KOLKOM

KOLLOQUIUM ÜBER KOMBINATORIK

14 – 15 November 2025

UNIVERSITÄT BIELEFELD

TRR 358

Dear combinatorialists,

It is our great pleasure to welcome you at Bielefeld University for the 42nd Colloquium on Combinatorics. The Colloquium on Combinatorics was established in 1981 and has since been held annually (with the exceptions in 2005, 2020, and 2021) in eight cities throughout Germany. This conference is today an established conference in Germany covering all areas of Combinatorics and Discrete Mathematics in a broad sense, including combinatorial aspects in Algebra, Geometry, Optimization and Computer Science.

This year there are about 60 participants. The program includes 30 contributed talks, organised in up to three parallel sessions, and four invited talks on a broad range of combinatorial topics.

Please note that there are 25-minute slots allocated for the contributed talks, which includes 20 minutes for the presentation, two minutes for discussion, and three minutes for room change.

Enjoy the conference!

Barbara Baumeister, Dirk Frettlöh and Lukas Kühne

All **talks** will be in Gebäude X at Bielefeld University (Universitätsstr. 24, 33615 Bielefeld)

Invited talks	:	X-E0-001
Contributed talks	:	X-E0-001, X-E0-202, X-E0-212
Coffee and snacks	:	Foyer (ground floor)
Registration desk	:	Foyer (ground floor)

The easiest way to reach Bielefeld University is via the tram line 4 towards Lohmanshof. Exit at the stop Universität, the X Gebäude will be sign-posted from the tram stop.

The **registration desk** is open on Friday from 8:20 to 9:00 and on Saturday from 9:00 to 9:30.

The **dinner** will take place at the restaurant *Brauhaus Joh. Albrecht* (Hagenbruchstr. 8) on Friday at 19:00.

The restaurant can be reached by a 50-minute-walk or by tram in 25 minutes.

There will be an **informal dinner** on Thursday evening at *The Bernstein* (Niederwall 2) starting at 18:00. Feel also free to join later once you arrive in Bielefeld.

A visit to the **Sparrenburg** outside of the conference program is highly recommended.

Friday, 14 November 2025

08:20 - 09:00	*Registration*
08:50 - 09:00	*Opening*
09:00 - 10:00	**Karin Baur**
10:00 - 10:30	*Coffee break*
10:30 - 12:10	**Parallel sessions**
12:05 - 13:35	*Lunch*
14:00 - 15:00	**Martina Juhnke**
15:00 - 15:30	*Coffee break*
15:30 - 17:10	**Parallel sessions**
19:00	*Dinner* at **Brauhaus Joh. Albrecht** (Hagenbruchstr. 8, Bielefeld)

Saturday, 15 November 2025

09:30 - 10:30	**János Pach**
10:30 - 11:00	*Coffee break*
11:00 - 11:50	**Parallel sessions**
12:00 - 13:00	**Jarkko Kari**
13:00	*Lunch and farewell*

Detailed program on Friday, 14 November 2025

Time	Section I X-E0-001	Section II X-E0-202	Section III X-E0-212
08:50 - 09:00	*Opening* **X-E0-001**		
09:00 - 10:00	**Karin Baur** Frieze patterns via surface combinatorics **X-E0-001**		
10:00 - 10:30	*Coffee break*		
10:30 - 10:50	Mütze	Garbe	Friedrich
10:55 - 11:15	Althöfer	Xie	Kaspers
11:20 - 11:40	Bielser	Mühlherr	Polujan
11:45 - 12:05	Natarajan	Van Werde	Rakhmonov
12:15 - 13:30	*Lunch*		
14:00 - 15:00	**Martina Juhnke** Monotone paths on polytopes: Positive and negative results **X-E0-001**		
15:00 - 15:30	*Coffee break*		
15:30 - 15:50	Winter	Klawuhn	Sagdeev
15:55 - 16:15	Degen	Krone	Hamann
16:20 - 16:40	Ramesh	Chen	van der Pol
16:45 - 17:05	Verciani	Steffen	Hoster
19:00	*Conference dinner*		

Detailed program on Saturday, 15 November 2025

Time	**Section I** **X-E0-001**	**Section II** **X-E0-202**	**Section III** **X-E0-212**
09:30 - 10:30	**János Pach** Colorings and embeddings of graphs **X-E0-001**		
10:30 - 11:00	*Coffee break*		
11:00 - 11:25 **11:30 - 11:55**	Rieck Cambie	Deppe Ipek	Rajasekaran Smith
12:00 - 13:00	**Jarkko Kari** Colorings of the two-dimensional grid with few local patterns **X-E0-001**		
13:00 - 14:00	*Lunch and Farewell*		

