
Algebraic Combinatorics
Combinatoire algébrique
(Org: **Nantel Bergeron** and/et **Mike Zabrocki** (York))

CAROLINA BENEDETTI, York University
Hopf monoid on the supercharacters of types C and D

We will talk about the supercharacter theory of the unipotent upper triangular matrices of types C and D endowing them with a Hopf algebra structure. Also, we introduce a Hopf monoid structure over them.

CHRIS BERG, Lacim, UQAM
Expansion of k -Schur functions for maximal k -rectangles within the affine nilCoxeter algebra

In joint work with N. Bergeron, H. Thomas and M. Zabrocki, we give multiple explicit combinatorial formulas for the k -Schur functions in non-commutative variables, contained in the affine type A nil-Coxeter algebra. I will discuss several of these formulas and their connection with the k -Littlewood Richardson coefficients.

FRANÇOIS BERGERON, UQAM
 h -Positivity and Diagonal Coinvariant Spaces

We discuss the implications of positivity of coefficients for the expansion of the "universal" multigraded Hilbert series of diagonal coinvariant spaces in the h -basis (of complete homogeneous symmetric functions). This universal series is shown to afford a description that is independent of the number of sets of variables. For the special case of 3 sets of variables, we give an analog of the "shuffle conjecture" (originally formulated for 2 sets of variables), and discuss several related new combinatorial identities involving r -Dyck paths and r -parking functions.

JONAH BLASIAK, University of Michigan
A crystal basis for two-row Kronecker coefficients

The Kronecker coefficient $g_{\lambda\mu\nu}$ is the multiplicity of the $GL(V) \times GL(W)$ -irreducible $V_\lambda \otimes W_\mu$ in the restriction of the $GL(X)$ -irreducible X_ν via the natural map $GL(V) \times GL(W) \rightarrow GL(X)$, where $X = V \otimes W$. A difficult open problem in algebraic combinatorics is to find a positive combinatorial formula for these coefficients. We outline an approach to this problem using crystal bases, describe its successful implementation in the $\dim V = \dim W = 2$ case, and discuss difficulties encountered in harder cases. This is joint work with Ketan Mulmuley and Milind Sohoni.

JONATHAN NOVAK, MIT
Monotone Hurwitz numbers and the HCIZ integral

A remarkable fact discovered by theoretical physicists is that certain integrals over N by N matrices admit large N asymptotic expansions whose coefficients are generating functions enumerating maps on compact surfaces. In certain cases these matrix integrals can be evaluated, and one gets enumerative formulas, e.g. for planar maps. A generalization of this theme involves integrating over pairs of interacting matrices - this corresponds to counting coloured maps. Unfortunately, one encounters a difficult obstruction to solving multimatrix integrals. This obstruction is yet another matrix integral known as the Harish-Chandra-Itzykson-Zuber integral. Physicists have conjectured that the HCIZ integral itself admits an asymptotic expansion for "something combinatorial," but this something was unknown. I will discuss recent work with Ian Goulden and Mathieu Guay-Paquet in which we show that the asymptotic orders of the HCIZ integral are generating functions for a desymmetrized variant of Hurwitz numbers, which we call "monotone Hurwitz numbers." The resulting combinatorics can be treated by

suitably augmenting the combinatorial approach to Hurwitz theory, and in this way one can get analytic results on the HCIZ integral by solving combinatorial problems.

STEVE PON, University of Connecticut
k-Schur functions in other types

We will present a generating set for noncommutative k -Schur functions for all classical Lie types in the affine nilCoxeter algebra, as well as (when possible) their symmetric function images.

ED RICHMOND, UBC
Littlewood-Richardson coefficients and tight fusion frames

A tight fusion frame is a sequence of orthogonal projection matrices which sum to a scalar multiple of the identity. To any such sequence, we can associate a weakly decreasing sequence of positive integers given by the ranks of these projections. The question we address is the following:

For which sequences of positive integers do tight fusion frames exist?

