AEC 2022

Algorithmic and Enumerative Combinatorics

4 – 8 July 2022

Vienna, Austria

Conference Program

(version of July 15, 2022)

	Monday	Tuesday	Wednesday	Thursday	Friday
09:00 – 09:30	Andrews	Raschel	Blümlein	Mishna	Corteel
09:30 – 10:00					
10:00 – 10:30	Coffee break	Coffee break	Hetyei	Coffee break	Coffee break
10:30 – 11:00	Sellers	Selkirk	Coffee break	Doolittle	Uncu
11:00 – 11:30	Bousquet-Mélou	Bisi	Panova	Singh	Hopkins
11:30 – 12:00		Wallner		Bhatnagar	Radu
12:00 – 12:30	Lunch break	Lunch break	Gilmore	Lunch break	Lunch break
12:30 – 14:00			Free		
14:00 – 14:30	Stanley	Schilling		Noy	Wachs
14:30 – 15:00					
15:00 – 15:30	Coffee break	Coffee break		Coffee break	Coffee break
15:30 – 16:00	Yoo	Aigner		Panafieu	Wong
16:00 – 16:30	Horak	Höngesberg		Requilé	Zafeirakopoulos
16:30 – 17:00	Bagno	Poster Session		Wahiche	
19:00 –			Conf. dinner		

Alternating sign matrices and totally symmetric plane partitions

02.06 **Florian Aigner**
(*LaCIM, Université du Québec à Montréal, Canada*)
Time: Tuesday 05.07., 15:30 – 15:55

Abstract: We study the Schur polynomial expansion of a family of symmetric polynomials related to the refined enumeration of alternating sign matrices with respect to their inversion number, complementary inversion number and the position of the unique 1 in the top row. We prove that the expansion can be expressed as a sum over totally symmetric plane partitions and we are also able to determine the coefficients. This establishes a new connection between alternating sign matrices and a class of plane partitions, thereby complementing the fact that alternating sign matrices are equinumerous with totally symmetric self-complementary plane partitions as well as with descending plane partitions. As a by-product we obtain an interesting map from totally symmetric plane partitions to Dyck paths. The proof is based on a new, quite general antisymmetrizer-to-determinant formula. This is joint work with Ilse Fischer, Matjaž Konvalinka, Philippe Nadeau, and Vasu Tewari.

Partition identities for k-regular partitions with distinct parts

01.01 **George Andrews**
(*Penn State University, University Park*)
Time: Monday 04.07., 09:00 – 09:50

Abstract: We start with a little-known Euler type theorem (due to Alladi) which is the following: The number of partitions of n into distinct parts not divisible by k (i.e. k-regular partitions with distinct parts) equals the number of partitions of n into odd parts none repeated more than $k-1$ times. $k=1$ and 2 are tautologies. $k=3$ plays a prominent role in Schur's 1926 partition theorem. Both Alladi and Schur have further partition identities related to $k=2$ which we will discuss. Obviously, $k=\infty$ is Euler's theorem. We then proceed to $k=4$ where an empirical investigation leads to a result for overpartitions. We conclude with a proof of the $k=4$ case and look at results and possibilities for $k>4$.

The Worpitzky identity for the groups of even-signed permutations

01.07 **Eli Bagno**
(*Jerusalem College of Technology, Israel*)
Time: Monday 04.07., 16:30 – 16:55

Abstract: The well-known Worpitzky identity $(x+1)^n = \sum_{k=0}^{n-1} A_{n,k}\binom{x+n-k}{n}$ provides a connection between two bases of $\mathbb{Q}[x]$: the standard basis $(x+1)^n$ and the binomial basis $\binom{x+n-k}{n}$, where the Eulerian numbers $A_{n,k}$ for the symmetric group serve as the entries of the transformation matrix. Brenti has generalized this identity to the Coxeter groups of types B_n and D_n (signed and even-signed permutations groups, respectively) using generatingfunctionology. Motivated by Foata-Schützenberger's and Rawlings' proof for the Worpitzky identity in the symmetric group, we provide combinatorial proofs for the generalization of this identity and for its q-analogue to the Coxeter groups of type D_n. Our proofs utilize the language of P-partitions for the D_n-posets, introduced by Stembridge. This is joint work with David Garber and Moti Novick.