Invited talks

Karin Baur:	Frieze patterns via surface combinatorics
Martina Juhnke:	Monotone paths on polytopes: Positive and negative results
János Pach:	Colorings and embeddings of graphs
Jarkko Kari:	Colorings of the two-dimensional grid with few local patterns

Contributed talks

Ingo Althöfer:	On a Candidate for Divergence in a natural Collatz Variant
Kerrin Bielser:	On a Question of Katona on Intersecting Families
Stijn Cambie:	Mean subtree order and average subpath length of graphs
Lei Chen:	Highly-arc-transitive digraphs
Sebastian Degen:	The polytope of all q-rank functions
Christian Deppe:	The Minkowski Dimension and Its Connection to the Capacity of Deterministic Identification
Chantal Friedrich:	Towards a Hilton-Milner type result of intersecting families of polynomials over a finite field
Frederik Garbe:	Asymptotically Enumerating Independent Sets in Regular k-Partite k-Uniform Hypergraphs
Matthias Hamann:	Asymptotic grid minors in infinite graphs
Elena Hoster:	Chow polynomials and Friends
Selman Ipek:	Polyhedral methods in the classical simulation of quantum circuits
Christian Kaspers:	Locally APN and k-th order sum-free functions
Lukas Klawuhn:	Designs of perfect matchings
Maximilian Krone:	Sufficient average and minimum degree conditions for the existence of highly connected subgraphs
Leonie Mühlherr:	Buildingset arrangements
Torsten Mütze:	Counterexamples to two conjectures on Venn diagrams
Abhiram Natarajan:	Partitioning Theorems for Sets of Semi-Pfaffian Sets, with Applications
János Pach:	Colorings and embeddings of graphs
Alexandr Polujan:	Constructing Millions of Inequivalent Quadratic APN Functions in Eight Variables
Ramar Rajasekaran:	ND Coloring Number in Graphs
Firdavs Rakhmonov:	L^p averages of the discrete Fourier transform and applications

Lakshmi Ramesh: Intersections of translated polytopes
Christian Rieck: Flipping odd matchings in geometric and combinatorial settings
Arsenii Sagdeev: Infinite Families in Euclidean Ramsey Theory
Zak Smith: Factors and powers of Hamilton cycles in the budget-constrained random graph process
Eckhard Steffen: Information dissemination and confusion in signed networks
Jorn van der Pol: Turan densities for matroid basis hypergraphs
Alexander Van Werde: Towards generalized spectral determinacy of random graphs
Francesco Verciani: Listing faces of polytopes
Martin Winter: Two-level polytopes and the conjectures of Mahler and Kalai
Xinyue Xie: Counting tight Hamilton cycles in Dirac hypergraphs

Ingo Althöfer (FSU Jena)

On a Candidate for Divergence in a natural Collatz Variant

The well known Collatz Variant with $3n-1$ instead of $3n+1$ can be reformulated in the following way: An odd natural number n is multiplied by $x = 3/2$, then downrounded, and then halving is done until an odd number results again. Common opinion for the $3n-1$ variant is that each odd starting number n converges to one of three cycles.The following rule is a generalisation: Given real numbers x and y with x between 1 and 2 and $y > 0$, for odd number n build $x * n + y$, then downround, and then do halving until a new odd number is reached. Observation: For $x = 4/3$, $y = 5/2$, and $n = 5$ iterated application of the rule gives the starting sequence 5, 9, 7, 11, 17, 25, 35, 49, 67, 91, 123, 83, 113, 153, 103, 139, 187, ... and after 1383 steps the very large number 13795 31244 62715 66584 35254 38621 96428 92836 273 (43 decimals)(computation with BigInt Integer Arithmetic). Conjecture: $x = 4/3$, $y = 5/2$ and starting value $n = 5$ gives a sequence diverging to infinity with speed about $(64/54)^{t/3}$ in t rounds.

Karin Baur (Ruhr-Universität Bochum)

Frieze patterns via surface combinatorics

Coxeter introduced frieze patterns around 1972. They correspond to polygon triangulations (Conway-Coxeter 1973). We explain how infinite frieze patterns arise from surfaces and study the growth behaviour of periodic patterns. In particular, we show that in affine types, cluster categories yield friezes with linear growth. Time permitted, we will also show how SL_k - friezes arise using Plücker coordinates.

