Book of Abstracts

SFB Winter Status Workshop

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Abstracts

Melda Akyazi (Universität Wien)
Scaling Limits in Totally Symmetric Self-Complementary Plane Partitions
Totally symmetric self-complementary plane partitions (TSSCPPs) form a highly symmetric subclass of boxed plane partitions and are central objects in algebraic combinatorics. Probabilistically, TSSCPPs can be realised as a dimer model on a 1/12th sector of a hexagon with a free boundary allowing monomers, giving rise to a Pfaffian structure absent from classical lozenge tiling models.

In this talk, I will present two aspects of ongoing joint work with Nathanaël Berestycki and Sunil Chhita on random TSSCPPs. First, I will show a limit shape phenomenon and describe edge fluctuations of the arctic boundary: while GOE Tracy–Widom behaviour occurs along the free boundary, we conjecture a crossover to $Airy_2$ (GUE-type) fluctuations at generic points away from it. Second, I will discuss progress towards Romik's rationality conjecture, which stipulates that probabilities of certain events in a related loop percolation model (a variant of critical bond percolation) take explicit rational values.

Fabien Baeriswyl (TU Wien)
Asymptotic results for Poisson cluster point processes
In this presentation, we discuss asymptotic results, in particular regular variation as well as scalar and functional large deviation principles for certain types of Poisson cluster point processes and their associated functionals. Particular emphasis is placed on the Hawkes process, which serves as an illustrative example of these results. This is joint work with Vale Chavez-Demoulin and Olivier Wintenberger.

Philipp Beltran (TU Wien]
Scaling limits of multitype Bienaymé trees
We consider irredicuble critical multitype Bienaymé trees conditioned on the value of a linear combination of the numbers of vertices of given types. We prove that, under a finite exponential moment condition, the scaling limit as the tree size tends to infinity is given by the Brownian Continuum Random Tree. Our main tools include a flattening operation applied to multitype trees and sharp estimates regarding the structure of monotype trees with a given sequence of degrees.

Ariane Carrance (University of Vienna)
Counting bicolored maps with an alternating boundary: what, why, how
Bicolored maps are also called constellations, hypermaps, dessins d'enfants, ... They are a fundamental family of maps possessing a richer structure than general maps. In particular, when considering bicolored maps with boundaries, the bicoloration introduces a lot of possibilities for the boundary condition. In this talk, I will focus on the alternating boundary condition. I will explain how it naturally appears in applications to models of random maps and statistical mechanics, and will showcase the interesting mathematical features of the associated generating functions. This is based on joint work with Jérémie Bouttier, and joint work in progress with Valentin Baillard, Bertrand Eynard and Thomas Lejeune.

Niccolo Bosio (TU Wien)
Gibbs partitions and lattice paths
Given two generating functions $V(z) = \sum v_n z^n$ and $W(z) = \sum w_n z^n$ we study the composition scheme $V(W(z))$ under some natural hypotheses regarding the asymptotics of v_n and w_n. We demonstrate a novel behavior for the total number of components of the scheme and a condensation phenomenon, producing a unique giant component comprising almost the entire mass.

Orphee Collin (TU Wien)
The two-dimensional simple random walk conditioned to avoid the origin
In this talk, I will introduce the SRW on Z^2 conditioned to avoid the origin (not so obvious!) and discuss some of its properties, revolving around its transience.

Anna Geisler (TU Graz)
Sampling from the antiferromagnetic Ising model on bipartite, regular expander graphs
The antiferromagnetic Ising model samples subsets of vertices of a graph with weights decaying exponentially in the number of edges induced. We study the problem of sampling from this model on the class of bipartite, regular graphs with good vertex expansion. A natural approach to sampling is to use a simple update Markov chain whose stationary distribution is given by the Gibbs measure of the Ising model. The efficiency of this method depends on the mixing time of the Markov chain, and we show that a natural choice, the Glauber dynamics, mix exponentially slowly in a wide range of parameters. This is due to a bottleneck between configurations that lie predominantly on one of the two bipartition sides. Having ruled out the Glauber dynamics as an efficient sampler, we present a polynomial-time sampling algorithm for the same regime, based on polymer models and the cluster expansion method. This also yields an FPTAS for the partition function of the antiferromagnetic Ising model on these graphs.

The talk is based on joint work with Mihyun Kang, Mihalis Sarantis, and Ronen Wdowinski.

Henry Giles(TU Wien)
A reflecting system of interlaced particles
As a model of interface evolution in 2d, we construct a natural system of reflecting interlaced particles. We are able to show that the system exhibits diffusive behaviour, and compute the diffusion coefficient explicitly.

Quentin Moulard (TU Wien)
Dimers with layered disorder
We study the dimer model on the square lattice in a layered random environment, where the edge weights are constant along each row but are i.i.d. between rows. This disorder structure is inspired by the celebrated two-dimensional McCoy–Wu disordered Ising model. The disorder produces dramatic effects, which I will discuss. In particular, we find an essential singularity in the free energy (with no analogue in the pure dimer model), at which dimer-dimer correlations decay as $exp(-\sqrt{distance})$. This is joint work with Fabio Toninelli (arXiv:2507.11964).

Kieran Ryan (TU Wien)
Ground states in the XXZ chain and the Lorentz mirror model with loop weight 2
Statistical mechanics models describe how the large scale behaviour of matter changes as parameters such as temperature are varied. Often these models exhibit phase transitions – a drastic change in the behaviour of the system at a critical temperature. The behaviour exactly at the critical temperature is in many models very special, and is expected to be conformally invariant as one takes the size of the lattice mesh to 0.