The calculus of series-divisors

04.04 **Gaurav Bhatnagar**
(*Ashoka University, Sonipat, Haryana, India*)
Time: Thursday 07.07., 11:30 – 11:55

Abstract: The recurrence

$$np(n) = \sum_{i=1}^{n} \sigma(i)p(n-i)$$

has been used by Erdős and credited to Ford (1931) but appears in Ramanujan's notebooks. Here the divisor function $\sigma(n)$ is related to the partition function $p(n)$. The objective of our talk is to develop a calculus by which, virtually by inspection, one can find analogous recurrences connecting a divisor function with a partition-theoretic function. In particular, we associate each of Glaisher's 1885 list of divisor functions with an infinite product, which further suggests connections with partition-theoretic objects. From one of these recurrences, we obtain an elementary proof of Ramanujan's famous congruences $p(5n+4) \equiv 0 \pmod 5$ and $\tau(5n+5) \equiv 0 \pmod 5$. The proof requires no more than what Euler and Jacobi knew. The proof extends to embed the congruences into 4 infinite families of congruences for rational powers of the eta function. Many congruences of this nature have been found recently by Chan and Wang (2019); seven of their assertions are covered in our list. This is joint work with Hartosh Singh Bal

Transition between characters of classical groups, decomoposition if Gelfand-Tsetlin patterns and last passage percolation

02.03

Elia Bisi
(*TU Wien*)
Time: Tuesday 05.07., 11:00 – 11:25

Abstract: We study the combinatorial structure of Schur polynomials of type A, B, C and D (i.e., irreducible characters of classical groups). Perturbing the expressions of these characters as generating functions of Gelfand-Tsetlin patterns, we produce two families of symmetric polynomials that interpolate between characters of type C and type B and between characters of type B and type D. Using a combinatorial bijection between Gelfand-Tsetlin patterns, we prove a determinantal formula for the polynomials of the first family and identify them as a one-parameter specialization of Koornwinder polynomials. We next present a method of Gelfand-Tsetlin pattern decomposition to establish identities between all these polynomials that, in the case of characters, can be viewed as branching rules. We finally mention our probabilistic motivation, which is related to last passage percolation models with symmetries and to random matrix distributions.

Analytic integration methods in quantum field theory

03.01

Johannes Blümlein
(*DESY Zeuthen, Berlin*)
Time: Wednesday 06.07., 09:00 – 09:50

Abstract: A survey is given on the present status of analytic calculation methods and the mathematical structures of zero-, single- and two-scale Feynman amplitudes, which emerge in higher order perturbative calculations in Quantum Field Theories and associated effective field theories. Main methods are guessing in the zero- and single-scale case, the method of generalized hypergeometric functions, Mellin-Barnes integrals, hyperlogarithms, difference and differential equations, as well as the Almkvist-Zeilberger algorithm. We also will discuss the different function spaces and algebras, which have been revealed during recent calculations from harmonic sums to elliptic integrals and modular forms and beyond.

Tutte's invariants

01.03

Mireille Bousquet-Mélou
(*Université de Bordeaux*)
Time: Monday 04.07., 11:00 – 11:50

Abstract: The enumeration of many classes of combinatorial objects (lattice paths, maps, permutations...), according to their size, can be performed by recording additional statistics, now often called "catalytic". In this talk, we will focus on examples for which a recursive decomposition of the objects yields a functional equation for their generating function that involves "divided differences" of the form

$(F(x) - F(0))/x$, where x is one of the catalytic variables. More precisely, we focus on examples with two catalytic variables x and y, and two divided differences.

Typical recent examples come from the enumeration of plane latice walks confined to a cone. But the historical example is a functional equation for planar triangulations equipped with a proper colouring, written by William Tutte in 1973. It took him about 10 years to solve this equation, and prove that its solution satisfies an ordinary differential equation. In this solution, he defined and used a crucial notion of **invariants**.

I will give a modern view of invariants, and show recent applications to walks confined to a cone.