Kerrin Bielser (Europa-Universität Flensburg)

On a Question of Katona on Intersecting Families

Starting point of this investigation is the problem of finding the maximum number of *inclusion-pairs* (A, B) with $B \subset A$ within an intersecting family. There are several variations of this kind of *Turán-like* question in Boolean lattices: Considering a family that avoids containing two disjoint sets (an intersecting family), what is the maximum number of tuples of sets with a given inclusion property (or a subposet)?the original problem above it is not hard to see that choosing all sets containing one specific element yields the optimal solution with a total number of $3^{n-1} - 2^{n-1}$ inclusion-pairs. Moreover, it turns out that this configuration is still best possible as long as the studied subposet contains exactly one minimal set. This can be proven not only by studying Boolean lattices but according to a method of B. Patkós also by polyhedral optimization as the *profiles* of intersecting families are well studied by P. L. Erdős, P. Frankl, and G. O. H. Katona (1984). As an outlook, it will be referred to ongoing research regarding the maximum occurrence of *cherries* within an intersecting family—i.e. the smallest example with two minimum sets: three sets of which two are subsets of the third one.talk is partly based on joint work with Gyula O.H. Katona and Balázs Patkós.

Stijn Cambie (KU Leuven)

Mean subtree order and average subpath length of graphs

he mean subtree order is the average order (size+1) of the subtrees of a graph.one only consider the subpaths, one gets a related notion with some relations to the average distance of a graph.this short talk, we present multiple connections between the various elementary notions,in particular adress the analogues of questions by Jamison from '83 and '84 for the aveage subpath length.

Lei Chen

(Bielefeld University)

Highly-arc-transitive digraphs

The investigation of s-arc-transitive graphs can be dated back to 1947, when Tutte proved that any cubic graph can be at most 5-arc-transitive. Later in 1981, Weiss showed that for all finite graphs, s is at most 7. On the other hand, the situation of finite digraphs can be quite different, since Praeger in 1989 proved that for any s and k, there exists an infinite family of s-arc-transitive digraph of valency k. I am going to introduce my recent work with Praeger on the classification of highly-arc-transitive digraphs, showing that any 6-arc-transitive digraph corresponds to a 2-arc-transitive digraph of almost simple type.

Sebastian Degen

(University Bielefeld)

The polytope of all q-rank functions

A q-rank function is a real-valued function defined on the subspace lattice of $\mathbb{F}_q^n$ that is non-negative, upper bounded by the dimension function, non-decreasing, and satisfies the submodularity law. Each such function corresponds to the rank function of a q-polymatroid. Intuitively, we can view these objects as q-analogues of polymatroids. In this viewpoint the concept of q-analogue can be interpreted as generalizing from finite sets to finite-dimensional vector spaces over finite fields. Their original motivation comes from algebraic coding theory, as the representable q-polymaroids arise from so-called rank-metric codes.this talk, we identify these functions with points in a polytope. The lattice points of that polytope correspond to integer-valued q-polymatroids, also called q-matroids. We show that all lattice points are among the vertices of the polytope and investigate several properties of convex combinations of two such vertices. In particular, we do so with regard to independence, flats, and cyclic flats of the q-polymatroids formed by these convex combinations.

Christian Deppe

(TU Braunschweig)

The Minkowski Dimension and Its Connection to the Capacity of Deterministic Identification

Building on foundational work by JaJa, Ahlswede, and Cai, and motivated by the recent renewed interest in deterministic identification (DI) via noisy channels, we investigate the problem in full generality for memoryless channels with finite output alphabets and arbitrary input alphabets. We establish that the optimal (redefined) DI rate is bounded above and below in terms of the Minkowski dimension of the set of output probability distributions within the probability simplex of the channel's output alphabet. This result is striking, as communication capacities are typically linked to metric properties of the output set. For example, Shannon's classical capacity is determined by the divergence radius. In contrast, our DI capacity bounds are inherently scale-invariant. In addition, we present a theorem, which provides upper and lower bounds on the maximum size of DI codes for arbitrary sets and block lengths. This yields meaningful capacity bounds even in cases where the Minkowski dimension vanishes.

Chantal Friedrich (Universität Rostock)

Towards a Hilton-Milner type result of intersecting families of polynomials over a finite field

A set of polynomials U over a finite field $\mathbb{F}_q$ of degree at most k is called intersecting if there is a $z \in \mathbb{F}_q$ such that $f(z) = g(z)$ for each $f, g \in U$. We say that an intersecting family is non-trivial if there is no point $(a, b) \in \mathbb{F}_q^2$ such that $f(a) = b$ for every $f \in U$. In this talk we present some results of Hilton-Milner type theorem for intersecting families of polynomials of degree 2. Moreover, we show that $|U| \leq \binom{q+1}{2}$ if $\min_{a \in \mathbb{F}_q} |\{f(a) : f \in U\}| = 2$.

