BUGCAT
Conference

Binghamton University Graduate Combinatorics, Algebra, and Topology

November 11-12, 2023

Acknowledgments

There are a lot of people we would like to thank that made BUGCAT Conference possible this year!

We will start by thanking Dr. Alexander Borisov, the faculty coordinator of BUGCAT Conference, for always being there to guide us through difficult decisions.

We thank Dr. Kappe and the Kappe family for their generous financial support of our conference in memory of Wolfgang Kappe.

We thank the Binghamton University Department of Mathematics and Statistics and our chair Dr. Marcin Mazur.

Special thanks go to our wonderful secretaries Dianne Anderson and Diana Heggelke, and our truly awesome financial coordinator Grace Holton. They have been a huge assistance in organizing this conference, ranging from handling travel reimbursements to booking hotel rooms to reserving lecture halls.

Many graduate students participated in organizing this conference. The Organizing Committee consists of Hari Asokan, Thomas Galvin, Tara Koskulitz, Chad Nelson, Alireza Salahshoori, Chris Schroeder, Justin Steinberg, Andrew Velasquez-Berroteran, and Lucas Williams. The Advisory Board is Meenakshy Jyothis. In addition, we would like to thank Naftoli Kolodny, Marwa Mosallam, Robbie Rust, and Jake Zukaitis.

Finally, a huge thanks to all our participants, speakers, and moderators! We thank you for making this conference a success.

Signed,
The BUGCAT Conference Organizing Committee

Schedule

Saturday, November 11		
Event	**Room**	**Time**
Breakfast and Reimbursement Paperwork	Lecture Hall Hallway	8:00 - 8:45
Introduction	LH 01	8:45 - 9:00
Participant Talks	LH 07-10	9:00 - 10:00
Coffee Break	LH Hallway	10:00 - 10:15
Keynote Talk (Isabel Vogt)	LH 01	10:15 - 11:15
Coffee Break	LH Hallway	11:15- 11:30
Participant Talks	LH 07-10	11:30 - 12:30
Conference Lunch	Chenango Room	12:30 - 1:30
Participant Talks	LH 07 -10	1:30 - 2:30
Coffee Break	LH Hallway	2:30 - 2:45
Keynote Talk (Karl Lorensen)	LH 01	2:45 - 3:45
Coffee Break	LH Hallway	3:45 - 4:00
Participant Talks	LH 07-10	4:00 - 5:00
Conference Banquet	Quality Inn	6:30

Sunday, November 12		
Event	**Room**	**Time**
Breakfast	Lecture Hall Hallway	8:00 - 9:00
Participant Talks	LH 07-10	9:00 - 10:00
Coffee Break	LH Hallway	10:00 - 10:15
Keynote Talk (Teena Gerhardt)	LH 01	10:15 - 11:15
Coffee Break	LH Hallway	11:15 - 11:30
Participant Talks	LH 07-10	11:30 - 12:30

List of Talks

This list of talks is organized by speaker last name (with page references for abstracts, room number, and time).

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Demystifying Plethysms through Combinatorics LH 7

Aditya Khanna Virginia Tech

"In representation theory, the character of the composition of polynomial representations is given by the plethysm operation on the corresponding symmetric function characters".

Too much algebra for you? Want some pictures? Well, you have come to the right place! In this talk, we showcase a visual and combinatorial interpretation of plethysm that not only generalizes the representation theoretic motivation but also helps us perform explicit computations. The basic building blocks are power-sum symmetric functions, which through a generous use of the universal mapping property of polynomials, lead us to the plethystic addition formula. Using this formula, we construct a combinatorial model (of plethystic skew-schur functions) which in classic combinatorics fashion ends up being given by a constrained filling of numbers in boxes.

The content of this talk is inspired by the paper "A computational and combinatorial exposé of plethystic calculus" by Loehr and Remmel. This is an expository talk. There are no prerequisites and all terms will be defined in the talk.

The space of ladder surface does not admit any MCG-invariant metric LH 8

Chaitanya Tappu Cornell University

We show that the moduli space of marked, complete, Nielsen-convex hyperbolic structures on the bi-infinite ladder surface does not admit any metric invariant under the action of the mapping class group of the ladder surface.

The Cartan-Leray spectral sequence of the braid group LH 9

Dezhou Li Northeastern University

In Cohen's famous calculation of the mod p cohomology of configuration spaces, the key ingredient was a complete description of the Cartan–Leray spectral sequence for the configuration space of k=p points. I will discuss work in progress aimed at giving a complete description of this spectral sequence for arbitrary k.

Linear Redundancies in Projective Space of Z_2^4 LH 10

Amanda Tran Tufts University

Given $P(Z_2^4)$, there are fifteen projective points and thirty-five projective lines. The projective line complex admissibility problem seeks to describe and generalize the underlying structures that separate admissible (linearly independent) versus inadmissible (linearly redundant) complexes. Specifically, the line complex problem is used in the context of Radon Transforms over these projective points. This project addresses necessary conditions that contribute to admissible and inadmissible linear structures using discrete analysis, vector analysis, linear algebra, and discrete geometry. In particular, we are interested in generalized classes of minimally inadmissible collections of lines, their associated geometry, and its dependence on the "Even Incident Condition" (which is proven and explored in this project.)