Cylindric partitions and Rogers Ramanujan identities

05.01 **Sylvie Corteel**
(*University of California at Berkeley*)
Time: Friday 08.07., 09:00 – 09:50

Abstract: Rogers-Ramanujan identities have many connections and one of them is representation theory. Thanks to this connection, it is expected that A_n-Rogers Ramanujan identities exist. The case $n = 1$ corresponds to the Andrews-Gordon and Andrews-Bressoud identities. Foda and Welsh had the brilliant idea to give another proof of these identities using cylindric partitions with two columns. It is now conjectured that cylindric partitions with $n + 1$ columns are the good combinatorial objects to attack the A_n problem for any n. In this talk I will explain recent progress in the case $n = 2$ and will state conjectures for the general case.

Subword complexes and facet-ridge isomorphisms

04.02 **Joseph Doolittle**
(*TU Graz, Austria*)
Time: Thursday 07.07., 10:30 – 10:55

Abstract: In 1987, Blind and Mani showed that simplicial polytopes are uniquely determined by their facet-ridge graph. Kalai conjectured that simplicial spheres are uniquely determined by their facet-ridge graph. In 2004, Knutson and Miller asked if spherical subword complexes are the boundary of similicial polytopes. In an effort to bring these worlds together, we show that spherical subword complexes of finite type are uniquely determined by their facet-ridge graph. This result supports the notion that subword complexes are the boundary of polytopes, especially in the case that Kalai's conjecture is actually false.

Coefficientwise total positivity of some matrices defined by linear recurrences

03.04 **Tomack Gilmore**
(*Lancaster University*)
Time: Wednesday 06.07., 12:00 – 12:25

Abstract: In this talk I will present some recent results and conjectures concerning the coefficientwise total positivity of a certain lower-triangular matrix with polynomial entries (in six indeterminates) that satisfy a three-term linear recurrence. This matrix is of particular interest since it includes, as special cases, a number of combinatorially significant integer matrices such as the Eulerian triangle and the reversed Stirling subset triangle. The former was conjectured to be totally positive over a quarter of a century ago by Brenti (this, unfortunately, remains a conjecture), while the latter can be shown to be totally positive by specialising one of our results. This is joint work with Xi Chen, Bishal Deb, Alex Dyachenko, and Alan Sokal.

Counting spanning hypertrees and meanders

03.02 **Gábor Hetyei**
(*University of North Carolina at Charlotte*)
Time: Wednesday 06.07., 10:00 – 10:25

Abstract: In this talk we revisit the notion of a spanning hypertree of a hypermap and show that it allows to shed new light on a very diverse set of recent results. The tour of a map along one of its spanning trees used by Bernardi may be generalized to hypermaps and it is equivalent to a dual tour described by Cori and Machì. We introduce hyperdeletions and hypercontractions in a hypermap which allow to count the spanning hypertrees of a hypermap recursively. Having a particular interest in hypermaps which are reciprocals of maps, we generalize the reduction map introduced by Franz and Earnshaw to enumerate meanders to a reduction map that allows the enumeration of the spanning hypertrees of such hypermaps.

Alternating sign matrices with reflective symmetry and plane partitions: n+3 pairs of equivalent statistics

02.07 **Hans Höngesberg**
(*University of Vienna, Austria*)
Time: Tuesday 05.07., 16:00 – 16:25

Abstract: Vertically symmetric alternating sign matrices are known to be equinumerous with lozenge tilings of a hexagon with a central triangular hole of size 2 that exhibit a cyclical as well as a vertical symmetry, but no bijection between these two classes of objects has been constructed so far. To approach a possible bijection, we introduce $n+3$ parameters for both objects and show that the joint distributions coincide. In fact, we present several versions of such results, but in all cases certain natural extensions of the original objects are necessary and that may hint at why it is so hard to come up with an explicit bijection. This is joint work with Ilse Fischer.

Growing connections between partition crank, mex, and Frobenius symbols

05.03 **Brian Hopkins**
(*Saint Peter's University, New Jersey*)
Time: Friday 08.07., 11:00 – 11:25

Abstract: The crank is a well-known statistic of integer partitions: requested by Dyson and eventually defined by Andrews and Garvan, it helps explain the Ramanujan partition congruences. The mex is a newer statistic, the minimal excluded positive part of a partition, with the name borrowed from combinatorial game theory. The first connection between these ideas, found independently by Andrews & Newman and Hopkins & Sellers in 2020, is that the number of partitions of n with nonnegative crank equals the number of partitions of n with odd mex. This has led to a flurry of related results, including connections to Frobenius symbols, proven with both analytic and combinatorial methods. The work presented here is joint with James Sellers, Dennis Stanton, and Ae Ja Yee.