Frederik Garbe (Czech Academy of Sciences)

Asymptotically Enumerating Independent Sets in Regular k-Partite k-Uniform Hypergraphs

Jenssen and Perkins introduced the cluster expansion method from statistical physics as a tool for determining the number of independent sets in regular bipartite expander graphs. We formulate this framework in the context of hypergraphs and asymptotically determine the number of independent sets in regular k-partite k-uniform hypergraphs which satisfy natural expansion properties. is joint work with Patrick Arras and Felix Joos.

Matthias Hamann (Universität Hamburg)

Asymptotic grid minors in infinite graphs

Halin showed in 1965 that every infinite graph with a thick end contains the half-grid as a minor. In this talk, we will look at coarse variants of this theorem. Here, we consider a notion of minors that stays visible when looking at the large-scale geometry of the graph: asymptotic minors. First, we discuss a direct analogue of Halin's theorem for asymptotic minors and then we look at quasi-transitive graphs, where we do not only apply that variant for asymptotic minors but also prove, under an additional assumption on the cycle space, the existence of a full-grid as an asymptotic minor. This latter result implies for finitely presented groups that any locally finite Cayley graph of such a group contains the full-grid as an asymptotic minor if and only if the group is not virtually free.This is based on joint work with Sandra Albrechtsen.

Elena Hoster (Ruhr-Universität Bochum)

Chow polynomials and Friends

The Chow polynomial of a matroid is the Hilbert series of its Chow ring. This notion extends to posets, where, for a large class of examples, the resulting polynomial exhibits classical combinatorial properties like palindromicity, unimodality, and gamma-positivity.The Chow polynomial arises as an evaluation of the extended ab-index, a polynomial introduced by Dorpalen-Barry, Maglione, and Stump. This connection links Chow polynomials to a larger family of polynomials, including the ab-index and the chain polynomial of a poset. Real-rootedness is a recurring conjecture within this family. In this talk, I will explain how Chow polynomials fit into this wider combinatorial picture.

Martina Juhnke (Universität Osnabrück)

Monotone paths on polytopes: Positive and negative results

To solve a linear program, the simplex method follows a path in the graph of a polytope, on which a linear function increases. The length of this path is a key measure of the complexity of the simplex method. Our starting point is a conjecture by Jesús De Loera stating that the number of paths counted according to their length forms a unimodal sequence. We give examples (old and new) for which this conjecture is true but we disprove this conjecture by constructing counterexamples for several classes of polytopes. However, we show that De Loera is "statistically correct": We prove that the length of a coherent path on a random polytope (with vertices chosen uniformly on a sphere) admits a central limit theorem. This is joint work with Germain Poullot.

Christian Kaspers (OVGU Magdeburg)

Locally APN and k-th order sum-free functions

Locally APN functions, which are functions from $\mathbb{F}_2^n$ to $\mathbb{F}_2^n$ with desirable cryptographic properties, were introduced by Blondeau, Canteaut and Charpin (IEEE Trans. Inform. Theory 57 (2011), 8127–8137) as a generalization of the well and extensively studied almost perfect nonlinear (in brief: APN) functions.

As another extension of APN functions, Carlet (J. Cryptology 38 (2025), paper no. 20) recently introduced k-th order sum-free functions.In this talk, we present a new construction of locally APN functions using subspace partitions and Sidon sets. We will show that in Dimension 6 these functions are also 3rd-order sum-free.

Jarkko Kari (University of Turku)

Colorings of the two-dimensional grid with few local patterns

A two-dimensional configuration is a coloring of the infinite grid Z^2 using a finite number of colors. For a finite subset D of Z^2, the D-patterns of a configuration are the patterns of shape D that appear in the configuration. The number of distinct D-patterns of a configuration is a natural measure of its complexity. We consider low-complexity configurations where the number of distinct D-patterns is at most $|D|$, the size of the shape. We use algebraic tools to study periodicity of such configurations. We show, for an arbitrary shape D, that a low-complexity configuration must be periodic if it comes from the well-known Ledrappier subshift, or from a wide family of other similar algebraic subshifts. We also discuss connections to the well-known Nivat's conjecture: In the case D is a rectangle - or in fact any convex shape - we establish that a uniformly recurrent configuration that has low-complexity with respect to shape D must be periodic. This implies an algorithm to determine if a given collection of mn rectangular patterns of size mxn admit a configuration containing only these patterns. Without the complexity bound the question is the well-known undecidable domino problem.