Rowmotion on Rooted Trees LH 7

Jamie Kimble Michigan State University

A rooted tree T is a poset whose Hasse diagram is a graph-theoretic tree having a unique minimal element. We study rowmotion on antichains and lower order ideals of T. Recently Elizalde, Roby, Plante and Sagan considered rowmotion on fences which are posets whose Hasse diagram is a path (but permitting any number of minimal elements). They showed that in this case, the orbits could be described in terms of tilings of a cylinder. They also defined a new notion called homometry which means that a statistic takes a constant value on all orbits of the same size. This is a weaker condition than the well-studied concept of homomesy which requires a constant value for the average of the statistic over all orbits. Rowmotion on fences is often homometric for certain statistics, but not homomesic. We introduce a tiling model for rowmotion on rooted trees. We use it to study various specific types of trees and show that they exhibit homometry, although not homomesy, for certain statistics.

Deformations of arithmetic: q vs G LH 8

Yuri Sulyma

There are many attempts to find a "deeper base" for arithmetic than the natural numbers, incorporating more combinatorics. One approach is to replace the natural number n with the "q-analogue" $(n)_q := 1 + q + \cdots + q^{n-1}$. Another is to replace the category of finite sets by the category of finite G-sets for a group G, then decategorify. I will discuss recent work linking these two approaches, which in particular clarifies some long-standing issues with the symbol "$f^{(n)_q}$". In technical language, our construction takes a λ-ring equipped with a formal group law and produces an S^1-Tambara functor.

High Dimensional Cohomology of Arithmetic Groups LH 9

Tatiana Abdelnaim University of Oklahoma

Arithmetic groups hold significant importance in algebraic K-theory and number theory. Borel and Serre established the virtual Bieri–Eckmann duality for these groups, with the Steinberg module as the dualizing module. This duality serves as a vital tool for delving into the high-dimensional cohomology of arithmetic groups. In this presentation, I will illustrate how this duality can be used to demonstrate the vanishing of high dimension cohomology groups of $SL_n(Z)$, highlighting the role of the Steinberg module. Additionally, I will outline various approaches available for tackling similar problems. Moreover, I will provide an overview of analogous results and reference some of the pertinent open questions in this area.

Orientation-preserving homeomorphisms of Euclidean space are commutators LH 10

Megha Bhat The Graduate Center, CUNY

Requiring that every element of a group be expressible as a commutator is a condition stronger than the group being perfect. Questions about commutator width have been asked and answered for various groups such as the alternating group and the symmetric group. I will talk about this question for homeomorphism groups of spheres, annuli and Euclidean space, and show that each of these has commutator width one.

Interpolation problems for curves

Isabel Vogt (Brown University)

Abstract

The interpolation problem is one of the oldest problems in mathematics. In its most broad form it asks: when can a curve of a given type be passed through a given number of points? I'll survey work on the interpolation problem from Euclid to the modern day, ending with recent joint work of mine with Eric Larson.

Forbidden subgraphs and complete partitions LH 7

John Byrne University of Delaware

A graph is called an (r, k)-graph if its vertex set can be partitioned into r parts of size at most k with at least one edge between any two parts. Let $f(r, H)$ be the minimum k for which there exists an H-free (r, k)-graph. In this paper we build on the work of Axenovich and Martin, obtaining improved bounds on this function when H is a complete bipartite graph, even cycle, or tree. Some of these bounds are best possible up to a constant factor and confirm a conjecture of Axenovich and Martin in several cases. We also generalize this extremal problem to uniform hypergraphs and prove some initial results in that setting.

The Functoriality of Odd Khovanov Homology up to Sign, and a Hecke Algebra Action on the Odd Khovanov Complex of the n-cable LH 8

Jacob Migdail-Smith Syracuse University

Odd Khovanov Homology is a homological invariant of knots and links which has a Bar-Natan category presentation. In this paper we extend the odd Khovanov complex to link cobordisms and show that it is functorial up to sign. We then use this functoriality to show that for the n-cable of a link, exchanging two adjacent strands induces an action of the Hecke algebra $H(q^2, n)$ at $q = i$ on the odd Khovanov complex of the n-cable of the link.

Stabilization of 2-Crossed Modules LH 9

Milind Gunjal Florida State University

For a Waldhausen category, 1-type of the K-theory spectrum is well studied by Muro and Tonks using stable crossed modules. Using the same technique we define the 2-type with the help of a 2-crossed module. Further we look at its stabilization using symmetric monoidal 2-categories.

Conjugation in Miller Machines LH 10

Conan Gillis Cornell University

In 1971 C.F. Miller associated to every finitely presented group G a free-by-free group M (G) known as the Miller Machine. We show that the conjugacy problem in M (G) is equivalent to a strong form of list conjugacy in G, which we term iso-computational list conjugacy.