Connected cubic graphs with the maximum number of perfect matchings

01.06 **Peter Horak**
(*University of Washington, Tacoma*)
Time: Monday 04.07., 16:00 – 16:25

Abstract: In 2008 Alon and Friedland showed that a simple cubic graph G on $2n$ vertices has at most $6^{n/3}$ perfect matchings, and this bound is attained by taking the disjoint union of bipartite complete graphs $K_{3,3}$. In other words, the above theorem says that the complete bipartite graph $K_{3,3}$ has the highest "density" of perfect matchings among all cubic graphs; thus the disjoint union of its copies constitutes the extremal

graph. However, this result does not provide any insight into the structure of extremal connected cubic graphs.

In this talk it will be presented that for $n \geq 6$, the number of perfect matchings in a simple connected cubic graph on $2n$ vertices is at most $4f_{n-1}$, with f_n being the n-th Fibonacci number, and a unique extremal graph will be characterized as well. In addition, it will be shown that the number of perfect matchings in any cubic graph G equals the expected value of a random variable defined on all 2-colorings of edges of G.

This is joint work with Dongryul Kim.

Kernel dynamics: towards a combinatorial understanding of transcendental functions

04.01 **Marni Mishna**
(*Simon Fraser University, Canada*)
Time: Thursday 07.07., 09:00 – 09:50

Abstract: A combinatorial elucidation of transcendental functions akin to those for algebraic and rational functions has been a motivating goal of enumerative combinatorics for several decades. Lattice path models regularly figure in a wide variety of classes with holonomic (aka D-finite) generating functions, from Baxter permutations, to Young tableaux of bounded height. In this talk we will survey some recent methods developed to classify the generating functions of small step lattice walks, and illustrate a key principle using a non-holonomic model. I will then discuss how these techniques can be used to show the differential transcendence of other combinatorial generating functions arising in the literature.

Counting 3-connected bipartite planar maps

04.05 **Marc Noy**
(*Universitat Politècnica de Catalunya, Barcelona*)
Time: Thursday 07.07., 14:00 – 14:50

Abstract: We provide a solution to the problem of counting rooted 3-connected bipartite planar maps. Our starting point is the enumeration of bicoloured planar maps according to the number of edges and monochromatic edges, following Bernardi and Bousquet-Mélou (2011). The decomposition of a map into 2- and 3-connected components allows us to obtain the generating functions of 2- and 3-connected bicoloured maps. Setting to zero the variable marking monochromatic edges we obtain the generating function of 3-connected bipartite maps, which is algebraic of degree 26. We deduce from it an asymptotic estimate for the number of 3-connected bipartite planar maps of the form $t \cdot n^{-5/2} \cdot g^n$, where $g = 1/r \sim 2.40958$, $t > 0$, and r is an algebraic number of degree 10. This is joint work with Clément Requilé and Juanjo Rué.

The birth of the strong components

04.06 **Élie de Panafieu**
(*Bell Labs France*)
Time: Thursday 07.07., 15:30 – 15:55

Abstract: The $D(n,p)$ model produces a random directed graph on n vertices, where each of the $n(n-1)$ possible arcs is present with probability p. For large n, the typical structure of such a random directed graph depends on whether p is smaller than, around, or above the threshold $1/n$. We obtain precise results on this phase transition for the $D(n,p)$ model and other variants. Our work relies on analytic combinatorics (generating function manipulations), the saddle point method, and the analysis of generalizations of the Airy function. The full article is available on arXiv. This is joint work with Sergey Dovgal, Dimbinaina Ralaivaosaona, Vonjy Rasendrahasina, and Stephan Wagner.

Poset inequalities

03.03 **Greta Panova**
(*University of Southern California*)
Time: Wednesday 06.07., 11:00 – 11:50

Abstract: Partially ordered sets are ubiquitous combinatorial structures which appear as objects from algebra (Young tableaux, Bruhat order) to general acyclic graphs. Counting their linear extensions (total orders) and order preserving maps are central problems in combinatorics without "nice" enumerative formulas and so understanding their behavior is a challenge. In this talk we will show various general inequalities for linear extensions and order preserving maps and prove some by explicit injections. Based on a series of joint paper with Swee Hong Chan and Igor Pak.