Lukas Klawuhn (Paderborn University)

Designs of perfect matchings

It is well-known that the complete graph K_{2n} on $2n$ vertices can always be decomposed into perfect matchings, called a 1-factorisation. In such a decomposition, every edge of K_{2n} appears in exactly 1 perfect matching. This was generalised by Jungnickel and Vanstone to *hyperfactorisations*. These are sets of perfect matchings such that every pair of disjoint edges of K_{2n} appears in a constant number of perfect matchings. Hyperfactorisations are examples of Cameron's *partition systems* and were rediscovered by Stinson who called them *hyperresolutions*. We generalise all these ideas to λ-factorisations of K_{2n} and characterise them algebraically as Delsarte designs in an association scheme using the theory of Gelfand pairs. We use this characterisation to derive divisibility conditions and non-existence results. Furthermore, we explore a connection to finite geometry, giving rise to explicit constructions of λ-factorisations.

Maximilian Krone

(Technische Universität Ilmenau)

Sufficient average and minimum degree conditions for the existence of highly connected subgraphs

Mader (1979) conjectured that an average degree of at least $3k-1$ in a graph is sufficient for the existence of a $(k+1)$-connected subgraph. The talk approaches this conjecture from two sides: First, every graph with average degree at least $3.109k-1$ has a $(k+1)$-connected subgraph on more than $1.2k$ vertices. Second, every graph with minimum degree at least $3k-1$ has a $(k+1)$-connected subgraph on more than $2k$ vertices. Regarding edge-connectedness in simple graphs, it is shown that an average degree of at least $2k$ is sufficient for a $(k+1)$-edge-connected subgraph on more than $2k$ vertices. Moreover, for every small $\alpha > 0$ and for k large enough in terms of α, already a minimum degree of at least $k + k^{\frac{1}{2}+\alpha} = \big(1+o(1)\big)k$ is sufficient for a $(k+1)$-edge-connected subgraph.Multiple variations of these results are considered and applied to decompose graphs into highly connected parts.

Leonie Mühlherr

(Universität Bielefeld/Universität Kassel)

Buildingset arrangements

In a recent work, Cuntz and Kühne defined the class of connected subgraph arrangements. This includes the resonance arrangement and some ideal subarrangements of Weyl arrangements. They studied among other things the freeness and simpliciality of these arrangements and found graph theoretical criteria for these properties. In this project, we want to extend the definition of these arrangements to hypergraphs and study the aforementioned properties in order to generalize the characterizations established by Cuntz and Kühne. This talk gives an introduction to the connected subgraph arrangements, explains the generalization idea, presents results pertaining to freeness of this arrangement class and shows an interesting connection to Boolean buildingssets.

Torsten Mütze (Universität Kassel)

Counterexamples to two conjectures on Venn diagrams

In 1984, Winkler conjectured that every simple Venn diagram with n curves can be extended to a simple Venn diagram with n+1 curves. His conjecture is equivalent to the statement that the dual graph of any simple Venn diagram has a Hamilton cycle. In this work, we construct counterexamples to Winkler's conjecture for all $n >= 6$. As part of this proof, we computed all 3.430.404 simple Venn diagrams with $n = 6$ curves (even their number was not previously known), among which we found 72 counterexamples.
We also disprove another conjecture about the Hamiltonicity of the (primal) graph of a Venn diagram. Specifically, while working on Winkler's conjecture, Pruesse and Ruskey proved that this graph has a Hamilton cycle for every simple Venn diagram with n curves, and conjectured that this also holds for non-simple diagrams. We construct counterexamples to this conjecture for all $n >= 4$.

Abhiram Natarajan (University of Warwick)