The essential bound of a k-polymatroid and applications to excluded minor problems LH 7

Fiona Young Cornell University

The singleton and doubleton minors of a polymatroid encode a surprising amount of information about its structural complexity. Starting with a k-polymatroid ρ, we subtract from it as many maximally-separated matroids as possible. Let the result be an m-polymatroid; this gives rise to a notion of boundedness for ρ. When k is sufficiently large, the bounds on the singleton and doubleton minors of ρ completely determine the bound on ρ. Much of this is motivated and guided by the polytopal perspective of polymatroids. Our results provide an organized framework for thinking about polymatroid excluded minor problems.

Crossing Number of Knot Cablings LH 8

Rob McConkey Michigan State University

If K is a satellite knot with companion knot C, the conjecture of whether crossing number of K is greater than or equal to the crossing number of C remains open. For a family of satellite knots we will show a stronger inequality to be true. Then we show how we can use the colored Jones polynomial to explicitly compute the crossing number of K for a family of satellite knots with respect to the crossing number of C. This is joint work with Dr. Efstratia Kalfagianni.

Strictification of infinity-groupoids LH 9

Kimball Strong Cornell University

The homotopy hypothesis asserts that spaces up to homotopy equivalence are modeled by infinity-groupoids, a generalization of a groupoid in which laws such as associativity, identity, and invertibility hold only up to higher morphisms, exactly in the way that composition of maps $S^n \to X$ have a group structure only up to homotopy. In this talk we will construct a "strictification" functor which takes as input an infinity-groupoid (modeled as a Kan complex) and outputs a *strict* infinity groupoid, in which all laws hold on the nose (not just up to homotopy). We will discuss how this relates to Whitehead's problem to find a complete algebraic invariant for the homotopy type of a space.

The q-Onsager Algebra and the Quantum Torus LH 10

Owen Goff University of Wisconsin

The q-Onsager algebra is encountered in the study of distance-regular graphs and association schemes. This algebra has two generators; the structure of this algebra is similar to that of $U_q(sl_2)$, and there is a series of elements called alternating elements, that are defined recursively. However, what the alternating elements look like as polynomials in the generators remains an open problem. In this talk, we display an algebra called the quantum torus and describe the images of the alternating elements under a homomorphism into this algebra, which can be expressed in closed form. We will also talk about other presentations of the q-Onsager algebra and what they looks like in the quantum torus.

Enumeration of nerves of the family of translates of a convex set in R^d LH 7

Shiyi Ma Binghamton University

Nerve is a simplicial complex on the vertex set [n]. A simplicial complex is called d-representable if it is the nerve of a family of convex sets in R^d. We want to find an asymptotic estimate for the number of nerves that the family of n translates of a convex set in R^d can have, and we obtain a lower bound for that.

Hyperbolization, cubulation, and applications LH 8

Lorenzo Ruffoni Tufts University

The Charney-Davis strict hyperbolization is a procedure that turns polyhedra into spaces of negative curvature, while preserving some topological features. It has been used to construct examples of manifolds that exhibit unexpected features, despite having negative curvature. One may expect the fundamental groups of these manifolds to display strange features as well. On the other hand, we show that these groups admit nice actions on CAT(0) cube complexes, both in the absolute and relative settings. As an application, we obtain new examples of negatively curved Riemannian manifolds whose fundamental groups are virtually special and algebraically fibered.

The Berkovich spectrum of a symmetric monoidal stable category LH 9

Tim Campion Johns Hopkins

We define a "norm" on a symmetric monoidal stable category C to be a function from the set of objects of C to the real numbers satisfying a short list of axioms. Similar ideas have been studied previously by Neeman; the difference here lies in considering compatibility with the monoidal structure.

We define a topology on the set of norms on C, giving a topological space which we call the "Berkovich spectrum" of C. This is analogous to the Berkovich spectrum of a ring studied in rigid analytic geometry, just as the Balmer spectrum of C is analogous to the Zariski spectrum of a ring. We discuss several structural results and several open problems in extending this analogy, and compute the Berkovich spectrum in some examples.

An example of a norm is giving by taking the Poincaré series of an object of C with respect to some homology theory with a Künneth formula and evaluating at a positive real number. All known examples are essentially of this form. We raise the question of whether norms not of this form can exist.

$GL_n(k)$-stable ideals in positive characteristic LH 10

Erin Delargy Binghamton University

Given a polynomial ring over a field, the general linear group acts on elements by linear substitution of variables. An ideal is said to be stable if this action on the generators preserves ideal membership. When the polynomial ring is over a field of characteristic zero, the only stable ideals are powers of the maximal ideal. When the field has positive characteristic, however, smaller ideals are stable. We will consider a characterization of stable ideals generated in a single degree and use this to construct the minimal free resolution of a large class of stable ideals in two variables.