Two different proofs of the Merca conjectures

05.04 **Cristian-Silviu Radu**
(*RISC, Johannes Kepler University Linz*)
Time: Friday 08.07., 11:30 – 11:55

Abstract: In the first part we report on progress during the SFB period. In the second part we focus on joint work with C. Krattenthaler and M. Merca. In this joint work we give two different proofs of a collection of q-series identities conjectured by M. Merca.

Persistence for a class of order-one autoregressive processes and Mallows-Riordan polynomials

02.01 **Kilian Raschel**
(*Université de Tours*)
Time: Tuesday 05.07., 09:00 – 09:50

Abstract: We establish exact formulae for the (positivity) persistence probabilities of an autoregressive sequence with symmetric uniform innovations in terms of certain families of polynomials, most notably a family introduced by Mallows and Riordan as enumerators of finite labeled trees when ordered by inversions. The connection of these polynomials with the volumes of certain polytopes is also discussed. Two further results provide factorizations of general autoregressive models, one for negative drifts with continuous innovations, and one for positive drifts with continuous and symmetric innovations. The second factorization extends a classical universal formula of Sparre Andersen for symmetric random walks. Our results also lead to explicit asymptotic estimates for the persistence probabilities. This is a joint work with Gerold Alsmeyer, Alin Bostan and Thomas Simon (arXiv:2112.03016).

Chordal graphs with bounded tree-width

04.07 **Clément Requilé**
(*Universitat Politècnica de Catalunya, Barcelona*)
Time: Thursday 07.07., 16:00 – 16:25

Abstract: A graph is chordal when every induced cycle of length at least four admits a chord, or equivalently when every separator is a clique. A remarkable class of chordal graphs are the k-trees, that are build as follows: start from a $(k+1)$-clique, add a vertex connected to all vertices of some subclique of size k, then repeat this process at will on the resulting graph. Interestingly, this class allows for an alternative definition of tree-width: a graph has tree-width at most k if it is the subgraph of a k-tree.

This talk will be about the enumeration of chordal graphs with bounded tree-width. In fact, the asymptotic number of k-connected chordal graphs with n labelled vertices and tree-width at most t is of the form $cn^{-5/2}\gamma^n n!$, for some constants c and γ depending on t and k. This result is valid for any $t \geq 2$ and

$0 \leq k \leq t$, and we compute γ for small values of t. We will also discuss the normal limiting distribution of the number of i-cliques ($i \leq t+1$) of a random graph in this class. Both results fit into the framework of families of graphs that are subcritical.

Joint work with Jordi Castellví, Michael Drmota and Marc Noy.

Plethysm and the algebra of uniform block permutations

02.05 **Anne Schilling**
(*University of California at Davis*)
Time: Tuesday 05.07., 14:00 – 14:50

Abstract: We study the representation theory of the uniform block permutation algebra in the context of the representation theory of factorizable inverse monoids. The uniform block permutation algebra is a subalgebra of the partition algebra and is also known as the party algebra. We compute its characters and provide a Frobenius characteristic map to symmetric functions. This reveals connections of the characters of the uniform block permutation algebra and plethysms of Schur functions. This is based on joint work with Rosa Orellana, Franco Saliola and Mike Zabrocki.

The distribution of the maximum protection number in random trees

02.02 **Sarah Selkirk**
(*Alpen-Adria-Universität Klagenfurt, Austria*)
Time: Tuesday 05.07., 10:30 – 10:55

Abstract: The protection number of a vertex v is the length of the shortest path from v to any leaf contained in the maximal subtree where v is the root. In this joint work with Clemens Heuberger and Stephan Wagner, we study the maximum protection number in simply generated trees using generating function and analytic techniques, and obtain the distribution for this parameter in general.

