Schedule of talks.

Saturday (February 24)
Morning session

9:30-10:15

Hailun Zheng (University of Houston)

Reconstructing simplicial polytopes from affine stresses (part I)

Abstract. What partial information about a simplicial polytope P is enough to uniquely determine P (up to certain equivalences)? We will discuss two versions of this question. Specifically, we will report on recent progress on conjectures of Kalai asserting that under certain conditions one can reconstruct P from the space of affine stresses of P — a higher-dimensional analog of the set of affine dependencies of vertices of P. The proofs rely on a mixture of techniques from combinatorics, discrete geometry, and commutative algebra.

No prior knowledge of affine stresses will be assumed. The first part of the talk will be more geometric-combinatorial, while the second part will be more algebraic.

The talks are based on recent papers by Novik—Zheng and Murai—Novik—Zheng

Saturday (February 24)
Morning session

10:30-11:15

Nathan Williams (University of Texas at Dallas)

Combinatorics and Braid Varieties

Abstract. We discuss a recent framework for finding and proving interesting combinatorial formulas. The combinatorics parametrizes a decomposition of certain braid varieties over finite fields, while the proofs relate the point count of these varieties to traces in Hecke algebras. We present several case-studies and open problems using this framework. This is based on joint work with Pavel Galashin, Thomas Lam, and Minh-Tâm Trinh, as well as with MRWAC 2023 and UTD students.

Saturday (February 24)
Morning session

11:30-12:00

Jordy Lopez Garcia (Texas A&M University)

Discrete Schrödinger operators and toric compactifications

Abstract. Bloch varieties arise as solutions to boundary-value problems in the spectral theory of Schrödinger operators on periodic graphs. For the grid lattice, Bättig gave an intrinsic compactification of the Bloch variety using toric geometry. This compactification organizes the asymptotics of the Bloch variety, and it reveals boundary-value problems coming from toric infinities. In this talk, we give recent developments of this construction that apply to more general periodic graphs. This is joint work with Matt Faust, Stephen Shipman, and Frank Sottile.

Saturday (February 24)
Afternoon session

2:00-2:45

Isabella Novik (University of Wahington)

Reconstructing simplicial polytopes from affine stresses (part II)

Abstract. What partial information about a simplicial polytope P is enough to uniquely determine P (up to certain equivalences)? We will discuss two versions of this question. Specifically, we will report on recent progress on conjectures of Kalai asserting that under certain conditions one can reconstruct P from the space of affine stresses of P — a higher-dimensional analog of the set of affine dependencies of vertices of P. The proofs rely on a mixture of techniques from combinatorics, discrete geometry, and commutative algebra.

No prior knowledge of affine stresses will be assumed. The first part of the talk will be more geometric-combinatorial, while the second part will be more algebraic.

The talks are based on recent papers by Novik—Zheng and Murai—Novik—Zheng

Saturday (February 24)
Afternoon session

3:00-3:45

Oleg Musin (University of Texas Rio Grande Valley)

The SDP bounds for kissing configurations using their distance distribution

Abstract. In this talk I present an extension of known semidefinite and linear programming upper bounds for spherical codes. The main result can be applied for the distance distribution of a spherical code and it will be shown that this method can work effectively. In particular, I get a shorter solution to the kissing number problem in dimension 4.

Saturday (February 24)
Afternoon session

4:00-4:30

Weston Miller (University of Texas at Dallas)

Rational Catalan Numbers for Complex Reflection Groups

Abstract. The spetsial complex reflection groups are well-generated complex reflection groups that behave as if they were the Weyl group for some connected reductive algebraic group. Analogs of unipotent characters, Harish-Chandra theory, and Lusztig's Fourier transform can be defined combinatorially for these groups, allowing some techniques from the representation theory of finite groups of Lie type to be extended to spetsial complex reflection groups.

In a recent paper, Galashin, Lam, Trinh, and Williams introduced a family of rational noncrossing objects for finite Coxeter groups using distinguished subwords. They then gave a type-uniform proof that these objects are counted by rational Coxeter-Catalan numbers by using Hecke algebra traces to compute the point count of braid Richardson varieties. Assuming standard conjectures, I prove that this trace technique extends to irreducible spetsial complex reflection groups. In particular, even though there are not braid Richardson varieties in this context, the trace of a power of a Coxeter element still produces a rational Catalan number. I'll also discuss applications to parking combinatorics.

Sunday (February 25)
Morning session

9:30-10:15

Brandt Kronholm (University of Texas Rio Grande Valley)

Congruences, Cranks and Combinatorial Witnesses for Coefficients of Gaussian Polynomials

Abstract. We establish infinite families of cranks witnessing infinite families of congruences for the function $p(n, m)$ which enumerates partitions of n into at most m parts. We show that Dyson's rank witnesses infinitely many of these congruences.

We discuss the existence of *supercranks* witnessing each and every modulo d congruence.

If time permits, we will discuss similar infinite families of congruences for $p(n, m, N)$, the function enumerating partitions into at most m parts, no part larger than N. For small values of m, we will establish cranks.

Sunday (February 25)
Morning session

10:30-11:00

Jose Lopez Garcia (Texas A&M University)

Gauge theory and exotic structures

Abstract. Mathematicians classify things. Since the work of Donaldson (1980s), Yang-Mills and Seiberg-Witten equations have been used extensively to study 4-dimensional spaces. In particular, solutions to YM and SW equations, called instantons and monopoles respectively, help us better understand the topology and geometry in 4-dimensional manifolds in order to determine when a manifold admits a smooth, topological, or triangulable structure. In this talk, we will discuss how gauge theory is used to tackle the classification problem.

Sunday (February 25)
Morning session

11:15-11:45

Joselyne Aniceto (University of Texas Rio Grande Valley)

Congruence properties of consecutive coefficients in arithmetic progression of Gaussian polynomials

Abstract. A 2023 result of Eichhorn, Engle, and Kronholm describes an interval of consecutive congruences for $p(n, m, N)$, the function that enumerates the partitions of n into at most m parts, none of which are larger than N, in arithmetic progression. This function is the partition theoretic interpretation of the coefficient on q^n of the Gaussian polynomial, $\begin{bmatrix} N+m \\ m \end{bmatrix}$, otherwise known as the q-binomial coefficient.

In this talk we will considerably expand their result to capture a much larger family of congruences. We will consider known infinite families of congruences for $p(n, m)$, the function that enumerates the partitions of n into at most m parts, and introduce a related infinite family of congruences for a two-colored partition function. The result Eichhorn, Engle, and Kronholm becomes a special case of our expanded theorem.