Linear Factors in the Kostant Vector Partition Function of the Type A Root System LH 7

Luis Pérez Cornell University

The Kostant vector partition function (KVPF) of the type A root system, $K_{A_{n-1}}$, counts the number of ways of expressing an integral vector in $\mathbf{Z}^n$ as a non-negative integral combination of the positive roots of A_{n-1}. Combinatorially, it counts the number of integer flows in a network with given inputs and outputs. Many important quantities in the representation theory of Lie algebras, such as weight multiplicities and tensor product multiplicities, are expressed in terms of $K_{A_{n-1}}$. It turns out that the KVPF of A_{n-1} is a piecewise polynomial function. De Loera, Sturmfels, and several others have observed that many of the polynomials in $K_{A_{n-1}}$ have a surprising amount of linear factors. Postnikov and Stanley explain the linear factors for one chamber of polynomiality. In my Master's thesis, Federico Ardila and I generalize their result to all the chambers on the boundary of the chamber complex using a localization theorem by de Concini, Procesi, and Vergne. For this talk, I will give a complete explanation of our result through the example of A_3.

Points, curves and surfaces LH 8

Sayantika Mondal The Graduate Center CUNY

We look at filling closed curves on hyperbolic surfaces and consider its length infima in the moduli space of the surface. In this talk I will focus on relations between the length infimum of curves and their self-intersection number. In particular, construct families of filling curves with same intersection number but different length infimum on any surface.

Homology self-closeness number and cofibration sequence LH 9

Gopal Chandra Dutta Indian Institute of Technology Kanpur

We study the homology self-closeness numbers of a cofibration sequence of simply connected CW-complexes. Moreover, recall homology decomposition X_n of a simply connected CW-complex X, which fits into the similar type of cofibration sequence. We investigate the homology self-closeness numbers of homology sections X_n and establish relations between the homology self-closeness numbers of X and X_n. Further, consider the homotopy decomposition (Postnikov tower) $X^{(n)}$ of X and find relations between the homology self-closeness numbers of $X^{(n)}$ and X. There exist relations between the homology self-closeness numbers of homology section and homotopy section. Applying these results, we compute some examples.

Representation Homology and some computations with unipotent coefficients LH 10

Guanyu Li Cornell University

The representation varieties are classical objects that people study a lot, among which the (multiplicative version of) commuting variety is a good example. It can be constructed by giving the fundamental group of a topological space and an affine group scheme. However, the varieties are generally very singular and the varieties lose the higher homotopy information of the space. But with the tools from Derived Algebraic Geometry, we can construct the derived functor of representation variety - representation homology, which gives us more geometrical and topological information. In this talk, I will talk about the construction of the representation homology, and use the example of multiplicative commuting variety of unipotent coefficients, to give an example when the representation homology gives back connections with other objects we care about.

Wolfgang and Luise Kappe Alumni Lecture

Rank Conditions on Rings and Measure-Theoretic Properties of Groups

Karl Lorensen (Penn State Altoona)

Abstract

In this talk, I investigate the link between two little-known properties of rings and certain measure-theoretic properties of groups, particularly amenability and supramenability. The first ring-theoretic property, introduced by Paul Cohn in the 1960s, is the property of having unbounded generating number (UGN). A ring R is said to have *UGN* if, for every positive integer n, there is no R-module epimorphism $R^n \to R^{n+1}$. My focus is on determining conditions under which a ring graded by a group possesses UGN if its base ring has UGN—a problem originally posed by Peter Kropholler in May of 2020.

One condition that turns out to be especially relevant to Kropholler's problem is a specific measure-theoretic property of the group in relation to its subset supporting the grading. This leads to a result about rings graded by amenable groups and one about rings graded by supramenable groups, with the former yielding a new ring-theoretic characterization of amenability. The portion of the talk about Kropholler's problem is based on a paper that I wrote together with Johan Öinert and that was just published in October.

Towards the end of the lecture, I will discuss some earlier results about a property of rings that is dual to UGN, called the strong rank condition (SRC). Even more obscure than UGN, the SRC property was, I believe, first defined by T. Y. Lam in 1997 in his well-known book *Lectures on Modules and Rings.* A ring R is said to satisfy *SRC* if, for every positive integer n, there is no R-module monomorphism $R^{n+1} \to R^n$. This property, too, happens to be closely related to amenability. The connection became clear in 2019 when Laurent Bartholdi (with a contribution by Dawid Kielak) proved that, for any group G and field k, the group ring kG satisfies SRC if and only if G is amenable. Moreover, in another paper published that same year, Kropholler and I generalized Bartholdi's argument to certain kinds of group-graded rings.

The talk will also include a rather surprising example of a $\mathbb{Z}$-graded ring that fails to have UGN but whose base ring possesses UGN. In addition, I intend to mention two significant open questions, one pertaining to UGN, and the other to SRC.

Big Ramsey Degrees of Countable Ordinals LH 7

Robert Rust Binghamton University

If COL is a coloring of $\binom{\mathbb{N}}{a}$ then, by Ramsey's Theorem, there is an infinite $H \subset \mathbb{N}$ so $\binom{H}{a}$ has only one color. We call the set H 1-homogeneous. We can extend this idea to the Integers and other linear orderings and it is clear that we can use the proof of Ramsey's Theorem to find a homogeneous infinite subset, however what if we want to add the stipulation that our infinite set H is order equivalent to the original ordering we colored? Past results have found a set-theoretic proof that if we finitely color $\binom{\mathbb{Z}}{a}$ we will find an infinite $B \subset \mathbb{Z}$ where B is 2^a-homogeneous. We call this 2^a the Big Ramsey Degree of our set $\binom{\mathbb{Z}}{a}$ and have developed a combinatorial proof. It was previously discovered that there exists a Big Ramsey Degree for any linear ordering $< \omega^\omega$ using a set-theoretic proof. We have a combinatorial proof of the exact upper and lower bounds for these degrees.

