lattices. Using mean field bounds, we show integrability of the critical temperature. We complement with numerics in dimension two and simulations in higher dimensions to obtain approximate values for the mean.

Shay Sadovsky. Geometric dualities and costs — how are they related?

In this talk we will see an extension of the notions of set duality and functional duality. The latter, functional duality, has generalizations in the form of cost-transforms, from the theory of optimal transport. We will show how such costs can also give generalized geometric dualities, and show that in fact all set dualities are induced by a cost function. We will see some interesting examples of such dualities and results pertaining to them.

Joint work with Shiri Artstein-Avidan and Kasia Wyczesany.

Noy Sofer Aranov. Escape of Mass in Positive Characteristic

It is well known that given a group H, compact H orbits support a unique H-invariant probability measure. One interesting question is given a sequence of H orbits, what can be the possible accumulation points of the corresponding measures. Shapira showed that when H is the diagonal group acting on the space of unimodular lattices, a possible weak star limit of such measures is the zero measure. We studied this question in the positive characteristic setting and showed that indeed the same result holds in the positive characteristic setting, and moreover this result provides counterexamples to Minkowski's uniqueness conjecture from geometry of numbers in this setting.

Vasiliki Velona. Inference on balanced community modulated random recursive trees

I will introduce a random recursive tree model with two communities, called balanced community modulated random recursive tree (BCMRT in short), which was inspired by the CMRT model of S. Bhamidi, R. Fan, N. Fraiman, and A. Nobel. The model is dependent on a parameter q and the asymptotic degree distribution coincides for all q as the number of vertices tends to infinity. Therefore, one wonders how to distinguish between different values of q when only the graph structure is observed. We find a statistic that manages to do this task and also discover a threshold for the possibility of testing, when one allows q to vary. This is joint work with Anna Ben-Hamou.

Shagjie Yang. Typical height of the (2+1)-D Solid-on-Solid surface with pinning above a wall in the delocalized phase

We study the typical height of the (2+1)-dimensional solid-on-solid surface with pinning interacting with an impenetrable wall in the delocalization phase. More precisely, let Λ_N be a $N \times N$ box of $\mathbb{Z}^2$, and we consider a nonnegative integer-valued field $(\phi(x))_{x\in\Lambda_N}$ with zero boundary conditions ($i.e.$ $\phi|_{\Lambda_N^\complement} = 0$) associated with the energy functional

$$\mathscr{V}(\phi) = \beta \sum_{x\sim y} |\phi(x) - \phi(y)| - \sum_x h\mathbf{1}_{\phi(x)=0\}},$$

where $\beta > 0$ is the inverse temperature and $h \geq 0$ is the pinning parameter. Lacoin has shown that for sufficiently large β, there is a phase transition between delocalization and localization at the critical point

$$h_w(\beta) = \log\left(\frac{e^{4\beta}}{e^{4\beta} - 1}\right).$$

In this paper we show that for $\beta \geq 1$ and $h \in (0, h_w)$, the values of ϕ concentrate at the height $H = \lfloor (4\beta)^{-1} \log N \rfloor$ with constant order fluctuations. Moreover, at criticality $h = h_w$, we provide evidence for the conjectured typical height $H_w = \lfloor (6\beta)^{-1} \log N \rfloor$.

Tomer Zimhoni. Random Permutations from Free Products

Let $\Gamma = G_1 * G_2 * ... * G_r$ be a group a free product of a finite number of finite groups and a finite number of copies of the infinite cyclic group. We sample uniformly at random an action of Γ on N elements. In this talk, we will discuss a few tools we developed to help answer some natural questions involving the configuration described above, such as: For $\gamma \in \Gamma$, what is the expected number of fixed points of γ in the action we sampled? What is the the typical behavior of the cycle structure of the permutation corresponding to γ etc.

This is a joint with Professor Doron Puder.