Partitioning Theorems for Sets of Semi-Pfaffian Sets, with Applications

We generalize the seminal polynomial partitioning theorems of Guth and Katz 1, 2 to a set of semi Pfaffian sets. Specifically, given a set Γ contained in R_n of k dimensional semi Pfaffian sets, where each element of Γ is defined by a fixed number of Pfaffian functions, and each Pfaffian function is in turn defined with respect to a Pfaffian chain q of length r, for any integer $D >= 1$, we prove the existence of a polynomial P in R of degree at most D such that each connected component of the complement of the zero set of P in R_n intersects at most approximately the size of Γ divided by D^{n-k-r} elements of Γ. Also, under some mild conditions on q, for any $D >= 1$, we prove the existence of a Pfaffian function P prime of degree at most D defined with respect to q, such that each connected component of the complement of the zero set of P prime in R_n intersects at most approximately the size of Γ divided by D^{n-k} elements of Γ. To do so, given a k dimensional semi Pfaffian set Γ contained in R_n, and a polynomial P of degree at most D, we establish a uniform bound on the number of connected components of the complement of the zero set of P in R_n that Γ intersects. That is, we prove that the number of connected components of the complement of the zero set of P in R_n intersected with Γ is at most approximately D^{k+r}. Finally, as applications, we derive Pfaffian versions of Szemeredi Trotter type theorems and also prove bounds on the number of joints between Pfaffian curves. Larry Guth, Polynomial partitioning for a set of varieties, Mathematical Proceedings of the Cambridge Philosophical Society, volume 159, Cambridge University Press, 2015, pages 459 to 469. Larry Guth and Nets Hawk Katz, On the Erdos distinct distances problem in the plane, Annals of Mathematics, 2015, pages 155 to 190.

János Pach (Renyi Institute and EPFL)

Colorings and embeddings of graphs

What makes the chromatic number of a graph large? There have been many attempts to answer this question. The most natural approach is to look for unavoidable substructures in graphs of large chromatic number. Hadwiger made the conjecture that every graph of chromatic number r can be transformed into a complete graph of r vertices by a series of edge contractions and vertex and edge deletions. This is known to be true for r<6. There are several related problems on embeddability properties of graphs that I plan to explain. The crossing number of a graph G is the smallest number of edge crossings in a proper drawing of G in the plane. According to Albertson's conjecture, the crossing number of every graph of chromatic number r is at least as large as the chromatic number of a complete graph with r vertices. We settle Albertson's conjecture for graphs whose number of vertices is not much larger than their chromatic number. Joint work with Jacob Fox and Andrew Suk.

Alexandr Polujan (OVGU Magdeburg)

Constructing Millions of Inequivalent Quadratic APN Functions in Eight Variables

The "big APN problem" refers to one of the central open questions in the study of almost perfect nonlinear (APN) functions, which are key objects in cryptography and finite field theory. It asks the following: Does there exist an APN permutation in even dimension? The only known example of an APN permutation in even dimension was obtained by modifying a specific quadratic APN function. Motivated by this result, there have been numerous recent attempts to construct new quadratic APN functions. Currently, 32,892 quadratic APN functions in dimension 8 are known, and two recent conjectures address their possible total number. The first, proposed in [1], suggests that there are more than 50,000 such functions. The second, suggested in [2], argues that their number exceeds that of inequivalent quadratic (8,4)-bent functions, which is 92,515. We computationally construct 3,775,599 inequivalent quadratic APN functions in dimension 8 and estimate the total number to be about 6 million. This talk is based on the joint work [3].

References [1] Y. Yu, L. Perrin. Constructing more quadratic APN functions with the QAM method. Cryptogr. Commun. (14(6): 1359-1369) (2022)

Alexandr Polujan, Alexander Pott. Towards the classification of quadratic vectorial bent functions in 8 variables. The 7th International Workshop on Boolean Functions and their Applications (https://boolean.w.uib.no/bfa-2022) (2022)

Christof Beierle, Philippe Langevin, Gregor Leander, Alexandr Polujan, Shahram Rasoolzadeh. Millions of inequivalent quadratic APN functions in eight variables. (https://arxiv.org/abs/2508.04644) (2025)

Ramar Rajasekaran (UAS, Sohar)

ND Coloring Number in Graphs

Given a simple graph G, a Neighborhood distinguishing coloring (ND-coloring) [4] is a proper coloring of vertices such that the codes for the vertices determined by the color partition are distinct for distinct vertices. Let $\pi = V1, V2, ..., Vk$ be a proper color partition of a simple graph G. Fixing this order of π, for each $u \in V(G)$, we assign a code denoted by $C(u)$ (or $C_\pi(u)$) as $C(u) = |N(u) \cap Vi|, i = 1, 2, ..., k$. Then π is called a Neighborhood Distinguishing Coloring partition (abbreviated as NDC-partition) if $C(u) \neq C(v)$ for all distinct $u, v \in V$. Also, the Graph G is called a Neighborhood Distinguishing Coloring Graph(NDC-Graph). The minimum cardinality of a neighborhood distinguishing coloring partition of a graph G is called "Neighborhood Distinguishing Coloring Number of G" and it is denoted by $NDC(G)$. A neighborhood distinguishing color partition of G with $NDC(G)$ elements is called a NDC-partition of G[4]. The minimum value of the cardinality of Neighborhood distinguish- ing proper color partition is called the neighborhood distinguishing coloring number of G and is denoted by $NDC(G)$.