Simplicial Complexes on Seifert Surfaces of Knots - A Tale of Two Structures LH 8

Ipsa Bezbarua City University of New York, Graduate Center

Over the last century, knot theory has developed into an active area of research in topology. This is partly due to its connections with several other areas of science and technology. In the domain of mathematics, low-dimensional topologists look to results and techniques from knot theory to gain a better understanding of 3-manifolds. One of the fundamental structures studied in knot theory is a compact connected surface whose boundary is the knot under consideration, called a Seifert surface. In this talk, we will learn about two simplicial complexes, constructed by Osamu Kakimizu using the Seifert surfaces of knots - the incompressible complex and the Kakimizu complex. We will also learn some classic properties of the Kakimizu complex, the more popular of the two, like contractibility and local infiniteness.

The LS-category of epimorphism of almost nilpotent groups LH 9

Nursultan Kuanyshov University of Florida

The Lusternik-Schnirelmann category is an important numerical invariant in algebraic topology, critical point theory and symplectic geometry. In this talk, we state a more than decade old question of Mark Grant whether cohomological dimension of a group homomorphism coincides with its LS-category. The question was motivated by the Eilenberg-Ganea theorem from the 50s saying that these two invariants agree for groups. We gave positive answer for Grant questions when groups are virtually nilpotent and almost nilpotent groups. Finally, we outline ideas for future work and some open problems.

Automatic Continuity of Group Isomorphisms between Lie Groups LH 10

Tomoya Tatsuno University of Oklahoma

Around 1930, E. Cartan and van der Waerden independently showed the following surprising result: any (abstract, not assumed to be continuous) group isomorphism between connected, simple, compact Lie groups must be continuous. This phenomenon is called automatic continuity.

In this talk, I will explain various results about automatic continuity in simple Lie groups, beyond the compact case. At the end, I will discuss an ongoing project in the case of nilpotent Lie groups.

Apex graphs and cographs LH 7

Jagdeep Singh Binghamton University

A class G of graphs is called hereditary if it is closed under induced subgraphs. The apex-class of G is the class of graphs H that contains a vertex v such that H-v is in G. In this talk, we show that if G has finitely many forbidden induced subgraphs, then so does the apex class of G. The hereditary class of cographs contains all graphs H that can be generated from the single vertex graph using complementation and disjoint unions. We talk about the corresponding result for the apex-class of cographs.

General flat structures on Riemann surfaces LH 8

Juliet Aygun Cornell University

A Riemann surface X is a topological surface equipped with an atlas of charts to $\mathbb{C}$ with holomorphic transition maps. Given a compact Riemann surface of genus greater than 1, the surface is hyperbolic, so it has constant negative curvature. Is there any metric we can place on such surfaces so that locally the surface is flat minus a discrete set of points? The answer is yes, and these are called 'flat surfaces.' In this expository talk, we will discuss the basic geometric and dynamical properties behind flat surfaces, including translation surfaces, $(1/k)$-translation surfaces, dilation surfaces, and most generally, a Riemann surface with any complex affine structure.

Formalizing the ∞-categorical Yoneda lemma LH 9

Jonathan Weinberger Johns Hopkins University

In recent years, formal verification of mathematical proofs on the computer has been gaining more and more traction. A notable recent project is the Liquid Tensor Experiment where a major result from condensed mathematics of Clausen–Scholze was formalized in the Lean proof assistant, within classical foundations. As opposed to set theory, homotopy type theory (HoTT), pioneered through Voevodsky and his univalence axiom, yields a new foundation of mathematics to do algebraic topology and homotopy theory synthetically, with many results formalized in various proof assistants. The basic objects of HoTT can be regarded as synthetic ∞-groupoids. However, an analogous development of synthetic ∞-category theory had been missing so far. But this has been made possible now in the proof assistant rzk, developed by Kudasov, based on a simplicial extension of HoTT due to Riehl and Shulman.

I'll present a formalization project, joint work with Nikolai Kudasov and Emily Riehl, in which we formalized the Yoneda lemma for ∞-categories in rzk, see: https://arxiv.org/abs/2309.08340

Homotopy Equivalence of Hypersurfaces and Coamoebae LH 10

Logan Hambric Lehigh University

A common structure in the study of algebraic hypersurfaces is the Pair of Pants, $P^{n-1} = V(z_1 + \ldots + z_n + 1) \subset (\mathbf{C}^*)^n$. This structure can be generalized to the simplicial algebraic hypersurface, which is given by $\tilde{P}^{n-1} = V(z_1^{p_{11}} \cdots z_n^{p_{1n}} + \ldots + z_1^{p_{n1}} \cdots z_n^{p_{nn}} + 1)$ such that the convex hull of the integral points $(p_{i1}, \ldots, p_{in})$ along with $(0, \ldots, 0)$ forms a non-degenerate n-simplex. In a 2021 paper, C. Arnal states a conjecture that there exists a homotopy equivalence between a simplicial algebraic hypersurface and its coamoeba which preserves the action of complex conjugation on homology. In this work we prove the conjecture stated by Arnal, using some constructions given by G. Kerr and I. Zharkov in their 2016 paper.