Congruences for k-elongated partition diamonds

01.02 **James Sellers**
(*University of Minnesota Duluth*)
Time: Monday 04.07., 10:30 – 10:55

Abstract: In 2007, George Andrews and Peter Paule published the eleventh paper in their series on MacMahon's partition analysis, with a particular focus on broken k-diamond partitions. On the way to broken k-diamond partitions, Andrews and Paule introduced the idea of k-elongated partition diamonds. Recently, Andrews and Paule revisited the topic of k-elongated partition diamonds in a paper that recently appeared in the Journal of Number Theory. Using partition analysis and the Omega operator, they proved that the generating function for the partition numbers $d_k(n)$ produced by summing the links of k-elongated plane partition diamonds of length n is given by $\frac{(q^2;q^2)_\infty^k}{(q;q)_\infty^{3k+1}}$ for each $k \geq 1$. A significant portion of their recent paper involves proving several congruence properties satisfied by d_1, d_2 and d_3, using modular forms as their primary proof tool. Since then, Nicolas Smoot has extended the work of Andrews and Paule, refining one of their conjectures and proving an infinite family of congruences modulo arbitrarily large powers of 3 for the function d_2.

In this work, our goal is to extend some of the results proven by Andrews and Paule in their recent paper by proving infinitely many congruence properties satisfied by the functions d_k for an infinite set of values of k. The proof techniques employed are all elementary, relying on generating function manipulations and classical q-series results.

This is joint work with Robson da Silva of Universidade Federal de Sao Paulo and Mike Hirschhorn of the University of New South Wales.

A lower bound on the average length of reduction in linear λ-terms

04.03 **Alexandros Singh**
(*LIPN, Université Sorbonne Paris Nord, France*)
Time: Thursday 07.07., 11:00 – 11:25

Abstract: Lambda calculi are formal systems which play a prominent role in logic and computer science, being central to various disciplines such as proof theory and the theory and design of programming languages. In this work, we focus on the (untyped) linear lambda calculus, which is related to linear logic and which enjoys a number of intriguing connections with combinatorial objects such as maps (graphs on surfaces). Motivated by the problem of the average-case complexity of normalisation for this calculus, we present a lower bound for the expected number of steps required to reduce a random linear lambda-term to its normal form. To do so, we study the expected number of occurrences of various patterns in these lambda-terms and their corresponding rooted cubic maps. This is joint work with Olivier Bodini, Bernhard Gittenberger, Michael Wallner, and Noam Zeilberger.

The X-descent set of a permutation

01.04 **Richard Stanley**
(*Massachusetts Institute of Technology*)
Time: Monday 04.07., 14:00 – 14:50

Abstract: Let X be a subset of $\{(i,j)\colon 1 \le i,j \le n,\ i \ne j\}$. The *$X$-descent set* of a permutation $w = a_1 \cdots a_n \in S_n$ is defined by $\mathrm{XDes}(w) = \{i\colon (a_i, a_{i+1}) \in X\}$. If $X = \{(i,j)\colon n \ge i > j \ge 1\}$, then $\mathrm{XDes}(w) = \mathrm{Des}(w)$, the ordinary descent set. We define a quasisymmetric function U_X which is a generating function for permutations $w \in S_n$ according to their X-descent set. It turns out that U_X is a symmetric function whose properties we will discuss. We also discuss some connections with Hamiltonian paths in digraphs.

Recent progress on cylindric partitions

05.02 **Ali Uncu**
(*RICAM, Austrian Academy of Sciences*)
Time: Friday 08.07., 10:30 – 10:55

Abstract: The cylindric partitions defined by Gessel and Krattenthaler attracted interest after a recent paper by Corteel and Welsh. In this talk, we will look at these objects and their symmetric versions as well as skew double shifted plane partitions. We will later shift our focus on weighted treatment of these objects and prove Schmidt's partition theorem and a recent result of Andrews and Paule.

Genocchi numbers and hyperplane arrangements

05.05 **Michelle Wachs**
(*University of Miami*)
Time: Friday 08.07., 14:00 – 14:50

Abstract: In joint work with Alex Lazar, we refine a result of Gabor Hetyei relating the number of regions of a homogenized version of the Linial hyperplane arrangement to the median Genocchi numbers. We do so by obtaining combinatorial interpretations of the coefficients of the characteristic polynomial of the arrangement and by deriving generating functions for the characteristic polynomials, which reduce to known generating functions for the Genocchi and median Genocchi numbers. Our work involves the Ferrers graphs of Ehrenborg and van Willigenburg, a class of permutations related to Dumont permutations, the surjective staircase tableaux of Dumont, and a result of Chung and Graham on chromatic polynomials of incomparibility graphs. Our techniques also yield type B analogs, and Dowling arrangement generalizations.