Firdavs Rakhmonov (University of St Andrews)

L^p averages of the discrete Fourier transform and applications

The discrete Fourier transform has proven to be an essential tool in many geometric and combinatorial problems in vector spaces over finite fields. In general, sets with good uniform bounds for the Fourier transform appear more 'random' and are easier to analyze. However, there is a trade-off: in many cases, obtaining good uniform bounds is not possible, even in situations where many points satisfy strong pointwise bounds. To address this limitation, the first named author proposed an approach where one attempts to replace the need for uniform ($L^{\inf}$) bounds with suitable bounds for the L^p average of the Fourier transform. In subsequent joint work, the authors applied this approach successfully to improve known results in Fourier restriction and the study of orthogonal projections. In this survey we discuss this general approach, give several examples, and exhibit some of the recent applications.

Lakshmi Ramesh (Universitaet Bielefeld)

Intersections of translated polytopes

Let P be a simple d dimensional polytope. We provide a framework to understand the combinatorics of the intersection polytope P intersected with $(P + u)$.. We provide a bound on the number of vertices of the intersection polytope, which in 4 dimensions or higher can be greater than the number of vertices of P.

Christian Rieck (University of Kassel)

Flipping odd matchings in geometric and combinatorial settings

We study the problem of reconfiguring odd matchings, that is, matchings that cover all but a single vertex. Our reconfiguration operation is a so-called flip where the unmatched vertex of the first matching gets matched, while consequently another vertex becomes unmatched.
We consider two distinct settings: the geometric setting, in which the vertices are points embedded in the plane and all occurring odd matchings are crossing-free, and a combinatorial setting, in which we consider odd matchings in general graphs.

This is joint work with Oswin Aichholzer, Sofia Brenner, Joseph Dorfer, Hung Hoang, Daniel Perz, and Francesco Verciani.

Arsenii Sagdeev (KIT)

Infinite Families in Euclidean Ramsey Theory

An important class of geometric Ramsey problems originates from the classic papers by Erdos, Graham, Montgomery, Rothschild, Spencer, and Straus who posed the following "metaquestion": is there an r-coloring of the points of $\mathbb{R}^n$ under which no element of the family F of congruent copies of a given point set is monochromatic? In this talk, we consider a similar question for other infinite families F of geometric nature.

Zak Smith (Universität Heidelberg)

Factors and powers of Hamilton cycles in the budget-constrained random graph process

Consider the following budget-constrained random graph process introduced by Frieze, Krivelevich and Michaeli. A player, called Builder, is presented with t distinct edges of K_n one by one, chosen uniformly at random. Builder may purchase at most b of these edges, and must (irrevocably) decide whether to purchase each edge as soon as it is offered.
Builder's goal is to construct a graph which satisfies a certain (monotone increasing) property.
In this talk, I will present the model in detail and discuss some state-of-the-art results for different properties, including new results for the containment of different F-factors or powers of Hamilton cycles.

This is based on joint work with Alberto Espuny Díaz, Frederik Garbe, and Tássio Naia.

Eckhard Steffen (Universität Paderborn)

Information dissemination and confusion in signed networks

We introduce a model of information dissemination in signed networks. It is a discrete-time process in which uninformed actors incrementally receive information from their informed neighbors or from the outside. Our goal is to minimize the number of confused actors - that is, the number of actors who receive contradictory information. We prove upper bounds for the number of confused actors in signed networks and in equivalence classes of signed networks. In particular, we show that there are signed networks where, for any information placement strategy, almost 60% of the actors are confused. Furthermore, this is also the case when considering the minimum number of confused actors within an equivalence class of signed graphs. Joint work with Ligang Jin.

Jorn van der Pol (University of Twente)

Turan densities for matroid basis hypergraphs

What is the maximum number of bases of an n-element, rank-r matroid without a given uniform matroid U as a minor?

This question arises in the problem of determining the TurÃ¡n density of daisy-hypergraphs. Ellis, Ivan, and Leader recently showed that this density is positive, thus disproving a conjecture by BollobÃ¡s, Leader, and Malvenuto. Their construction is a matroid basis hypergraph, and we show that it is best-possible within the class of matroid basis hypergraphs.

This is joint work with Zach Walsh and Michael C. Wigal.