The conference banquet will take place at 6:30 at the Quality Inn, 4105 Vestal Pkwy E.

The RAAG Recognition Problem for Bestvina–Brady Groups LH 7

Yu-Chan Chang Wesleyan University

Given a finite simplicial graph, the associated right-angled Artin group (RAAG) is generated by the vertex set of the graph, and two generators commute if they are connected by an edge. The RAAG Recognition Problem asks whether a given group is a RAAG. In joint work with Lorenzo Ruffoni, we consider this recognition problem for Bestvina–Brady groups (BBGs). In this talk, I will describe a graphical condition to certify when a BBG is a RAAG. In particular, we will see a complete solution to the RAAG Recognition Problem for the BBGs defined on 2-dimensional flag complexes.

Generalization of the Matrix of Rotation Symmetric Boolean Functions LH 8

Manuel Albrizzio Bucknell University

Knowing the properties of rotation symmetric boolean functions, we naturally consider the action on $\mathbb{F}_2^n$ by cyclic permutations ($\mathbb{Z}/n\mathbb{Z}$). Two elements $x, y \in \mathbb{F}_2^n$ are in the same orbit, say $G_n(x)$, if they are cyclic shifts of each other. Several authors considered the square matrix ${}_n\mathcal{A}$ calculated by picking orbit representatives. In 2018, Ciungu and Iovanov proved the property that ${}_n\mathcal{A}^2 = 2^n{\cdot}\mathrm{Id}$, the identity matrix of dimension $g_n \times g_n$ where g_n is the number of orbits. In this talk, we explore the semidirect product $\mathbb{F}_2^n \rtimes \mathbb{Z}/n\mathbb{Z}$ and use the theory of characters of semidirect products to reproduce the properties of this matrix proved in Ciungu and Iovanov's paper. This new information inspires a generally-constructed matrix that we further explore and find similar properties to the specific example, as well as match those properties appearing in the well-known Hadamard matrix.

The Trace Method in Algebraic K-theory LH 9

Albert Yang University of Pennsylvania

In this talk, I will briefly overview the classical trace method towards the algebraic K-theory by Bökstedt-Hsiang-Madsen, which heavily relied on the cyclotomic trace and tools in equivariant stable homotopy theory. I will also mention some recent approaches in the infinite category settings by Nikolaus-Scholze.

Finite groups with many p-regular conjugacy classes LH 10

Chris Schroeder Binghamton University

Let G be a finite group and let p be a prime. In this talk, we discuss the structure of finite groups with a large number of p-regular conjugacy classes or, equivalently, a large number of irreducible p-modular representations. We prove sharp lower bounds for this number which constrain the p-structure of G. We also prove a new best possible criterion for the existence of a normal Sylow p-subgroup.

Interpolating between classic and bumpless pipe dreams LH 7

Gabe Udell Cornell University

I'll introduce hybrid pipe dreams, in which some rows are specified to contain classic pipe dream tiles (plus a couple new ones) and some to contain bumpless pipe dream tiles (albeit upside down). For each of the 2^n possibilities of row specification, there is a sum over hybrid pipe dreams to compute each double Schubert polynomial. I'll discuss a bijection that swaps the specifications on two adjacent rows, demonstrating the equivalence of the many formulæ.

On The Finite Presentation of the Mapping Class Group of a Closed, Orientable Surface LH 8

Olu Olorode Cornell University

In 1987 Hatcher and Thurston gave a proof that the mapping class group of a closed orientable surface is finitely presented, by studying the action of this group on the cut system complex. In their study the work of Jean Cerf appears and serve as the lynchpin that makes everything work. How exactly did Hatcher and Thurston prove this fundamental result in the theory of mapping class groups? Come to this talk to find out more.

Fiber of the cyclotomic trace for the sphere spectrum and Tate-Poitou duality LH 9

Myungsin Cho Indiana University

K-theoretic Tate-Poitou duality at odd primes has been proved by Blumberg-Mandell This tells us that the duality can be promoted to Anderson duality between K(1)-local K-theory of number fields and its fiber of cyclotomic trace. I will briefly introduce their idea and introduce on going project at p=2 case.

Diagrammatic Categories from Representation Graphs LH 10

Ryan Reynolds Bucknell University

Expanding on the work Barnes, Benkart, and Halverson, we can use the data encoded in the representation graph of any finite subgroup, G, of $SU(2)$ to construct a diagrammatic category which admits a full functor onto a certain full subcategory of G-**mod**. Furthermore, we can give a diagrammatic condition which, once satisfied, will induce a fully faithful functor onto the same subcategory. We may then extend this to much more general setting.