Quantum models in d dimensions in their ground state are sometimes describable in terms of classical d+1 dimensional models. In this talk we will discuss a widely studied quantum model, the spin-1/2 Heisenberg XXZ model, in 1 dimension in the ground state. We will explore how it can be described in terms of 2-dimensional classical models, including the Lorentz mirror model. We prove a strong sign of the aforementioned conformal invariance: spin-spin correlation functions decay slowly, and an associated height function delocalises.

Marcus Schönfelder (Universität Wien)

The 1/4-phenomenon of placement probabilities of tilings in the Aztec diamond

Let R be a region in the plane consisting of a union of unit squares which align with the square grid Z^2. A domino tiling of R is a covering of the region with 1×2- or 2×1-rectangles called domino tiles. Given R, enumerative combinatorics asks for the number of domino tilings. Naturally, This number heavily depends on the underlying region R. We consider domino tilings of the Aztec diamond, a well studied model region in this discipline. Using the "Domino Shuffling" algorithm introduced by Elkies, Kuperberg, Larsen, and Propp (1992), we are able to generate domino tilings uniformly at random. In this talk, we investigate the probability of finding a domino at a specific position in such a random tiling. We prove that this placement probability is always equal to $1/4$ plus a rational function, whose shape depends on the location of the domino, multiplied by a position-independent factor that involves only the size of the diamond. This result leads to significantly more compact explicit counting formulas compared to previous findings. As a direct application, we derive explicit counting formulas for the domino tilings of Aztec diamonds with 2×2-square holes at arbitrary positions.

Lisa Wang (TU Wien)

Local Central Limit Theorem for subgraph counts in subcritical graph classes

The study of subgraphs in random discrete structures is a central area in graph theory. In this talk, we consider subgraphs on a random graph in the so-called subcritical class, the most prominent examples of which include forests, outerplanar graphs, and series-parallel graphs. We show that, in a uniformly chosen connected graph of size n from a subcritical graph class, the number of copies of a fixed connected graph satisfies a central limit theorem – and in fact a local central limit theorem too – with linear expectation and variance in the size n. The proof method is based on analytic combinatorics.

Ronen Wdowinksi (TU Graz)

Counting independent sets in percolated graphs via the Ising model

Given a graph G, we form a random subgraph G_p by including each edge of G independently with probability p. We prove an asymptotic expansion of the expected number of independent sets in random subgraphs of regular bipartite graphs satisfying certain vertex-isoperimetric properties, extending work of Kronenberg and Spinka on the percolated hypercube. Combining graph containers with the cluster expansion from statistical physics, we give an expansion of the partition function of the Ising model in certain range of the parameters. As a tool, we prove a refined container lemma for the Ising model that mildly improves recent bounds of Jenssen, Malekshahian, and Park for the hard-core model.

This is joint work with Anna Geisler, Mihyun Kang, and Michail Sarantis.

Atsuro Yoshida (Universität Wien)

A Probabilistic Bijection from the Twenty-Vertex Model to a Fixed Point Set of Arrowed Gelfand–Tsetlin Patterns

In this talk, I will explain a correspondence between two classes of combinatorial objects: twenty-vertex models on quadrangular domains with domain wall boundary conditions, and arrowed Gelfand–Tsetlin patterns. Both objects exhibit rich combinatorial structure, and their enumerations are governed by the same explicit product formula, which is reminiscent of the Robbins numbers and also appears in the enumeration of domino tilings of the Aztec triangle. Motivated by this coincidence, I will present a probabilistic bijection between twenty-vertex configurations with free west boundary, which can be viewed as a generalization of the domain wall (fixed west boundary) case, and a certain class of arrowed Gelfand–Tsetlin patterns with bounded entries satisfying explicit local constraints. Using the known characterization of these patterns as the fixed-point set of an involution at the specialization corresponding to the product formula, this bijection yields a direct combinatorial explanation for the equality of the enumeration formulas in the domain wall case.

Yizheng Yuan (Universität Wien)

The scaling limit of the intrinsic metric and the random walk on 2D critical percolation

Intrinsic metrics (a.k.a. chemical distance) and random walks on percolation models have been attracting a lot of mathematical attention. The case of (low-dimensional) critical percolation, however, has remained poorly understood. Despite the significant progress in understanding the large-scale geometry and scaling limits of $2D$

critical percolation (thanks to the works of Schramm, Smirnov, and others), the metric properties are not captured by these results. Basic questions such as finding the spectral dimension of the critical percolation cluster, or finding the exponent for the shortest path length relative to the Euclidean distance, remain unresolved.

Our work establishes the scaling limits of the intrinsic metric and the random walk on $2D$ critical percolation clusters. They converge to the canonical shortest-path metric and the canonical Brownian motion, respectively, on the CLE_6 gasket which we construct in our work. The CLE (conformal loop ensemble) gaskets are a family of random fractals describing conjectural scaling limits of FK and loop $O(n)$ models. For this family we show that there exists a canonical geodesic metric and a canonical Brownian motion on the CLE gasket which are uniquely determined by its local geometry. Our work implies in particular the existence of the exponents for the metric and the walk on critical percolation.

This talk is based on joint works with Valeria Ambrosio, Irina Danković, Maarten Markering, and Jason Miller.