Alexander Van Werde (University of Münster)

Towards generalized spectral determinacy of random graphs

Wang and Xu (2006, 2017) discovered sufficient conditions for a graph to be uniquely characterized by the spectra of its adjacency matrix and of its complement graph. They conjectured that these conditions are satisfied with nonvanishing frequency, but this remains open and it was not clear what proof techniques could be used. I will present a new line of attack which approaches the problem as a question about random groups. This allows making connections to proof techniques from combinatorial random matrix theory. The results which I will present are in a toy case, but it is expected that the employed perspective will generalize. This talk is based on my paper, Cokernel statistics for walk matrices of directed and weighted random graphs [Combinatorics, Probability and Computing (2025)]

Francesco Verciani (Universität Kassel)

Listing faces of polytopes

We investigate the problem of listing faces of combinatorial polytopes. More precisely, we consider the face lattice, which is the inclusion order of all faces of a polytope, and we seek a Hamiltonian cycle in its cover graph, i.e., for any two consecutive faces, one must be a subface of the other, and their dimensions differ by 1. We construct such Hamiltonian cycles for hypercubes, permutahedra, B-permutahedra, associahedra, cyclic polytopes, 3-dimensional polytopes, graph associahedra of chordal graphs, and quotientopes. Our constructions yield time- and space-efficient algorithms for computing the aforementioned cycles and thus for listing the corresponding combinatorial objects, including ordered set partitions and dissections of a convex polygon.

Martin Winter (TU Berlin / MPI Leipzig)

Two-level polytopes and the conjectures of Mahler and Kalai

A polytope is 2-level if for each facet all vertices lie either on this facet, or on a parallel face. The class of 2-level polytopes subsumes important polytope families, such as Hanner polytopes, Hansen polytopes, order polytopes, certain stable set polytopes and spanning tree polytopes. Besides their ubiquity in combinatorial optimization, 2-level polytopes are also exceptional in that they are, in some sense, "combinatorially minimalistic" and "geometrically compact". In particular, centrally symmetric 2-level polytopes are interesting test cases for famous open conjectures such as Mahler's conjecture, Kalai's 3^d conjecture and the full flag conjecture. Studying these conjectures on the class of 2-level polytopes has not only taught us new perspectives on the conjectures themselves, but also points to hidden connections between them. In this talk I will give an introduction to the class of 2-level polytopes. I will discuss some of their most fascinating properties and their significance for the mentioned conjectures. Eventually, I will report on some promising new computer experiments.

Xinyue Xie (Heidelberg University)

Counting tight Hamilton cycles in Dirac hypergraphs

Given a k-uniform hypergraph (or k-graph) G, a tight Hamilton cycle in G is a cyclic ordering of the vertices such that every k consecutive vertices form an edge. For $k \geq 2$ and $\delta \geq 1/2$, we say that G is an (n, k, δ)-graph if G is a k-graph on n vertices and every $(k-1)$-subset of $V(G)$ has at least $(\delta + o(1))n$ neighbours. Dirac's classical theorem and its generalization by Rödl, Ruciński, and Szemerédi show that every $(n, k, 1/2)$-graph contains a tight Hamilton cycle.
We use probabilistic methods to establish a lower bound on the number of tight Hamilton cycles in an (n, k, δ)-graph G, denoted by $\Psi(G)$. Specifically, we prove that $\log \Psi(G) \geq \frac{k}{k-1} h(G) - \frac{n}{k-1} \log \binom{n}{k-1} + \frac{k-2}{k-1} n \log \delta + n \log n - n \log e$, where $h(G)$ is the hypergraph entropy of G. As a corollary, we obtain $\Psi(G) \geq n! \delta^n$. This settles a conjecture of Ferber, Hardiman and Mond, and generalizes known results on Hamilton cycles in graphs and Hamilton ℓ-cycles in hypergraphs for $0 \leq \ell < k - 1$.
(Joint work with Felix Joos)

Selman Ipek (Leibniz Universität Hannover)

Polyhedral methods in the classical simulation of quantum circuits

A central problem in quantum computation is to understand the boundary between what can and cannot be simulated efficiently on a classical computer. One approach leads to a family of convex bodies, called simulation polytopes, which capture the geometric structure underlying certain classical simulation methods for quantum circuits. Simulation polytopes are objects embedded in the space of Hermitian operators and are defined in their H-representation as polar duals of certain highly symmetric orbit polytopes, known as stabilizer polytopes. Their H-representations are therefore known explicitly through group-theoretic symmetries, while their V-representations remain unknown. Consequently, their facial structure is strongly constrained by invariance under a large symmetry group and by additional semigroup actions coming from dynamical update rules. In this talk I will introduce these polytopes, describe what is known about their structure, and highlight open problems where combinatorial and group-theoretic methods may be of value, such as orbit enumeration, vertex–facet complexity, and symmetry reduction.