A q-Nekrasov-Okounkov formula in type $\tilde{C}$

04.08 **David Wahiche**
(*Université Claude Bernard Lyon 1, France*)
Time: Thursday 07.07., 16:30 – 16:55

Abstract: Between 2006 and 2008, using various methods coming from representation theory, gauge theory and combinatorics, several authors proved the so-called Nekrasov–Okounkov formula involving hook-lengths of integer partitions. Later Dehaye and Han proved an identity which can be reformulated as a q-analogue of the Nekrasov–Okounkov identity. This result was generalized by both Rains–Warnaar and Carlsson–Rodriguez-Villegas in 2018. In this talk, I will explain how we can use the Littlewood decomposition on partitions and its interpretation in terms of bi-infinite words, together with Maconald's fomula for affine root system of type $\tilde{C}$, to derive a q-analogue of Pétréolle's Nekrasov–Okounkov type formula for double distinct partitions.

Phase transitions of composition schemes: Mittag-Leffler and mixed Poisson distributions

02.04 **Michael Wallner**
(*TU Wien*)
Time: Tuesday 05.07., 11:30 – 11:55

Abstract: Multitudinous probabilistic and combinatorial objects are associated with generating functions satisfying a composition scheme $F(z) = G(H(z))$. The analysis becomes challenging when this scheme is critical (i.e., G and H are simultaneously singular). Motivated by many examples (random mappings, planar maps, directed lattice paths), we consider a natural extension of this scheme, namely $F(z,u) = G(uH(z))M(z)$. We also consider a variant of this scheme, which allows us to analyse the number of H-components of a given size in F.

We prove that these two models lead to a rich world of limit laws, where we identify the key rôle played by a new universal three-parameter law: the beta-Mittag-Leffler distribution, which is essentially the product of a beta and a Mittag-Leffler distribution. We also prove (double) phase transitions, additionally involving Boltzmann and mixed Poisson distributions. In all cases we obtain moment convergence and local limit theorems. We present several applications of our results for, e.g., random walks, trees, Pólya urns, and the Chinese restaurant process.

On strict unimodality of q-binomial coefficients

05.06 **Elaine Wong**
(*RICAM, Austrian Academy of Sciences*)
Time: Friday 08.07., 15:30 – 15:55

Abstract: In 2013, Igor Pak and Greta Panova proved the strict unimodality property of q-binomial coefficients $\begin{bmatrix}\ell+m\\ m\end{bmatrix}_q$ (as polynomials in q) based on the combinatorics of certain Young tableaux and the semigroup property of certain Kronecker coefficients. They showed it to be true for all $\ell, m \geq 8$ and a few other cases. We propose a different (step-by-step, computation-based) approach to this problem, where we establish a closed form for the coefficients of these polynomials and use one of our favorite computer algebra tools (cylindrical algebraic decomposition) to identify exactly the range of coefficients on which strict unimodality holds (for all ℓ and m). We believe that this strategy allows for generalizations of the problem to show unimodality with larger gaps. This is joint work with Christoph Koutschan and Ali Uncu.

Combinatorial description for the Hall-Littlewood expansion of unicellular LLT and chromatic quasisymmetric polynomials

01.05 **Meesue Yoo**
(*Chungbuk National University, Cheongju, South Korea*)
Time: Monday 04.07., 15:30 – 15:55

Abstract: In this work, we obtain a Hall-Littlewood expansion of the chromatic quasisymmetric functions by using a Dyck path model and linked rook placements. By using the Carlsson-Mellit relation between the chromatic quasisymmetric functions and the unicellular LLT polynomials, this combinatorial description for the Hall-Littlewood coefficients of the chromatic quasisymmetric functions also gives the coefficients of the unicellular LLT polynomials expanded in terms of the modified transformed Hall-Littlewood polynomials. This is joint work with Seung Jin Lee.

A walk in the integer partitions gallery

05.07 **Zafeirakis Zafeirakopoulos**
(*Gebze Technical University, Turkey*)
Time: Friday 08.07., 16:00 – 16:25

Abstract: The connection between lattice points in polyhedra and integer partitions is well known. Many researchers have used geometric methods to study generating functions of interesting partition families. But this connection is deeper than that. Many of the tools used to compute generating functions of integer partitions have elegant geometric interpretations. In this talk we will walk through a gallery of pictures of integer partition methods.