In this talk, I will discuss joint work with K. Luoto and M. Bownik where we explore this problem. In particular, we give a combinatorial characterization in terms of nonvanishing Littlewood-Richardson coefficients. This connection between algebraic combinatorics and frame theory yields several interesting results in both fields of mathematics.

FRANCO SALIOLA, Université du Québec à Montréal
Poset Topology and Left Regular Bands

Over the past 15 years, it has been noticed that several combinatorial objects admit a particularly nice monoid structure. These monoids are known as left regular bands. The representation theory of left regular bands has found applications to probability (for example, spectra of random walks on hyperplane arrangements) as well as algebraic combinatorics (for example, the descent algebras of finite Coxeter groups).

This talk will begin by surveying several examples of these monoids and then explore representation-theoretic aspects of their monoid algebras. This involves mixing combinatorial and algebraic tools: poset topology; Leray numbers; and cohomology and classifying spaces of small categories.

This is joint work with Stuart Margolis and Benjamin Steinberg.

LUIS SERRANO, LaCIM, Université du Québec à Montréal
Bijections between k -triangulations, k -fans of Dyck paths, and certain pipe dreams.

We present a bijection between k -triangulations of an n -gon and k -fans of Dyck paths (both generalizations of well known Catalan objects). This bijection goes through widely used objects in combinatorics such as pipe dreams and flagged tableaux. If time permits, we will discuss a generalisation of the associahedron obtained in this manner, and mention a conjectured cyclic sieving phenomenon. This is joint work with Christian Stump.

VASU TEWARI, University of British Columbia
Title: Combinatorial computation of certain Kronecker coefficients

It is a long standing open problem in algebraic combinatorics to compute the Kronecker coefficients of the symmetric group using a combinatorial rule. In this talk I will discuss explicit combinatorial formulae (for 5 new cases) for Kronecker coefficients arising in the inner tensor product of two Schur functions indexed by near-rectangular partitions of small height. As an application of the description of Kronecker coefficients thus obtained, I will also describe an enumerative formula for a specific case of counting Standard Young tableaux of bounded height in terms of Catalan and Motzkin numbers.

HUGH THOMAS, University of New Brunswick
Jeu de taquin for equivariant cohomology of Grassmannians

In this talk, I will present an approach to the problem of calculating Littlewood-Richardson coefficients for the equivariant cohomology ring of a Grassmannian. This approach is based on a *jeu de taquin* procedure which applies to what we call *equivariant tableaux*, which are Young tableaux in which labels are also permitted to appear on horizontal edges of boxes of the tableau, and well as within the boxes.

This is joint work with Alex Yong.

STEPH VAN WILLIGENBURG, UBC
Collected results on quasisymmetric Schur functions

In this talk we describe quasisymmetric Schur functions, which partition Schur functions in an intuitive way. Furthermore, we show how these quasisymmetric Schur functions refine many well-known Schur function properties with combinatorics that strongly reflect the classical case. Examples of properties include

- quasisymmetric Kostka numbers
- skew quasisymmetric Schur functions
- a quasisymmetric Littlewood-Richardson rule and
- an analogue of Young's lattice.

This is joint work with Christine Bessenrodt, Jim Haglund, Kurt Luoto and Sarah Mason.

VINCE VATTER, University of Florida
Geometric grid classes of permutations

A geometric grid class consists of those permutations that can be "drawn" on a specified set of line segments of slope ± 1 in the plane. Thus geometric grid classes are permutation classes, meaning that they are closed downward under the permutation containment order. I will discuss recent work with Albert, Atkinson, Bouvel, and Ruskuc which, using a mixture of geometric and language theoretic methods, establishes that geometric grid classes are among the best behaved permutation classes. In particular, these classes can be specified by finite sets of forbidden patterns, are partially well-ordered (i.e., don't contain infinite antichains), and have rational generating functions.