Algebra in topology and topology in algebra: advances in algebraic K-theory

Teena Gerhardt (Michigan State University)

Abstract

The field of algebraic topology has exposed deep connections between topology and algebra. One example of such a connection comes from algebraic K-theory. Algebraic K-theory is an invariant of rings, defined using tools from topology, that has important applications to algebraic geometry, number theory, and geometric topology. Algebraic K-groups are very difficult to compute, but advances in algebraic topology have led to many recent computations which were previously intractable. Equivariant homotopy theory, a branch of algebraic topology which studies topological objects with a group action, has been particularly important in the study of algebraic K-theory. In this talk I will introduce algebraic K-theory and its applications, explaining the interesting role of equivariant homotopy theory in this story. I will also discuss recent advances in the study of algebraic K-theory.

Graph Embeddings and Systole Bounds LH 7

Marie Kramer Syracuse University

While obstructions to embedding graphs into the plane and the real projective plane are well understood, there is no known complete list for other surfaces such as the torus or the Klein bottle. Work by Kennard, Wiemeler, and Wilking shows that the existence of embeddings of graphs into surfaces implies good bounds on graph systoles, co-girths of regular matroids, and geometric data of special torus representations. For our purposes, we are interested in cubic graphs with small first Betti number. In this talk, we will discuss ongoing work towards a conceptual proof of Chambers' computer assisted results regarding cubic torus obstructions, as well as an analogue for the Klein bottle for small graphs.

Betti Numbers of Preferential Attachment Flag Complexes LH 8

Chunyin Siu Cornell University

Random topology is a new branch of topology that studies the topological properties of random models. In this talk, we consider a class of random graphs generated by the preferential attachment mechanism and we study the topology of their flag complexes. We determine the asymptotics of their expected Betti numbers and illustrate our result with simulations. Homotopy connectedness of the flag complex will also be discussed. This is joint work with Gennady Samorodnitsky, Christina Lee Yu and Rongyi He.

The K-theory of the stable module category LH 9

Chase Vogeli Cornell University

In this talk, I'll discuss how to analyze modular representation theory with tools from algebraic K-theory. In the representation theory of a finite group G over a field k, Maschke's theorem states that every representation is projective as a kG-module iff the characteristic of k is coprime to the order of G. When the characteristic of k is *modular*, i.e. dividing the order of G, the failure of kG-modules to be projective is measured by the so-called *stable module category* of kG: the category of kG-modules "quotiented by" the category of projective kG-modules in an appropriate sense. The stable module category turns out to have enough homotopical structure for us to consider its algebraic K-theory, and I'll describe some things we can say about this invariant.

Arithmetic Differential Operators on Compact DVRs LH 10

Sarah Lamoureux Binghamton University

Let R be a compact DVR and $S = \hat{R}^{ur}$ the completion of its maximal unramified extension. We investigate the relationship between so-called 'arithmetic differential operators' and analytic maps in three contexts: maps $S^d \to S$, maps $R^d \to S$, and maps with domain the R-points of a smooth affine scheme of finite type over R.

A combinatorial curiosity from tournaments and permutations LH 7

Benjamin Thompson Cornell University

Encountering a pattern in an unexpected place can be a satisfying experience. Describing such a pattern can feel even better. Best of all is figuring out where such a pattern comes from and presenting it as a Theorem. But that's also the hardest part (at least it is for us), since we're stumped! Luckily what we've found so far is still sharable. In this talk we'll present a cute combinatorial pattern that arises from playing around with tournaments, permutations, and probabilities. If anyone knows where it comes from, please contact us immediately. Joint with Nikhil Sahoo and Gabe Udell.

Pants in onesies LH 8

Arya Vadnere University at Buffalo

Pants are spheres with 3 holes. Onesies are spheres with 5 holes. The pants graph of a surface is a graph whose vertices are pants decompositions (maximal collections of pairwise disjoint simple closed curves) on a surface, with edges corresponding to elementary moves. In this expository talk, we shall explore various results about the geometry of the pants graph of a sphere with 5 holes. Several of these results are still open for general surfaces, but are believed to be true.

Compatibility on transfer systems LH 9

Valentina Zapata Castro University of Virginia

Transfer systems are combinatorial objects that encode the transfers carried by algebras over certain equivariant operads. They let us use combinatorial tools to study equivariant homotopy theory. Compatible pairs of transfer systems correspond to multiplicative structures compatible with an underlying additive structure. In this talk, we will introduce the concept of transfer systems and compatible pairs. We will discuss when a transfer system is only compatible with at most two other transfer systems and a criteria when the group is cyclic of order $p^r q^s$. The work discussed in this talk began as a collaboration through the Women in Topology workshop and is joint with Kristen Mazur, Angélica M. Osorno, Constanze Roitzheim, Rekha Santhanam, and Danika Van Niel.

Iwasawa lambda invariant and Massey products LH 10

Peikai Qi Michigan State University

How does the class group of number field change in field extensions? This question is too wild to have a uniform answer, but there are some situations where partial answers are known. I will compare two such situations. First, in Iwasawa theory, instead of considering a single field extension, one considers a tower of fields and estimates the size of the class groups in the tower in terms of some invariants called λ and μ. Second, in a paper of Lam-Liu-Sharifi-Wake-Wang, they relate the relative size of Iwasawa modules to values of a "generalized Bockstein map", and further relate these values to Massey products in Galois cohomology in some situations. I will compare these two approaches to give description of the cyclotomic Iwasawa λ-invariant of some imaginary quadratic fields (and other field) in terms of Massey products.

This concludes the conference. Thank you for attending!

Participants List

Tatiana Abdelnaim	University of Oklahoma
Manuel Albrizzio	Bucknell University
Hari Asokan	Binghamton University
Levi Axelrod	Binghamton University
Juliet Aygun	Cornell University
Haley Bahn	University of Oklahoma
Alvaro Belmonte	Johns Hopkins University
Ipsa Bezbarua	CUNY Graduate Center
Megha Bhat	CUNY Graduate Center
Tanishq Bhatia	Northeastern University
Pedro Brunialti	University of Virginia
Julian Bushelli	Drexel University
John Byrne	University of Delaware
Tim Campion	Johns Hopkins University
Sean Carroll	Northeastern University
Anunoy Chakraborty	George Mason University
Yu-Chan Chang	Wesleyan University
Shaivi Chavan	CUNY Graduate Center
Myungsin Cho	Indiana University
Nate Cornelius	The University of Kentucky
Erin Delargy	Binghamton University
Gopal Chandra Dutta	Indian Institute of Technology Kanpur
Hannah Ehlich	Binghamton University
Luke Elliott	Binghamton University
Alex Feingold	Binghamton University
Evan Franchere	University of Kentucky
Ryan Gelnett	University at Albany
Sayan Ghosh	Ramakrishna Mission Vidyamandira
Conan Gillis	Cornell University
Owen Goff	University of Wisconsin
Isaac Goldberg	Cornell University
Milind Gunjal	Florida State University
Vishal Gupta	University of Delaware

Participants List

Siddharth Gurumurthy	University of Rochester
Usman Hafeez	University of Kentucky
Logan Hambric	Lehigh University
Justin Haverlick	University at Buffalo
Lydia Holley	University of Illinois at Chicago
Quaid Iqbal	Binghamton University
Abdellah Islam	Drexel University
Elana Israel	Syracuse University
Villaire Jackson	Binghamton University
Hanlim Jang	Binghamton University
Hikaru Jitsukawa	Tufts University
Luise-Charlotte Kappe	Binghamton University
Ashton Keith	Purdue University
Jesse Keyes	University of Kentucky
Osman Khan	CUNY Queens College
Aditya Khanna	Virginia Tech
Jamie Kimble	Michigan State University
Naftoli Kolodny	Binghamton University
Tara Koskulitz	Binghamton University
Marie Kramer	Syracuse University
Nursultan Kuanyshov	University of Florida
Matty LaCombe	Liverpool High School
Sarah Lamoureux	Binghamton University
Guanyu Li	Cornell University
Dezhou Li	Northeastern University
Louisa Liles	University of Virginia
Zeyu Liu	University of California San Diego
Shiyi Ma	Binghamton University
Ryan Maguire	Dartmouth College
Cary Malkiewich	Binghamton University
Sreedev Manikoth	University of Rochester
Peter Mao	Drexel University
Rob McConkey	Michigan State University

Tomas Mejia Gomez	Johns Hopkins University
Jorge Mello	Oakland University
Jacob Migdail-Smith	Syracuse University
Sayantika Mondal	CUNY Graduate Center
Marwa Mosallam	Binghamton University
Chad Nelson	Binghamton University
Ray Ng	Binghamton University
Kirsten Nielsen	Bryant & Stratton College
Olu Olorode	Cornell University
Luis Pérez	Cornell University
Alonso Perez-Lona	Virginia Tech
Henry Potts-Rubin	Syracuse University
Peikai Qi	Michigan State University
Ryan Reynolds	Bucknell University
Vievie Romanelli	Tufts University
Lorenzo Ruffoni	Tufts University
Robert Rust	Binghamton University
Adithya Sathyanarayana	Michigan State University
Chris Schroeder	Binghamton University
Luke Seaton	Michigan State University
Sayak Sengupta	Binghamton University
Nart Shalqini	Virginia Tech
Mahmood Kamil Shihab	University of Debrecen
Jagdeep Singh	Binghamton University
Chunyin Siu	Cornell University
McKenzie Skrastins	Binghamton University
Zach Stewart	Michigan State University
Kimball Strong	Cornell University
Yuri Sulyma	
Chaitanya Tappu	Cornell University
Tomoya Tatsuno	University of Oklahoma
Benjamin Thompson	Cornell University
Amanda Tran	Tufts University

Participants List

Arya Vadnere	University at Buffalo
Chase Vogeli	Cornell University
Jonathan Weinberger	Johns Hopkins University
Lucas Williams	Binghamton Unviersity
Albert Yang	University of Pennsylvania
Songyu Ye	Cornell University
Lucas Yong	University of Oklahoma
Fiona Young	Cornell University
Valentina Zapata Castro	University of Virginia
Jake Zukaitis	Binghamton University